DOOR CONTROLLER USING SMART CARD AND INTERACTIVE CODE LOCK

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Abstract- **Security and user access are very important aspect of our everyday life. The world having attained its level of digitalization requires a smart way of door access and control. This work models a door that reads and validates a smart card and then enables a digital display and keypad if the validation is successful. To further authenticate the bearer of the smart card, an interactive code is required within 1 minute of smart card validation to complete the door unlocking process. The door automatically closes after 30 seconds once opened. Further research areas: database to tag each entrance to a particular user, deactivation of the keypad and screen after a minute of smart card validation and yet no pass code input.**

Index Terms—**Smart card, code lock, door controller, security, card reader**

I. INTRODUCTION

In the contemporary world that we are in now, most Organizations make use of different types of security designs in different sections of the Organization depending on the level of importance of that section. For example in banks, the type of security applied in the general entrance door is different from that used in the strong room door, the file cabinet, the Manager's office door etc.

Door security can range from key locks, pad locks, security personnel, smart-locks, pass code locks, biometric locks and what have you with each one having its own series of advantages and demerits.

This work places emphasis on the use of microcomputer and microcontroller to read smartcards and request for password to authenticate further the genuineness of the card bearer. All smartcards comes with built-in chip(s) though some as originally implemented using light rays for its analysis while some have a flash upgradeable firmware [4], [13]. The smart card used here is implemented using a vero board soldered with a 1kΩ resistor while the card reader which is achieved using a 555 timer circuit wired to a microcontroller accesses the card when it is inserted into its analyses area. The reader calculates the resistance of the inserted card and sends to the microcontroller for validation. If the card is valid, access password is demanded for and if a correct code is given, access to the door is gained.

This work is broken down into 3 stages:

- Hardware design and interfacing of the project
- System/Data Analysis
- Control Software design of the project

II. METHODOLOGY

a. Hardware design and interfacing

The hardware is comprised of the following:

- ✓ Smartcard design: There exist 3 basic types of smart card which are; microcomputer integrated smart card, resistive smart card and capacitive smart card [4], [13]. A resistive type which has a resistive circuit as the chip and a reader circuit which understands the resistive circuit and counts to a given code pattern for the controller unit is used. This is implemented using a vero board with a 1kΩ resistor soldered to it to serve as the card chip which is read up by a card reader. Any card that does not provide a 1KΩ value to the card reader is classified as invalid.
- ✓ Smartcard reader design: This is a simple 8 pin 555 timer designed to read and authenticate the resistive value of the card connected to it. The 555 timer is configured as a one-shot mono-stable multi-vibrator where the smart card acts as the R2 of the 555 timer circuit. It compares the resistance of the card inserted into it with the internal resistance which has been set to be 1KΩ and if equal sends a signal to the microcontroller for validity. The reader is designed to be installed on the door and reads the card. The 555 Timer or card reader unit is further connected to the microcomputer.
- ✓ The electronic door: A CD-ROM drive bay with a wooden frame at its open end to serve as an electronic door area was used. The CD-ROM is left permanently opened to lap with the wooden frame; serving as a closed door. When the CD-ROM bay slides inside the CD-ROM, an opening is created and it is seen as an open door.
- ✓ The micro-controller unit: A 40 pin DIP AT89C51 controller having four ports of eight pins each thus

32 I/O pins was used. The controller holds the codes which drives the card reader. On validating the smart card, it loads and shows a VB screen on the monitor asking for user password. This is used to ensure that the user is actually the authenticated owner of the card.

- ✓ The power section design: This is required to power the electronic door, the microcontroller, keypad section and the card reader. The power source is the AC from the wall socket which is been stepped down to 12V DC and then regulated to 5V DC which most of the system components requires. Components like relays and motor that need 12V tap power before the voltage regulation process.
- ✓ The keypad section: It is made of 12 switches arranged in a 3 x 4 matrix format using dot matrix configuration. The rows elements are connected to port 1 of the controller while the column elements to port 3. For the controller to detect a depressed key, it places a Logic 0 on the first row and Logic 1 on all other rows. It places a logic 1 on all the columns thus if any switch on the first row is depressed, the logic state of that row/column intersect is altered and the numeric value for that intersect is registered. This is applicable to other intersects. The keypad is connected to the microcontroller for data sending using port 1 for the row elements; P1.4, P1.5, P1.6 and using port 3 for the column elements; P3.0, P3.1, P3.2, P3.3. To ensure that the key is properly depressed, a Buzzer is connected to indicate the contact of a key.
- ✓ The output visual display section: A microcomputer is interfaced to the microcontroller of the project through a parallel printer port using an LTP cable. A VB control program was written to accept few characters input from a user keypad after authenticating the resistive signal from the card reader. Once the smart card is validated, the keypad is activated and the microcomputer screen brings up a username and password screen for interactive key code verification. The door opens for just 30 seconds and closes automatically if a valid pass code is keyed in.

