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INTRODUCTION

Dear Readers,

This maiden issue of “Scientia et Fides: Journal of Multidisciplinary Research and Review” is one of the outputs of the First International Conference on Asean Studies in October 2015. It aims to provide an avenue for discussions on advancements in various areas of studies. In this issue, eight papers are focused on Engineering. These are noteworthy findings that can be used as reference for any basic and developmental undertakings.

Readers who would like to learn more about techniques to improve the learning process among students are also included in one of the research studies. Findings on approaches to alternative classroom teaching through eLearning, collaboration and inventive design for courses are highlighted. These studies developed innovative techniques on how to make instruction easier and informative. Practical techniques such as the use of rain gauge and wind risk assessment were developed. This is to make the community alert through predictions using the previously mentioned techniques. Assessment of environmental pollution is another consideration towards policy making.

Furthermore, this issue shared outputs on studies dealing with the efficient use of energy. This is ideal for far flung areas with an abundant supply of flowing water. It is further enriched by studies which applied the concept to the designs of a controller and three-phase low voltage power supply.

The development of lemongrass as a healthy beverage is also tackled. This is one way of providing an alternative drink to health-conscious consumers. The concepts of data banking for the management of information system can likewise be read on this issue.

With this, I would like to encourage readers to make use of the information which can be found in this publication. Researchers who have notable findings are also challenged to contribute in the succeeding issues of this journal. This is one way of disseminating the findings of your study to wider community of readers. On behalf of the Editorial Board and Staff, I would like to congratulate the contributors and wish the readers an enjoyable quest for scientific information.

JAIME C. CABARLES JR., Ph.D
Editor-in-Chief

PREFACE

Congratulations Scientia et Fides: Journal of Multidisciplinary Research and Review on your maiden issue!

When the first International Conference on Asean Studies was held at Central Philippine University in October 2015, and was participated in by researchers and presenters from Korea, Vietnam, Japan, and the Philippines, we only had one thing in mind: publication. Research takes its complete cycle when shared to the world, and the world is enlightened or educated of the research findings.

As your President, I am delighted that finally, we have this journal that will publish research works on multidisciplinary studies, with the ultimate goal of sharing what we have to the academic community, both locally and internationally. The publication is here to publish significant research articles and manuscripts that will contribute to the body of knowledge, and researchers all over the world will find meaningful and useful.

Scientia et Fides, or Science and Faith, the university's motto, embodies this journal as we endeavour to deliver the kind of education that educates the whole person. For this maiden issue, the journal contains research articles focused on Science and Engineering Discipline, and are mostly written by our faculty members. I am happy that our faculty have imbibed the research mindset, and will continue doing so in our pursuit for research excellence.

I hope that this journal will draw interest from different fields all over the world, and will make a great contribution to the society.

I commend the people behind the journal for working hard, and for making research a part of our culture. I pray that commitment will overflow and support will abound as we work hard to the realization of our academic dreams at Central Philippine University.

God Speed!

TEODORO C. ROBLES, Ph.D.
President

EDITORIAL POLICY

Scientia et Fides: Journal of Multidisciplinary Research and Review

Introduction

Scientia et Fides: Journal of Multidisciplinary Research and Review is the official journal of higher education research publication of Central Philippine University. It is internationally refereed and comes out annually. The aim of this journal is to provide an avenue for discussions on advancements in various areas of studies. The journal upholds the University's ideals of excellence, scholarship, and community service.

Content

I. Definition of Terms

Acknowledgment

Authors may acknowledge individuals who have contributed to the study and the writing of the manuscript, but do not qualify as authors. Authors may also acknowledge organizations that provided funding for the research.

Authorship

"Authors are generally defined as persons who have contributed sufficiently to a scientific report to be listed on the byline of the published report" (CSE). An individual may be considered an author if he/she had been involved in designing the research, collecting and analyzing data, and writing of and giving final approval to the manuscript. Authorship also involves publicly acknowledging the contributions an individual has made.

Conflict of Interest

"Conflicts of interest arise when authors, reviewers, and editors have interests that are not fully apparent and that may influence their judgment on what is published. They have been described as those which, when revealed later, would make a reasonable reader feel misled or deceived" (COPE, 2016).

Confidentiality

A manuscript is considered confidential, and thus should not be disclosed without the expressed permission of the author(s).

Peer Review

Peer review (or refereeing) is the process where experts of the field, not affiliated with the publication and chosen by the editor, examine the manuscript with the aim of improving the research study, theoretical paper, critical reading, etc.

Misconduct

Misconduct refers to activities that may jeopardize/compromise the integrity of the research/publication process. This includes violation of this editorial policy, journal policies and publication ethics.

Dual Use Research/ Dual Use Research of Concern

Dual Use Research/ Dual Use Research of Concern (DURC) is life science research that is conducted for legitimate purpose, such as to improve the quality of life or advance knowledge. However, the results may also be misused to threaten life or security.

II. Statement of Policies

Section 1. **Journal Ownership**

The Journal is owned by Central Philippine University. Copyright for articles accepted by the Journal for publication belongs to the University unless other arrangements have been made prior to the submission of the manuscript. Articles may only be reprinted/ republished with the written consent from the Editorial Board.

Section 2. **Authorship**

Authors should adhere to the International Standards for Authors (Wager and Kleinert, 2010) in writing their paper as published studies become the basis for future research and application of the results.

The following criteria (ICMJE, 2016) may be used as the basis for authorship: 1. The individual significantly contributed in developing the design of the study or in acquiring, analyzing, or interpreting the data; 2. The individual wrote or critically revised the study; 3. The individual gave his/her consent to publish the manuscript; and 4. The individual agreed to bear responsibility for all aspects of the study, guaranteeing its accuracy and integrity.

Authorship order (i.e. principal authorship and other publication credits) is based on the contribution, scientific or professional, irrespective of the individual's status. A student, for example, may be regarded as a principal author in a published work with multiple authors if the study was substantially derived from the student's work.

However, authorship need not be conferred in the following cases: a) granting funding or resources; b) providing guidance, advice and/or

mentorship; or c) contributing during research, but not being involved in the process of publishing the paper.

Any person who made substantial but insufficient contribution for him/her to be qualified for authorship should be identified in the Acknowledgement section.

Changes in Authorship. If the need for changes in authorship should arise, the following steps shall be taken:

1. The reason for the alteration (addition or removal) should be clarified. In cases where misconduct is suspected, appropriate actions shall be taken by the Ethics Committee to investigate the matter.

2. If all authors agree to the change and/or all behavior and conduct were found to be in accordance with policies and ethics, the appropriate change in authorship shall be made. The study shall then be reviewed and/or published.

Section 3.**Article Type**

The CPU *Scientia et Fides*: Journal of Multidisciplinary Research and Review considers original articles, case studies, critical readings, theoretical articles, and review articles for publication.

Original articles (also known as research article or empirical article) may be considered as primary literature. They are detailed studies which report findings of original empirical research.

Case studies are also considered as primary literature. These are research works that focus on phenomena involving an individual or a small group.

Critical readings are analyses of literary works to identify patterns such as values, language usage, symbols, and the like. These elements are taken together to offer an interpretation or assertion of the underlying meaning of the text. Critical readings are an evaluative text of a single literary text or may be cross-media (e.g. comparing a novel to its film version).

Theoretical articles do not contain original research; thus, they are considered secondary literature. The author uses current published research to either present an original theory or to analyze or criticize existing theories.

Review articles summarize the present state of research in a particular field of study. They discuss the recent major findings and developments, limitations of and gaps in current knowledge, debates or conflicts, and the directions future research may pursue. Review articles are considered as secondary literature.

Section 4. **Preparation of Manuscript**

4.1. The cover or title page should detail the title of the paper; the author(s), title(s), affiliation(s), email address; and any acknowledgments.

4.2. Original articles, case studies, and critical reading should contain these essential parts: Title, Author(s) (with affiliations indicated as footnotes), Abstract, Key Words, Introduction, Materials and Methods for experimental study or Methodology for non-experimental study, Results and Discussion, Conclusions, Acknowledgement, and References. Theoretical and review articles have no definite format although the paper should still indicate the Title, Author(s), Abstract, Key Words, Acknowledgment and References. Also, author(s) should be open to requests to edit their work during the revision stage. Numbered sections. Sections of the article should be clearly numbered using Arabic numerals (e.g. 1. Introduction, 2.Methodology, etc.). Subsections should also be numbered. Any subsection should have a clear heading (e.g. 2.1. Preparation of the Compound, 2.2.Isolation of Bacteria, etc.). The Abstract, Acknowledgement and References are not included in the numbering.

4.3. Draft manuscript on Letter size (8.5x11 in.) paper, double spaced, with 1 in. (or 2.5 cm) margins all around; font size should be Times New Roman, size 12. There should be two spaces before and after major headings and two spaces before and after subheadings. References, table titles, and figure legends should be single-spaced and numbered consecutively.

4.4. Number of words should not be less than 4000 but should not exceed 6000. This includes the Title, Abstract, Key Words, and References. The abstract alone should be 100-120 words long. There should be at least 3 keywords that include the discipline of study, concepts investigated, method/process used, geographic location (i.e. the country and continent).

4.5. Endnotes (if the discipline requires) should be used instead of footnotes.

4.6. When acronyms or unfamiliar abbreviations are used, they should be spelled out when first mentioned.

4.7. The complete scientific name with author(s) should be used when first mentioned. Succeeding references may use the scientific name without author(s). Scientific names should be written in italics.

4.8. Numbers 1-9 and numbers used at the start of the sentence should be spelled out. Numbers should not be spelled out when they are used in tables and lists or with units of measurement. The metric system or International System of Units (ISU) should be used. Units of measurement should be abbreviated when written next to numbers; otherwise, they are spelled out. For compound units, bars should be used. For decimals less than 1, a 0 is placed before the decimal point.

4.9. Titles for tables and figures should be concise. Figures may be in the form of simple line drawings, computer-generated graphics, and/or good quality photographs. Computer-generated graphics may

use Adobe Photoshop, Adobe In design CS and/or any portable document format (PDF). Photographs should be original and not electronically enhanced, in jpeg or png format. Labels of figures should still be readable even when figures are resized by as much as 50%.

4.10. Citation (in-text and in the list of references) should follow the format prescribed by the American Psychological Association (APA) 6th Edition.

4.11. To preserve anonymity during the peer review, author(s) should not directly/indirectly identify themselves. Author(s) may use first person or third person point of view in writing the paper.

Section 5.**Submission of Manuscript**

Authors should note the following guidelines for submitting manuscripts:

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5.2. All manuscripts should be submitted via email as word file or PDF to this email address: *cpu.researchjournal@gmail.com*

5.3. Revisions must be submitted within two weeks after the article was passed for peer review.

5.4. Articles and manuscripts under review at *Scientia et Fides* are prohibited from being concurrently reviewed at another journal without prior discussion with and written permission from the journal editors.

Section 6.**Policy on Conflict of Interest/Disclosure**

6.1. Authors must disclose, upon submission, any association that poses a conflict of interest in connection with the manuscript and acknowledge all funding sources supporting the work. Failure to disclose a conflict of interest upon submission may result in author sanctions. (Authors are required to complete the Declaration Form to disclose any conflict of interest, and to acknowledge all funding sources supporting the work. The corresponding author must guarantee that all authors have been asked to disclose any conflicts of interest. This is to be submitted along with the manuscript.

6.2. Reviewers may decline the review of any manuscripts they perceive to have a conflict of interest. Editors should also decline from considering any manuscript that may have conflicts of interest.

6.3. All parties involved in the peer-review process should disclose any conflicts of interest and allow the Editor to decide how they should be handled.

Section 7. **Peer Review**

7.1. All reviews will use a double-blind review process. The reviewer(s) and the author(s) do not know each other's identity. The reviewers are left with only the manuscript without any information that might enable them to uncover identity of the author(s). Information removed includes the names(s) of the author(s), address/affiliation, country, phone/fax and email. Stated information in the Acknowledgement and Declaration of Conflict of Interest that may lead to the uncovering of the identity of the author should also be removed from the manuscript before peer-reviewing.

7.2. The Journal peer reviewers shall come from institutions outside of Central Philippine University and may include foreign reviewers.

7.3. The peer review shall take 2-3 weeks.

7.4. Reviewers are not allowed to make any use of the work described in the manuscript or to take advantage of the knowledge they gained by reviewing it before publication. (Every manuscript is treated by the editors and reviewers as confidential information, and they are instructed to exclude themselves from the review of any manuscript that might involve a conflict of interest or the appearance thereof.)

7.5. The Editorial Office is responsible for choosing reviewers. Author's suggested name(s) of referee(s), or experts in the field, will be subjected to approval of the Editorial Office. The referees must have an excellent track record as researchers in the field as evidenced by published researches in refereed journals, research-related awards, and relevant peer-review experience.

7.6. The Editorial Board should send copies of the author's work to referees through e-mail. For a given article, there are three or five referees.

7.7. The review process employs the Manuscript Management System. Referees make one of the following recommendation marks: a. Accept As Is b. Requires Minor Corrections c. Requires Moderate Revisions d. Requires Major Revisions e. Reject With Option To Resubmit f. Reject On Grounds Of (Specify reason) _____.

Section 8. **Misconduct and Investigation**

8.1. All submissions are expected to include data that are honestly and accurately reported according to the best accepted practices of scholarly publishing.

8.2. Duplicate publication, falsification, plagiarism, or fabrication will be considered actionable violations of this policy. The manuscript must contain proper acknowledgment of the work of others, including clear indications of the sources of all information quoted or offered, except that what is common knowledge. The undersigned authors must acknowledge the contributions of people, organizations and

institutions who helped in the process of research and provided technical help or financial funding (in the acknowledgment and in the Author Declaration Form) Citation manipulation is the excessive self-citation by a journal where articles are found to contain references that do not contribute to the scholarly content of the article and have been included solely for the purpose of increasing citations, misrepresents the importance of the specific work and journal in which it appears, and is thus a form of scientific misconduct. Honest errors or honest differences in interpretation or judgment of data are not considered to be misconduct.

8.3. Editors of the journal are responsible for the specific editorial conduct and compliance with relevant policies and procedures. When a report of a suspected violation has been sent to the Editor, he/she will contact the corresponding author directly and request an explanation.

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9.1. Articles can be withdrawn by either the publishers or the authors. A signed statement from the author will be required to be submitted to the Editorial Office before an article can be withdrawn.

9.2. If an article is found to violate ethical publishing guidelines of journal such as plagiarism, data fabrication, miscalculation or experimental error, or bogus claims of authorship, the article can be withdrawn by the publisher.

9.3. If any error is detected in a paper after publication, corrections (Erratum, Corrigendum, Addendum) will be published in the next issue. The corrections will be published only if significant errors are found (factually inaccurate published information). Minor corrections which do not affect the understanding and content of the paper such as spelling mistakes and grammatical errors will not be published. a.

Erratum is published when errors are not detected in the article during editing. This includes typographical errors, errors in figure or table numbers, corrections submitted but not included during the editing, wrong details of author's address or email. b. Corrigendum is published when errors are detected by the authors after publication of the manuscript which compromises the validity of the scientific content, its accuracy and reproducibility. If the reader(s) detects any error in any paper, he/she is requested to submit their comments as "Letter to the Editor" following the prescribed article format. The "Letter to the Editor" articles will be peer reviewed and will also be sent to original authors for their comments. On acceptance for publication, the "Letter to the editor" and comments of the original authors will be published in the same issue. c. Addendum is published if the author(s) unintentionally omitted significant information at the time of submitting the manuscript and wants to add this content in the article after it has been published. Information submitted as addendum will be peer reviewed by the Editorial Board before acceptance. Addendum will be published only in rare circumstances when it is decided by the editors that the information in the addendum is essential to understand a significant part of the published article.

9.4. Retractions are published situations like, if the paper's conclusion is found to be based on faulty logic or computation by recent information available after the paper has been published; if plagiarized data has been published, if the paper is based on fabricated data, or if duplicate publications exist.

9.5. The editor, the author, and the reviewers of the article will decide on a case-by-case basis whether retraction is necessary or not. A signed statement from the author/s will be required to be submitted to the Editorial Office before and article can be retracted.

9.6. An article may be removed from a journal. If any legal issues arise, the distribution of the article is discontinued by a court order. The contents of the article may pose serious health risk if acted upon by others, also if the article violates copyright laws, or if it is found to be defamatory or infringing on other's legal rights.

Table of Contents

Efficiency of a Three-Phase Low Voltage Power Supply for Electrical and Electronics Student Laboratory

*Ramon A. Alguidano Jr.

ABSTRACT

Understanding basic electrical circuit principles can be difficult for students taking up basic electrical engineering course. Enhancing learning methodologies requires experiments with adequate laboratory equipment. The lack of basic equipment required for these laboratory experiments hinder students from learning and fully comprehending their lessons. Affordable and locally designed equipment is needed as a substitute for the expensive technology that many schools in the Philippines cannot afford. This study is aimed to design, construct and test a low cost Three-Phase Low Voltage Variable Power Supply for Electrical and Electronics Laboratory with the following components: three-phase high voltage power supply of 220VAC, low voltage variable three-phase AC power supply with an output of 3V, 4.5V, 6V, 9V, 12V and DC output of ±12V, +5V, ±1.25V – ±12V. Central Philippine University College of Engineering requires laboratory subjects to facilitate and enhance learning methodologies. All output was provided with overcurrent circuit protection to protect the circuits and the components from overload and accidental short circuit. Result shows that all data have met the requirements for reliable, accurate and ready-to-use power supply equipment. The construction of the circuit was completed, thereby meeting the needs of the electronics and electrical students for a Three-Phase Low Voltage Power Supply.

Keywords: current flow, electrical circuit, low voltage variable power supply

Introduction

Experimentation in basic electrical and electronics engineering is necessary to reinforce learning among the students and to understand their lessons further. Availability of instruments and equipment related to this course is a must to address the learning needs of the students. Colleges and universities offering this course were required to have the specific equipment to facilitate and enhance learning. Colleges and universities in the Philippines specifically in the Visayas region offering electrical, electronics and allied courses could not afford to buy this expensive and imported equipment.

Central Philippine University College of Engineering requires

*Iloilo Science and Technology University

laboratory subjects to facilitate and enhance learning methodologies. Engineering curriculum integrate basic electrical and electronics engineering and technology subjects. These courses require basic equipment like the low voltage Three-phase variable power supply with complete switching and protection. Most of Engineering schools and colleges have a limited number of this equipment. Classes perform laboratory experiments in large groups. Some schools have acquired this equipment abroad. Most electronic equipment requires power supply specifically DC voltages for their operation. These can be provided by batteries or by internal power supplies that convert alternating current available at the home electric outlet, into regulated DC voltages. The first element of the basic power supply circuit is transformer, which steps up or steps down the input voltage to a level suitable for the operation of the equipment.

This component is then followed by a rectifier, normally, a full-wave bridge diode converting AC voltage to pulsating DC voltage. The next stage is the capacitor filter circuit that reduces ripple voltage or harmonics from the rectified signal. To maintain the output voltage with the change in the load current and the source voltage, a regulator is then added to the output of the filtered power supply.

The modern and state-of-the-art regulated power supply is the switching type. The advantages of switching supplies are that these are smaller in size compared to linear type, low weight, low material cost, and their ability to actively regulate at no additional cost. (Maloney, 2003)

The existing equipment currently used in the Electronics and Electrical laboratories is the Lab Volt manufactured in Canada which costs a few million pesos. These are a sophisticated set of electrical and electronic equipment. It utilizes a high voltage of 220 Vac and dc. It also has complete circuit protection. Also, Hamden Company developed AC, DC Power Supply model BPS – 103A with the following features 0 – 128Vdc 6A max, 0 – 140Vac 6A max, 0 – 220 3 phase, 9A max, 220Vac 3 phase, 15A max, 0 – 150Vdc 1A max and 110V single phase 15A maximum. Lab Volt EMS 8621 power supply has 120/208, three phase 15A maximum, 0 – 120V/208V – 5A maximum, three phase 0 –120V, 8A DC. This power supply, however, does not have the electronic over current protection and variable step voltage. The Lab Volt EMMS 8621 power supply is applicable only to a very high voltage. This is not recommended for classroom use for it may compromise student's safety and cannot be used in low voltage application. The design, fabrication, and evaluation of a three – phase low voltage power supply is designed specifically for low voltage current application suitable for laboratory experiments in electrical and electronics subjects. Because of the higher cost of imported equipment, the Electrical and Electronics department could not afford to purchase the adequate number needed in the Electronics and Electrical Laboratory. As a result, experiments cannot be performed in a small group

of students or individually but rather in a large group. With this scenario, it becomes difficult for an instructor to effectively demonstrate and relay information for students to better understand the subject matter.

Locally fabricated equipment can be utilized for experimental purposes. Developing and fabricating a three-phase low voltage power supply will provide students in Electronics and Electrical Engineering and allied courses with a low–cost power supply. This will also allow them to be able to perform hands–on experiments that can meet their level of satisfaction [9]. The power supply is simple in design and developed using locally available materials, simple circuits and components. It is very convenient and easy to use because the AC and DC supply are already in a bank and placed in the panel. All that the students have to do is plug the connectors to the value specified in the laboratory experiments.With the limited number of equipment in the electronics and electrical laboratory of the college, the design and construction of this low cost, locally made equipment was conducted to address the needs of the laboratory. This study was aimed to design, construct and test a low cost Three-Phase Low Voltage Variable Power Supply for Electrical and Electronics Laboratory.

Methodology

The block diagram of the Three – Phase Low Voltage Power Supply showed in Figure 1 is composed of eight blocks labeled with a name that corresponds to its specific functions and operation. The block diagram has eight major components: the regulated power supply both fixed and variable, the transformer bank with step down voltage from 220 VAC to a variable 3V, 4.5V, 6V, 9V, and 12VAC voltage, the overcurrent circuit protection for both AC and DC, the 220V ac output voltage directly connected to a 220VAC 3 phase line, and the low voltage DC and AC output. The regulated DC power supply design is an IC voltage regulator with variable and fixed output voltage. The output voltage is from 1.25V to 37 V with built-in over current circuit protection and for fixed IC regulator, the output voltage is being specified based on their rating and the latter has also a built overcurrent circuit protection. The AC and DC output were provided with overcurrent circuit protection. Itis carefully designed to limit the operating current to one (1) ampere and for the protection of the transformer bank and the main component specifically transistors and IC voltage regulator. Each of the circuits is provided with a fuse to further protect the circuit in case over current protection fails. The design of this power supply unit is unique compared to an existing power supply because it uses locally available materials, which are affordable and easy to use. Also, all the outputs were provided with electronically activated overcurrent circuit protections using a simple circuit design, but safe and effective.

