AUTOMATED IDENTIFICATION AND SECURITY SYSTEM FOR ECE LABORATORY

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Abstract: ***The population of ECE students of Central Philippine University (CPU) is increasing and the staff of ECE Lab has the hard time monitoring students who want to access the Lab. Laboratory teachers usually require the laboratory assistants to record the time duration the student uses the laboratory. Manual log-in and log-out is done for this purpose and it cannot be avoided that sometimes this system gives erroneous results and take up considerable time. This paper describes our project under Engr. Cirilo C. Calibjo which is a solution to problems inherent to manual log-in and log-out procedures. The objective of the project is to design an automated identification and security system using the M68HC11 microcomputer unit (MCU) of Motorola to remedy the problem. We developed a system which requires two sets of numbers to gain access in the lab., a prototype was made to test the functionality of our design. Although actual field implementation and testing was not possible, the prototype results were encouraging.***

INTRODUCTION:

Laboratory classes, walk-in laboratory classes in particular, are inherent to engineering education and instructors handling laboratory classes often desire to monitor the use of laboratory facilities. This monitoring process helps the teachers determine who among his students are actually performing their laboratory exercises and to answer other questions about the performance of their students. To aid in monitoring factors such as frequency and duration of use of laboratory facilities of students of each student, logbooks have often been used. Although this is the least complicated solution, it is not necessarily the most efficient. Human errors are inherent in such system and takes time specially when the volume of students entering and leaving the laboratory is of considerable size.

The alternative solution to manual log is automation. Automation is best implemented using microprocessors and micro controllers. Automated log minimizes human error since minimal human intervention is required and this also speeds up the process. Automation can be implemented by hardwiring individual logic gates to derive the desire output but this complicates the implementation and introduces inflexibility to the system.

Microprocessors and micro controllers have evolve from simple devices such as the abacus to the complicated mechanical computers of Charles Babbage to the first electronic computer called ENIAC and to the present silicon-based single-chip electronic devices. Microprocessors are VLSI (Very Large Scale Integration) chips, which performs the function of a CPU (Central Processing Unit).

The microprocessor chosen in the implementation of the solution was the M68HC11 micro controller. This reports describes the solution and method of implementation using the M68HC11. The project demonstrates the feasibility of using the M68HC11 micro controller in an automation solution and its capabilities.

General Description of M68-HC11:

The micro controller used in this project is the M68HC11 by Motorola. It is usually referred to as M68HC11 Evaluation Board or EVB. The high-density complementary metal-oxide semiconductor (HCMOS) MC68HC11A8 is an advance 8-bit MCU with highly sophisticated, on-chip peripheral capabilities. New design techniques were used to achieve a nominal bus speed of 2 MHz. In addition, the fully static design allows operation at frequencies down to dc, further reducing power consumption. The EVB requires a user supplied +5, +12, and -12 Vdc power supply and an RS-232C compatible terminal for operation.

The HCMOS technology used on the MC68HC11A8 combines smaller size and higher speeds with the low power and high noise immunity of CMOS. On-chip memory systems include 8K bytes of read-only memory (ROM), 512 bytes of electrically erasable programmable ROM (EEPROM), and 256 bytes of random-access memory (RAM).

Major peripheral functions are provided on-chip. An eight-channel analog-to-digital (A/D) converter is inclined with eight bits of resolution. A synchronous serial communications interface (SCI) and a separate synchronous serial peripheral interface (SPI) are included. The main 16-bit, free-running timer system has three input capture lines, five output-compare lines, and a real-time interrupt function. An 8-bit pulse accumulator subsystem can count external events or measure external periods.

Self-monitoring circuitry is include on-chip to protect against system errors. A computer operating properly (COP) watchdog system protects against software failures. A clock monitor system generates a system reset in case the clock is lost or runs too slow. An illegal op code detection circuit provides a non-maskable interrupt if an illegal op code is detected.

To demonstrate the capabilities of this MCU, the EVB was designed along with a monitor/ debugging program called BUFFALO (Bit User Friendly Aid to Logical Operations). This program is contained in EPROM external to the MCU. The EVB provides a low cost tool for debugging and evaluation of M68HC11 MCU-based target system equipment. It is designed to operate in either the debugging or evaluation (emulation) mode of operation.

