Biometric Door Entry Control System

by

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A SENIOR THESIS PROPOSAL

Presented to the Faculty of

The Computer and Electronics Engineering Department

In Partial Fulfillment of Requirements

For CEEN 4980 Senior Thesis Proposal

Major: Computer Engineering

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The accompanying Senior Thesis Proposal, "Biometric Door Entry Control System," is submitted in accordance with the requirements of CEEN 4980, Senior Thesis Proposal. As stated in the proposal, the project will be completed and funded by ourselves.

Respectfully yours,

Vincent A. Cappellano Aaron J. Freed

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I. BACKGROUND

It is the opinion of this Senior Thesis Team that an extensive problem of access control is present in all companies, businesses and even educational facilities. The simple truth is that companies must spend a great deal of money and use complicated means by which to protect their assets from theft or damage. Many organizations, including the Peter Kiewit Institute, have installed centrally controlled entry systems that operate using proximity cards and the Wiegand effect. Although these systems may be cost effective when a great deal of doors need to have their own security rosters, but what about a small business with one or two doors to protect? Per our research no systems currently exist that allow for self-contained high quality identity verification for the purpose of access control. A small business could not afford the expense of a high-tech entry verification system designed for up to a 1000 doors, when they only have 1 or 2 doors on location.

II. THESIS OVERVIEW

The project generated by this Senior Thesis Team will serve to provide entry control to a single door, showing that a self-contained (i.e. “non-networked”) entry control system can be both inexpensive while providing a high level of security. The door control system will require two forms of identification for the verification of identity, a fingerprint matching a list of accepted users, and a key. Only with both will the user be able to disable an electromechanical locking device, giving them access to the room. The device will be able to be managed (adding and subtracting users, diagnostics, settings) through a laptop, or PC that will be plugged into the control device via the USB port.

III. GENERAL DESCRIPTION

In order to accomplish the thesis described several technologies will need to be incorporated into the project. They are listed and described below:

1.) Biometrics – To verify the identity of an individual who is outside of a protected door we need to compare something about him/her to a stored list of features belonging to those with permission to access the room. Many such technologies exist, such as retinal scanners, fingerprint scanners, and even facial recognition systems. For ease of use for the person wishing access to the room our team has chosen fingerprint verification. Many companies produce fingerprint scanners with OEM control boards. These could be used with our Microcontroller based system by implementing them through Serial Communication. Command sets are typically developed for these devices that allow for the addition or subtraction of a Fingerprint to and from the list of accepted access users. Many of these devices have onboard Flash storage for the fingerprints, external storage is an option in a large number of people will be needing access to a specific room. The majority of the systems we looked at held under 100 fingerprints onboard.

2.) Microcontroller – Some form of microprocessor or microcontroller will be needed in order to manage the data flow and control procedures for the entry system. Since two forms of verification (fingerprint and key) will be required we will need to have firmware that only unlocks the door when both of these qualifications have been met. Also the microcontroller will

have to send a signal to a circuit that will control the electromechanical lock, to allow for opening and closing of the door. Some of those functionalities could be done in other ways, but the real usefulness of the microcontroller base system comes from its use in interfacing over USB with a laptop where an application (that will be developed) will be used for the configuration of the systems, such as the addition or subtraction of a person from the access list. Several diagnostic functions could also be implemented with the microcontroller to allow the owner to not be overly dependent on the company for simple service needs such as a broken electromechanical device.

3.) Electromechanical Control – Since this thesis will involve the locking and unlocking of a door we will need some manner by which to electronically control this functionality. Commercial electromagnetic locking devices are available, working similar to a solenoid. These devices can require several amps of current in order to change states from locked to un-locked, an amount of power not possible to be generated by a microcontroller, so a circuit will need to be designed to allow for the constant changing of states of a lock, requiring a high current draw, without causing un-necessary heating, or surges on the power line that controls our Microcontroller and fingerprint scanner. This circuit can be developed using discrete logic and power control devices such as a Triac, or a Relay. Also indicator lights should be used to show the current state of the door, which could be useful in debugging and repair processes. This device needs to require very little

input power, as it will be controlled by the microcontroller which has a low current output on its gates.

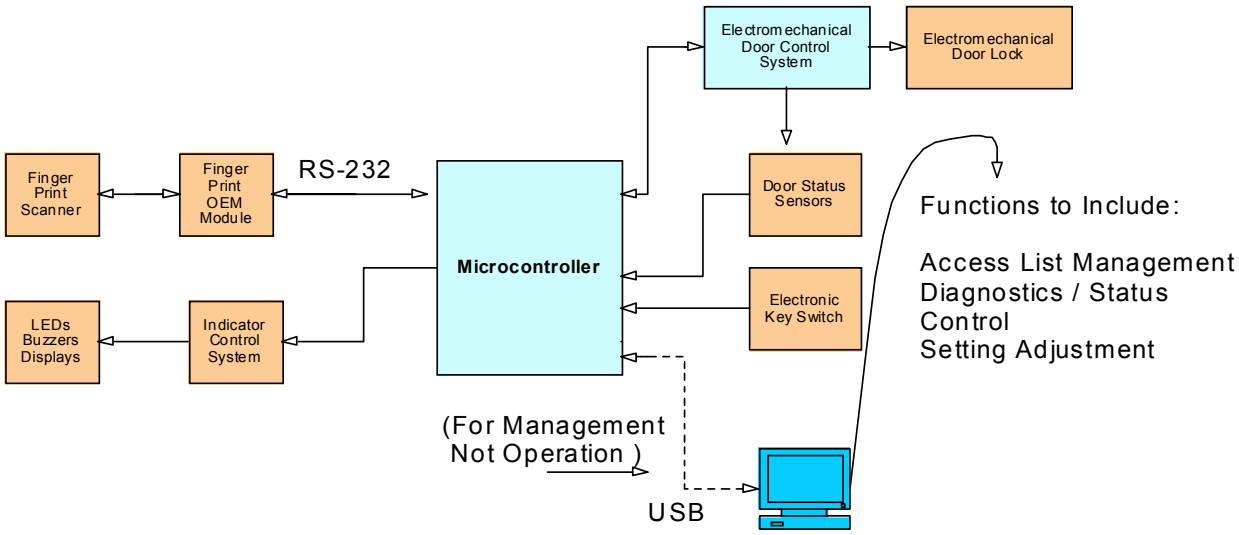
4.) Serial Communication – Communication is going to be needed in several aspects of this thesis, the communication between the microcontroller and the fingerprint scanner will be done using an RS-232 Level signals, also we will need to connect our device to a Laptop or PC for the management features described earlier. We explored each of the three primary computer peripheral interfaces (Serial, Parallel, and USB), and decided that the Universal Serial Bus protocol would work well for this project. The USB port on any USB compliant Computer or Laptop will provide a high enough data rate, as well as provide hot swapping so our business owner doesn't have to shut down his PC or Laptop in order to manage his security.