b. System/Data Analysis

This involves the analysis of the working principles of the project work which entails what and how each circuit cooperates with each other when in operation. The operation hence starts with energizing the hardware component which resets all the functional units. The control unit listens to the computer system to know which card to accept.

The whole operation is designed to serve the purpose of security. To gain access to the room;

- If the password is valid, the microcontroller sends a Logic 1 to forward bias transistor1 which in turn causes relay1 to force the door's motor to move in the forward direction (by electromagnetism) thus opening the door. The controller also after 30 seconds sends Logic 0 to transistor1 to become reverse bias while forward biasing transistor2 which causes relay2 to force the motor to move in the opposite direction thus closing the door.

- The controller is connected to the microcomputer through a DB 25 LTP cable for visual interface using two data lines and one status line; D0, D1, S3. The controller also is connected to a buzzer through a transistor. It sends a Logic 1 to this transistor which on forward biasing, triggers off the buzzer if an invalid smart card is tried three consecutive times or if an invalid code is used three consecutive times within a space of 5 minutes. This is to alert security of intrusion.

c. Software Design

C Programming Design for the Atmel AT Controller

The software was designed using CRIMSON EDITOR C compiler and SDCC (small device C compiler) which contains the header file of the Microcontroller (AT89C51). It will generate an Intel hex file which is transferred into the microcontroller via a computer interfaced programming device. Refer to appendix C for the code.

Designing the Visual Basic Interface/Form and Code

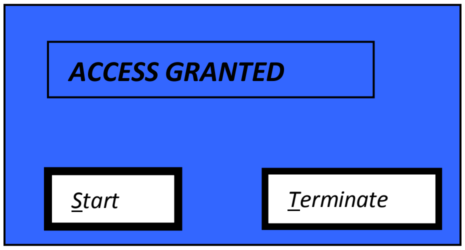

Fig. 1: VB Interface

Refer to Appendix D for code.

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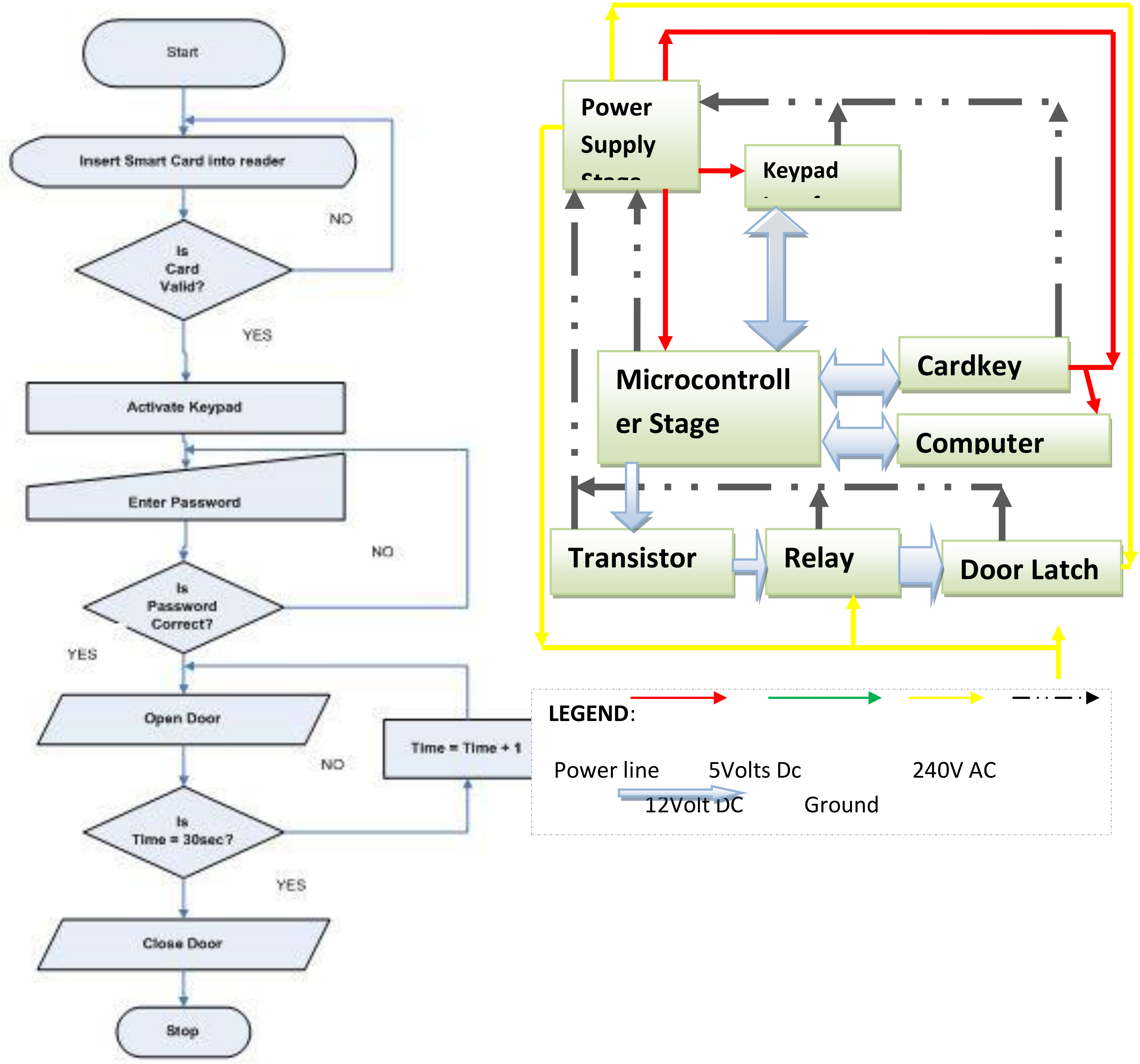
APPENDIXES