The overcurrent circuit protection circuit board is dynamically designed and easy to use with the other power

supply circuit. Lastly, this power supply is specifically designed for low voltage low power application and is safe for students to use.

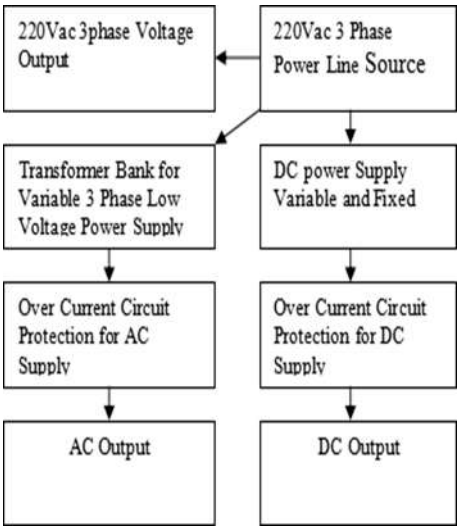

Figure 1. Block Diagram of Three – Phase Low Voltage Power Supply

Design

The design of the circuit board is split into three categories: the design of the regulated DC power supply, over current circuit protection, and the design of the three-phase transformer bank. The regulated DC power supply was used to provide the following voltages: ±12V, +5V and variable ±1.25V to 15V assuming at no load condition. The AC power supply is split into two types: the high voltage AC power supply with an output voltage of 220VAC/60Hz three phase and low voltage variable AC power supply which has five different output levels, selected by using the six position selector switch with the following output voltages: 3V, 4.5V, 6V, 9V and 12V.

Construction of the RAJ Power Supply – 3 Phase low voltage variable power supply

The construction of the three – phase low voltage power supply is done at Central Philippine University, College of Electronics Engineering Laboratory, and constructed by the designer and technician in-charge of the laboratory.

The process and procedure involved in the construction of the power supply are as follows:

1. Making the layout of the power supply. This process involves arrangement of the different components of the power supply, the position of the knob, terminal post, transformer bank, switches, LED indicator, circuit boards wiring, and fuses.
2. Drilling a hole in the casing of the power supply.
3. Component assembly: putting the component into its proper places based on the component layout.
4. Wiring: making a connection between circuit components.

Testing the Circuit Design and Pre-evaluation

The testing of the design will be done at Electronics Laboratory, College of Engineering, Central Philippine University; the parameters tested are the output voltage, maximum load current.

The three source-input was tested before the testing of the circuit components, and followed by the three-phase low voltage power supply. Next are the DC output voltage and the regulated output. To make system circuit functional, the

overcurrent circuit protect was inserted in each of the outputs of the power supply. It applied overcurrent to the system to test the function and operation of the circuit.

Final Evaluation and Testing

Final evaluation of the three – phase low voltage power supply was done at EN204 Electronics Laboratory tested by the personnel from the EE/ECE Department during the week of continuous operations.

The final testing and evaluation of the power supply are the same in testing the circuit design and pre-evaluation procedure.

Instrumentation

The ammeter and voltmeter are used to measure voltage and current. Additional accessories are the resistor, capacitor, inductor, and connectors used to connect each component to become a complete circuit.

During the evaluation and testing of the Three – Phase Low Voltage Power Supply Board, the following instruments were used:

DMM (Digital Multimeter).

METEX model M380 is a Digital Multimeter instrument used in measuring of Voltage, Current, and Resistance of a given circuit and component.

An oscilloscope is an instrument used to measure phase angle of a three phase output voltage.

Connectors. These accessories are used to connect one component to another to complete the circuit.

Three- Phase Power Source. These are line voltage that will provide or supply the power connected to a 220Vac line.

Data Gathered

During the performance evaluation of the three – phase low voltage power supply, the following data were gathered:

1. The phase angle of the line voltage or source and the output voltage
2. The maximum operating current.
3. The minimum and maximum output voltage of a variable regulated power supply

Parameters Analysed

The parameters of this study are the percent error of the actual measured value and the value specified by the specification sheets and the required specifications.

Result and Evaluation

The power supply shown in Figure 2 operates at 220VAC/60Hz three-phase input supply and has a three-phase variable low voltage AC output and a regulated DC output voltage with built-in over current circuit protection to protect the system from load current beyond the capacity of the power supply.

The schematic diagram of a 78XX and 79XX series IC voltage regulator shown in Figure 3 consist of the input voltage (Vi) output voltage (Vo) and the two nF capacitor. This circuit was used to regulate the fixed output voltages. The capacitor connected to the input and output terminal is used to filter out

harmonics produced by the active component and the high- frequency interference. (Mehbub, 2012).

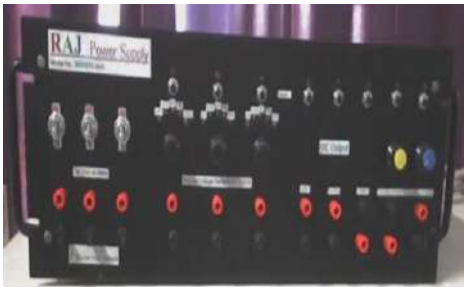

Figure 2. The Actual Three-Phase Low Voltage Power Supply

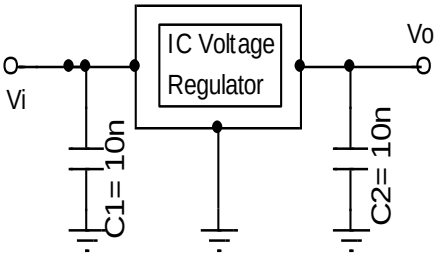

Figure 3. Fixed IC Voltage Regulator

The circuit shown in Figure 4 used LM317 and LM337 that provides a variable DC output voltage is composed of input unregulated voltage (Vi), regulated output voltage (Vo), 10 k variable resistor (P1) used to adjust an output voltage and 1 k resistor R1 used to set the operating current of the regulator.

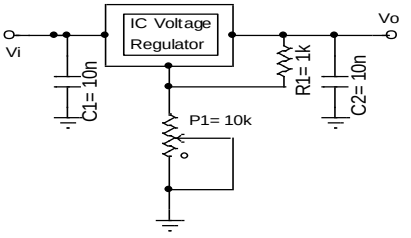

Figure 4. Variable IC Voltage Regulator

The transformer bank is used to step-down voltage from 220Vac to 3V, 4.5V, 6V, 9V, and 12V ac using the Delta – to- Wye connection.

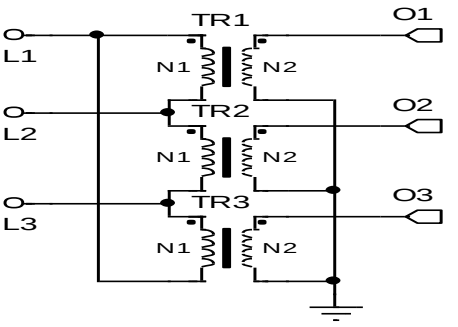

Figure 5. Three Phase Transformer Bank

The rotary switch is used to select the variable ac supply output to 3V, 4.5V, 6V, 9V, and 12V ac from the three phase wye connected transformer bank.

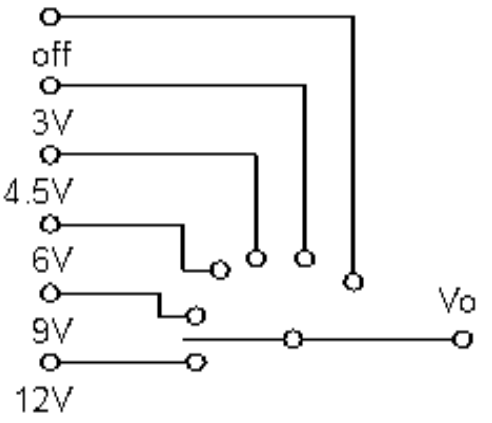

Figure 6.Six Position Selector Rotary Switch

Protection Circuit

The circuit shown in Figure 7 is the overcurrent protection circuit; relay (RL1) is used to automatically switch on and off the output terminal automatically. T2 is the PNP

transistor used to senses the error voltage and triggered the relay on by triggering the gate terminal of SCR1. The 2 ohm resistor R1 controls the maximum operating current. When the voltage across R1 equal or higher than 2V the transistor T2 will turn on, thereby triggering the SCR1 to turn the relay on, and the PB1 is the push button used to reset the supply whenever there is an overload in the power supply.

The output of each power supply protects the system from overload, when the current is more than the power supply rating or the line is being short-circuited. The circuit will automatically shut off and the LED indicator will light indicating that the circuit is overloaded and the system needs to be reset.

The reset button is provided in each line using the normal ON push-button. Pressing this momentarily resets the system back to its normal operation.

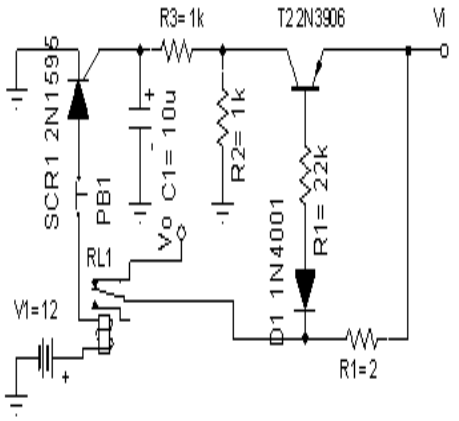

Figure 7. Over-Current Protection Circuit

Result of Voltage Measurement

Data in Table 1 shows that the expected source voltage on the calculated value was 220VAC/60Hz, whereas the actual supply uses to test the instrument were 210.8VAC/60Hz, 211.5VAC/60Hz and 211.3VAC/60Hz on Phase 1, Phase 2 and Phase 3, respectively. These voltages were not constant because voltage depends on the line source voltage. The 220VAC/60Hz was the typical line voltage source and the standard value voltage being used. These voltages were checked before the testing of the secondary output voltage of the connected transformer.

Table 1
Source Voltage Reading

Expected Value per Phase	Measured Value		
	Phase 1	Phase 2	Phase 3
220VAC/60Hz	210.8V	211.5V	211.3V

The expected values per phase reading were 3V, 4.5V, 6V, 9V, and 12V. During the testing, the actual measured values per phase were shown in Table 2 where: for Phase 1, 3.09V, 4.56V, 6.06V, 8.97V, and 11.88V; for Phase 2, 3.07V, 4.58V, 6.08V, 9.01V and 11.95V; and for Phase 3, 3.07V, 4.57V, 6.07V, 8.99V, and 11.92V.

These value voltages were based on the measured source voltage as shown in Table 1. The values of these voltages were not regulated because when the source voltage

changes, the output voltage will also change.

The percent differences are not constant because the values depend on the line source voltage regulation.

The purpose of these measurements is to ensure that all three transformers provide acceptable output voltages.

Table 2

AC Output Voltage Reading

Expected	Measured Value (V)			% Difference		
	Ø1	Ø2	Ø3	Ø 1	Ø2	Ø3
3	3.09	3.07	3.07	-3	-2.33	-2.33
4.5	4.56	4.58	4.57	-1.33	-1.77	-1.55
6	6.06	6.08	6.07	-1	-1.33	-1.16
9	8.97	9.01	8.99	0.33	-0.11	0.11
12	11.88	11.95	11.92	1	0.42	0.66

As shown in Table 3, the expected values for each output voltage were based on the type of IC regulator used in the circuit. The measured value obtained in +5V regulator was 5.04V with a percent difference of –0.8%. For +12V and –12Vthese were 12.03V and –11.87V with a percent difference of –0.25% and 1.08%, respectively.

The results were based on the NO LOAD condition. This value was determined to ensure that the voltage regulator provides an accurate output voltage and to ensure its functionality.

Table 3

DC Output Voltage Reading

Expected Value	Measure Value (V)	% Difference
+5	5.04	–0.8
+12	12.03	–0.25
–12	–11.87	1.08
+1.25→15	+1.25→ 15	–0.24 → 0
–1.25→-15	-1.27→-15.98	-1.44→ 6.53

The expected maximum load current was 1A for both AC and DC as shown in Table 4. But the measured value obtained from this test was approximately 0.6A for AC and 0.7A for DC. The difference of value will not significantly affect the consistency of the power supply. It only shows that the power supply will handle only that amount of the maximum load current. The maximum condition is not determined because it will cause permanent damage to the active component as well as the circuit and system itself. However, the maximum load current can be further achieved by adjusting the value of sensing resistor R1 using the precision resistor.

This substantial percent difference of 40 % and 30% respectively was due to the tolerance of the resistor and during the implementation approximate value of resistor was used rather than the actual calculated value because of its availability in the local supplier. The value of a current of 0.6 A and 0.7A is enough to demonstrate the experiments in the basic electrical and electronics subjects. The experiments will be designed not to exceed this operating current.

Table 4
Current Reading

Maximum Load Current	Expected	Measured	% difference
AC	1A	0.6A	40%
DC	1A	0.7A	30%

Data in Table 5 shows that the expected phase angle per phase is 120^0. On the other hand, angle per phase is 116.47^0, 121.76^0, 116.47^0 for phase 1, phase 2, and phase 3, respectively. This only shows that the system voltages were balanced and the power supply not contributing changes in the power factor of the supply voltage. The wave form shown in Figure 8, 9 and 10 show that the voltage per phase is approximately balanced.

Table 5
Phase Angle Measurements

Expected Value/Ø	Measured Value		
	Ø1	Ø2	Ø3
120 degrees/Ø	116.47^0	121.76^0	116.47^0

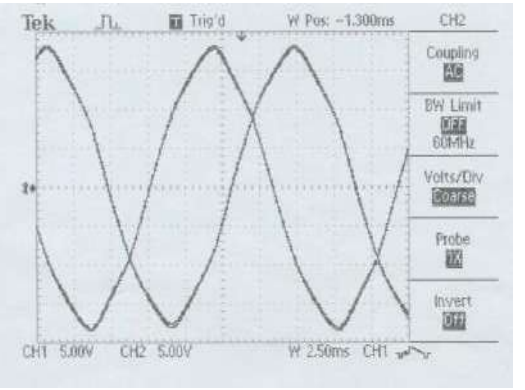

Figure 8. Voltage Waveform of Ø1

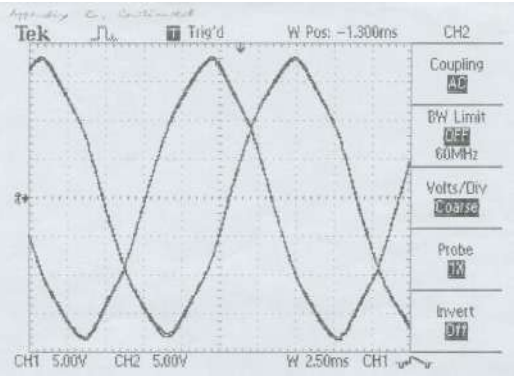

Figure 9. Voltage Waveform of Ø2

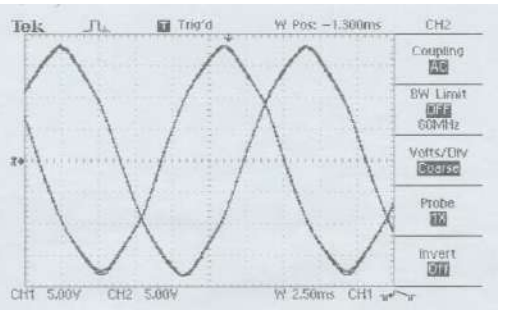

Figure 10. Voltage Waveform of Ø3

Based on the results of the testing and evaluation of the system, the power supply provides acceptable results. The individual circuit

component provide an accurate result with an acceptable percent error and also gives reliable response to the varying load current specifically the overcurrent circuit protections.

The circuit was successfully designed and developed using the locally available materials. It is simple and very useful. The power supply can now be mass produced to address the needs of the school, colleges, and universities.

Summary

This study aimed to design, construct, and test the three-phase low voltage variable power supply for Electronics and Electrical Laboratory. Furthermore, the study designs and develops a system basic circuit board, integrating each discrete component, calculate the component values and determine the circuit and active component parameters, test and evaluate the designed circuit, construct the circuit board, and do the final testing and evaluation of the constructed circuit board and the entire system.

The block diagram of the system is composed of eight blocks: the regulated power supply both fixed and variable, the transformer bank with step down voltage from 220 VAC to a variable 3V, 4.5V, 6V, 9V, and 12VAC voltage, the over current circuit protection for both AC and DC, the 220V ac 220VAC 3 phase line, and the low voltage DC and AC output.

The regulated DC power supply design is an IC voltage regulator with variable and fixed output voltage. The output voltage is from 1.25V to 37 V with built-in over current circuit protection, and for fixed IC regulator, the output voltage is being specified based on their rating and the latter has also a built over current circuit protection.

Based on the drawn diagram, the Three-Phase Low Voltage Variable Power Supply was constructed and pre-evaluated at the Electrical and Electronics Laboratory College of Engineering Central Philippine University.

The parameters tested were the phase angle (for AC output voltage only), the AC and DC output voltages, and the maximum load current also, for both DC and AC output. Final testing was done for a week at the Electronics Laboratoryby the students. The power supply functions normally and is reliable by protecting overcurrent and short circuit, therefore being safe for educational use because it utilizes a low voltage with complete overcurrent protections.

The regulated DC power supply has no problem with the variation of the line voltage, because the output is regulated, capable of maintaining the output voltage within a tolerable limit even if the source voltage varies. The load current of 0.6A for AC and 0.7A for DC is more than enough for the required laboratory experiments, because the laboratory experiments were designed for low current (normally from 10mA – 100mA load current). The resulting phases are approximately 120 degrees for each phase, which only shows that the lines are balanced when the power supply was tested.

Conclusion

The design, construction, and evaluation of a three–phase low voltage power supply for the Electronics and Electrical Engineering Laboratory was successfully done using locally available materials, simple circuit design and minimal number of components, therefore making the system more affordable. The integration and the test evaluation of each component was successful with precise results. The construction of the circuit was completed and the final testing and evaluation was also successful, providing accurate results for measurements. The system was also evaluated to use the best circuit option for this design. Furthermore, this power supply meets the needs of the Electronics and Electrical students.

Recommendation

Based on the results of test, it is recommended that the current capability of the power supply be increased. The 2 ohms resistor five Watt connected to the overcurrent protection circuit) will be changed to less than 2 ohms and the transformer bank will be changed to 2 A rating. The load current capability of the power supply normally depends on the rating of the transformer used for AC voltage output and for DC output voltage. The addition of series pass transistor and also the transformer rating must be higher depending on the maximum load current.

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E-Learning System for Graduate Program Of Central Philippine University

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ABSTRACT

This study aims to develop an E-learning system for the Graduate Program to address teaching-learning issues. This system is a significant tool in helping instructors, students and department heads as they can manage and monitor classes online with facility, effectiveness, and efficiency. The system for the Graduate Program includes course management, classroom management, learning management, online assessment management, monitoring message board for communication, course feedback for instructors, and virtual classroom for discussion. RAD (Rapid Application Development) was applied in developing this system. This model is a team-based technique that focuses on fast information system development for the construction of prototypes which allow users to examine a working model as early as possible, to determine if it meets their needs, and to suggest necessary changes. The model includes phases of planning, analysis, prototype cycle, design, implementation and deployment. After the system was done, a questionnaire was given to the respondents. The questionnaires were taken from ISO standard questionnaires for evaluating systems functionality, reliability, usability, efficiency, maintainability, and portability. After the evaluation was done, it was found out that all aspects of the system were rated above the average which indicates that the system complies with all the necessary functionality and features of an E-Learning System. Thus, the system can be implemented in the Graduate Program of Central Philippine University.

Keywords: eLearning System, Graduate Programs, RAD (Rapid Application Development)

Introduction

Distance learning or so-called e-learning has become the dominant form of education. The demand for the use of the alternative approach to the typical classroom setting is widespread. Universities need to consider cost-effective and efficient methods of operation. The current Classroom Management System of the Graduate Program of Central Philippine University is done manually with the use of a traditional class record. This record contains all necessary information regarding a specific class. It includes the record of each student with his attendance, scores, and grade components. Checking and administering of exams are done manually by instructors who find it tedious with a large class size. At the end of the semester, grades are submitted to the school record

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system, and final grades are mailed to the student each semester. Distribution of class materials uses a traditional way by means of photocopying. Classroom discussions are done in a conventional way (face to face or 100% in person), in which instructors discuss lessons and students collaborate and exchange ideas inside the classroom. Instructors use whiteboards as a tool in writing the topics and illustrations. Also, bulletin board announcements are made manually. All reports are subject to the approval of the Dean of the college. Moreover, communications between instructor and students rely on email (e.g., Yahoo mail and Gmail) and Social site, (e.g., Facebook) or sometimes on mobile phones. Submission of requirements and assignments are also done by email or by personal submission in the department.

The following are the different problems encountered by both students and instructors in the current learning process done inside the classroom:

1. Availability of online materials is limited;
2. The traditional classroom management arrangement is not flexible with the working schedule of students;
3. There is no portal that allows students to view their academic progress online;
4. Faculty members have a hard time informing or updating their students regarding class-related activities;
5. Students have difficulty in continuing their studies in the university when they leave the country or if assigned in another place.

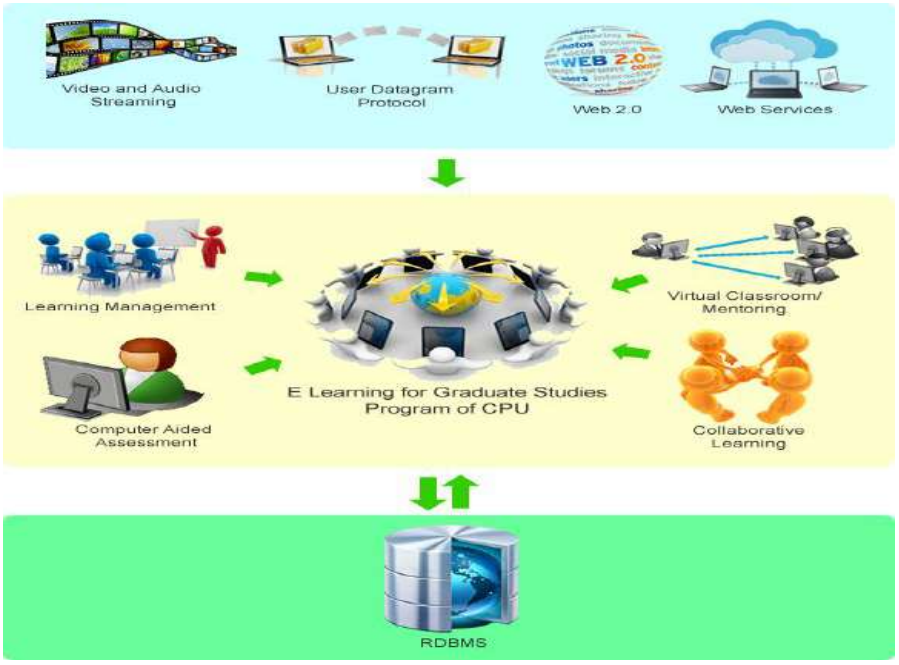

Figure1. Conceptual Framework of E-learning System

To address these difficulties, an e-learning system was developed for the Graduate Program of Central Philippine University. This e-learning became a solution to problems on course management, classroom management, learning management, online assessment, monitoring message board for communication, course feedback for instructors, and virtual classroom for discussion.