System Overview:

The study entails designing a security system that will act as an electronic lock that can be unlocked using numeric data. Unlike ordinary electronic locks were a constant security code is shared by those who are authorized, the system shall require each authorized user of the system to enter a security code unique to each user. The valid numeric code includes the identification number (ID) and personal identification number (PIN). The system also requires continuous power for its operation.

The whole system can be divided into three subsystems namely the PC (personal computer), EVB, and keypad. Sensors and servomotor are also added for efficient implementation of the system. This can be best describe with the aid of Figure 1.

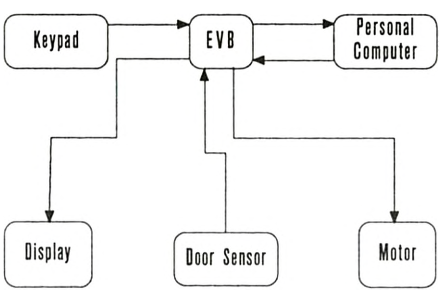


Figure 1. Block Diagram of Automated Identification and Security System.

The system is initiated in the Personal Computer. When the system software is executed in the personal computer, the first thing it does is download the EVB software to the EVB and then commands the EVB to execute the downloaded software.

The software executing on the EVB is the one responsible for accepting and interpreting the data from the keypad. It displays relevant messages, prompts, data, and information on the display. It also senses the status of the door to ensure that the door is closed when it should be closed and open when and only when it should be open.

Operational Description:

The only way that the user can communicate with the control unit (computer) is through the keypad. The circuit for the keypad is shown in Figure 2. The term keypad is applied to an array of keys, usually a small number of keys. In keypad, each key is associated with a particular symbol or binary value. When the key is pressed it generates a corresponding binary code. The keys are arranged in a matrix form. To determine that a key has been pressed, and to identify that key, the matrix is scanned. The matrix is been scanned using the program, by making all the rows of the matrix logic 0 and sensing the logic values of the columns. If one or more columns is a zero, then one or more keys has been pressed. To encode the key, each horizontal wire is, in turn, made logic 0 with all other horizontal wires logic 1.

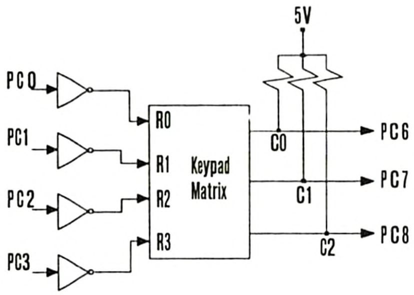


Figure 2. Schematic Diagram of the Keypad

While the horizontal wire is logic 0, each of the vertical wire is examined to see whether it is logic 0. When a vertical line is logic 0, the number of that line, together with the number of the logic 0 row, identifies the key. The rows of the key matrix are controlled by the output port, and its column are sensed through the input port.

It happens that the data needed for this operations is composed of the identification (ID) number and the personal identification number (PIN). The first set of data to be punched on the keypad is the ID number. Through the aid of the program for the keypad, the EVB will interpret whatever number has been pressed on the keypad. Then the EVB will send this data to the computer. The computer will compare the ID number received with the existing data. If it finds a match it will notify the EVB and the EVB will prompt the user to enter its PIN number. The same process as discussed previously will take place. When the ID and PIN number conforms with what is stored in the computer, the computer will send a signal to the EVB to open the door. The EVB will trigger the motor circuit. The door will be opened and there will be a sensor to determine if the door is fully opened for the user to enter. After the EVB sensed (through the sensor) that the door is fully opened, it will also trigger the motor circuit to close the door.

The EVB prompts the user to enter the required code using the display unit. Displays are provided to help the user use the keypad. LEDs with different colors are also installed to guide the user on what to do. The display unit consists of two DL1414Ts and several indicator lights as shown in Figure 3. The display unit can display only 8 characters at a time, limiting the maximum length of strings of characters to be displayed to eight. Using the running lights concept can circumvent this limitation. A string of character of any length can be displayed by scrolling it across the display. The display unit will scroll the string of characters to be displayed across the display in batches of eight. First, it displays eight characters starting at the first character. Then after a precalculated delay, it will display the next eight starting at the second character.