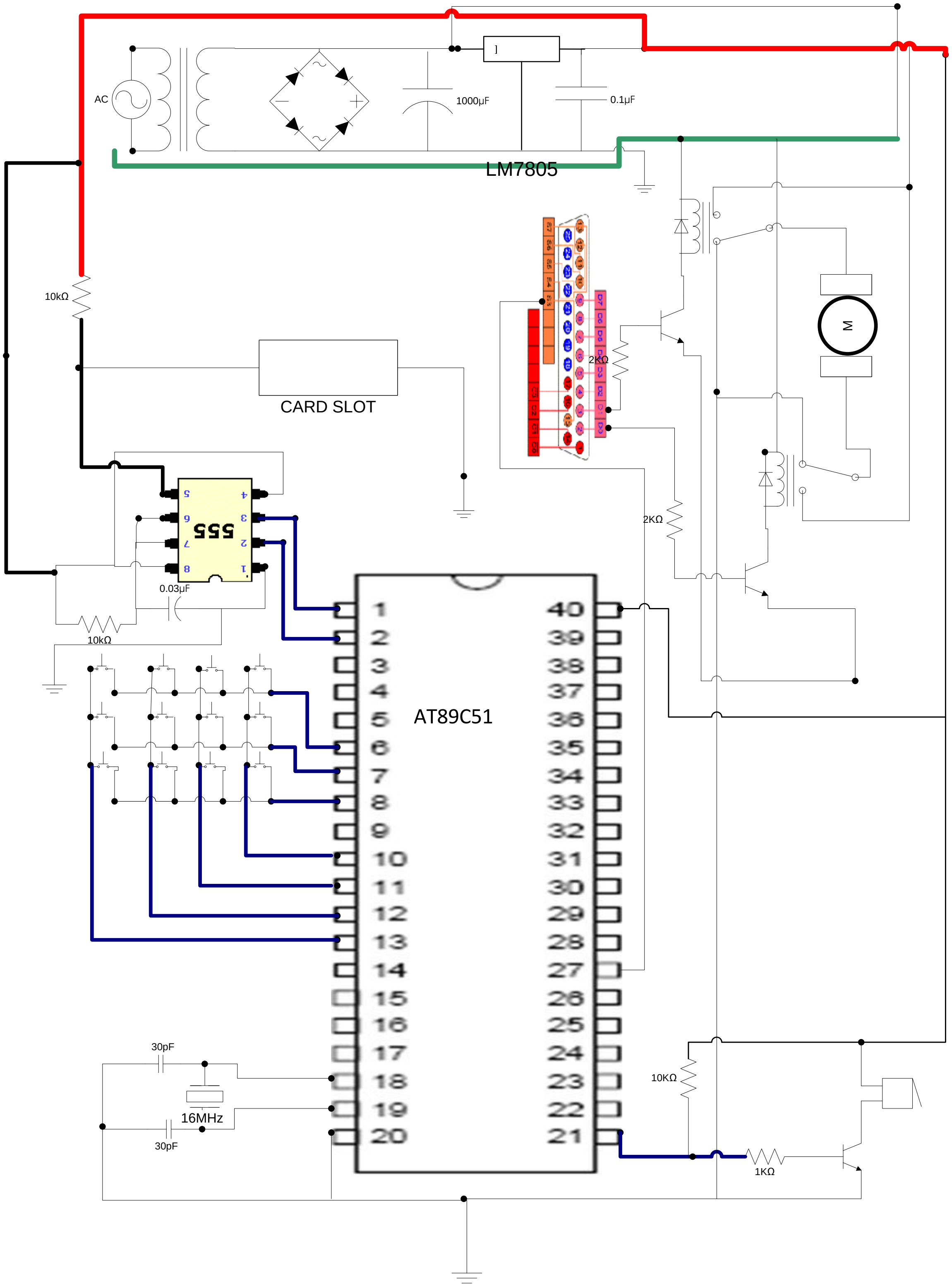
APPENDIX A

Flowchart and Block Diagram of the Project



APPENDIX B

Complete System Circuit Schematics



ISSN: 2278 – 1323

APPENDIX C

SOFTWARE SOURCE CODES

C Program Code for the Atmel AT89C51 Microcontroller

```
#include “at89x52.h”

Unsigned char a,b,c,d,e;

bit flag,flag1;
```

```
//delay function:

Void delay (int pause)

{

While (!(pause == 0))

{

            Pause --;

_asm;                                    //1ms assembly code (for 18MHz crystal)

             Mov r6,#3                   // adjust to crystal frequency

             Mov r7,#215

00111$

_endasm;

}

return;

}
```

```
// Card reading function

Void main (void){

         P2=0=flag=flag1=1

         delay(1000);                        // call delay

         while(1){

    if (!P3_0){while(!P3_0){;}delay(50);

        if (P3_0){a=b;b=c;c=d,d=1;

              P0_1=0;delay(500);P0_1=1;}
```

```
 }