Methodology

Rapid Application Development Model

Rapid Application Development was used in developing the E-Learning System. This model is a team-based technique that focuses on fast information system development for the construction of prototypes which allow users to examine a working model as early as possible, to determine if it meets their needs, and to suggest necessary changes. Based on user input, the prototypes are modified, and the iterative process continues until the system is entirely developed and users are satisfied.

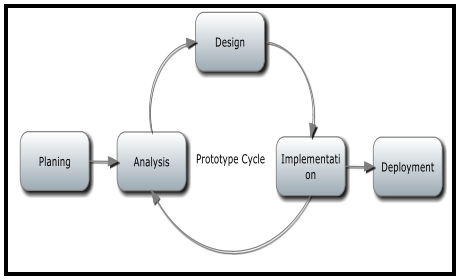

Figure 2. Rapid Application Development

System Implementation

The primary purpose of this phase is for the construction and documentation to develop or modify the system. Activities in this phase include the development, testing and debugging, installation, and user evaluation of the developed or modified system. Development is the activity for constructing/coding the programs that serve as the building blocks of the proposed system. After coding, each module will then be tested and debugged to ensure that it functions properly. The program is evaluated by the user and is used as the basis for modification of the proposed system. If the system is already verified by the user, he/she must sign the acceptance form for approval.

System Deployment

Integrated system performance and its functional requirements as specified in the system are checked in this phase.

The software is presented to the MSCS course of a graduate program of the College of Computer Studies to test the system and determine whether the system can satisfy their needs, and also to identify errors and missing requirements of the system.

To support the study, a survey was conducted to the Personnel of UCSC and MIS Department at Central Philippine University and students, and instructors of MSCS course under the College of Computer Studies. Respondents were composed of four (4) experts, four (4) instructors and nine (9) students under the College of Computer Studies. This set of evaluation was taken from ISO 9126 which is an international standard for the evaluation of software. The standard is divided into four parts which address, respectively, the following subjects: quality model, external metrics, internal metrics, and quality in the use of metrics. ISO 9126 Part one, referred to as ISO 9126-1 is

an extension of previous work done by McCall (1977), Boehm (1978), FURPS and others in defining a set of software quality characteristics.

Questionnaire Designer Phase

The questionnaire designing phase starts after the E-Learning system is done which gives users a chance to interact with the system and to have a better understanding of the whole e-learning system. The questionnaires were taken from ISO standard questionnaires for evaluating systems functionality, reliability, usability, efficiency, maintainability, and portability. Each criterion has its own set of questions. All questions are close-ended, which covers different aspects of systems evaluation. Questions can be answered in 5 choices: 5 for excellent, 4 for very good, 3 for good, 2 for Poor, and 1 for very poor. In addition to close-ended questions, the questionnaire also requires the respondent's name and type of evaluator which is divided into 3 groups - expert, instructor, and student. Evaluator's name and comment are optional. These can be left blank if no comment or name is provided. The overall questionnaire pattern and format is clearly presented.

Results and Discussion

Analysis of Questionnaire

The respondent's responses to each question and each group were calculated to get the accurate results. The data obtained from the questionnaire are then tabulated to show their statistical values.

Close-ended Questions

This section presents a comprehensive view of the feedbacks with the aid of tables.

The table below shows the rating for each question per aspect, rated above average in which out of 18 questions, 12 are rated “excellent”, and six (6) are rated “very good” by the evaluators.

Table 1
E-Learning System Evaluation Result on its Functionality, Reliability, Usability, Efficiency, Maintainability and Portability

Criteria	Rating
Functionality	
The software works according to it specifications.	Excellent
The software shows the correct information/data accessed by the user.	Excellent
The software interacts with other components or systems.	Excellent
The software complies with the industry/ government laws and guidelines.	Very Good
The software protects its information and property.	Excellent
Reliability	
The system is capable of maintaining its level of performance.	Very Good
The software provides correct link process.	Excellent
The software can re-establish or recover the data in case of failure.	Excellent
Usability	
The software provides easy recognizable logical concepts.	Excellent
The software requires minimal effort when used.	Excellent
The software operates according to what the user expects.	Excellent
Efficiency	
The software requires less time in processing.	Excellent
The system performs actions accordingly based on resource used.	Excellent
Maintainability	
The software bears on risk of unexpected effects of revisions.	Very Good
The ability to minimize the effort in changing /modifying the system.	Very Good
The ability to minimize effect in verifying /testing a system change.	Excellent
Portability	
The software is easy to transfer to another environment.	Very Good
The software can adapt to different environments without applying other functions.	Very Good

The data below shows the overall rating of all aspects of the systems. It shows that all aspects of the system were rated above the average which indicates that the system complies with all the necessary functionality and features of an E-Learning System.

Table 2
Overall Assessment Result of the E-Learning System

ASPECT	RATING
Functionality	Excellent
Reliability	Excellent
Usability	Excellent
Efficiency	Excellent
Maintainability	Very Good
Portability	Very Good

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

E-Learning for Graduate Studies Program was designed to serve a tool to enhance classroom instructions and management.

This study applied E-learning concepts and set objectives to give solutions to problems encountered by students and their and instructors in the current learning process. It can create modules to (1) store and manage online learning materials and manage student grades through online grade book; (2) manage announcements through online bulletin board and (3) easily access online materials which students can use to participate in discussion through virtual classroom.

E-learning system was found to be a significant aid to enhance learning course and classroom management. Administrators could manage courses, subjects, curricula and instruction with facility. Through this online learning system and technology, instructors can create and manage their classes easily. Posting of assignments, exercises and custom scores can easily be achieved by instructors handling classes.

Discussions can be administered through virtual classrooms, where students and instructors log into the system and do web conferencing. The system also provides assessment, creation and activation where instructors can create and set schedule for online assessments. Students' grades can be accessed and viewed through online grade-book.

This study applied E-Learning concepts and set objectives to give solution to the problems with the traditional classroom instruction where reports and
exams are misplaced by the teacher; availability of online learning materials is very limited; traditional classroom management is not flexible with the working schedule of professionals enrolled in the graduate program; there is not portal which allows students to view their academic progress; and faculty have a hard time updating their students on class-related activities; and students have difficulty continuing their studies when they leave the city or the country.

Conclusions

There is no doubt that introducing and integrating digital

technologies into education will surely enhance the learning process of the student, and will open up greater interactions between learners, study, work, home and community environments, simply because the learning environment can be extended into those places. Using a web-based E-Learning provides the student the flexibility to access information. Instructor and student could easily find time to discuss lessons through web conferencing. Students learning outcome could be evaluated by instructors through online assessments. At the end of the semester, instructor's performance can be evaluated through online course feedback.

With the results of the surveys that were taken at ISO 9126 which is an international standard used for evaluating different aspects of the software (e.g.: functionality, reliability, usability, efficiency, maintainability, and portability), all areas were rated "above average," which simply shows that the system complies with all necessary functionality and features of an E-Learning System.

Recommendations

Despite the potentials and advantages of this E-Learning System to distance education, there are some problems that need to be resolved. These problems include the quality of instruction, misuse of technology, assurance, and equipment problem. Each one of these has a significant effect on the overall quality of distance learning as a product.

Quality of Instruction

The first problem to be resolved in implementing distance learning is the quality of instruction. Much of the quality of instruction depends on the attitude of the administration and the instructor. The data collected in a 1999 study by Elliot Inman and Michael Kerwin showed that instructors had conflicting attitudes about teaching distance education. They reported that after teaching one course, the majority of instructors were willing to teach another, but that they rated the quality of the course as only equal to, or lower in quality than other classes taught on campus. Moreover, it seems that the administration believes the technology itself will improve the quality of the class.

Misuse of Technology

Despite the full potential of the system, there is a possibility of users not utilizing it. These problems arise because of lack of training such as the instructor's defiance about using the technology. Still others encounter hardware problems, and with this, it seems too obvious that instructors need to be trained to be able to adapt the new environment of distance learning.

Reliability

Another issue on implementing E-Learning is the reliability of the results of assessment. Instructors must be assured that his students are actually the ones who are taking his online exams. Without the benefit of online monitoring, the result of online assessments will be unreliable.

Problems with Equipment

Dysfunctional equipment and hardware can be a great detriment to the success of distance learning. When a problem occurs many times, everything comes to a halt, the learning environment is interrupted, and the entire course is affected.

The following are recommendations for a successful implementation of E-Learning in the school of Graduate Studies:

1. E-Learning favors innovation and should be included in the training strategies of organizations and institutions to answer the increasing demand for trainer efficiency;
2. Communication campaigns must be given attention both internally and externally in the organizations and institutions (show of concrete successful and efficient experiences.)
3. Transparency is a must to users, especially in their data treatment, protection and use.
4. Motivation of the teachers and trainers is an essential element for the quality of e-learning (status recognition and career enhancement, and making them understand that it can facilitate their activities and teacher training);
5. Hardware must be properly monitored and maintained due to high bandwidth consumption;
6. The University is encouraged to acquire a high bandwidth and redundant internet connection for reliability and high availability of service and for critical operation.

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Issues and Concerns Arising from Research Collaboration Among Civil Engineering Students of De La Salle University and Central Philippine University in the Philippines

[1]Alexis M. Fillone and [2]Mary Earl Daryl A. Grio

ABSTRACT

This paper is an assessment of the outcome of research collaboration between 4th year De La Salle University (DLSU) Civil Engineering students major in Transportation Engineering and 4th year Civil Engineering students of Central Philippine University (CPU), Iloilo City. Specifically, it aims to identify issues and concerns in terms of time, communication, computation knowledge and tools, and logistics/resources during the research collaboration process, gather feedback from those involved and recommend improvements. Three undergraduate thesis groups from DLSU-Manila composed of eleven (11) students and four (4) groups from CPU-Iloilo City composed of twelve (12) students were asked to rate the research collaboration between the institutions as the students worked together under the guidance of their thesis advisers from both universities. Out of the original four (4) groups composed of twelve (12) students from CPU-Iloilo City, only two (2) groups involving six (6) students were able to conduct studies on transportation engineering. The data gathered by two other groups were utilized in the completed research of both institutions. The collaboration has helped the student groups from both institutions to finish their civil engineering projects on time. It has provided opportunities to help a local community as well as disseminate information to other communities through the presentation of the research papers in national and international conferences. Overall, the research collaboration was considered successful.

Keywords: student research collaboration, transportation studies, undergraduate thesis

Introduction

Few civil engineering schools in the country require students to make a research paper or thesis to apply the theories and engineering models learned from four to five years of undergraduate course. Other civil engineering institutions require students to make a project study with emphases on the design of a civil engineering structure, to apply structural design principles and to address the need for that structure.

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This research paper discussed what transpired after one year of research collaboration in the field of transportation engineering between DLSU-Manila and CPU- Iloilo City. The objective of this study was to assess the outcome of this research collaboration between the civil engineering departments of DLSU-Manila and CPU-Iloilo City. Specifically, it aimed to identify issues and concerns during the research collaboration process and to gather feedback from those involved to improve the research work collaboration between the two schools.

A total of three groups of thesis students (11 students in all) from DLSU-Manila and four groups of students (total of 12 students) from CPU-Iloilo were involved in this collaboration.

The civil engineering department of DLSU-Manila belonged to the first group, while the civil engineering department of CPU-Iloilo formed the second group. This disparity, however, did not hinder the two departments from collaborating and conducting research in the field of transportation planning and engineering with Iloilo City as the area of study.

Many previous studies have been done about research collaboration, especially between the university and industry. Frame and Carpenter 1979, (International Research Collaboration) and Katz and Martin 1997 (Research Policy) tried to measure research collaboration through co-authorship. Lee (1996) examined the emerging 'technology transfer' that the US academics play in industrial innovations. A paper by Uden et al. (2007) mentioned about the need to pool experts and resources to maximize research collaboration between universities.

The degree of Bachelor of Science in Civil Engineering (BSCE) is offered by CPU and DLSU-Manila. However, DLSU-Manila offers this course with five different majors, namely; Structural Engineering, Construction Management, Water Resources, Geotechnical Engineering and Transportation Engineering which deals with transportation systems engineering and planning, land use and transportation interaction, urban planning studies, and the traditional planning process of trip generation, trip distribution, modal split, and traffic assignment. CPU, on the other hand, offers no specialization.

In DLSU-Manila, the regular senior students in the civil engineering department do their thesis in each of the three trimesters in the 4th year. The students enroll a 1-unit thesis course per trimester. The first-trimester offering is THSCIV11-Project Study 1. The second-trimester is THSCIV12-Project Study 2, and the third-trimester is THSCIV13-Project Study 3, for a total of 3 units. On the other hand, CPU-Iloilo senior students enroll their project study during the 2nd term of their fourth year namely: Engr. 422 – Methods of Research (1 unit) and 1st term in their fifth year, CE 5102 – Civil Engineering Project (3units) with a total of 4 units for the project study. Therefore, both institutions require BSCE students to have civil

engineering projects before they graduate.

Methodology and Discussion of Results

A Visit to Iloilo City

The senior students from DLSU-Manila visited Iloilo City for two days only last September 2011. Upon arrival, these students from DLSU-Manila immediately met with CPU-Iloilo senior students to discuss the procedures for collection of data. Before this, several e-mail exchanges between the faculty advisers were made to formulate possible titles for the collaborative researches and to schedule the time most convenient for the data gathering of both parties.

Figure 1. DLSU-Manila and CPU-Iloilo Students and Faculty Advisers Involved

Research Collaboration Output

From DLSU-Manila, three research groups composed of eleven (11) students were able to finish on time and defended their undergraduate thesis. The research titles and corresponding authors were shown in Table 1. From the original four (4) groups composed of twelve (12) students from CPU-Iloilo City, only two (2) groups involving six (6) students were able to conduct researches on transportation engineering. These two (2) groups completed their researches on the 1st Semester AY 2012-2013.

Table 1
DLSU-Manila Undergraduate Thesis Conducted in Iloilo City

Proposed Thesis Titles	Student Authors	Remarks
A Proposed Circulation System for the Old Calle Real Iloilo	Adrian Alarcon, Angelica Christine Ongkinco, Juanito Dator III, Hector Lemmuel Macapagal	The three groups successful defended and finished their undergraduate thesis on time
Establishing the Vehicular Speed-Density-Flow Relationships along Selected Primary Roads in Iloilo City	Keane Gregory Landoy, Miguel Antonio Pena, Joselito Luis Pabiton	
Proposed Scheduling Scheme for Public Transport in Iloilo City	Angelo Dominic Dumalus, Anezka Bianca Go, Ray Geynil Samonte	

However, the data gathered by the two other groups were still utilized in the completed research of both institutions. The research titles with corresponding authors are shown in Table 2.

Table 2
CPU-Iloilo Undergraduate Thesis Conducted in Iloilo City

Proposed Thesis Titles	Student Authors	Remarks
Proposed Parking Facilities for the Heritage Site in Iloilo City	Paul Vincent Lacson, Razel Davila, Jolly Mae San Luis	Also Involved in the data gathering were six other CPU BSCE students, namely: Alvin Cabangal, Glenn Estenor, Shiela Faldas, Angelo Somcio, Raymund James Leganio and Jude Gonzales
A Preliminary Study on the Service Operating Characteristics of Jeepneys in Iloilo City	Kristian John Carvajal, Cel John Crisostomo, Faye Marie Francisco	

These researches were presented by the students in national and international conferences. The titles and the student members are listed in Table 3.

Table 3
List of Papers Presented in International and National Conferences

Paper Titles	Student Authors	International/ National Conference/ Venue/Date
A Proposed Circulation System for the Old Calle Real Iloilo	Alarcon, Ongkinco, Dator III, Macapagal (DLSI-Manila)	• Student Conference on Transportation Research/ DLSU-Manila /March 10, 2012 • 2012 Asian Transportation Research Society (ATRANS) Student Symposium/ Bangkok, Thailand/ August 24, 2012 • Transportation Science Society of the Philippines (TSSP) Annual Conference/ Panglao, Bohol/September 28, 2012
Establishing the Vehicular Speed-Density-Flow Relationships along Selected Primary Roads in Iloilo City	Landoy, Pena, Pabiton (DLSU-Manila)	• Student Conference on Transportation Research/DLSU-Manila/March 10, 2012 • 2012 Asian Transportation Research Society (ATRANS) Student Symposium/Bangkok, Thailand/August 24, 2012
Proposed Scheduling Scheme for Public Transport in Iloilo City	Dumalus, Go, Samonte (DLSU-Manila)	• Student Conference on Transportation Research/DLSU-Manila/March 10, 2012
Proposed Parking Facilities for the Heritage Site in Iloilo City	Lacsao, Davila, San Luis (CPU-Iloilo)	• Student Conference on Transportation Research/ DLSU-Manila /March 10, 2012 • 2012 Asian Transportation Research Society (ATRANS) Student Symposium/ Bangkok, Thailand/ August 24, 2012 • Transportation Science Society of the Philippines (TSSP) Annual Conference/Panglao, Bohol/September 28, 2012

Therefore, four types of researches were presented in two national conferences while three researches were presented at an international conference. Only one group from CPU-Iloilo was able to present in two national and one international conference. In the case of DLSU-Manila, two groups were able to present in at least one national and one international conference.

Feedback from Students Involved

There were twelve (12) students from CPU and ten (10) of the eleven (11) students from DLSU who gave feedback on the collaboration. A questionnaire survey was conducted with the students involved in the research as respondents.

The following were summarized answers of CPU and DLSU students based on the questionnaire survey.

1. What were the problems and issues that you encountered during the research collaboration, especially during your research?

Responses from CPU Students

a. Time
   - The two-day stay of DLSU students was not enough to gather the massive data required for the research. The CPU students gathered the missing data.
   - There was still a problem with the availability of CPU students and the time required to gather accurate data.
   - Moreover, the students also did not have ample time to work comfortably together especially during the data gathering process.

b. Communication.
   - There were errors in the data gathering procedures, thus, the need to repeat collection of data.
   - The two-day stay was not sufficient to adequately connect the students from the two universities.
   - During the computation of results, there were also some miscommunications in the computation procedures.
   - Some CPU students were not aware of what was required of them. They did not know where to use the data they gathered about their specific researches.

c. Computations Knowledge and Tools
   - CPU students cannot analyze and appropriately interpret the results of their gathered data because of the lack of knowledge on computations and also use of computer software in transportation engineering.

Responses from DLSU Students

a. Time
   - The time allotted for the data gathering was quite short.
   - Limited planning and preparation to be familiar with the place. Limited time to familiarize with jeepney routes and the road network of Iloilo City
   - Six out of 10 mentioned this in their comments

b. Communication
   - Miscommunication with other students due to the differences in dialect
   - There is only one-way communication because CPU students cannot comprehend the instructions coming from their DLSU group mates.
   - Clarity of instructions in the data gathering since some data (like street names) was not obtained

c. Logistics/Resources
   - Few people conducted the data gathering
   - Difficulty in delegating the work to be done

2. Do you have any suggestion on how we can further improve and strengthen the research collaboration between DLSU and CPU?

Responses from CPU Students

a. Improve communication between the students and advisers
   - The communication between the students can be improved by conducting a one-day team-building activity. Team-building can be done during the yearly annual visit of CPU 4th year students to DLSU-Manila in their subject Inspection Trips and Seminars where in March CPU students visit Manila and nearby provinces at civil engineering related companies and institutions.
   - An internet group forum must be created and regular scheduled meetings must be conducted.

b. Conducting more researches in Iloilo and nearby provinces
   - Is a sure way to improve and strengthen research collaboration to continue the partnership or linkage between the two schools.

c. Management of Time and other Resources
   - Briefing and preliminary research titles must be provided beforehand.
   - Documentation must be kept by both parties. These documents include forms, data collection procedures, computations, and so forth.
   - Individual student roles must be defined from the start of the research collaborations.
   - A calendar of activities and list of contact persons must be created and provided for both parties.
   - Commitment, the delegation of work, more systematic procedures must be agreed upon by both parties.

Responses from DLSU Students

a. More time to plan and conduct data gathering
   - DLSU students should stay longer in Iloilo City to be familiar with the place and to gather data
   - Those involved should have met earlier to plan and discuss the data gathering in order to be prepared during the data gathering
   - More trips going to Iloilo for the data gathering and CPU

students can also visit DLSU to discuss the research
- More time to meet the students from CPU and get to know them
- More hands-on practice with the data gathering method

b. Improve communication between DLSU and CPU groups
- More communication between DLSU and CPU students like face-to-face meeting with the students using skype
- If possible, the members from DLSU and CPU have talked already before the actual data gathering
- Create an interaction program for the DLSU students and CPU like Yahoo groups or Facebook
- Students with CPU should be more confident to suggest ideas

c. More research collaboration between the two schools
- There should be more research projects to best strengthen the collaboration between the schools.

3. Aside from finishing your undergraduate research, what did you gain from this research collaboration?

Responses from CPU Students

a. Appreciation of the civil engineering profession
b. How to deal or work with people / team player / cooperation / gain friends
c. Build up non-technical skills such as self-esteem, confidence, patience, and decision-making skills.
d. Acquire sound knowledge of research methodologies
e. Improve technical writing abilities
f. Appropriately respond to criticisms and give constructive feedback
g. Opportunity to participate in local, national and international conferences

Responses from DLSU Students

a. Ability and knowledge in data gathering improved
b. Know more people and gained friends, students from CPU were very hospitable and friendly
c. Once in a lifetime opportunity and experience
d. Developed resourcefulness, common sense, and interpersonal skills
e. Learn ideas and feedback from others
f. Enjoyed vacation and fun
g. Improved leadership and ability to work with others
h. Gained insight/perspective from other students and their research
i. Ideas about how transportation engineers conduct research
j. Exposed to the culture of Iloilo City.