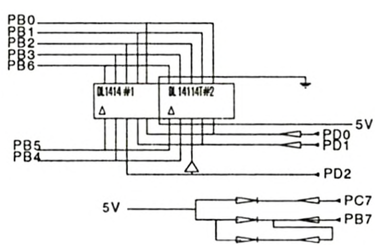
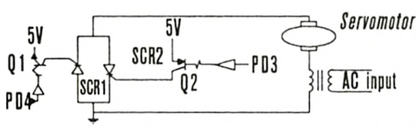


Figure 3. Schematic Diagram of the Display Unit

As stated above, the solution to the first problem in the display unit was to scroll messages of any length across the display unit's eight-character outputs. This solution presents another problem of its own. The M68HC11 chip, the microprocessor used in the EVB, only have a limited number of output ports. A scrolling display requires that each character in the display unit can be access separately and this requires ports. One way to minimize port usage is to multiplex the two DL1414Ts of the display unit and connect all data and select ports in parallel. In able to access a specific character on the display unit, not only will we have to set the select lines properly but also to enable and disable the proper DL1414T. This will require another port. To further save on ports, a single bit is used to select the proper DL1414T instead of two - one for each DL1414T. This can be achieved by using the inverted enable/ disable pin of one DL1414T as the enable/ disable connection of another.

Figure 4. Schematic Diagram of the Servomotor Driver



The servomotor driver as shown in Figure 4 is an SCR-based system that allows the EVB to control the servomotor. It is controls the direction of the DC motor by changing the direction of the current. To allow the current to change directions, two SCRs were used and connected in head-to-tail fashion and supplied with AC power. Although this can also be achieved by using a single triac, two SCRs were used instead to simplify the design. It is easier to use two SCRs since there would two separate gates for control thereby eliminating the need to determine the instantaneous value of the supply voltage. One problem that arose in the design is that the gates of the SCRs would alternately turn on causing the DC servomotor to rattle. To allow the gates to float when no triggering is applied, the SCR gates are connected to and driven by two PNP transistors. When the transistors are off, the gate is effectively floating. The emitters of the transistors are connected to the +5VDC supply. The basis of the transistors are set to +5VDC to turn off the transistors. To switch the transistors on, the base is driven low to ground.

Another sensor will prompt the EVB if the door is forced open. The EVB will also inform the computer that there is an intruder. In this case, the intruder can be apprehended without his knowledge.

The PC is still capable of doing task other than monitoring the status of the security system. The PC system software is designed to perform a type of multitasking - it can handle requests by the EVB for verification of ID numbers and PINs and at the same, perform tasks which the PC operator wishes to do.

If it is desired to monitor the access to a certain room, the system can be modified to coordinate with a log-in program running on the PC. This way, the system is not limited by the microcontroller memory and can store variable log data in the hard disk of the PC for the future reference.

Conclusion:

The prototype was implemented solely for the purpose of testing the functionality of the design and no quantitative tests were conducted. During trial runs, the prototype performed satisfactorily. The following important results are listed in conjunction with the performance of the prototype.

- The design system simplifies the manual log-in and log-out and gives accurate results. It lessens the job of the monitoring staff.
- M68HC11 MCU is relatively easy to work with and have most of the essential features needed for a complete control system.
- M68HC11 MCU has built-in interface capability that is suitable for sensors, actuators, and communications, which makes it more flexible to any automation applications.
- The time clocking of M68HC11 is very accurate.
- A single port of M68HC11 can be used as either input or output ports which then provides more ports for more applications.

Recommendation for Future Work:

Based on observations of the performance of the prototype, several aspects of the solution will have to be modified because few errors are evident. One of the errors was a software bug which came up when a much faster PC was used other than the one on which software was developed. The bug was possibly rooted in the DELAY instruction of the PASCAL language which unexpectedly performed faster than intended. This caused by EVB to log and communications between the PC and the EVB to fail. This bug can be remedied in two ways: use a slower PC or replace the DELAY instruction with an interrupt-driven subroutine dependent on the system clock and not on PC speed.

Another shortcoming of the prototype was the absence of the feedback mechanism in the door system. Since there was no feedback, the MCU had no way of knowing whether the door was actually closed, open, or somewhere in between. A feedback mechanism may be introduced or a totally different mechanism like electrically operated mechanical locks can be used.

Some of the modifications are largely aesthetic in nature like the addition of tone-producing circuits in the keypad, which will produce a tone every time a key is pressed. The system may be further be modified to act as central control unit for the whole room, turning the laboratory into an "intelligent room." It can then control the lighting, locks, and even electrical distribution in the room.

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