           if (!P3_1){while(!P3_1){;}delay(50);

       if (P3_1){a=b;b=c;c=d,d=2;

            P0_1=0; delay(500);P0_1=1;}

 }

          if (!P3_2){while(!P3_2){;}delay(50);

       if (P3_2){a=b; b=c;c=d,d=3;

            P0_1=0; delay(500);P0_1=1;}

 }

          if (!P3_3){while(!P3_3){;}delay(50);

       if (P3_3){a=b;b=c;c=d,d=4;

            P0_1=0;delay(500);P0_1=1;}

 }

         if (!P1_4){while(!P1_4){;}delay(50);

           if (P1_4){a=b=c=d=0;

            P0_0=P0_1; delay(500);P0_1=1;}

 }

       if (!P1_5){while(!P1_5){;}delay(50);

          if (P1_5){

                    ++e; P0_1=0; delay(500);P0_1=1;

                     If (e==3){ flag = 0;}

                     If (a==1 && b==2 && c==3&& d==4){ P0_0=0;e=a=b=c=d=0;

                     0;}}

  }

  if (!P_0){while(!          P1_0){;}

  if (P1_0){P0_1=0; delay(5000);P0_1=1;}

  }

  if (!flag){P2_0=0; delay(500);P2_0=1; delay(500);}

}

}
```

