KULLIYYAH OF ENGINEERING
DEPARTMENT OF MECHATRONICS ENGINEERING

PROJECT REPORT

MCTE 2332
Digital System and Microprocessor

DIGITAL DOOR LOCK

NAME	WAN ALYA ATHIRAH BT WAN ROSHDI
MATRICS	1912914
SECTION	1

1.0 GOAL OF THE PROJECT

The system that was chosen to be constructed is a digital door lock which needs to key-in the password to make the door open. Only if the keyed-in password is the same with the setted one. This system is implemented to :

- Avoid unwanted incidents like burglary cases which easily break the door lock using a hammer or unlock the door with a pin.
- Lead the world towards the technological era.
- Prevent from a situation where the owner cannot enter the house because lost or forgot to bring the key.

2.0 DESIGN PROCESS

The main point of designing a digital door lock is about choosing gates. It is because the system needs gates that have characteristics which will become high only if the keyed-in and setted one is the same. Hence, XNOR gates and AND gates are the most suitable for the system.

XNOR gates is the first restriction of the system. This is because XNOR gates will compare each digit of keyed-in password with the original one. If both are the same , the output will be HIGH and if they are opposite, the output will be LOW. Hence, the system uses 4 XNOR gates because it is a 4 digit password and will compare each of the digits.

After that, it will go through an AND gate which will accept the outputs of the XNOR gates. The purpose of AND gate is either keep the door locked or unlock it. This coincides with the rule of AND gate which will be HIGH if and only if all inputs are HIGH and otherwise it will be LOW. Hence, the door will be unlocked when the AND gate is HIGH.

Furthermore, after gaining the output from the AND gate, and LED will be on either in green which indicates the password is correct and door will be unlocked or otherwise in red which the password is wrong.

3.0 DETAILED DESIGN

Truth Table :

A1	B1	C1	D1	A2	B2	C2	D2	X
0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	1	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	1	0
0	0	0	0	0	1	1	0	0
0	0	0	0	0	1	1	1	0
0	0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	1	0
0	0	0	0	1	0	1	0	0
0	0	0	0	1	0	1	1	0
0	0	0	0	1	1	0	0	0
0	0	0	0	1	1	0	1	0
0	0	0	0	1	1	1	0	0
0	0	0	0	1	1	1	1	0
0	0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	1	1
0	0	0	1	0	0	1	0	0
0	0	0	1	0	0	1	1	0
0	0	0	1	0	1	0	0	0
0	0	0	1	0	1	0	1	0
0	0	0	1	0	1	1	0	0
0	0	0	1	0	1	1	1	0
0	0	0	1	1	0	0	0	0
0	0	0	1	1	0	0	1	0
0	0	0	1	1	0	1	0	0
0	0	0	1	1	0	1	1	0
0	0	0	1	1	1	0	0	0
0	0	0	1	1	1	0	1	0
0	0	0	1	1	1	1	0	0
0	0	0	1	1	1	1	1	0
0	0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	1	0
0	0	1	0	0	0	1	0	1
0	0	1	0	0	0	1	1	0
0	0	1	0	0	1	0	0	0
0	0	1	0	0	1	0	1	0
0	0	1	0	0	1	1	0	0
0	0	1	0	0	1	1	1	0
0	0	1	0	1	0	0	0	0
0	0	1	0	1	0	0	1	0
0	0	1	0	1	0	1	0	0
0	0	1	0	1	0	1	1	0
0	0	1	0	1	1	0	0	0
0	0	1	0	1	1	0	1	0
0	0	1	0	1	1	1	0	0
0	0	1	0	1	1	1	1	0
0	0	1	1	0	0	0	0	0
0	0	1	1	0	0	0	1	0
0	0	1	1	0	0	1	0	0
0	0	1	1	0	0	1	1	0
0	0	1	1	0	1	0	0	0
0	0	1	1	0	1	0	1	0
0	0	1	1	0	1	1	0	0
0	0	1	1	0	1	1	1	0
0	0	1	1	1	0	0	0	0
0	0	1	1	1	0	0	1	0
0	0	1	1	1	0	1	0	0
0	0	1	1	1	0	1	1	0
0	0	1	1	1	1	0	0	0
0	0	1	1	1	1	0	1	0
0	0	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	1	0
0	1	0	0	0	0	1	0	0
0	1	0	0	0	0	1	1	0
0	1	0	0	0	1	0	0	1
0	1	0	0	0	1	0	1	0
0	1	0	0	0	1	1	0	0
0	1	0	0	0	1	1	1	0
0	1	0	0	1	0	0	0	0
0	1	0	0	1	0	0	1	0
0	1	0	0	1	0	1	0	0
0	1	0	0	1	0	1	1	0
0	1	0	0	1	1	0	0	0
0	1	0	0	1	1	0	1	0
0	1	0	0	1	1	1	0	0
0	1	0	0	1	1	1	1	0
0	1	0	1	0	0	0	0	0
0	1	0	1	0	0	0	1	0
0	1	0	1	0	0	1	0	0
0	1	0	1	0	0	1	1	0
0	1	0	1	0	1	0	0	0
0	1	0	1	0	1	0	1	1
0	1	0	1	0	1	1	0	0
0	1	0	1	0	1	1	1	0
0	1	0	1	1	0	0	0	0
0	1	0	1	1	0	0	1	0
0	1	0	1	1	0	1	0	0
0	1	0	1	1	0	1	1	0
0	1	0	1	1	1	0	0	0