5.) Power Management – We do not want this unit to be a financial or electrical burden on our users, so some power management will be required. The goal will be to develop a system using the least power consuming devices available. The electromechanical device will take the highest current draw out of all of the circuit, but should only require current when we are changing states. There also needs to be management of our power that also for the device to stay in a locked state in the event of a power outage, assuming this is the wish of our user, to protect the assets of the company despite power failure.

The general operation of this circuit is described below in a flow chart:

Figure 1: Basic Hardware Interconnect and Data Flow

Biometrics Door Access Controller System



IV. COMPONENT LIST

Biometric Devices
Fingerprint Scanning OEM Board budgeted $ 300.00

Microcontroller System
PIC16C745 $ 11.00
6Mhz Crystal $ .75
Various Capacitors and Resistors $ 3.00
Connectors to interface with Biometric Board $ 2.00
LEDs for indicators $ 1.00
Diodes for power protection $ .50
DC12V to DC5V Converter Circuitry $ 5.00
USB 'B' style connector $ 2.00
6 foot USB Cable $ 3.00

Electromechanical System
Locking Device budgeted: $ 50.00
Relays and Control Logic budgeted: $ 20.00
Door Status Sensor budgeted: $ 10.00

Key Control System
Key Switch budgeted: $ 10.00

Miscellaneous
Wire Wrap Sockets $20.00
Wire Wrap Ids $ 5.00
Wire Wrap Wire $ 5.00
Solder/Miscellaneous $ 5.00

Budgeted Total: $ 453.25

V. TIME SCHEDULE

Proposal Due Date 1/24/02

Development of USB Communication between Microcontroller and PC 1/28/02

Expected Response Date for Proposal 2/07/02

Development of Communication between Microcontroller, Fingerprint Scanner, and PC 2/11/02

Implementation of Electromechanical Device and Controller into Project 3/05/02

Schematic Design Review with Sharif 3/05/02

Finalize Design 3/07/02

Development of Software to Control Entry System 3/18/02

Debugging and Testing 3/25/02

Project Completed and Demonstrated 4/09/02

Documentation Completed 4/30/02

Presentation of Project 5/07/02

VI. ACCEPTANCE TESTING

In order for this project to be accepted as "Complete" the following will have to be accomplished:

1.) Software Control Shell Developed Successfully – This will be demonstrated by the execution of the program, and the proper addition and subtraction of individuals from the access list for the door. Also demonstrated by the "On Command" opening of the door for testing purposes and the changing of door access control settings.

2.) USB Communication Successfully Established – This will be demonstrated by the display of a message from the microcontroller displayed upon the programs execution. As well as the successful control of the hardware by an on screen menu.

3.) Electromechanical Control System Functional – Demonstrated by the unlocking of the door at the appropriate time, as well as the status of the door being displayed correctly in the software program.

4.) Proper Indicator Lights – Demonstrated to show the user exactly what to do and when in order to open the door.

5.) Proper Fingerprint Identification – Demonstrated by the door unlocking when a person known to be on the access list places his thumb on the control pad. As well as demonstrated by the door not opening when a person known not to be on the list places his thumb on the control pad.

Obviously these are listed in a dependent order, if a software shell cannot be developed, then clearly we cannot do the acceptance testing for the "On Demand"

control and addition and subtraction of individuals on the access list. So each higher number item is dependent on the successful completion of the lower number item before it.

VII. TEAM MEMBERS

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VIII. ASSIGNMENT OF EACH MEMBER

Cappellano, Vincent A.
Development of USB Communication
Implementation of Fingerprinting OEM Board
Door Status Sensor Implementation

Freed, Aaron J.
Development and Implementation of Key Control Enable/Disable System
Development and Implementation of Indicator Lights System
Physical Construction (Cases and Mounting)

Team Assignment
These items will be developed and implemented by both members of the team:

Host Computer Software Design
Design and Construction of Electromechanical Lock System
Microcontroller Circuit Construction
Testing and Debugging

IX. SUMMARY

Upon completion of this project we will have the ability to control the access to a specific room to a set list of individuals with permission to access it. We will be able to dynamically add and subtract individuals from the access list as well as to control the system for testing purposes. Our Senior Thesis Team plans on implementing this project on an actual door for the purposes of demonstration.