4. Would you recommend this research collaboration to the junior civil engineering students who are about to do their undergraduate research/thesis and why?

All students with CPU answered affirmatively to this question with the following opinions about the research collaboration:

a. It provides an opportunity to explore the different fields of civil engineering and appreciation of their future profession.
b. It helps to make students understand how to conduct researches.
c. It develops one's non-technical skills such as self-esteem, confidence, decision-making, team playing, and personality as a whole.
d. It provides an opportunity to be presented at conferences locally, nationally and internationally.
e. The two different schools with different cultures can share their knowledge and resources to turn ideas into reality.

All students from DLSU also answered affirmatively to this question for the following reasons:

a. To gain experience in researching a new place and is more interesting
b. It promotes camaraderie with thesis mates and fellow student researchers.
c. The research collaboration will save much effort, time and even expenses in data gathering
d. This kind of research will help them realize the value of hard work
e. Learn how to delegate and manage time properly since everybody has a task to do
f. With collaboration, there will be more workforce in data gathering, and there will be sharing of knowledge and ideas
g. Great opportunity and places outside Metro Manila need studies for the improvement of its transportation. We should give focus to these areas for the betterment of the whole nation.

All students from CPU (12 students) and DLSU (10 students) were asked to rate the research collaboration at a personal and group level. This is to evaluate the influence of the collaboration on the individual student and also on the institutions. The results of the evaluation with 5 (highest) and 1 (lowest) are shown in Table 4.

As reflected in Table IV and also as shown in Figure 2, the rating of CPU students at the personal level were slightly higher than that of DLSU students. These include ratings on developed confidence in research, improved interpersonal relations and increased skill and ability to conduct research. While on a group level, the ratings of DLSU students was a bit higher than that of CPU students. These include ratings on the helpfulness of faculty and students, the sharing of data and research materials, the extent of communication between groups and the success of the research collaboration. The differences in the ratings were not that significant between the groups. Notably important was that "constant communication" got the lowest rating since limited communication was going on between the two student

groups. This communication gap could be influential in the decision of the two groups from CPU to change their research topics. However, necessary data were still gathered and provided by those CPU students to their DLSU counterparts to complete the latter's researches.

Table 4
Rating of Students Regarding the Effect of the Research Collaboration

	School	Rating					Ave.
		1	2	3	4	5	
Personal Level							
1. Increased my skill and ability to conduct research	CPU				(5) 41.67%	(7) 58.33%	4.58
	DLSU			(3) 30.0%	(4) 40%	(3) 30%	4.00
2. Improved my interpersonal relations with a group especially data gathering	CPU				(5) 41.67%	(7) 58.33%	4.58
	DLSU			(2) 20.0%	(3) 30%	(5) 50%	4.30
3. Developed confidence in my research capability	CPU				(6) 50%	(6) 50%	4.50
	DLSU			(1) 10.0%	(6) 60%	(3) 30%	4.20
Group Level							
1. Faculty and students from both schools are helpful and shared a lot in terms of data and research materials	CPU			(1) 8.33%	(7) 58.33%	(4) 33.33%	4.25
	DLSU		(1) 10.0%		(3) 30.0%	(6) 60.0%	4.40
2. There was constant communication and collaboration through the course of the research	CPU		(1) 8.33%	(6) 50.0%	(2) 16.67%	(3) 25%	3.58
	DLSU		(2) 20.0%	(2) 20.0%	(3) 30.0%	(3) 30.0%	3.7
3. the research was successful between the two schools	CPU				(6) 50%	(6) 50%	4.50
	DLSU				(3) 30.0%	(7) 70.0%	4.70

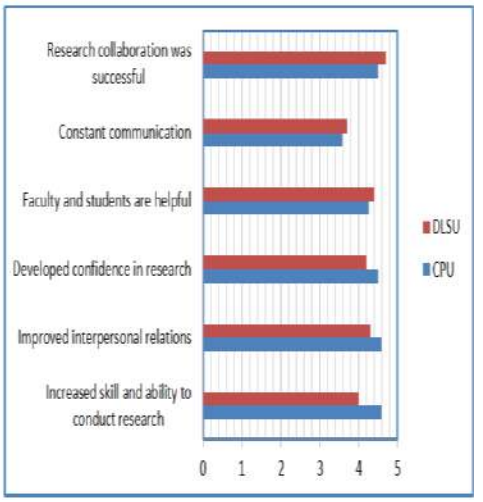

Figure 2. Summary of Rating of Students

The research collaboration, at the student level, has resulted in an increased confidence and capability in the conduct of researches and has also improved interpersonal relations among the students. This was implied that collaborative researches was an excellent way for exchanges of thoughts and ideas as well as improve the technical and social skills of the students.

As a whole, the faculty and members involved in the collaboration were reasonably helpful for the researches to be completed on time. Although there were communication problems between the groups, research collaboration was still considered successful. This entails a culture of unity, commitment, focusing on overcoming any barrier to achieving the goal.

The application of issues and problems in the conduct of the research collaboration between the two universities and prepare possible solutions can improve the research collaboration process, reduce delay and misunderstanding between the groups.

This research collaboration further includes the following implications:

a. Creation of a continuing partnership between two or more institutions is a great possibility,
b. Many resources such as time, facilities, materials and money are shared and saved, and
c. A local community, in this case Iloilo City, is a beneficiary of this endeavor.

Conclusion and Recommendation

Conclusion

The major concerns in the conduct of the research collaboration identified by the students from both schools, are the following: lack of time allotted for data gathering, the limited logistical resources (manpower and materials) during the data gathering, the limited communications between the groups during the progress of the researches, and the limited knowledge and tools to analyze the data gathered. Suggestions to address these concerns include:

1. Planning and allotting more time to conduct the data gathering.

2. Improving communication between the two groups through the use of online resources, and continuing research.

3. More collaboration between the schools to enhance research skills and at the same time share new knowledge as well as the use of

appropriate tools and facilities for research.

Aside from finishing their research projects, a lot has been gained by the students involved which include: appreciation of the civil engineering profession especially transportation engineering, hands-on experience of conducting research, becoming a team player, gaining collaboration to their junior civil engineering students for reasons cited previously.

The research collaboration has greatly helped the student groups from both institutions to finish their civil engineering projects on time. It has provided opportunities to help a local community as well as disseminate information to other communities through the presentation of the research papers in national and international conferences. Overall, the research was considered successful.

Recommendation

As mentioned by students, the lack of time especially during the data gathering phase and the limited communications during the research study period were the major issues encountered. The recommendations made by the students are quite insightful such as the use of the internet for continuous communication and constructive feedback while the lack of time during the data gathering could be addressed by going to Iloilo City several times but would entail more costs. However, the proper guidance of CPU students in Iloilo City in data gathering can help minimize the travel cost of the DLSU-Manila students.

It was strongly recommended that a Memorandum of Understanding (MOU) between the local government units (LGU) and the two universities be developed to assure continuous involvement and linkages and also to demonstrate additional logistical and financial support. Expenses incurred in the conduct of the collaborative researches have been shouldered by the student researchers. Thus, it is suggested that external research funding must be sought and that administration of both institutions must subsidize some if not all of the research expenses.

In 2012 and 2013, transportation research collaborations between DLSU-Manila and CPU-Iloilo were conducted in Iloilo City and Guimaras. This time, the collaboration involved graduate students from DLSU-Manila. In 2014, the research collaborations extended to the structural engineering researches specifically in the assessment of structures with regards to wind, seismic and fire risks. The heritage buildings in Iloilo City and schools in Guimaras were primary beneficiaries of these researches. Hardbound copies of the researches were endorsed by persons in authority both for Iloilo City and Guimaras. These researches have been used for

friends, development of non-technical skills, improvement of technical writing skills, learning the culture of a place, participation in national and international conferences, among others.

One hundred percent (100%) affirmatively responded that they would recommend this research

policy-making and evaluation of some current ordinances.

Finally, the two schools have committed in making the collaborations became part of the college's annual research agenda where the City of Iloilo and nearby places will be the areas of study. In the future, there were plans to be revised and offer graduate and post graduate degree program in line with these researches.

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Level of Harmonics Produced by Variable Frequency Drive Controller Used in Induction Type Water Pump Motor

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ABSTRACT

This study focuses specifically on the determination of electrical noise or harmonic level generated by the variable frequency drive controller in terms of its amplitude and frequency. The central area of concern is the effect of harmonics on the power quality of the electrical supply of Central Philippine University at the point of the pump-motor equipment. Based on the results of the tests, the harmonics of the supply voltage was 2.25%. Running the 5-HP motor directly produced a lower harmonics of 2.10%. When the controller was used to run the motor, the controller in itself produced a significant level of harmonics of 8.42% which interferes with nearby electronic appliances within a very close proximity. A substantial part of the harmonics produced by the controller is filtered from going out of the device itself, so that the harmonic level at the source terminal was about 3.93 %, showing an increase of 1.83% compared to running the motor without the use of the controller. The value is within the acceptable limits of 5% for electronic circuits and systems, but not acceptable for medical and other related highly sensitive instruments, which require a total harmonic distortion (THD) of not more than 3%.

Keywords: *induction type water pump motor, level of harmonics, variable frequency drive (VFD)*

Introduction

Central Philippine University (CPU) is a non-stock, non-profit, Christian, private institution of higher learning founded by American Baptist missionaries in 1905 at Jaro, Iloilo City. Its 24-hectare campus is well laid out with trees, lawns, big fields and several buildings that serve as classrooms, laboratories, libraries, or offices for administration, finance, student services and much more.

The water needed by the school has been supplied by the local water utility Metro Iloilo Water District (MIWD) as well as deep wells within the grounds, to have an ample, continuous supply even when water from the MIWD at times is not available. The university has also put up a 91.13 m^3 water tower that is 21.72 m high. Water is raised to that height by a pump that is driven by a three 3-phase, 5-Hp, 220-V electric motor. It

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is controlled (start and stop) using direct-on-line method.

The central area of the study is the effect of harmonics on the power quality of the electrical supply of CPU at the point of the pump-motor equipment. Harmonics is the occurrence of any "non-linear" current or voltage in an electrical distribution system. The determination of the level of harmonic produced by VFD was a case study conducted at Central Philippine University, Jaro, Iloilo City Philippines to determine the effect of utilizing the VFD for the three-phase induction motor use in the water pumping system of the said institution.

According to the SQUARE D Product data Bulletin, harmonics is a component of a periodic wave having a frequency that is an integral multiple of the fundamental power line frequency of 60 Hz (Stephen David Hearn. PE). The total harmonic distortion is the contribution of all the harmonics frequency currents to the fundamental frequency.

Harmonics is the by-product of modern electronics. The common harmonic producing devices include VFDs (Variable Frequency Drive), lighting and computers. It can interfere with the normal operation of an electrical system. High level of harmonics can reduce the efficiency of the facility's wiring and electrical equipment and increase the amount of interference in the electrical/electronic systems. (Bulletin No 8803PD9402 August 1994 Raleigh, NC, U.S.A)

The presence of this harmonics increases power losses, equipment heating, interference and other related problems. Improve Power Factor and Reduce the Harmonics Distortion of the System (Sandesh, J. et al.), shows that a low power factor entails cost to the community and constitutes additional electrical charges and poor power quality. The major contributor of this problem is the highly inductive load like motors and the in-efficient load. On the other hand, harmonics were generated by active components used in the electronics control system. To address this problem, the system must be capable of correcting the power factor up to unity or adjusting it according to the users' desire. Another would be for the system not to generate harmonics to reduce losses.

The proposed utilization of the VFD controller specifically GPD515 raises some concerns especially on its effect on the power quality at CPU. The use of a controller, specifically VFDs will produce harmonics because of the nature of the front-end rectifier design the most pulse width modulated VFDs. In addition to that, this will render additional cost since most VFD controllers are expensive. On the other hand, the use of this device to control the induction type motor can reduce energy consumption by controlling its speed. Moreover, it can minimize current surges during the motor start; lessen the wear and tear of the parts specifically the moving and rotating components, prolong the life of the motor, smoothen the response by maintaining the speed and balance the supply voltage. .(http://www.vfds.org/vfd-basic-theory-271552.html).

The said device has been designed to control loads, such as three-phase induction type motors up to 5 Hp. The controller can be programmed for specific applications to smoothen the response of the system.

The GDP515 comes with easy to install mounting systems. Each unit comes with a customized program from the factory for maximum performance when used with the C-4 Card Drive, utilizes state-of-the-art 32-bit processing, motor algorithms, auto-tuning, and other benefit-laden technologies creating the cutting edge in AC drive design. It provides flexibility to customers, with a single drive platform offering traditional V/Hz control, sensor less vector, and flux vector control performance.

There is also an issue for current waveform distortion which is Total Harmonic Distortion (THD) versus the actual loading of the equipment power source. As with voltage waveform distortion, the best location to measure current waveform distortion is the power source that feeds the equipment location (i.e., isolation transformer or main service entrance). It gives the best representation of the overall current waveform distortion. "Computers and allied equipment, such as programmable controllers, frequently require AC sources that have no more than 5% harmonic voltage distortion factor, with the largest single harmonic being no more than 3% of the fundamental voltage. Higher levels of harmonics result in erratic, sometimes subtle, malfunctions of the equipment that in some cases, have serious consequences. Instruments can be affected similarly, giving erroneous data or otherwise perform unpredictably. Perhaps the most serious of these are malfunctions in medical instruments." (IEEE Std 519-1992)

To summarize, here are the issues in the use of the GPD515 which include: the degree of harmonics produced by the controller that might cause interference in the public address system of CPU and other related equipment and appliances; the suppressions of current surges; the possibility of significantly conserving energy; and finally, the future development of an assembly system that would be used in the Electrical and Electronics laboratory at CPU College of Engineering.

Methodology

Determining the quality of any given circuit or systems and knowing what is behind any signal power quality is very critical. This will include the measurements of voltage and current and analyze the harmonic content to evaluate whether the controller, the loads, or the external environment produces harmonics. (Bulletin No. 8803PD9402 August 1994 Raleigh, NC, U.S.A).

There are many research studies about harmonics that determine the level and its effect to the electronic and electrical loads. Power system harmonics research: a survey (G.K. Singh), the use of variable frequency speed drives and other nonlinear devices in industrial power systems produces voltage and current distortion called "harmonics."

The testing of the system included the following: the performance of the system with and without the controller by measuring the energy consumption with a specific fixed load of 3-phase 5-Hp induction type motor and the measurement of the degree of harmonics present in the system.

The block diagram shown in Figure 1 was the set-up needed for the testing of the system. It was composed of eight building blocks which were

properly labeled with their corresponding function and operation: The 220 Vac, 60 Hz three-phase line voltage was the main source of the system that supplies power to each of the blocks. Two single-phase kW-Hr meters were used to measure the energy consumption of the entire system. The GPD515 is the VFD controller that can be programmed and reprogrammed to control the operation of the motor. The magnetic contactors were used to switch on and off the system. The selector switch was used to select the mode of operation of the system, with or without the controller. A combiner circuit was used to combine the output of the two magnetic contactors for the specific mode of operation. Lastly, the three-phase AC motor acts as an inductive load of the system.

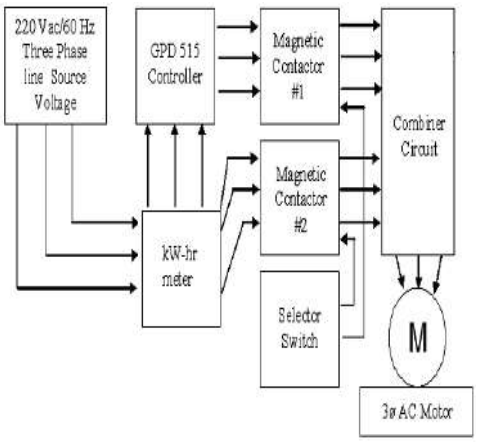

Figure 1. Block diagram for Testing of the System

The system functions as follows: the supply voltage coming out from the source enters into the kW-Hr meter, wherein its output is then connected to the GPD515 controller and on to magnetic contactor one while the other branch circuit is directly connected to the magnetic contactor two. The purpose of this is to select the mode of operation via the selector switch. The selector switch is labeled with the following: bypassed and controller "ON." When the selector switch is set to controller "ON" mode, the controller drives the motor. If the selector switch is in the bypassed mode, the controller cannot be used and the motor is directly connected to the source voltage. The energy consumption was measured. The data will be compared to the testing of the performance of the system with and without the controller. Also, the harmonics produced by the system are measured based on the two modes of operation. Spectrum analyzer was used to plot the harmonics generated by the system, and a number of harmonics produced was determined by using the THD.

During testing, the following data were collected: voltage per phase, current per phase, the energy consumed per hour and the harmonics' amplitude and frequency, both with and without the controller.

The percent total harmonic distortion (%THD) of the harmonics with and without the controller. The percent total harmonic distortion (%THD) is computed using the formula:

$$\%THD = \sqrt{\frac{V_2^2}{V_1^2} + \frac{V_3^2}{V_1^2} + \frac{V_4^2}{V_1^2} + \ldots \frac{V_n^2}{V_1^2}} \text{ X } 100\%$$

Where: V_1 = fundamental signal
V_2 = second harmonics
V_3 = third harmonics
Vn = the n^{th} harmonics

Moreover, tests were applied to determine if there were additional harmonics present in the electrical

system (before the GPD515 controller is used). Should there be such distortions in the quality of power, it will then be determined if it is within the permissible levels, and if the use of the device would either add or reduce system harmonics.

Results

The specifications of each component were determined based on the ratings of the
three-phase induction motor that is currently being used in the water pumping station of CPU. The pump motor being used is a 5-Hp, 220 V AC, three phase induction type. Based on these ratings, the following components were used; 3-phase 30-A circuit breaker, 30-A magnetic contactor with over current protection for direct-in-line connection without the controller, and 20-A magnetic contactor with over current protection at the output of the controller. The line current was measured using the current transformer with a 50/5 ratio. The panel board layout of the
system is shown in Figure 2 above. As can be seen, power can be supplied to a motor load either through direct starting via the 30-A contactor or using the controller passing the 20-A contractor.

The next illustration shows the entire set-up of the testing measuring and testing. In measuring the circuit parameters, there were two conditions considered; the motor was directly connected to source (direct-in-line), and when the motor was controlled by the GPD515 controller.Before the system was tested the voltage in each line was measured and the reading was 232.3 VAC and 8.6-A respectively. This test was used to determine whether the source supplied the desired voltage to the system and the current measurement was used to determine the normal operation of the induction motor. The other phase voltage was 232.5 V, the system supply voltage is almost balanced, indicating that the supply voltage was ideal for testing.

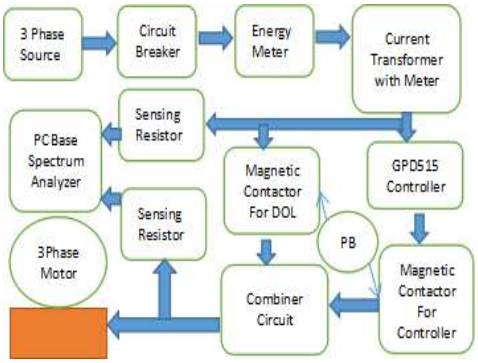

Figure 2. Panel Board

System Testing with GPD 515 Controller.

Figure 3. The complete Set-Up of the System

The result of the source voltage reading was almost similar to that of DIL testing, as the output voltage using the controller was 233.7 VAC with 9.52-A at 60.00 Hz. This will indicate

that the system operated normally and was ideal for performance testing and determination of the degree of harmonics produced.

Testing the Harmonic Content of the System.

In testing the harmonic content of the system, there were two conditions considered; (1) test the harmonics with direct-on-line connection with the motor directly connected to the source, (2) test the harmonics content with the motor controlled by the GPD515 controller. The harmonics were measured using the PC based spectrum analyzer.

Testing the Harmonic Content of the System Using Direct-On-Line Method.

Before testing the harmonics produced by the system, that of the source voltage was determined first, and these served as the reference data in determining the harmonics content at the source are shown below in Figure 4.

Initially, with the load OFF, there were some significant harmonics present at the source terminal. The highest peak was the fundamental frequency which was the line frequency of 60.55 Hz, 0.7126 V. The second peak was the first significant harmonics or the dominant harmonics, with a frequency of 301.8 Hz, and the amplitude of 0.01486V and the third peak was the second harmonics present with frequency of 422.9 Hz, 0.006037 V. and the rest of the peaks were insignificant because the amplitudes were very low.

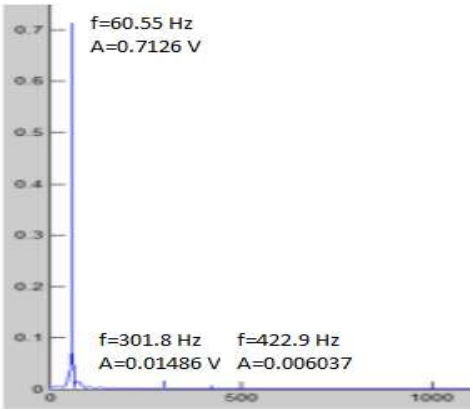

Figure 4. Frequency Spectrum of the Source Voltage with Load OFF.

of frequency at the higher frequency range. Figure 5 is the zoomed version of Figure 4, used for a more unobstructed view of the small peaks shown in the previous figure.

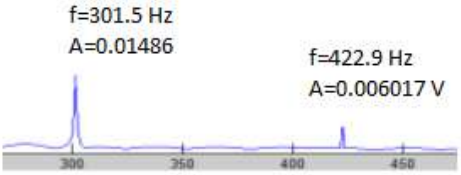

Figure 5. Frequency spectrum of the source voltage with load OFF, zoomed-in version.

The percent total harmonics distortion (%THD) was calculated to be equal to 2.25% which was below the required limit of the IEEE standard of 5%. It means that the source noise is an acceptable level and therefore a good power source.

In turning on the system which enables the direct-on-line connection, the motor was connected directly to the source terminal without the controller. To measure the harmonics content at the source terminal, the Spectrum Analyzer was connected to the sensing resistor installed at one of the phases of

the source. The instruments automatically plotted the harmonics and saved the data, as shown in the graph of Figure 6. The same procedure was followed to get the data to the load side terminal.