0	1	0	1	1	1	0	1	0
0	1	0	1	1	1	1	0	0
0	1	0	1	1	1	1	1	0
0	1	1	0	0	0	0	0	0
0	1	1	0	0	0	0	1	0
0	1	1	0	0	0	1	0	0
0	1	1	0	0	0	1	1	0
0	1	1	0	0	1	0	0	0
0	1	1	0	0	1	0	1	0
0	1	1	0	0	1	1	0	1
0	1	1	0	0	1	1	1	0
0	1	1	0	1	0	0	0	0
0	1	1	0	1	0	0	1	0
0	1	1	0	1	0	1	0	0
0	1	1	0	1	0	1	1	0
0	1	1	0	1	1	0	0	0
0	1	1	0	1	1	0	1	0
0	1	1	0	1	1	1	0	0
0	1	1	0	1	1	1	1	0
0	1	1	1	0	0	0	0	0
0	1	1	1	0	0	0	1	0
0	1	1	1	0	0	1	0	0
0	1	1	1	0	0	1	1	0
0	1	1	1	0	1	0	0	0
0	1	1	1	0	1	0	1	0
0	1	1	1	0	1	1	0	0
0	1	1	1	0	1	1	1	1
0	1	1	1	1	0	0	0	0
0	1	1	1	1	0	0	1	0
0	1	1	1	1	0	1	0	0
0	1	1	1	1	0	1	1	0
0	1	1	1	1	1	0	0	0
0	1	1	1	1	1	0	1	0
0	1	1	1	1	1	1	0	0
0	1	1	1	1	1	1	1	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	1	0
1	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	1	0
1	0	0	0	0	1	1	0	0
1	0	0	0	0	1	1	1	0
1	0	0	0	1	0	0	0	1
1	0	0	0	1	0	0	1	0
1	0	0	0	1	0	1	0	0
1	0	0	0	1	0	1	1	0

1	0	0	0	1	1	0	0	0
1	0	0	0	1	1	0	1	0
1	0	0	0	1	1	1	0	0
1	0	0	0	1	1	1	1	0
1	0	0	1	0	0	0	0	0
1	0	0	1	0	0	0	1	0
1	0	0	1	0	0	1	0	0
1	0	0	1	0	0	1	1	0
1	0	0	1	0	1	0	0	0
1	0	0	1	0	1	0	1	0
1	0	0	1	0	1	1	0	0
1	0	0	1	0	1	1	1	0
1	0	0	1	1	0	0	0	0
1	0	0	1	1	0	0	1	1
1	0	0	1	1	0	1	0	0
1	0	0	1	1	0	1	1	0
1	0	0	1	1	1	0	0	0
1	0	0	1	1	1	0	1	0
1	0	0	1	1	1	1	0	0
1	0	0	1	1	1	1	1	0
1	0	1	0	0	0	0	0	0
1	0	1	0	0	0	0	1	0
1	0	1	0	0	0	1	0	0
1	0	1	0	0	0	1	1	0
1	0	1	0	0	1	0	0	0
1	0	1	0	0	1	0	1	0
1	0	1	0	0	1	1	0	0
1	0	1	0	0	1	1	1	0
1	0	1	0	1	0	0	0	0
1	0	1	0	1	0	0	1	0
1	0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	1	0
1	0	1	0	1	1	0	0	0
1	0	1	0	1	1	0	1	0
1	0	1	0	1	1	1	0	0
1	0	1	0	1	1	1	1	0
1	0	1	1	0	0	0	0	0
1	0	1	1	0	0	0	1	0
1	0	1	1	0	0	1	0	0
1	0	1	1	0	0	1	1	0
1	0	1	1	0	1	0	0	0
1	0	1	1	0	1	0	1	0
1	0	1	1	0	1	1	0	0
1	0	1	1	0	1	1	1	0
1	0	1	1	1	0	0	0	0