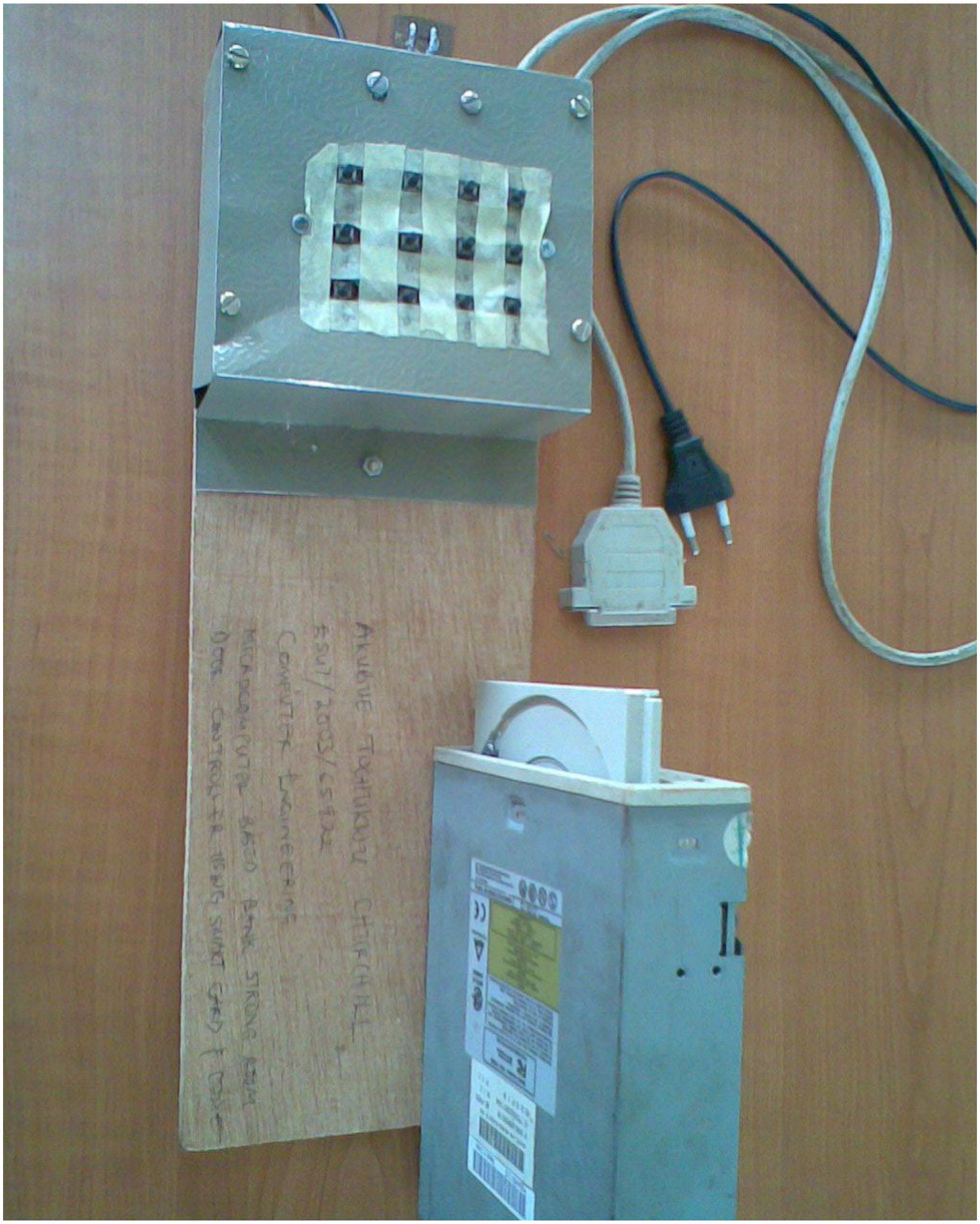
APPENDIX D

Code for VB interface

```
Option Explicit
Private Declare Sub Sleep Lib “Kernel32” (By Val dwMilliseconds As Long)

Private Sub Command1_Click()
        Timer1.Enabled = True
End Sub

Private Sub Command2_Click()
        End
End Sub

Private Sub Form_Load()
        Label1.Visible = False
        Timer1.Enabled=False
        Command1.Caption = “&Start”
        Command2.Caption = “&Terminate”
End Sub
Private Sub Timer1_Timer()
        If PortIn (889) =111 Then
                Label1.Visible = True
                Label1.Caption = “ACCESS GRANTED”
                Call PortOut (888,5)
                Sleep 300
                Call PortOut (888,6)
                Sleep 300
                Call PortOut (888,0)
                Sleep 300
                Call PortOut (888,4)
                Sleep 300
                End If
End Sub
```

APPENDIX E

Photograph of the System


AKUDIE TOCHUKWU CHURCHILL
ESUT/2003/CS404
COMPUTER ENGINEERING
MICROCOMPUTER BASED BANK STRONG ROOM
DOOR CONTROLLER USING SMART CARD