Figure 6 shows the frequency spectrum of the source and load terminal. The highest peak still was the fundamental frequency of 60.55 Hz with amplitude of 0.6445 V, the next peak was the second highest significant harmonics in the system with frequency of 301.8 Hz, 0.01251 V while the third highest was at 421.9 Hz, 0.00522 V. The other harmonics were insignificant. This showed that the three-phase, 5 Hp, 220 V AC induction motor did not produce significant harmonics when it was in use. This was not a harmonically generated load. Based on the data shown from the frequency spectrum the %THD is 2.10% which was lesser than the previous values without load.

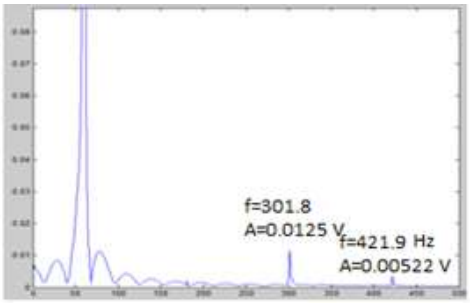

Figure 6.Frequency spectrum of the source voltage with load OFF.

Testing the Harmonic Generated by a GPD515 Controller.

The harmonics were measured first at the load side with the same procedure followed by the measurements of harmonics at the source side. The result was shown in Figure 7.

In Figure 7, the highest peak is at 59.57 Hz with amplitude of 0.5402 V, followed by the 299.8 Hz at 0.04303 V, many smaller peaks were produced within the band of 500 Hz - to - 4000 Hz. The data show that when the controller was used it generated a % THD of 8.42%, The value is much higher compared to the standard limits sets by IEEE.

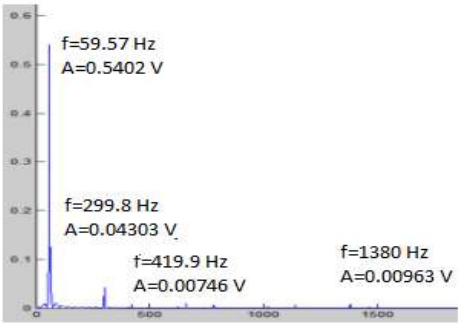

Figure 7. Frequency Spectrum of the Load Voltage of the Controller.

This indicates that the output of the controller produces significant number of unwanted signals. These harmonics may interfere with electronic appliances, equipment, and systems if not properly shielded and grounded. The harmonic or noise coming from the output of the controller was caused by the following: the output of the controller was not pure sine wave; and the controller utilizes active devices to regulate the load which generates harmonics. These harmonics generated by this controller do not pose a problem with induction type motors because such harmonics have very small amplitudes.

However, the presence of these may cause interference with the nearby equipment specifically audio and other related appliances, equipment, and

systems if these are not properly installed and are in very close proximity with the controller. Figures 8 and 9 are the zoomed-in versions of Figure 7 to highlight the smaller peaks from 300 Hz-to-2000 Hz.

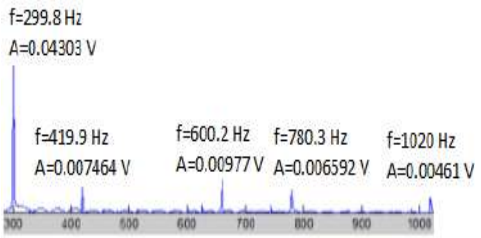

Figure 8. Magnified frequency spectrum of the load voltage of the controller at 100 Hz-to-1000 Hz

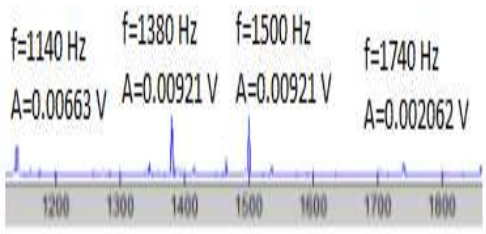

Figure 9. Frequency spectrum of the Load Voltage of the Controller from 1000 Hz –to- 1900 Hz.

The resulting Figure 10, shows the frequency spectrum at the source side, with the highest peak at 60.55 Hz having an amplitude of 0.5331 V, which was the source frequency. The next highest peak was the 300.8 Hz, with 0.01681 V which was the first significant harmonics present followed by the 420.9 Hz, with 0.007966 V. The other peaks of very low amplitude were not considered significant.

Based on Figure 10 the total harmonics distortion (THD) of the system with controller is 3.93%. It was shown that there were significant increases in the number of harmonics and the amplitude, but the harmonic content was still within the acceptable level. It only shows that the harmonics at the output of the controller were also present at the source terminal. However, the bigger harmonics at the output side of the controller were significantly reduced because the controller has a built-in mechanism that suppresses the harmonics, thereby, minimizing these electronic noises induced that would otherwise revert to the system. Figure 11 shows the clearer view of the small peaks in Figure 10.

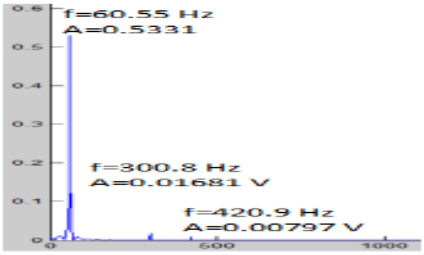

Figure 10. Frequency Spectrum of the Source Voltage of the Controller Load "ON"

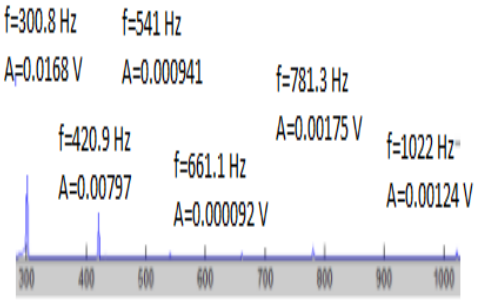

Figure 11.The Magnified Frequency Spectrum of the Source Voltage of the GPD515 Controller.

Figure 12 shows the output waveform of the controller in the time domain. The waveform is a modified sine wave, which is an acceptable supply voltage for the operation of the system. This waveform consists of harmonics, which was the integral multiple of fundamental frequency from 300.8 Hz, 420.9 Hz, 541 Hz, 661.1 Hz, 781.3 Hz and 1022 Hz as shown in Figure 16b. The harmonics shown were the ones that can be viewed significantly by the spectrum analyzer.

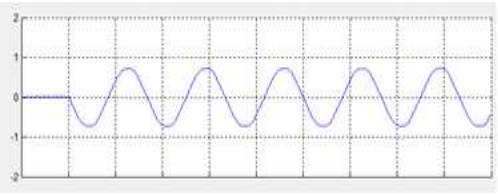

Figure 12. The Output Waveform of the GPD515 c

Figure 13 shows the smooth sine wave signal coming from the electrical power supply. This is an ideal signal for the source to run the load smoothly.

Nevertheless, there were still small amounts of peaks or irregular shapes caused by electronic noise or electromagnetic interference.

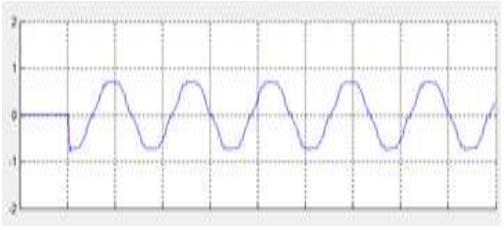

Figure 13. The waveform of the output Voltage without controller

Testing the Energy Consumption of the System

The two-watt meter method of measuring the energy consumption utilized two single phase energy meters. The readings of the two meters were added to obtain the total energy consumed by the three-phase system. The initial readings of the meters were recorded before the actual testing.

The actual energy consumption is the sum of the differences between the initial readings and the readings after one-hour. The reading of the meter was calculated by subtracting the initial reading of the meter and the reading after an hour.

The average energy consumed is the sum of the usage in kW-Hr divided by the number of trials. Table 1 show that M1 average reading was 1.019 kW-Hr while M2 was 1.868 kW-Hr, giving the overall average difference of the two meters of 0.849 kW-Hr. The average difference in readings between the meters was about 0.849 kW-Hr and this value shows that the system using the DIL was unbalanced. The energy consumed per line had a large discrepancy; therefore, the power delivered per line was not equal. This will affect the performance of the motor as well as its mechanical parts and components.

Table 1.
System Data Using Direct-On-Line (DOL)

No. of Trials	Revolution/minute (RPM)	Initial Reading		Reading After 1 hour		M1 Diff (kW-Hr)	M2 Diff (kW-Hr	Energy Used (kW-Hr)
		Meter 1 (kW-Hr)	Meter 2 (kW-Hr)	Meter 1 (kW-Hr)	Meter 2 (kW-Hr)			
1	3514	400.75	556.6	401.7	558.55	0.95	1.95	2.9
2	3514	403.15	560.05	404.08	562	0.93	1.95	2.88
3	3514	405.6	563.43	406.55	565.33	0.95	1.9	2.85
4	3514	408.15	566.75	409.05	568.6	0.9	1.85	2.75
5	3513	426.23	598.1	427.79	599.5	1.56	1.4	2.96
6	3518	429.15	601.05	430.12	603.02	0.97	1.97	2.94
7	3514	450.12	641.98	451.11	643.9	0.99	1.92	2.91
8	3514	452.53	645.51	453.54	647.42	1.01	1.91	2.92
9	3516	455.07	648.97	456.02	650.85	0.95	1.88	2.83
10	3514	456.02	650.85	457	652.8	0.98	1.95	2.93

The same procedure was used to acquire the data in Table 2. The average energy consumed by the system after ten (10) trials is about 3.029 kW-Hr with GPD51 controller. This means that the system with controller will consume an average energy of 3.029 kW-Hr in one hour of continuous operation while the DIL will consume around 2.887 kW-Hr. In addition to that, the average difference between meter 1 (M1) and meter 2 (M2) was about 0.007 indicating that the system was almost balanced in terms of the energy consumption per line. This means that the controller deliver almost the same power per line and these will further improve the performance of the motor.

Table 2.
Percent Difference of the Energy Consumed Between DOL and with GPD 515

No. of Trials	DIL	W/ GPD 515	Diff	%Diff
	Energy Consumed (kW-Hr)	Energy Consumed (kW-Hr)		
1	2.9	3.05	0.15	4.918
2	2.88	2.95	0.07	2.373
3	2.85	2.95	0.1	3.39
4	2.75	3.02	0.27	8.94
5	2.96	3.1	0.14	4.516
6	2.94	2.98	0.04	1.342
7	2.91	3.03	0.12	3.96
8	2.92	3.08	0.16	5.195
9	2.83	3.06	0.23	7.516
10	2.93	3.07	0.14	4.56

The percent difference between the consumption of the two systems is shown in Table 3. There was a 4.67% difference in energy consumption which shows that there was a 4.671 % of power consumed in excess when using the controller as compared to using without it. This means that there were no significant powersavings in using the controller, however, the effect of using it is the balanced power consumption of the motor, which in effect, makes the motor more efficient and minimizes the wear and tear of the mechanical components of the motor.

Moreover, even if there were no power savings with the use of controller, the revolution- per-minute (rpm) of the motor is higher compared to without the use of controller as shown in Table 2 and 3. This indicates that the efficiency of the motor increases with the use of the controller.

There were no significant energy savings when the controller was used in the system. Nevertheless, with the aid of a controller, the energy consumed by both meters was nearly balanced as indicated by a 0.007 average “meter reading difference” which was better as compared to running the pump motor without the controller, where the readings were more unbalanced as evidenced by a 0.849 average meter reading difference.

Furthermore, the use of the controller regulates the starting current to rise gradually until full load current is achieved which negates a high starting current found in using DOL control. This prevents current spikes that could otherwise damage the connections of contactors, thereby prolonging their use. High starting torque is also minimized which contributes to the protection of the motor from wear and tear and results in extended life of the mechanical parts.

Summary, Conclusion and Recommendation

Summary

The determination of the level of harmonics produced by the variable frequency drive controller used to control the induction type water pump motor at the water pumping station of Central Philippine University was explicitly determined by the electrical noise or harmonic level generated by the controller. Also, the researchers tested whether or not the use of the controller could reduce the power consumption of the system. The test system was constructed with its specific components along with its needed tools and instruments for testing. The PC virtual spectrum analyzer was utilized to test the harmonics of the system which include the initial reading of the harmonics without and with the aid of a controller. The DMM was used to measure the voltage, while a clamp ammeter was used to measure the operating current of the motor and two single-phase kW-Hr meters were used to measure the power consumption of the system. To determine the degree of harmonics present in the system the researchers used the equation given by the percent total harmonics distortion (%THD) and the reference data was based on the IEEE standard of not more than 5% allowable total harmonic distortion for the normal operation of the system. The reduction of the power consumption was calculated using the difference between the power consumption of the motor, first with the controller and then without the controller. This showed that the controller produced a significant level of harmonics that can cause interference to nearby electronic appliances which are sensitive to electrical noise specifically computers, radios, public address systems and other related electronic circuits and systems if they are within very close proximity. However, this noise or harmonic generated was not significantly induced at the source terminal because the controller has a built-in filter circuit that will substantially reduce its amplitude and the number of harmonic components within the acceptable range at the source terminal. Thus, there was acceptable "throwback" of significant harmonics to the power system. Lastly, there was no significant reduction in the energy consumption with the use of the controller over the DOL using open loop control mode.

Conclusion

The determination of the level of harmonics produced by the variable frequency drive controller used to control the induction type water pump motor at the water pumping station of Central Philippine University was successfully conducted by designing the block diagram for testing of the system. The researchers were able to construct, and test the function and operation of the system for harmonics content. The level of harmonics content was also evaluated using THD and it was found out that there was an increase of 1.83% in the THD of the system when using the controller as compared to without using it. There was no significant reduction in the energy consumption of the system when using the controller, but there were significant increases in amplitude and the number of harmonics produced in the system. The harmonics produced

at the source terminal was within the acceptable level but at the load terminal, it was above the maximum allowable value. However, this will only affect nearby sensitive electronic appliances, system and circuits, but, not on the system which are connected far from the same peak-off point. The controller provides a balanced supply voltage, which improved the motor performance.

Recommendation

It is recommended that when installing this system, it should be located far from noise sensitive electronic devices or systems. When installing the controller and load, the wiring must be as short as possible and must be shielded to minimize electromagnetic induction or interference.

To further improve the installation of the system, an input filter, and reactor circuit must be installed at the source terminal to reduce further the noise or harmonics induced by the controller. In spite of a significant number of harmonics produced by the controller, it is recommended that this controller must be installed with an induction type motor for the reduction of wear and tear of the mechanical component of the motor, thereby prolonging the life of the mechanical devices specifically the mechanical motor and improvement of its performance.

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Performance of Student Trainees in a Co-operative, Education-Integrated Six-Year Engineering Degree Program

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ABSTRACT

Cooperative Education or Co-op is an immersion program which allows engineering students to gain professional work experience while still in college. Co-op work experience provides students with the opportunity to explore career interests and goals, use the workplace as their classroom, and gain professional development. This paper describes how the CPU College of Engineering Six Year Engineering program integrates Co-op education into its curriculum. This paper is intended to give the description, mechanics and evaluation of the impact of the six-year degree program herein referred to as the Co-operative Education Program. Co-op Education students are allowed to enroll in this engineering program by selection criteria of top (20) percent of the class. Overall student evaluating Co-op experience was 47.78 percent (good). The six-year engineering curriculum and teaching approaches are aligned with and responsive to the needs of the industry.

Keywords: Co-operative Education (Co-op), curriculum, engineering program

Introduction

The constant effort of the government, industry, and academe to provide excellent engineering education and produce competent and globally competitive graduates have inspired the College of Engineering of Central Philippine University to offer a six-year Engineering degree program since 2004. This six-year degree program includes Co-operative Education in its curriculum which is during the senior year. Students are allowed to enroll in the six-year engineering degree program if they belong to the top twenty (20) percent of the class. For the entire duration of the period of the program, the students are allowed maximum of two (2) failing grades; more than two failing grades will exclude the students from the program. Engineering students who opt for internship or company immersion during their last year will have to finish two Co-op work terms to be able to graduate. A co-operative education program integrates career-related work experience into the students' academic studies. Three groups cooperate in this program: the university, the students, and the company. It discusses how the program was implemented, the challenges the program went through,

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and the success it gained. The College of Engineering of Central Philippine University believes that the work term experience is such an important part of educating today's engineer that students under this program are required to complete two Co-op work terms to graduate. The hallmark of co-operative education is the work experiences that provide them the opportunity to enhance their ability to connect theory to a real-life situation. This paper is intended to give the description, mechanics, and evaluation of the impact of the six-year degree program herein referred to as the Co-operative Education Program.

Methodology

Majority or 47.78% of Co-op Students evaluated their Co-op experience as "good". The results/feedbacks were based on the evaluation of the Co-op students and company supervisors. The College of Engineering is well aware of the problem Filipino engineer's face about the practice of their profession in other countries. In the Philippines, it takes a minimum of fifteen years for a student to complete or graduate with an engineering degree while in other countries, engineering degree courses take a minimum of sixteen to seventeen years to finish. Compared to other countries, the Filipino engineer, therefore, lacks one or two more years of education. This discrepancy in the number of years of schooling explains why Filipino engineers' are not allowed to practice their profession in most advance countries. Though Filipino engineers can be capable of doing the job, some countries will not allow them to work as engineers. This reality is mainly the reason why the Philippines finds it difficult to have its engineers recognized by ASEAN and APEC countries in their drive to allow only engineers of member countries to practice the profession in other member countries.

So, in high hopes of giving a remedy to the situation, the Central Philippine University administration offered a six-year degree program in engineering, approved by the Commission on Higher Education (CHED). Table I describes the representation of the program. In the program representation below, AT stands for Academic Term, SAT for Summer Academic Term, and WT OJT for Work Term On-the-Job-Training. The program consists of the necessary academic requirements for a five-year engineering course plus the two work term requirements (minimum requirements 650 hours), which should be undertaken in a Co-op company, preferably in the same company for WT 2 OJT. Work Terms 1 and 2 OJT are each for nine (9) units credit with a minimum requirement of 325 hours. The program was designed for the students to be able to finish it in five (5) years.

Table I.
Co-op Program Representation

Year	First Sem June-Oct	Second Sem Nov.-March	Summer April - May
1	AT-1A	AT-1B	SAT – 1
2	AT-2A	AT-2B	SAT- 2
3	AT-3A	AT-3B	Term off
4	AT-3A	AT-3B	Term off
5	AT-5	WT 1	1& 2 OJT
(minimum requirement-650 hrs.)			

Before students are allowed to proceed with the work terms in the program, they are required to submit the accomplished/signed Parent's/Guardian's request for work term assignment form. It signifies the commitment of their parents or guardian to provide financial support for the entire duration of the co-op program of their child, even with or without allowance from the Co-op company. Also, indicated in this form is their parent's or guardian's geographical preference. The willingness of the parents or guardian of the Co-op students to provide financial support for the program is noteworthy for Co-op students who have remained under the program for their work term 2.

The Engineering Co-op Coordinator is the link between the Co-op company and the students. He is the one responsible for the placement of the students in the companies, monitoring of the conduct of the training and welfare of the students through constant communication and worksite visits. Before the students leave the campus for work, the co-op coordinator should make sure that all requirements are met, forms are accomplished, and necessary documents including essential dates are on hand. The coordinator must conduct an orientation for the students on things to do before leaving the campus, while on work, and when they return to campus. The orientation also includes topics about conflict of interest, copyright, and confidentiality. Moreover, the orientation should remind the students of their responsibilities and give tips for success in their work term. After the evaluation of the academic records of the students under the program and applying for a work term job, a ranking based on the Grade Point Average (GPA) of those qualified students for placement to Co-op companies is made. Only when the accomplished parent's/ guardian's request for work assignment forms are submitted by the applicants is the list of Co-op students for the work term is made final. The Co-op students are then required to submit their resumes to the coordinator.

The Co-op coordinator has a list of Co-op company contacts with Memorandum of Agreement (MOA) for placement of the co-op students. However, the student is also allowed to search and make initial contact for and with a company for his/her work term, but final arrangement and endorsement must be made through the coordinator.

The deployment of students follows the following steps:

1. A letter of request for work term jobs is sent by the program coordinator to each Co-op company.

2. The Co-op coordinator selects the students to be assigned or to be candidates for the Co-op listed companies, by their geographical preference and GPAs.

3. Resumes of the candidates are forwarded, and the company's representative may contact the shortlisted students directly.

4. The Co-op coordinator may be contacted to arrange the date, time, and location of exam/interview of students. Usually, the company uses our campus facilities for examinations and interviews. Telephone interviews can be arranged as well.

5. Confirmation of the placement of students with the company is done

by the coordinator. Once the student is accepted, the Co-op coordinator must provide the student with the list of requirements for him/her to comply with before reporting to work.

6. Enrolment for WT 1 and 2 OJT. Students are required to enroll both WT 1 and 2 OJT once and in the second semester.

7. Endorsement to the Co-op company for work. The students should report to the company with the pertinent documents/requirements including the endorsement letter signed by the Dean of the College, the Coordinator of the program and the Vice President for Academic Affairs.

The Engineering Co-op Coordinator makes work site visits for the students. The student and the company are contacted to arrange the date and time for the visit. Site visit goals include:

- Meeting with the student and the supervisor to ensure that the work term objectives and expectations are being met.
- Becoming familiar with the Co-op company requirements, facilities, and Co-op needs. This knowledge helps in counseling students and grading work term reports.
- Discussing with the Co-op company supervisor the student performance review and making an offer for the student return to the company for the next work term.

The Engineering Co-op Coordinator prepares a detailed Co-op Supervisor Student Trainee Evaluation instrument to be used by the Co-op supervisor for the evaluation of the performance of the Co-op student.

The form is used in two phases: at about the middle of the term, and when the student has completed the work term. The accomplished form is mailed to the coordinator immediately after the work term or may be carried by hand by the student. The Co-op supervisor must approve the work term report topic of the student, affix his signature on the title page, and indicate whether the report is confidential or not. His/her signatures should also appear in the logbook of the student for his/her activities.

Results and Discussion

Table II provides for the overall performance of the Co-op students from 2012 to 2015, using the scale: 1 – unsatisfactory, 2 – uncomplimentary, 3 – Fair, 4 – commendable, 5 – Exceptional.

The final grades of the Co-op student is computed by Students Performance Review (75 percent), Work Term Report (15 percent), and Logbook (10 percent).