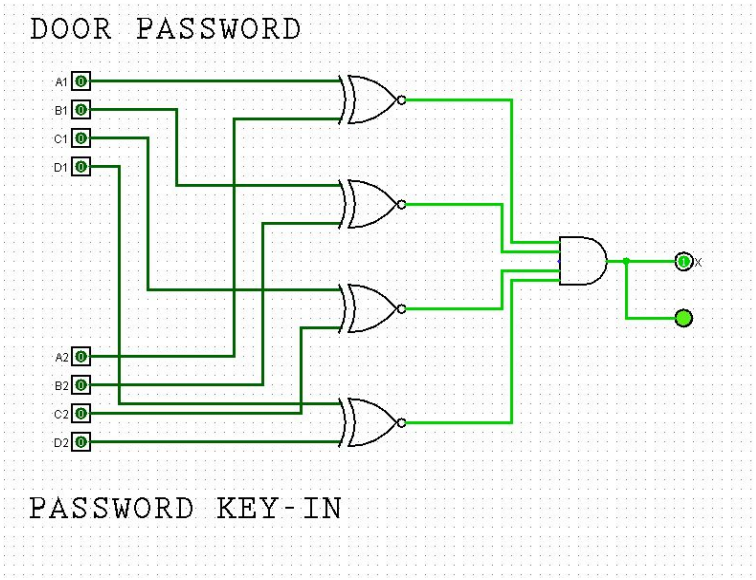
1	0	1	1	1	0	0	1	0
1	0	1	1	1	0	1	0	0
1	0	1	1	1	0	1	1	1
1	0	1	1	1	1	0	0	0
1	0	1	1	1	1	0	1	0
1	0	1	1	1	1	1	0	0
1	0	1	1	1	1	1	1	0
1	1	0	0	0	0	0	0	0
1	1	0	0	0	0	0	1	0
1	1	0	0	0	0	1	0	0
1	1	0	0	0	0	1	1	0
1	1	0	0	0	1	0	0	0
1	1	0	0	0	1	0	1	0
1	1	0	0	0	1	1	0	0
1	1	0	0	0	1	1	1	0
1	1	0	0	1	0	0	0	0
1	1	0	0	1	0	0	1	0
1	1	0	0	1	0	1	0	0
1	1	0	0	1	0	1	1	0
1	1	0	0	1	1	0	0	1
1	1	0	0	1	1	0	1	0
1	1	0	0	1	1	1	0	0
1	1	0	0	1	1	1	1	0
1	1	0	1	0	0	0	0	0
1	1	0	1	0	0	0	1	0
1	1	0	1	0	0	1	0	0
1	1	0	1	0	0	1	1	0
1	1	0	1	0	1	0	0	0
1	1	0	1	0	1	0	1	0
1	1	0	1	0	1	1	0	0
1	1	0	1	0	1	1	1	0
1	1	0	1	1	0	0	0	0
1	1	0	1	1	0	0	1	0
1	1	0	1	1	0	1	0	0
1	1	0	1	1	0	1	1	0
1	1	0	1	1	1	0	0	0
1	1	0	1	1	1	0	1	1
1	1	0	1	1	1	1	0	0
1	1	0	1	1	1	1	1	0
1	1	1	0	0	0	0	0	0
1	1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0	0
1	1	1	0	0	0	1	1	0
1	1	1	0	0	1	0	0	0
1	1	1	0	0	1	0	1	0