Table II-A
Overall Performance of Co-op Students

Leadership and Teamwork	4.06
Professional Qualities	4.26
Overall Average	4.10

The Co-operative Education Program of Central Philippine University began in 2004. It was able to overcome the challenges encountered, and it has survived because the additional investment is justified by the benefits realized. Even if now, as required by CHED, On – the - Job- Training (OJT) is already included as part of the curriculum for most if not all engineering courses, the

duration of 240 hours is too short. The original design for the program had the two work terms in alternation with academics, with Work Term 1 during the summer of the fourth year (240 hours) and Work Term 2 during the second semester of the fifth year (420 hours). From the feedbacks of the supervisors, 240 hours of OJT is not beneficial for it is very short for an immersion program to be effective.

Table II-B
Cooperative Education Supervisor's Evaluation

Skills/Abilities	Average
Communication	4.08
Conceptual and Analytical	4.00
Leadership and Teamwork	4.06
Professional Qualities	4.26
Overall Average	4.10

Thus, the program was redesigned to have Work Terms 1 and 2 to run continuously for 650 hours. The present set up of the program that made it more beneficial to both the Co-op company and the students provides the rationale for those who will opt to be under the said program.

This program provides opportunities mutually beneficial to the Co-op company and students – a win-win situation. The following are the benefits realized by the Co-op students according to the result of their work term 1 and 2 OJT evaluation of the Co-op Education Program:

- The real world experience they had in their work term enabled them to decide on which career track to take.
- There were improvement and development of their communication skills.
- They had learned and experienced the value of teamwork.
- They developed their technical and even interpersonal skills.
- There was an appreciation of the fact that they will graduate with a degree plus professional experience, an edge over graduates and graduating students who have not had co-op experience.
- There was a realization of the importance of hard work, the right attitude, skills development, and human relations.
- They have enhanced their knowledge and application of the firsthand experiences learned in school.
- There was recognition of the importance of one's love and dedication for work.
- The academic and work term requirements in the program have provided them with a better understanding of the need to relate theoretical concepts to real-world situations.
- It improved their leadership and time management skills.

Table III shows the result of the Coop students' evaluation of their Co-op experiences, expressed as the percentage of the total number of trainees from 2012-2015.

Table III.
Overall Student Evaluation of Co-op Experience

Scale	Percentage
Excellent	44.44
Good	47.78
Average	6.67
Fair	1.11
Unsatisfactory	0.00

The list below showed some of the perceived and realized reasons why co-op students are helpful to their organization, based on the comments of the Co-op supervisors in their evaluation of the program:

- A regular supply of well trained, highly motivated students who want to work and learn
- An opportunity to complete short-term tasks or undertake stand-alone projects
- Relief for permanent professionals during peak work periods
- A cost-effective method of evaluating the potential of future employees
- An opportunity to bring the latest technical skills or research techniques in the organization.
- An opportunity for permanent employees to experience supervising a co-op student
- Community recognition for being a partner in education.

Indeed, there is no substitute for real work experience in engineering. By hiring students, the company becomes part of the educational process and helps shape the engineers of tomorrow. It is only through the support of the Co-op company that the Co-operative Education works.

Conclusion

Co-op supervisor evaluation shows that our Co-op students can produce commendable performance results in all the four areas evaluated and for overall performance, signifying that the six-year engineering curriculum and teaching approaches are aligned with and responsive to the needs of the industry. Furthermore, this implies that our students, before they report for work, are ready to demonstrate the skills, knowledge or attributes the industry needs, and they are also ready to meet expectations.

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Philippine Red Cross Online Blood Bank Management Information System

*Romarie Jhoanna. C. Eder

ABSTRACT

Philippine Red Cross (PRC) is one of the major suppliers of blood in the country. Blood Centers of the PRC all over the country are having a hard time managing and communicating their data from one blood center to another. Generating monthly reports is also challenging on their part since records are unorganized and data retrieval is time-consuming. To address the issue, the Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was developed. It is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS). The system was developed using V-model to lessen errors during the development of the system. PHP programming language was used in the development and MySQlwas used for the database tool. Ozeki and Visual C# was used in the integration of SMS into the system. Having been developed using the web architecture, the system provided a more effective networking ability that will help PRC employees in proficiently profiling their donors, keeping their blood stock data updated and generating statistical reports.

Keywords: *Blood Banking, Philippine Red Cross (PRC), PRCOBBMIS*

Introduction

The global market for blood banking and blood products is forecast to reach US$36 billion by the year 2015. The aging population, emergence of new infections and efforts to make available qualitative blood the world over are fuelling market growth. Stringent regulatory and healthcare policies adopted across the globe are also influencing the market for blood banking and blood products.

In the Philippines, the main governing body for the Blood Transfusion Services (BTS) is the National Council for Blood Services chaired by the DOH with the Philippine Red Cross Society as Deputy Chair. There are several technical subcommittees including one for blood donor mobilization, which is chaired by the Philippine Red Cross Society. Currently, there are at least 2,000 licensed health facilities across the country and at least 200 authorized blood banks (BB). However, these are not part of a single system, so there remains a high degree of fragmentation and a high need for centralization and rationalization (Global Industry Analyst, Inc., 2016).

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The Philippine Red Cross (PRC), founded in 1947, is a premier humanitarian organization in the country, committed to providing quality life-saving services that protect the life and dignity especially of indigent Filipinos in vulnerable situations. In all its 65 years of reputable existence, where it used to be involved only in providing blood and in disaster-related activities, the Philippine Red Cross now offers a broader array of humanitarian services ranging from preventive medicine to therapeutic counseling, to youth leadership (Philippine Red Cross.,2017).

PRC has one National Blood Center, and it is located in Bonifacio Drive, Port Area, Manila. There are three PRC regional blood centers in the country, namely: Eastern Visayas Regional Blood Center (EVRBC) located at Osmeña Blvd., Cebu City; Western Visayas Regional Blood Center (WVRBC) located at Bonifacio Drive, Iloilo City; and Mindanao Regional Blood Center (MRBC) located at Capitol Compound, Cagayan de Oro City. Under this regional blood, centers are blood service facilities. On the other hand, WVRBC, together with all other regional blood centers and blood service facilities, are communicating to the PRC national headquarters with the use of the phone, e-mail, and fax.

In line with the strategic directions of national voluntary blood services program under the Department of Health, the WVRBC recruits voluntary blood donors, collects blood for testing, and processing into blood and blood products like packed red blood cells (PRBC), platelets and fresh frozen plasma.

These processed blood components are delivered directly to the hospital blood stations to make blood readily available to the patients, especially during emergency cases. By doing so, lives are saved because the turnaround time of getting blood from the Red Cross to the hospital has been eliminated.

On the contrary, blood served directly to the patients confined at the hospitals are advised to recruit blood donors to help support the blood program at the same time ensure the continuity of blood stocks for future patients.

To guarantee the acceptability of these blood donors going to WVRBC, a donor database is necessary to assure that donors are qualified to donate blood. That is, the frequency of donation must be at least once every three months, and they must be non-reactive to laboratory test for the five transfusion-transmissible diseases such as Hepatitis B, Hepatitis C, HIV-AIDS, Syphilis, and Malaria.

The PRC-WVRBC started to computerize its donor records in 2004 and is only accessible to the center itself. They are utilizing one computer to save all files, and they are using JAVA and SQL.

The donor database consists of the following information: source of donor (patient directed / walk-in), date of blood donation, name of blood donor, complete address of the donor, age, sex, serial no. of blood, blood type, type of bag used, rhesus (Rh) factor and laboratory results. They issue donor cards but it does not include the donor's photo that can

verify donor's identity. The laboratory results are very confidential that only the authorized medical officer(s) and nurse(s) can access the results. But staff members who are the first to screen the donors don't have any means of identifying if the donor was tested positive in one of the five transfusion-transmissible diseases in other blood centers unless they test the blood themselves. They also have a difficulty in identifying donors that have already donated blood in less than three months, especially if they come from other regions.

Since the PRC-WVRBC does not have their local website yet, they are just utilizing the website of the PRC national headquarters for information dissemination purposes.

Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was developed out of the prevailing problems encountered by PRC. PRCPBBMIS is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS).

Methodology

The Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was based on the Government to Citizen (G2C) Theory. G2C is the communication link between a government and private individuals or residents.

In the case of PRCOBBMIS, the government links with the Philippine Red Cross and their allied hospitals to cater to the services that they provide to the public such as blood testing, extraction, storage and dispensing.

Those who are under "citizen" are the patients and donors needing the services.

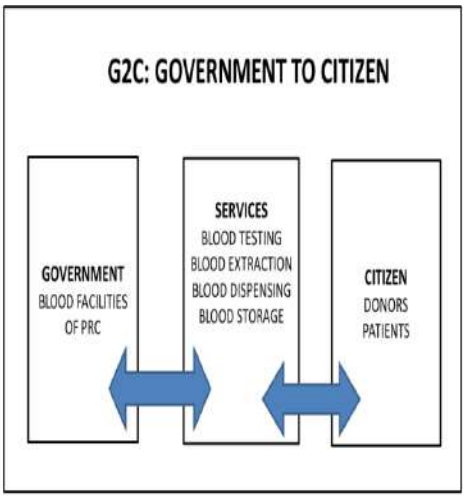


Figure 1. PRCOBBMIS

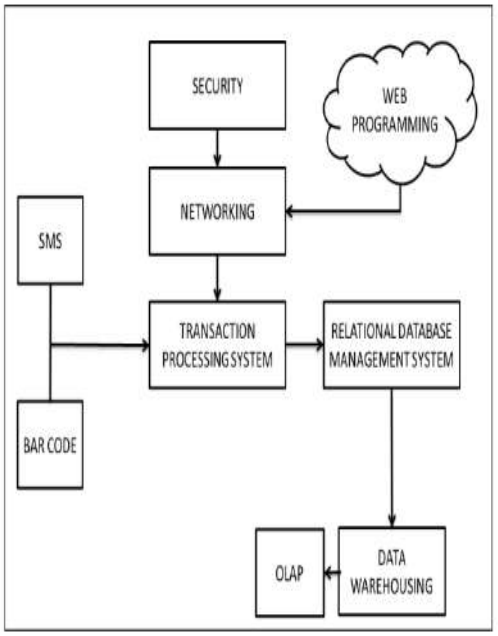


Figure 2. Conceptual Framework of PRCOBBMIS

The Conceptual Framework of PRCOBBMIS is composed of the Security System with Internet connection; Networking, Transaction Processing System (TPS) with Short Message Service (SMS) and Barcode, Relational Database Management System (RDBMS), Data Warehousing, Data Mining and Online Analytical Processing (OLAP). These technologies were formed into an integrated system.

Security

To ensure the security of the system from hackers, bycrypt is used which is a password hashing function. To access the system, the PRC employee must first register with the administrator, and he will be given his username and password which will be used to log-in. Once the username and password are verified by the system, then the user can access data according to the level of accessibility the administrator has given to that user.

The usernames and passwords are given by the administrator for easy control of users in the system. However, as soon as the employee can log–in, he has the option to change his password.

Networking

Wide area networking (WAN) is used in this proposal since PRC is a national organization and this is used on all PRC blood centers nationwide, for easy access and sharing of essential blood and blood donor data. Internet connection is vital for the user to access the system. As long as they are connected to the internet, they can pull up any data connected to the system.

Transaction Processing System

TPS ensures a smooth flow of transaction, isolating particular transactions that have no credible assurance of the collected data's authenticity in this system.

It also provides accurate information that guarantees immediate action to negotiations made by persons and companies involved.

Atomicity is one of the characteristics of TPS. In the PRCOBBMIS, atomicity is implemented such as if a particular process is not fully completed.

Therefore, the transaction does not exist. It also has a real-time processing feature in which if the blood donated has negative results from any tested diseases, it automatically adds up to the total list of available blood in that blood bank.

Short Message Service

SMS is a feature that is incorporated into the system for inquiry purposes. In case a patient is isin need of blood, and the blood type is not available in the hospital's blood bank, the medical personnel, for instance, can just use his mobile phone and text his inquiry to the system instead of running to a computer with internet connection.

As the message reaches the system, automatically the system looks for available supply on that particular blood type on all PRC blood centers registered on the system and replies back to the medical personnel.

They can immediately contact the specific PRC blood center that has an available supply. This feature is

accessible to those who are registered in the system.

Barcode

The system allows barcode entry for easy retrieval of donor profile and blood information.

Relational Database Management System

RDBMS facilitates the organization, storage, access, security, and integrity of data and eliminates data redundancy. It stores the data in a set of tables, each of which contains a unique identifier.

The system was developed using MySQL and the programming language was
PHP. MySQL is a relational database management system (RDBMS) based on SQL (Structured Query Language) that runs as a server providing multi-user access to some databases.

MySQL is selected in this system because of its cross-platform capabilities. It means that one can develop his database on a Windows laptop and deploy on Windows Server 2003, a Linux server, an IBM mainframe, or an Apple XServe, just to name a few potential platforms.

This gives a lot of versatility when choosing server hardware. One can even set up replication using a master on a Windows platform with Linux slaves. (Hillyer, M. 2004).

Although under constant development, MySQL Server today offers a variety of functions. Its connectivity, speed and security make MySQL Server highly suited for accessing databases on the Internet.

Data Warehousing

Data warehousing in the system is combining data from multiple and usually varied sources into one comprehensive and easily manipulated database. Common accessing systems for data warehousing include queries,
analysis, and reporting.

Because data warehousing crea tes one database, in the end, the number of sources can be anything you want it to be, provided that the system can handle the volume. The final result, however, is similar data, which can be more easily manipulated. Data warehousing is responsible for integrating data from multiple and usually varied sources into one comprehensive and easily manipulated database. For example, any data connected to the donor's name is seen such as the serial number of the blood bag, the test results, the patients who used the different components of the donor's blood, etc.

Online Analytical Processing

OLAP is responsible for generating the data required for report generation. Such reports have multidimensional data like for instance, in a certain month it displays all donors that are men under ages 20-30 years old having blood type "A". Below is Table 1 that shows the comparison of PRCOBBMIS to other existing systems from other countries.

Table 1
Comparison of PRCOBBMIS to Other Existing Systems from Other Countries

No.	Title	Donor Profiling	Donor Management	Record Blood Record Management	SMS Blood Stock Query	Online Blood Stock Query	Report Generation
1	A Web-based blood donor Management Information system for the Red Cross Society, Uganda (WBBDMI)	✓	✓	✓			✓
2	Online blood donation reservation and management system in Jeddah	✓	✓				✓
3	A study on blood bank Management	✓	✓	✓			
4	Online Blood Donation Reservation and Management System (OBDRMS)	✓	✓	✓		✓	
5	Blood Bank Management System	✓	✓			✓	
6	Android Blood Donor Life Saving Application in Cloud Computing	✓	✓		✓		✓
7	Web-based Information System for Blood Donation	✓	✓	✓			✓
8	International Institute for Communication and Development (IICD) Supported Programme: Integrated Blood Donor Data Base Management System-Zambia	✓	✓	✓			
9	PRCOBBMIS	✓	✓	✓	✓	✓	✓

The existing systems as shown in the comparison table have similar functions to PRCOBBMIS, but they still fall short since none of them were able to capture all six functions that PRCOBBMIS offers. Therefore, it was concluded that the PRCOBBMIS is the answer to all to the needs of PRC in terms of handling blood stock and donor data.

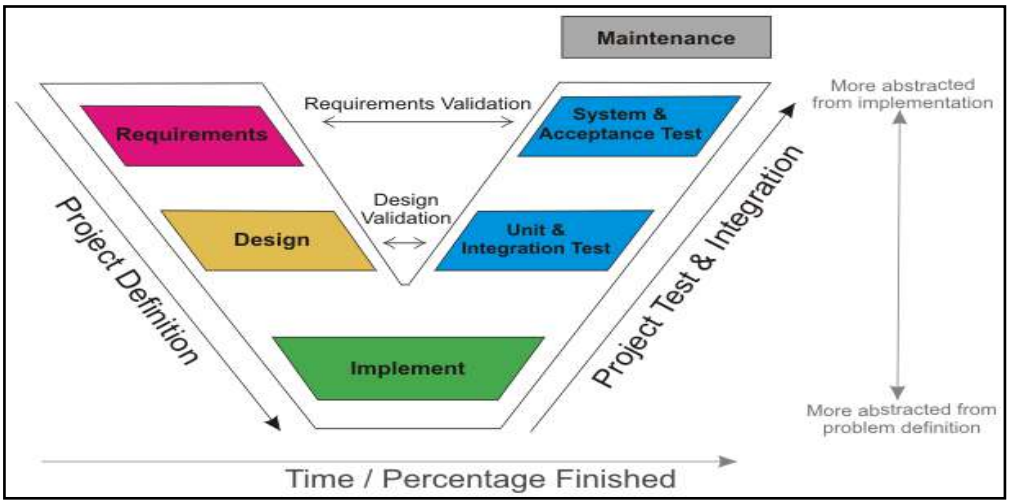


Figure 3. PRCOBBMISV Model for the System Development Life Cycle

Methodology

The PRCOBBMISV followed the Model for the system development life. V Model development methodology may be thought of as an extension of the waterfall model; it still breaks the implementation down into discrete phases. It recognizes that there is feedback from testing that feeds in at the requirements level, and it also shows at each stage the abstraction, different from the implementation. This model was chosen because it is easy to understand, the deliverables are easily defined for each stage, and there is an early stage of testing which improves the likelihood of success. The defects were detected at the early stage of this model, and unlike the waterfall model, planning and test designing happened before the coding. The phases of the study include Requirements gathering, Design, Implementation, System Acceptance Test, and Unit Integration Testing.

Requirements

In this phase, some of the employees of the Philippine Red Cross (PRC) Western Visayas Regional Blood Center were interviewed to gather information about the client. Based on the actual process used by the client, the current data flow diagram (see Figure 4 and Figure 5) was created. A copy of all the active forms used in their blood banking operations was given by the client; from the donor registration to the blood extraction, until the blood is ready for dispensing.

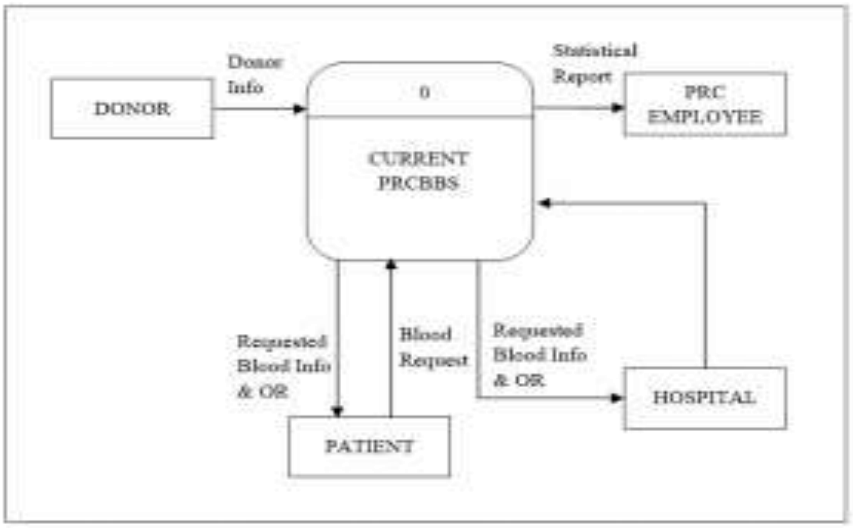


Figure 4. Contextual Diagram of Current PRC Blood Bank System

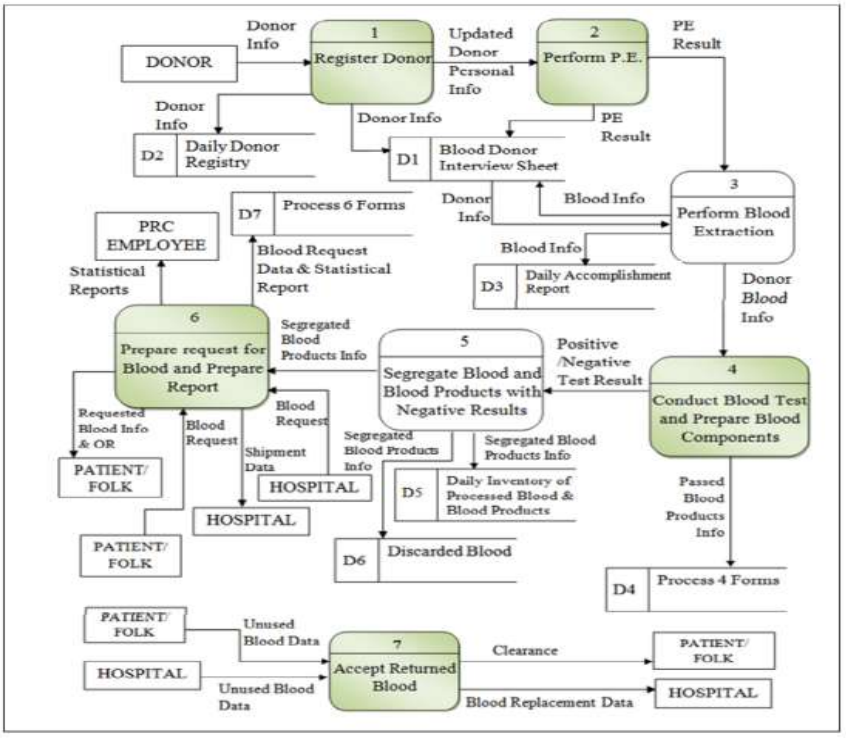


Figure 5. Diagram Zero of Current PRCBBS

Design

The next phase of the V model is the design phase. In this phase, all the data gathered from PRC were studied and analyzed and able to generate a proposed data flow diagram. See Figure 6 and 7.

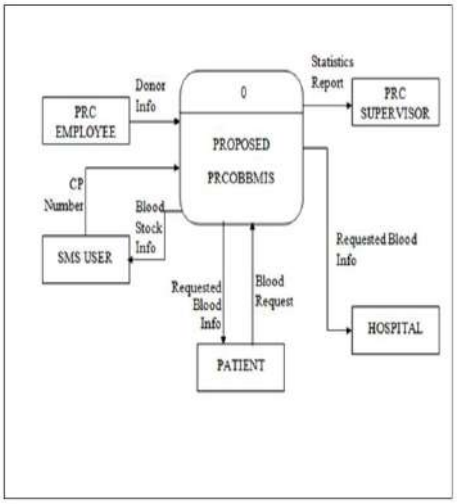


Figure 6.Contextual Diagram of Proposed PRC Online Blood Bank Management Information System

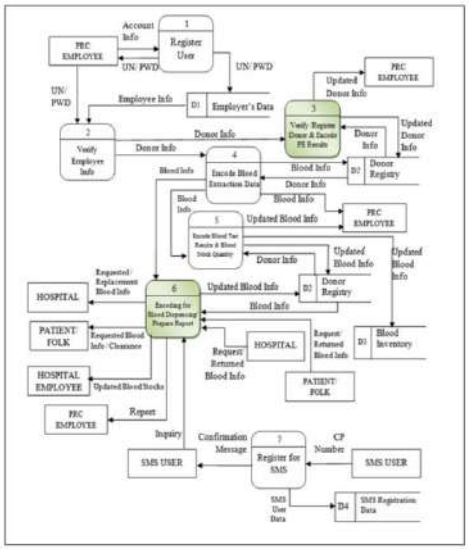


Figure 7. Diagram Zero of PRCOBBMIS

A prototype was also created and an interface for Home, User, Donor, Blood Donation, Blood Centers, Contact Us and About was designed. At the Home interface, functions such as Change Pass, Contacts, Coordinates, Report by Quantity and Report by Disease is integrated.