1	1	1	0	0	1	1	0	0
1	1	1	0	0	1	1	1	0
1	1	1	0	1	0	0	0	0
1	1	1	0	1	0	0	1	0
1	1	1	0	1	0	1	0	0
1	1	1	0	1	0	1	1	0
1	1	1	0	1	1	0	0	0
1	1	1	0	1	1	0	1	0
1	1	1	0	1	1	1	0	1
1	1	1	0	1	1	1	1	0
1	1	1	1	0	0	0	0	0
1	1	1	1	0	0	0	1	0
1	1	1	1	0	0	1	0	0
1	1	1	1	0	0	1	1	0
1	1	1	1	0	1	0	0	0
1	1	1	1	0	1	0	1	0
1	1	1	1	0	1	1	0	0
1	1	1	1	0	1	1	1	0
1	1	1	1	1	0	0	0	0
1	1	1	1	1	0	0	1	0
1	1	1	1	1	0	1	0	0
1	1	1	1	1	0	1	1	0
1	1	1	1	1	1	0	0	0
1	1	1	1	1	1	0	1	0
1	1	1	1	1	1	1	0	0
1	1	1	1	1	1	1	1	1

Logic equation :

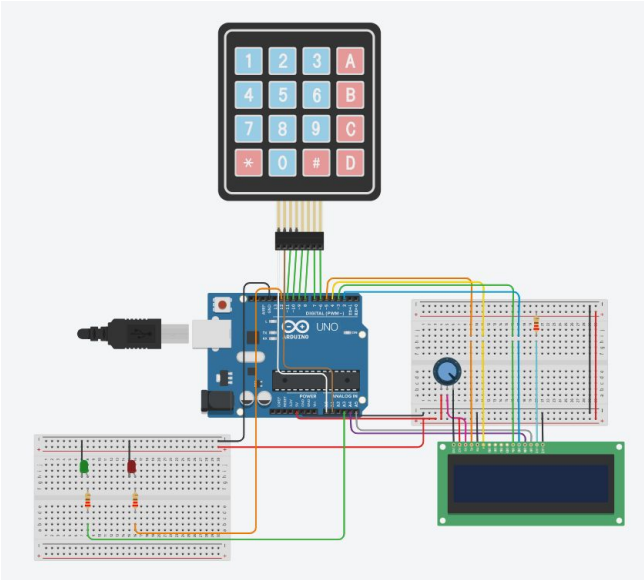
$$
\begin{aligned}
&\overline{A1}\,\overline{B1}\,\overline{C1}\,\overline{D1}\,\overline{A2}\,\overline{B2}\,\overline{C2}\,\overline{D2} \\
&+ \overline{A1}\,\overline{B1}\,\overline{C1}\,D1\,\overline{A2}\,\overline{B2}\,\overline{C2}\,D2 \\
&+ \overline{A1}\,\overline{B1}\,C1\,\overline{D1}\,\overline{A2}\,\overline{B2}\,C2\,\overline{D2} \\
&+ \overline{A1}\,\overline{B1}\,C1\,D1\,\overline{A2}\,\overline{B2}\,C2\,D2 \\
&+ \overline{A1}\,B1\,\overline{C1}\,\overline{D1}\,\overline{A2}\,B2\,\overline{C2}\,\overline{D2} \\
&+ \overline{A1}\,B1\,\overline{C1}\,D1\,\overline{A2}\,B2\,\overline{C2}\,D2 \\
&+ \overline{A1}\,B1\,C1\,\overline{D1}\,\overline{A2}\,B2\,C2\,\overline{D2} \\
&+ \overline{A1}\,B1\,C1\,D1\,\overline{A2}\,B2\,C2\,D2 \\
&+ A1\,\overline{B1}\,\overline{C1}\,\overline{D1}\,A2\,\overline{B2}\,\overline{C2}\,\overline{D2} \\
&+ A1\,\overline{B1}\,\overline{C1}\,D1\,A2\,\overline{B2}\,\overline{C2}\,D2 \\
&+ A1\,\overline{B1}\,C1\,\overline{D1}\,A2\,\overline{B2}\,C2\,\overline{D2} \\
&+ A1\,\overline{B1}\,C1\,D1\,A2\,\overline{B2}\,C2\,D2 \\
&+ A1\,B1\,\overline{C1}\,\overline{D1}\,A2\,B2\,\overline{C2}\,\overline{D2} \\
&+ A1\,B1\,\overline{C1}\,D1\,A2\,B2\,\overline{C2}\,D2 \\
&+ A1\,B1\,C1\,\overline{D1}\,A2\,B2\,C2\,\overline{D2} \\
&+ A1\,B1\,C1\,D1\,A2\,B2\,C2\,D2
\end{aligned}
$$

Logisim:

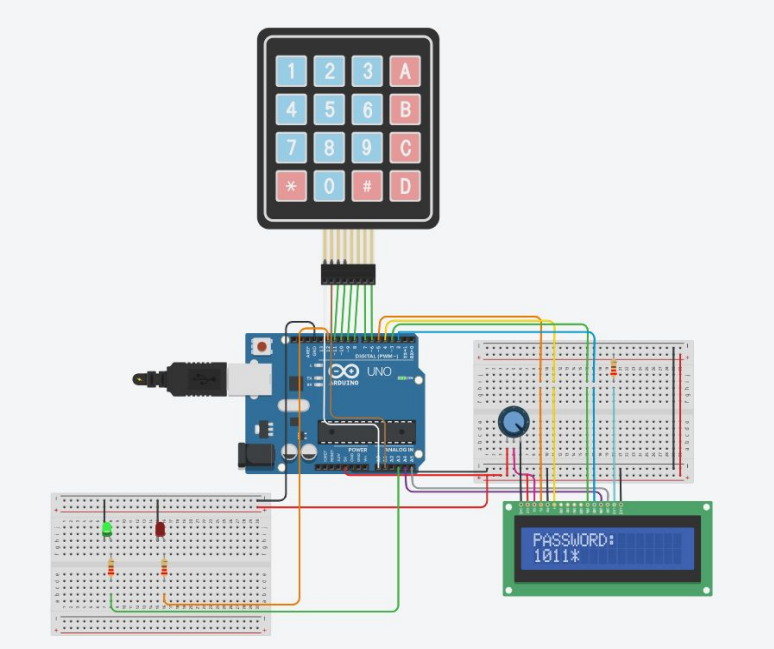


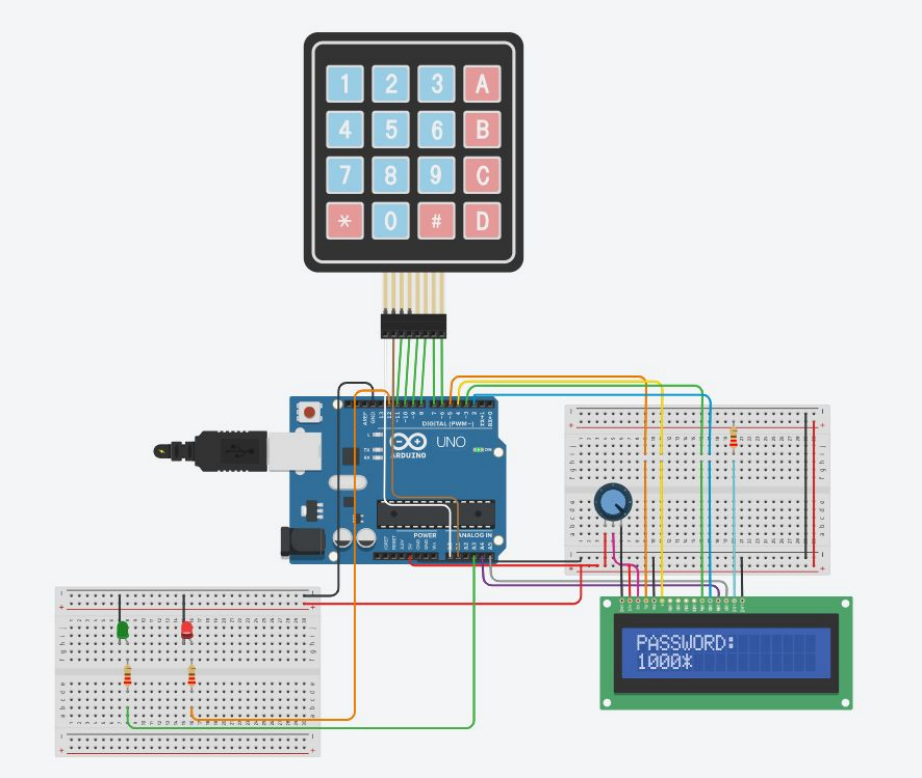
4.0 DESIGN VERIFICATION

The design verification has been done in tinkercad. The attachment below is the circuit of the design. Designing the door lock system, several components are used such as arduino board, keypad, lcd and leds. The function of keypad and lcd is to key-in the password and display the digit on the lcd. While the leds, green and red are verification of the password entered.