At the User interface, one can manage user accounts for the PRCOBBMIS. The Donor interface manages donor profile while the Blood Donation interface manages blood information. The Blood Centers, Contact Us and About interface displays all blood centers in the country, their contact information and history of PRC, respectively. A Gantt chart (see Appendix A) was also developed to be the basis of the timeline for the project.

Results and Discussion

The design from the prototype was converted using PHP language, and MySQL server was used for the database. Ozeki was used for the SMS integration in the system. Tabs were created for the major modules and functions. Buttons were created for some functions such as the Change Pass, Contacts, Coordinates, Report by Quantity and Report by Disease on the Home tab. On the User, Donor and Blood Donation tabs, View All button, New button, a search field and some links for editing was added. All buttons and links were tested and made sure that these were working and displaying the correct page.

Unit and Integration Test

The individual source code was tested to determine if they are fit for

use. The internal logic code was verified by testing every possible branch within the function. All possible data inputs were passed to all functions to test if the system is giving the correct output or if it is going to the correct link. The proponent begun the testing from the start of the process which is the registration of the User account (Staff, Supervisor, Administration), then followed by the registration and updating of donor accounts. Blood Donation module was also tested and made sure that data of blood stocks were updated in real time. Report generation was then tested.

After the unit testing, integration testing followed. Separate modules such as the Home, User, Donor, and Blood Donation and all the buttons and links were tested together to expose faults in the interfaces and the interaction between integrated components.

System and Acceptance Test

After the integration test was completed, the next test level was the system test. In this stage, the system specifications were compared against the actual system. System testing checks if the integrated product meets the specified requirements.

The last stage of the initial testing was the acceptance testing. In this stage, the system was presented to the client, and they were showing how the system worked and made sure that they have met the hardware and software requirements. Then the client let their staff, supervisors and some people from the administration try the system and have them make some evaluations. The client suggested a few revisions, but they still decided to accept the system.

The initial testing was followed by the final testing. In this stage, the nonfunctional testing like stress, load and performance testing was performed. The revisions suggested by the client were already addressed. Final test execution reports and documents were prepared in this phase.

Launching and Maintenance

After the client was satisfied with the system, it was donated to them, specifically to the PRC Western Visayas Regional Blood Center in Iloilo City. All data will be stored in the cloud and FileZilla which is a free software; cross-platform FTP application will be used to update the system. However, since PRC is a non-profit organization, they will still have to look for financial donors that will help them launch and implement the system for actual use.

Philippine Red Cross Blood Bank Management Information System (PRCOBBMIS)

System Overview

The system can be accessed through three types of accounts: Staff, Supervisor, and Administrator. The system is composed of the following modules: Home, About, Donors, Blood Donation, Blood Centers, Inquiry, Users, Statistical Reports and Contact Us. The Staff and Supervisor accounts have some limitations on the accessibility of some modules, but the Administrator Account has access to everything. The developed system can add, edit and search records of

blood donors. Blood stocks can be monitored, and statistical reports can be generated with the use of the system.

System Features

The following are the features of the system:

- Efficient recording of blood donor data and laboratory results
- Sharing of donor and blood data in different PRC blood centers
- SMS and online inquiry of blood stocks
- Generate statistical reports for planning and decision-making purposes

System Objectives

Philippine Red Cross Online Blood Bank Management Information System aims to provide:

- Blood donor information
- Updated Blood stocks information
- Statistical reports with graphs and charts

Systems Functions

The system is divided into different subsystems which are then incorporated to attain the overall objective of the system. Three users must be able to log-in by entering their username and password on the log-in field. There are three types of accounts which have different levels of accessibility:

Administrator Account

The administrator has access to all modules, and he is the only one that can create supervisor and staff accounts. He is the only one that can upload events and activities of PRC on the website

Supervisor Account

The supervisor can access the donor and blood donation module. This account can create, update, and edit donor and blood donation data as well as view confidential laboratory results.

Staff Account

The staff account can also access the donor and blood donation module but with limitation. They can create and update donor and blood donation data, but they cannot edit and view confidential laboratory results.

Figure 8. The Log-in Screen

Donor Function

This function handles the registration process of blood donors. It allows adding, updating, editing and searching of donor's data. Donor history profile and PRC employee traceability can also be found in this function. Donor credits and clearances can be managed in this function.

Figure 9. Donor Screen

Blood Donation Function

This function manages laboratory results, shows traceability of blood records processed by PRC, and blood dispensing process.

Available blood stocks with its specific data can be searched and seen in this module. Registration and displaying a list of affiliated hospitals and its detailed information can be accessed here.

Figure 10. Blood Donation Screeen

Specific serial blood number can be searched in this function to see the blood status if is still available, has been dispensed or expired.

Inquiry Function

This function allows the user to search using SMS or online data for the quantity available of bloodstock of a certain blood type in a province or region. For online inquiry, the results can be displayed in a list (Figure 8) form and map (Figure 9) form.

Figure 11. Inquiry Screeen

Figure 12. View Map Screen

For SMS, registered users can text the inquiry to the system, and the user will receive the blood quantity of a particular blood type as seen in Figure 13.

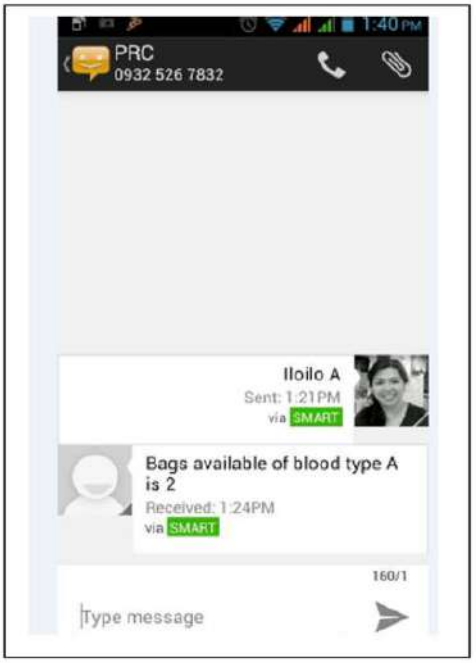
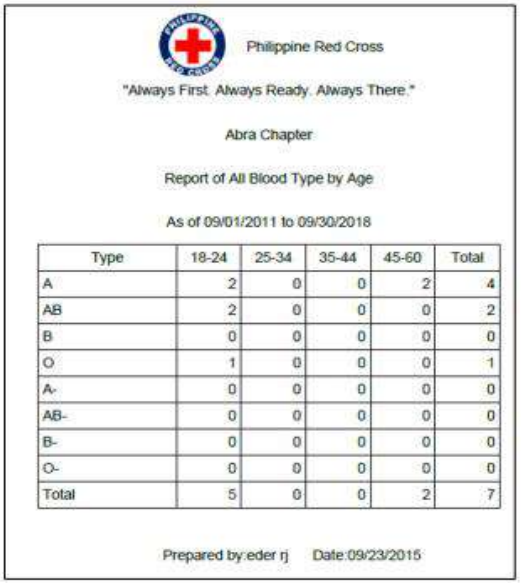


Figure 13. SMS Screeen

Statistical Report Function

This function as shown in Figure 14 allows the user to generate statistical reports in two ways: reports by quantity and reports by disease.

Reports by quantity display some blood stocks in a chosen location, date and blood type indifferent categories such as age group, gender, location, dispensed, expired, returned and donated. On the other hand, reports by disease generate the total number of blood that was positively tested of any of the five transfusion-transmissible diseases in a chosen location, date, gender, age group and blood type.



Philippine Red Cross

"Always First. Always Ready. Always There."

Abra Chapter

Report of All Blood Type by Age

As of 09/01/2011 to 09/30/2018

Type	18-24	25-34	35-44	45-60	Total
A	2	0	0	2	4
AB	2	0	0	0	2
B	0	0	0	0	0
O	1	0	0	0	1
A-	0	0	0	0	0
AB-	0	0	0	0	0
B-	0	0	0	0	0
O-	0	0	0	0	0
Total	5	0	0	2	7

Prepared by:eder rj Date:09/23/2015

Figure 14. Statistical Report Screen

Operating System: Microsoft Windows 7

Windows 7 is the next release of the Windows client operating system, built on the secure foundation of Windows Vista and Windows Server 2008. Performance, reliability, security, and compatibility are core tenets of this release as we collect your Feedback to meet the engineering goals of making Windows 7 the best-performing and most stable Windows operating system to date.

All the innovations in this product are meant to enhance IT professional capability to provide better service by the PRC and manage increasingly mobile PCs. It can protect data as it can enhance end-user and personal productivity.

Front End: Visual C#

C# (pronounced "C sharp") is a programming language that is designed for building a variety of

applications that run on the .NET Framework. C# is simple, powerful, type-safe, and object-oriented. The many innovations in C# enable rapid application development while retaining the expressiveness and elegance of C-style languages.

Visual C# is an implementation of the C# language by Microsoft. Visual Studio supports Visual C# with a full-featured code editor, compiler, project templates, designers, code wizards, a powerful and easy-to-use debugger, and other tools.

The .NET Framework class library provides easy access to many operating system services and it can improve the speed of the development cycle.

Physical Environment
Hardware Specification

Table 2
List of Hardware Requirements

	Minimum Requirements
CPU Type Model	Dual Core 2.3 GHz or Higher
Storage Type	500 GB Hard Disk or Higher
Input	Mouse, Keyboard, Webcam, bar code scanner
Output	Monitor,Printer

Software Specification

Table 3.
List of Software Requirements

	Minimum Requirements
Operating System	Microsoft Windows 7 or Higher
Programming Software	PHP, Visual C#, Ozeki
Database	MySQL

Back End: MySQL

MySQL is a database management system (DBMS). A database is a structured collection of data. It might be anything from a simple shopping list to a picture gallery, to the vast amounts of information in a corporate network.

To access, manipulate, and process data stored in a database, a DBMS is needed. Because computers are very efficient at handling large amounts of data, database management plays a central role in computing. But more than being a DBMS, MySQL is a relational database management system (RDBMS).

A relational database stores data in separate tables rather than

putting all the data into one large repository.

Doing so adds tremendous speed and flexibility. The tables are linked by defined relations, making it possible to combine data from several tables upon request.

User Technical Requirement

The intended users of the system are the PRC employees. The user must, at least, be able to know how to browse the internet and must have for data entries and printing of reports.

Cost and Benefit Analysis

In evaluating the detailed assessment of the financial resources spent on the development of this system, the cost per stage is determined by multiplying the estimated number of hours spent on that stage and the rate per hour which was inquired by the researcher from the PRC.

The system is found to be technically feasible since there is already an available hardware and software component which is needed to implement the system. In the long run, the intangible benefits of time and effort saved brought about by the implementation of the system surpasses the essential knowledge and skills to use computers with tangible benefits of paperless transactions in the PRC.

PRC employees can be more productive with their time spent in the workplace by not spending a lot of time manually preparing statistical reports.

The breakdown of the system's cost is shown in Table 4.

Table 4
Development Cost of the System

Stages	Time	Cost	Amount
Gathering of Requirements, Analysis and Consultations	430hrs	PHP 50.00	PHP16,000.00
Design of the System	160 hrs	PHP 50.00	PHP 8,000.00
Programming	1120 hrs	PHP 50.00	PHP 56,000.00
Testing and Evaluation	40 hrs	PHP 50.00	PHP 2,000.00
Polishing of Prototype and Implementation	120 hrs	PHP 50.00	PHP 6,000.00
TOTAL COST	1760 hrs	PHP 50.00	PHP 88,000.00

Architectural Design

The network layout of the system is shown in Figure 15.

The system is installed on the server and connected to the internet. A short message service (SMS) modem is also connected to cater mobile inquiries. Users can only access the system URL if they are connected to the internet.

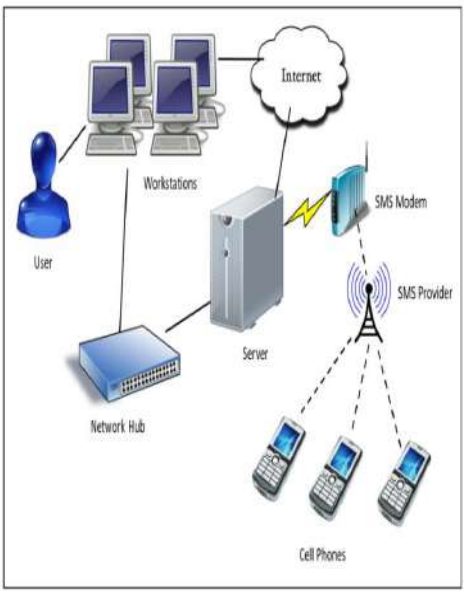


Figure 15. Setup with Online Hosting with SMS

Design and Implementation Issues

Several issues had been encountered during the development of the system. The first was the integration of the SMS feature to the PHP software of the system. Whenever the system receives an SMS inquiry, it cannot reply automatically. The solution is to process the SMS application on the desktop through a timer to make the processing more efficient. Another issue encountered is that when the barcode was being scanned to enter data, it automatically triggers the submit that will prevent the automatic triggering of the submit button. The solution is creating an algorithm button.

Conclusion

The Online Blood Bank Management Information System for Philippine Red Cross was able to:

- Efficiently record blood donor data and laboratory results
- Share donor and blood data in different PRC blood centers
- Use SMS and online inquiry of blood stocks
- Generate statistical reports for planning and decision-making purposes

The Blood Service Program of the Philippines operates by the provisions of the National Blood Services Act of 1994 or Republic Act (R.A.) 7719. In tripartite cooperation with the Department of Health and the Philippine Blood Coordination Council, the Philippine Red Cross (PRC) is one of the key organizations tasked to provide safe blood to the country through its active role in advocacy, promotion of voluntary blood donation, donor retention and care and the operation of a network of 74 Blood Service Facilities all over the country.

The Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS). PRCOBBMIS allows donor profiling and sharing of blood records to all blood centers and blood service

facilities of PRC nationwide. It also allows SMS query of blood stock quantity which makes data more accessible. The system can generate accurate statistical reports which can help in their planning and decision making.

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Rain Gauge System for Community-Based Disaster Risk Reduction Program in Northern Iloilo

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ABSTRACT

When Typhoon Yolanda (Haiyan) hit the area of Northern Iloilo, it brought so much devastation in the town of Concepcion. It prompted the College of Engineering, Central Philippine University to design and develop a rain gauge system for community-based disaster risk reduction program and an early warning system (EWS) for rain-induced landslides. The system was installed in eight (8) selected sites in the vicinity of the said town which were identified as landslide-prone areas. This system comprises of a self-emptying tipping bucket, strobe lights, alarm system, solar PV system, Bluetooth module, Android-based mobile unit, and the main control unit. The function and operations of the EWS were based on two factors: rain volume rate and soil absorption. Data were gathered from identified areas, and soil testing was conducted to determine the soil permeability. Three samples were taken from each site, and the highest permeability value was utilized to predict the possibility of a landslide occurrence. The result of the soil test was the basis of the EWS. The system was installed in the identified places, and final testing and evaluation were made to ensure its functionality. The rain gauge system for the prediction of a rain-induced landslide was successfully designed, developed and implemented.

Keywords: *early warning system (EWS), rain gauge system, risk reduction program*

Introduction

Strong winds and rain-induced landslides are two related hazards identified with typhoon prone areas and communities. Strong winds can destroy houses or topple down trees and electric posts. On the other hand, landslides can cause property damage, injury and even death. Rain induced landslides is prevalent and inevitable during rainy season cause by extreme weather conditions.

The factors contributed to an occurrence of landslide typically include: slope angle, climate, climate water content, vegetation, and geology. A number of elements will cause landslide, however, there were often triggers the movement of the soil. One of the major contributory factors is the prolonged rainfall that results in the elevation of pore pressure due to the water elevation difference as water flows from higher to lower elevation (Australian Government, 2016).

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The soil acts as a sponge to take up and retain water due to soil infiltration, percolation, permeability or hydraulic conductivity. Soil infiltration is the movement of water into soil, percolation is the downward movement of water within a soil. Water infiltrate and percolate the soil through pore space like conduit and serves as the storage of water (Australian Government, 2016).

Permeability is the ability of water to move and determine how far water will move through the soil in a given time. Soil complex property varies with location, soil type depth, soil moisture content and direction of flow. Permeability of soil was classified into very rapid to very slow. This classification determines how fast the water penetrates the soil. This natural disaster (typhoon) brought so much devastation in Concepcion, Iloilo that prompted the College of Engineering of Central Philippine University to design and develop a rain gauge system for community-based disaster risk reduction program and an early warning system (EWS) for rain-induced landslides.

Methodology

Table 1 shows the soil permeability classes. Infiltration and permeability is the manner by which water moves into and through soil. The water content can be determined by gravimetric (water/g soil) and volumetric (ml water/ml soil). But, the volumetric content is commonly used, since 1 gram of water is equal to 1 millilitre of water and can easily determine the weight and volume of water. The water content of soil at its saturation point is equal to the percent of porosity. Saturation is the soil content when all pores are filled with water, the soil water content after has been saturated and allowed to drain freely for about 24 - to - 48 hours is known as soil Field capacity (Wang, J., 2013).

Table 1
Soil Permeability Classes
* Saturated samples under constant water head of 1.27 cm.

Soil Permeability Cases	**Permeability rates***	
	cm/hour	cm/day
Very slow	Less than 0.13	Less than 3
Slow	0.13 - 0.3	3 – 12
Moderately slow	0.5 - 2.0	12 – 48
Moderate	2.0 - 6.3	48 – 151
Moderately rapid	6.3 - 12.7	151 – 305
Rapid	12.7 – 25	305 – 600
Very rapid	More than 25	More than 600

Water usually converted from a percentage volume basis to a depth of inches of water/foot of soil. Fine sandy loam, silt loam, and silty clay loam have the highest water holding capacity while coarse soil (sandy, loamy sand, and sandy loam) have the lowest water holding capacity, (Columbia Weather Systems, 2016) shown in Table 2.

Table 2

Soil Texture classes

Texture Class	Water Holding Capacity, inches/foot
Coarse Sand	0.25 - 0.75
Fine Sand	0.75 - 1.00
Loamy Sand	1.10 - 1.20
Sandy Loam	1.25 - 1.40
Fine Sandy Loam	1.50 - 2.00
Silt Loam	2.00 - 2.50
Silty Clay Loam	1.80 - 2.00
Silty Clay	1.50 - 1.70
Clay	1.20 - 1.50

With these given parameters of the soil, predictions of the rain-induced landslide are possible and providing a state of the art early warning system is a must to mitigate the effects of these natural calamities.

There are many early warning systems developed related to this system. The Intelligent Soil Monitoring and Control System for Forecasting and Enhancement of the Community Based Rain Induced Geologic Hazard (Yu Fan-Chieh, 2006). Method of forecasting stability of soil slope under condition of raining (Maneesha, R. V. & Vidyapeetham, A.V., 2012) and the Infinite Slope Safety Analysis System According to a Rain Fall Saturation Depth Ration Capable of Reinforcing Landslide Prediction Ability (Wu Chae1, B.G., Lee, J.H.,& Park H.J. Choi, J. (2014).

This system utilized soil characteristics and complex soil features to predict the occurrence of landslide. To further enhance the early warning and mitigation system, the rain volume flow rate and the permeability must be considered. The localized procedure in determining the soil sample characteristics must be done for further development and improvement of the system, before there were no existing systems that could do early warning and mitigation forecasts for possible disasters to ensure safety for the community and save lives.

The system shown in Figure 1, composed of the following: self-emptying tipping bucket, strobe lights, alarm, solar PV system, main control unit. The control unit composed of the following: microcontroller unit (MCU), blue tooth module, LED display, driver and relay circuit, Solar PV module, charge controller and the battery.

The system operation starts with the detection of rainfall volume from the rain gauge using the tipping bucket. The bucket is designed to tip every five (5) milliliters of water. The volume is then recorded in the microcontroller that processes the data on the soil permeability of the area to determine the saturation level of the soil. When the saturation level reaches an alarm level, the microprocessor will turn on the alarm intermittently every five (5) minutes. When the saturation level reaches critical level, the alarm will be turned on continuously. The alarm is in the form of strobe lights and a horn. An LED display and an application program for smartphone are developed so that the saturation level can be viewed in real time using

Bluetooth connectivity. To ensure uninterruptible power, the EWS is designed using solar PV system as its main power source. (Maxwell Scientific Organization, 2015)

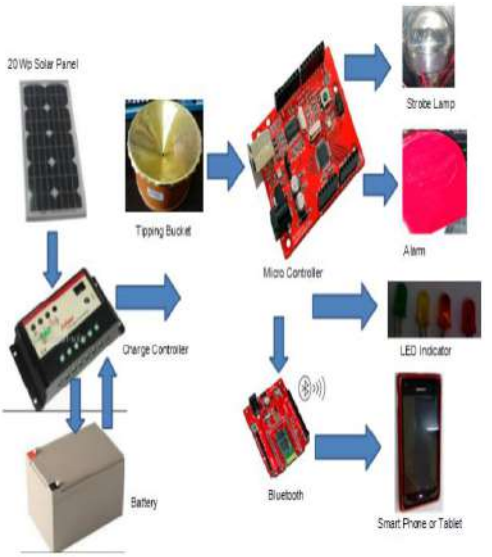

Figure 1. Block Diagram of the Rain Gauge System

Data gathered from the specific location and soil testing was done to determine the soil characteristics specifically its permeability, k(cm/sec). There were eight (8) selected sites in the vicinity of Concepcion Iloilo identified as landslide prone areas; Malangabang, Loong, Nipa, Macatunao (Balabago),Polopina, Salvacion, Bagongon and Bacjawan Norte. The identification of these areas was done by the local National Risk Reduction Management Council (NDRRMC) of Concepcion.

Three soil samples were taken from each location. The soil samples were taken at approximately one-meter depth to ensure that actual soil characteristics of the area are accurate. The samples were taken from the upper, middle, and lower elevation of the area. The soil samples were brought to a soil-testing laboratory to determine its characteristics specifically its permeability k (cm/s).

The profile of the area was also considered and data regarding inclination angle and existing vegetation was noted. Other relevant parameters such as GPS coordinates, existing cellular phone signal, and history of landslide occurrences were also noted. These data are necessary for the design and development of the control and data acquisition system of the rain gauge.

Results

Figure 2 shows the main unit of the system housed in a water proof metal box. On the front panel are two light emitting diodes (LED) that serve as the communication status indicator for Bluetooth connection. The six (LED) with colors of green, yellow, orange and red represent the warning system level.

Figure 2. Main Unit of the EWS

Table 3 shows the result of the soil testing of the eight identified locations. Out of the eight locations, and three samples from each site, the highest soil permeability was registered in barangay Macatunao with the value of 0.0747 cm/sec while the lowest was in barangay Loong with the value of 0.0015 cm/sec. The result shows that the higher the permeability value of the soil, the higher is the probability of rain-induced landslide occurrence.

However, the prediction of the landslide occurrences does not only depend on the soil permeability, but also on the profile of the area.

Table 3

Soil Test Result

Barangay	**Permeability Values, k (cm/sec)**		
	I (UPPER)	**II(MIDDLE)**	**III (LOWER)**
Bacjawan Norte	0.0037 0.0056	0.0028 0.0042	0.0252 0.0378
Bagongon	0.0092 0.0138	0.0022 0.0033	0.0035 0.0053
Loong	0.0015 0.0023	0.0073 0.0110	0.0055 0.0083
Macatunao (Balabago)	0.0332 0.0498	0.0498 0.0747	0.0016 0.0024
Malangabang	0.0035 0.0053	0.0047 0.0071	0.0042 0.0063
Nipa	0.032 0.0486	0.0485 0.0728	0.0034 0.0051
Polopina	0.008 0.0120	0.0281 0.0422	0.0071 0.0107
Salvacion	0.0074 0.0111	0.0054 0.0081	0.0039 0.0059

Table 4 shows the sample profile of Barangay Salvacion. The sample profile in Table 4 includes GPS coordinates, existing cellular phone signal in the area, the slope or grade of the area, history of landslide gathered from an interview with the residents and the type of vegetation in the area. These data were considered in the design and development of the control system for the EWS.

Table 4

Sample Project Site Profile

Rain Gauge Location	Brgy. Salvacion, Concepcion, Iloilo		
GPS Coordinates	N 11°14.798', E 123°12.566'		
Cell Phone Signal	Smart	Globe	Sun Cellular
Slope	67˚		
History of Landslide	Yes	No	
Vegetation	Barren	Grass/Shrubs	Trees

The rain gauge uses two data in giving of warning: the rate of rainfall and soil absorption. This data are correlated to the soil permeability found in Table I. If the rainfall rate together with the reciprocal of the permeability is high, then a warning is given. With the consideration of the site profile and factor of safety, the warning is given before the critical rainfall rate happens.

Another factor for warning is the water penetration depth in the soil. There were four indicated levels: first

level for a depth of penetration less than one meter; second level for a depth greater than one meter but less than 1.5 meter; third level (warning level) for a depth level greater than 1.5 meters, but less than 2 meters; and fourth level (critical level) for a depth greater than 2 meters. The volume rate of penetration is calculated based on the permeability of the soil and the rainfall rate. Depth penetration is defined by the equation:

$$Depth = permeability\left(k, \frac{cm}{sec}\right) x\ rainfallrate(cm) x\ 60$$

The fourth level of critical level will activate only if the depth is greater than 2 meters. During this time, both strobe lights and horn will turn "ON" mode. This alarm is repeatedly sound for 10 minutes. The strobe lights will continuously be in the "ON" within the 24 hours even after the rain stops.

Conclusion

The rain gauge system for the prediction of a rain-induced landslide was successfully designed, developed, and implemented. It was installed in the eight (8) selected barangays of Concepcion, Iloilo. It was developed locally with the required specifications needed in the implementation and installation of the system.

The system was tested and functioned as expected and is already in use by the community in the selected site/location. It is recommended that for the prediction of possible landslide occurrences, further study on the effect of vegetation and slope of each site must be done.

Also, in order for the system to be reliable, maintenance of the system is required at least twice a year, mainly before the start and the end of the rainy season. Replacement of the sensor every six month is required for the reliability of sensing and measurement of rainfall.

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Sensory, Chemical, and Microbial Characteristics of Lemongrass (Cymbopogon citratus Stapf.) Beverage Products

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ABSTRACT

The production and consumption of ready-to-drink health beverages have increased in recent years because of greater demand for health benefits. Central Philippine University (CPU) engaged in a study of lemongrass (Cymbopogon citratus Stapf.) with Kalamansi-Ginger formulation to determine its sensory, chemical and microbial characteristics. Methodology involved sensory analysis in terms of turbidity, flavor and general acceptability; chemical analysis in terms of citral content, titrable acidity and anti-oxidant activity; and microbiological analysis in terms of total counts of bacteria and fungi, as well as shelf-life. Generally acceptability mean scores for sensory evaluation of beverage samples decreased with longer storage period in both room temperature and controlled temperature. Chemical analysis on citral content, titrable acidity and antioxidant activity changed through time, with freshly prepared beverages having the highest values. Microbial analysis revealed fungi count but no bacterial count for a formulation stored in glass bottles. Shelf-life is 17 days for both ambient room conditions at 27ºC average temperature and at controlled incubator temperature. These characteristics make lemongrass acceptable as a ready-to-drink beverage product for production and consumption.

Keywords: anti-oxidant activity, lemongrass drink, shelf-life, sensory analysis

Introduction

Production and consumption of non-carbonated beverage drinks have increased in recent years due to the growing consumer preference for health drinks over carbonated drinks.

In the Philippines, the government through the Department of Education (DepEd) has even issued a policy banning the sale of carbonated, sugar-based synthetic or artificial, juices in school canteens. (DepEd 2007)

More discerning and informed consumers now take an interest in ready-to-drink (RTD) beverages with health benefits, such as those from natural medicinal sources and those containing high antioxidants. In recent years, the

fastest growing beverage category based on total percentage volume is RTD tea and is expected to grow continuously. (Haffner, 2011)

Lemongrass (*Cymbopogon citratus* Stapf.) or *tanglad* is one health drink that has long been used for its many medical benefits as remedy for high blood pressure, general body weakness, and debility. The lemongrass, when used with ginger as a decoction, can be applied to treat stomach ache, flatulence and indigestion (Quisumbing, 1978; Onaylos, 1984; Ticzon, 1996).

Many studies have shown that lemongrass possesses antioxidant activity (Vinitketkumnuen et al., 1994; Suaeyun et al., 1997; Ojo et al., 2006). The essential oil of lemongrass contains citral, which is reported to possess antioxidant (Rabbani et al., 2005), and anticancer properties (Dubey et al., 1997; Dudai et al., 2005). Thus, the lemongrass beverage could become a healthy alternative to soft drinks not just for school children but for the general public as well.

A previous study showed that the tea prepared from fresh and dried lemongrass plants by decoction and infusion contains citral, as well as, high amounts of antioxidants (Villalobos, 2010).

The preparations and conditions to obtain high amounts of citral and antioxidants on decoctions from fresh lemongrass sheaths have been previously studied (Villalobos & Nocal, 2013) and were used as bases in the study by Gico, et al. of sensory evaluation, antioxidant activity and citral content determination of different RTD lemongrass beverage formulations.

Sugar and lemongrass concentrations were fixed for the final beverage products and results showed that the flavour variants with the highest antioxidant activity were the *kalamansi*-ginger and *dalandan*, while all flavour variants had high citral contents (Gico et al., 2013).

With the final formulations already identified, Lemongrass is a potential ready-to-drink beverage. This study provided an analysis on the sensory, chemical and microbial characterisitcs of Lemongrass to determine the possibility of product commercialization which can generate income for the university, at the same time provide a healthy alternative drink for students and the general public.

Methodology

Food quality is described or evaluated regarding qualitative or sensory attributes, chemical attributes, and microbiological attributes (Molnar, 2009). Thus, characterization of the product including microbial analysis to determineits shelf life is necessary not only for quality control but also for packaging considerations, and as part of package development study.

Below is an illustration of the shelf-life evaluation of the product.

Shelf-life Evaluation of the Product

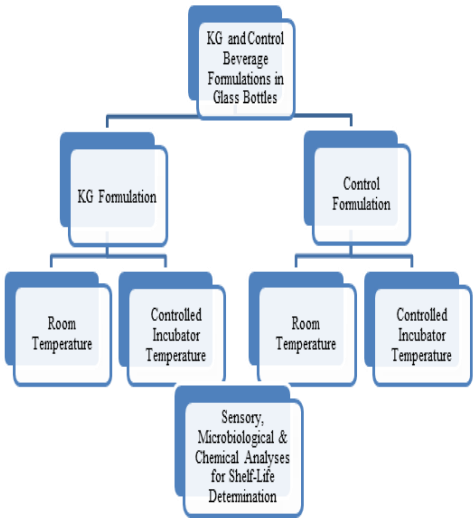

Figure 1. Experimental Set-up for Shelf-Life Testing and Analysis

Product Preparation and Filling.

Two sets of beverage product samples were prepared and bottled for shelf life determination; the*Kalamansi*-Ginger (KG) formulation which was a patented lemongrass beverage with *kalamansi* and ginger formulation, and the Control Formulation(CF) which was unflavored lemongrass beverage. A 380-glass bottle with metal lug-style closure and shrink band was used for shelf-life testing to withstand hot-filling operations.

Sensory Analysis

Sensory analysis was carried out using trained panelists. Properties evaluated and analyzed were turbidity, flavor, and general acceptability. Turbidity and flavor were evaluated using a descriptive analysis using a 4-point rating scale. General acceptability was rated using a 9-point hedonic scale.

Chemical Analysis

Titrable acidity and antioxidant activity were monitored at weekly intervals using three replicates based on reviewed procedures (Wireko-Manu *et al.*, 2010; Zaeoung *et al.*, 2005; Molyneux, 2004). Citral content was determined using gas chromatography analysis.

Microbiological Analysis

Test procedures were based on US FDA Bacteriological Analytical Manual (BAM) (Maturin & Peeler, 1998) and laboratory manual in food microbiology (Mallari, 2009). Shelf life in the number of days was determined by the period in days before 1000 CFU/mL on total plates count was reached based on industry standard for acceptable microbiological safety for acidic (pH below 4.5) beverages according to the microbiological regulations of European Union (EC No. 2073/2005) (Walkling-Ribeiro, et al., 2009. Microbial decontamination in the food industry:.).

Shelf-life Testing

The samples were stored at two different conditions: at ambient room of average 27ºC temperature (RT) inside the CPU-packaging laboratory storage area, and at controlled conditions of constant 32ºC temperature (CT) inside the incubators. Formulations were then randomly drawn every week for sensory, microbiological, and chemical analyses. Shelf-life was

based on total bacteria and fungi counts.

Results and Discussion

Sensory Analysis

Turbidity Sensory Evaluation

Results of the sensory evaluation for turbidity of lemongrass beverage samples shown in Figure 2 indicate that all the samples were slightly homogeneous with mean scores ranging from 2.25 to 2.5 in the 4-point rating scale even after 22 days of storage at both room temperature and controlled temperature. This means that all the lemongrass beverage samples were not clear. Turbidity (cloud investor haze) can result from colloidal or larger particles that may precipitate in a container.

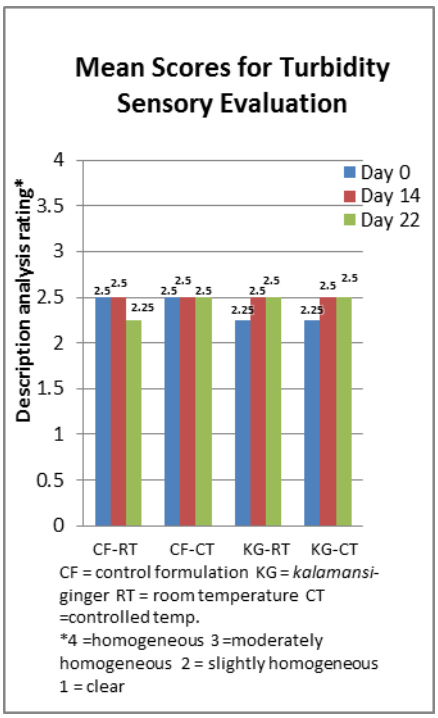

Figure 2. Sensory Evaluation Results for Turbidity

Flavor Sensory Evaluation

As shown in Figure 3, sensory evaluation results for flavor indicate that generally, flavor diminished with longer storage time. Most foods undergo deterioration following production. The stability of beverages containing citrus juice depends on the raw materials, processing conditions, packaging materials, and storage conditions. These factors cause microbiological and physicochemical changes which further result in an alteration in the flavor of the beverage. Microbial growth, commonly yeasts, causes the production of unpleasant flavors and product deterioration (De Souza et al., 2004).

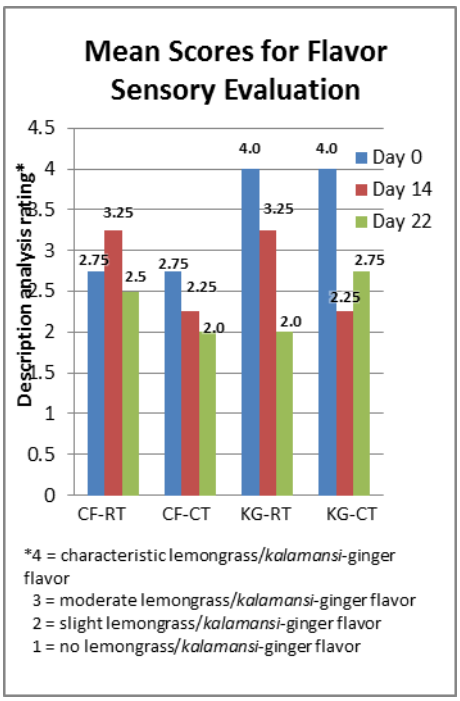

Figure 3. Sensory evaluation results for flavor

General Acceptability

Results show that generally, acceptability mean scores of beverage samples decreased with longer storage period in both room temperature and controlled temperature. However, even after 22 days of storage, the beverage samples were still moderately acceptable, as shown in Figure 4.

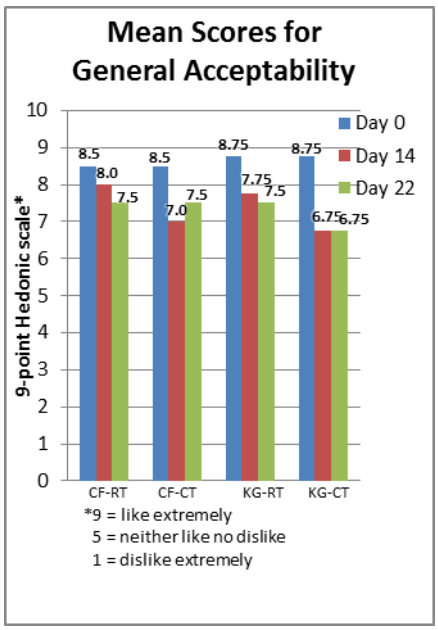

Figure 4. Sensory evaluation results for general acceptability

Chemical Analysis

Titrable Acidity

Figure 5 shows the trend of the acidity of the different formulations when stored at room temperature and controlled temperature at weekly intervals. The CF beverage, stored at both room and controlled temperatures, was more acidic than the KG beverage stored at both room and controlled temperatures. This is because the acidity of the CF beverage was lowered to a pH of 4.5 and below (% citric acid) so it can be processed using the hot fill method. On the other hand, the acidity of the KG beverage was not lowered because it already had a pH of 3.1 which was within the range of acid foods.

Results further show that the acidity of the control and KG formulations remained the same during the 4-week storage, whether stored at room temperature or accelerated temperature. This means that a three-degree Celsius rise in temperature did not change the acidity of the control, as well as the KG beverage.

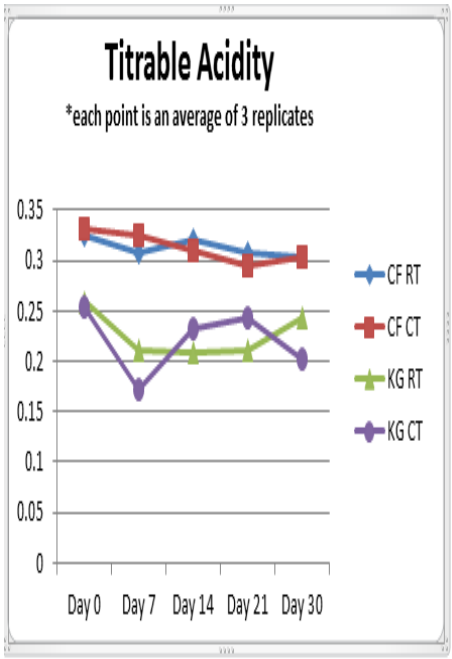

Figure 5. Chemical evaluation results for titrable acidity

Antioxidant Activity

Figure 6 shows the trend of antioxidant activity of the different formulations when stored at room temperature and accelerated temperature at weekly intervals.

Antioxidant activity changed through time, with freshly prepared beverages (Day 0) having the highest values.

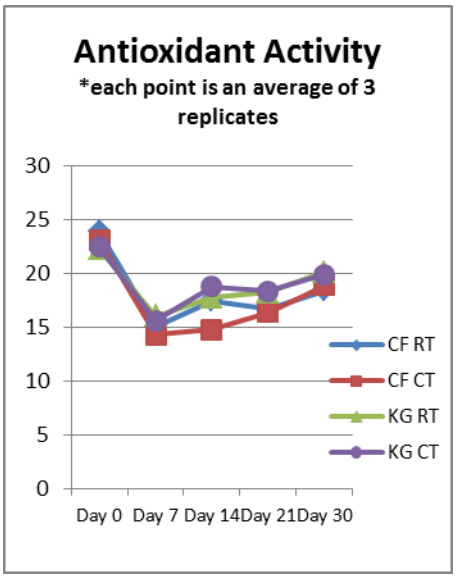

Figure 6. Chemical Evaluation Results for Antioxidant Activity

Citral Content

Citral content was below the detection limits of the gas chromatography instrument. However, the peaks of the citral isomers geranial and neral, were visible in the chromatogram which signified that citral is still present in the lemongrass beverages but in very low amounts.

Microbiological Analysis

Figures 7 and 8 show the colony counts for the CF and the KG beverages, respectively, stored at room temperature and controlled incubator temperature over a span of four weeks. It is evident that there were no bacterial counts at the beginning of storage time (Day 0) in the CF and KG samples at both temperatures.

The pH values of the lemongrass beverages used in these experiments were highly acidic (pH of 2.7 to 3.1) to inhibit the growth of bacteria. Likewise, the type of thermal treatment used in processing the beverages prevented the growth of bacteria (Sonida et al., 2009). However, fungi counts were observed for both CF and KG samples at the start of storage time.

These results are in agreement with the results from microscopic examinations indicating that the major microorganisms in the orange juice were mainly yeast and mold, as indeed citrus juices are most susceptible to yeast and mold spoilage due to their low pH and high contents of sugar and vitamins (Leizerson & Shimoni, 2005).

The shelf life (period in days before 1000 CFU/mL on total plates count was reached)of lemongrass beverage is estimated to be 17 days at both ambient room temperature and controlled conditions.

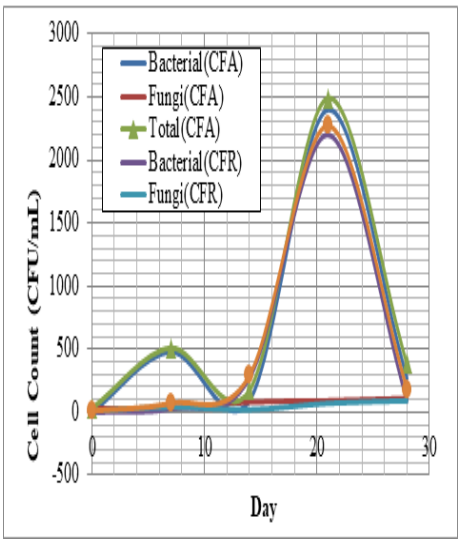

Figure 7. Microbiological Evaluation Results for Bacteria, Fungi and Total Counts for CFat Room (CFR) and Controlled (CFA) Temperatures

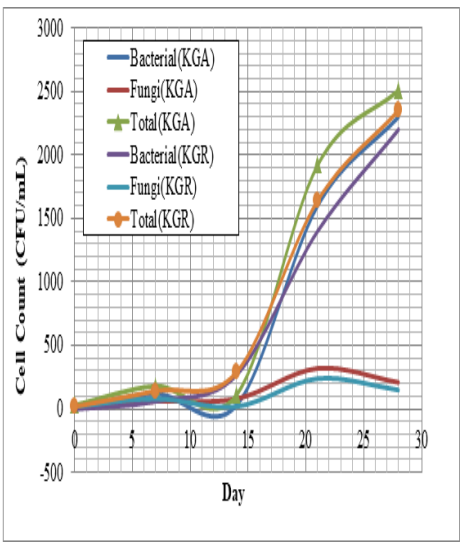

Figure 8. Microbiological Evaluation Results for Bacteria, Fungi and Total Counts for KG

Conclusions

Shelf life for bottled lemongrass with *Kalamansi*-Ginger formulation is determined to be 17 days at ambient room average temperature (27ºC) and controlled incubator temperature (32ºC) based on microbiological analysis. Generally acceptability mean scores for sensory evaluation of beverage samples decreased with longer storage period in both room temperature and controlled temperature. Turbidity was slightly homogeneous and browning was observed to increase throughout the storage period. The titrable acidity of beverage samples was not affected by the difference in temperature of storage conditions. Antioxidant activity changed through time, with freshly prepared beverages having the highest values.

The relatively short shelf-life of the product and the type of packaging used are the two factors that can still be further studied for analysis and improvement. It is recommended that more studies be done on product and package developments to extend the shelf life of the lemongrass beverage. Improved manufacturing procedures and use of cheaper and lighter bottles that can withstand hot-filling temperatures must be further studied. The product and package launch and the complete business plan and market analysis can be the next steps in the intended commercialization of the product.

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