As stated in the design process, the green led will be on when the password entered is the same as the setted one or otherwise the red led will be on. For example, if the original password is set as 1 0 1 1. The output will be shown as below.





Next, the coding of the system is stated as below. Also, the link of tinkercad is attached here,
https://www.tinkercad.com/things/3aTS0WVLAuS-dld-project/editel?sharecode=S6rS69NehXdZPCydwEUCLEt0izVpVXmAWdGp7Mp3z5k

```
//DIGITAL DOOR LOCK SYSTEM

#include <Keypad.h>
#include <LiquidCrystal.h>

LiquidCrystal lcd(5, 4, 3, 2, A4, A5);

#define length 5

int pw[length] = {1,0,1,1};                  //set password
char set[length];
char keyin[length];
const byte ROWS = 4;                         //four rows
const byte COLS = 4;                         //four columns
char keys[ROWS][COLS] = {
  {'1','2','3','A'},
  {'4','5','6','B'},
  {'7','8','9','C'},
  {'*','0','#','D'}
};
byte rowPins[ROWS] = {A0, A1, 11, 10};       //connect to the row pinouts of the keypad
byte colPins[COLS] = {9, 8, 7, 6};           //connect to the column pinouts of the keypad
int LCDCol = 0;
int LCDRow = 0;
int z = 0;
int specific = 4;
int m=0;
int hot= 12;
int cold= A3;

Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
```

```
void setup()
{
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.clear();
  lcd.setCursor(LCDCol, LCDRow);
  lcd.print("PASSWORD:");
  lcd.setCursor(LCDCol,++LCDRow);
  pinMode(12,OUTPUT);
  pinMode(A3,OUTPUT);
}

void loop()
{
   set [m] = pw[m] + '0';

    char key = keypad.getKey();

  if (key)
    {
      Serial.print ("m = ");
      Serial.println (m);

      keyin[m]= key;

      Serial.print ("keyin[m] = ");
      Serial.println (keyin[m]);

      Serial.print ("set[m] = ");
      Serial.println (set[m]);

      m++;
```

```
    if ( LCDCol > 15  )
    {
     ++LCDRow;

      if (LCDRow>1)
      { LCDRow=0; LCDCol = 0 ;  lcd.clear(); }

    LCDCol = 0 ;
    }

    lcd.setCursor (LCDCol, LCDRow);

    lcd.print(key);

    ++LCDCol;

    }



  if( z < 5 && keyin[specific] == '*')
  {
    light(keyin,set);
    z=z+5;
    lcd.clear();
  }


}
```

```
void light(char x [], char y[] )
{

  int a=0; int b=1; int c=2; int d=3;

  Serial.print ("x[a] = ");
  Serial.println (x[a]);

  Serial.print ("y[a] = ");
  Serial.println (y[a]);

  if (x[a]==y[a] && x[b]==y[b] && x[c]==y[c] && x[d]==y[d])
  {digitalWrite(hot,LOW);
  digitalWrite(cold,HIGH);}

  else
  {digitalWrite(hot,HIGH);
  digitalWrite(cold,LOW);}

  delay(7000);
  digitalWrite(hot,LOW);
  digitalWrite(cold,LOW);

}
```

5.0 CONCLUSIONS

The aim of constructing digital door locks is to take care of the people's safety because houses should be the most secure place. This is the most important technology that should be implemented because nowadays a lot of burglary cases happen. By implementing this system, incidents can be reduced and situations like forgot the house key or losing it can be avoided. It is because the owner just needs to set the password and key-in the same password for the other time to enter their house. The door will be unlocked only if the password is the same and green light is on. The existence of digital door locked systems will spark awareness among the community especially during this new norm which some people make a decision to rob as their financial is greatly affected. Besides that, it will create a better and safer environment for all. Hence, the objectives of the system are achieved.