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Finger Print Recognition: An Application Approach

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Abstract:

In this paper, we have presented an application approach to the finger print recognition system. As now a days most of us are familiar and are using the finger print recognition machine in different places, like colleges, hospital, offices, bank and many more. In fact in most of the conferences and in the seminar or workshops we use to talk about the technology behind the finger print recognition system. But at very few palaces we find the real interfacing of the machine with the user. Here a practical approach is discussed to interface the finger print machine with the user.

Key words: - Sensor, Microcontroller, Serial Communication, Mikro C Compiler

Introduction

Finger print recognition is a method of making a verification match between many human finger print. Major building block of finger print recognition are Segmentation process, normalization process, Code generation & to make the verification. Segmentation uses the Arch, Loop & Whorl to represent the finger [1]. During the normalization and Code generation process the minutia is converted in to the codes. Further during the matching process these codes are verified with the stored once. If the code is found in the database the output is generated as true verify. And if the code is not found in the database then the Output is considered as true reject. Refer [2] for false acceptance, false rejection. True acceptance and true rejection. As stated earlier we have interfaced finger print recognition sensor with the microcontroller. In most of the finger print recognition sensor the technology behind to match the generated code is based on the serial communication [3-4]. Whenever initially when we enroll the user to the machine i.e. we are giving a unique code to the user. The length of the given code will be depend on the number of user that can be enrolled with the machine and the number of bits that has been defined to be assigned to the user during the manufacturing process of the machine [5-6]. Let us take a example to interface a machine manufactured by the company "MAIXIS technology".



Figure 1 Finger print sensor used for recognition

Main technical detail of this machine is: -
Enrollment time: - Less then 250 ms
Search Time: - Less then 1 Sec
Capacity: -768 Templates
FAR: -0.0001 %
FRR: -0.01 %
Power Supply:- 5 V
Peak Current: -90 mA
Communication Interface: - TTL
Baud Rate: - 57600 bps

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Working Temp: - -10 Deg to + 40 Deg

Design Approach

Here we have interfaced a sensor of finger print recognition with the help of serial communication of 8051 family microcontroller. Initially the user is being enrolled to the machine & then he or she can use its finger print to recognize him/her self [7-8]. During the recognition we have interfaced a motor which will run for a moment of time indicating that the correct user is, and a buzzer which will make the sound to show that unauthorized user [9-10]. For the software part we have used the famous Mikro C Compiler of 8051. Might we all know that the Serial communication is a method of data transfer between two devices. Data stream is being transferred from one device to other serially (i.e. one by one) [11-12]. Data rate in between the source and destination is decided by the agreement of the baud rate at the initially. Here we have used serial communication with a baud rate of 57600 bps. Following instruction are used to initialized the machine for the serial communication: -

```
SCON=0X50;
T2CON=0X30;
TH2=0XFF;
TL2=0XFA;
ES = 1;
TR2 = 1;
```

SCON is the serial communication register. Which is given a HEX value 50 indicating that serial mode 1 is used with 8 bit data along with 1 stat bit and 1 stop bit. TH2 & TL2 is used to define the baud speed of 57600 which is already doubled with the use of SCON. ES =1: enable serial interrupt & TR2=1; will start the timer. Above specified instruction will initialize the timer 2 of 8051 in mode 1 & 8051 will get ready to work with a baud of 57600. All the data transfer between the 8051 & machine will be done under the timer 2 [13-14]. Whole circuit including the motor, buzzer, LCD, Controller is operating on = 5 V. The power supply used is as follow: -

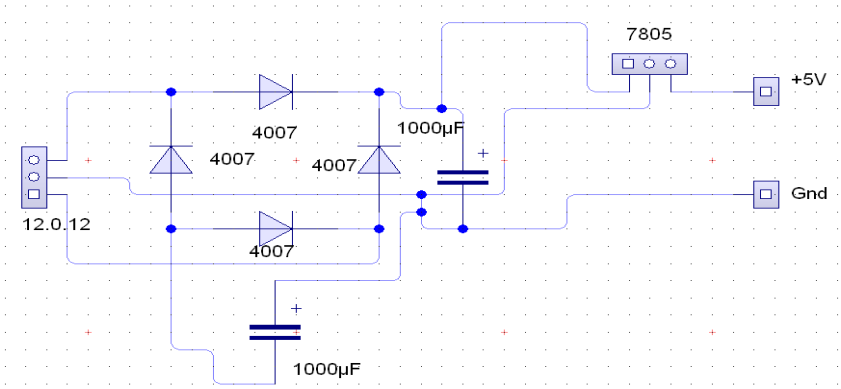


Figure 2 Power supply used for the proposed circuit

Here we have used a 16x2 LCD display to display the message to the user. We have interfaced the LCD in which we have use only lower 4 bits of data bus of LCD. Remaining well known 3 control pin RS, R/W & Enable pin are connected as normally. Refer: Mohd. Mazidi for LCD interfacing [3]. Buzzer is used with the pin P11 in the following fashion. If we write P11=1; buzzer will make sound & if we write P11=0; buzzer will stop.

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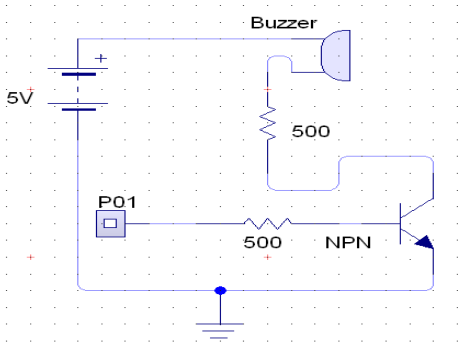


Figure 3 Circuit connections for buzzer

Motor is used with the pin P12 in the following fashion. If we write P12=1; motor will run and if we write P12=0; motor will stop.

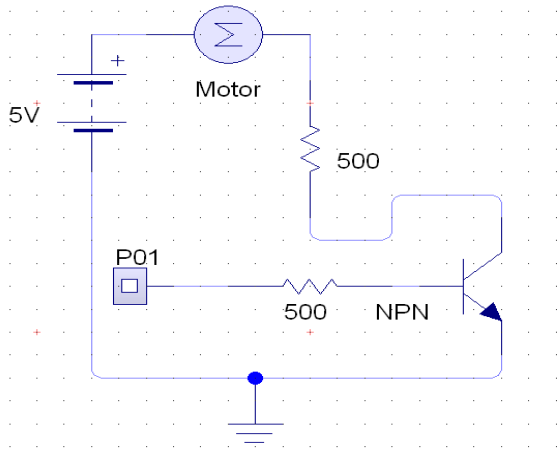


Figure 4 Circuit connections for motor to be used

Microcontroller interfacing and its programming

Here we have used 8051 family microcontroller. It is not mandatory that one should use this M.C. Instead one may use either 8051/PIC/AVR or ARM processor also. All of them support the baud rate of 57600 bps. 8051 family controller consist of 4 port named P0,P1,P2 & P3. Here we have used only P0, P1 & P2. P3 is left blank. As we explain above motor & buzzer are connected to the port 1. Before connected to the buzzer or motor we should take care of the pull up resistance, because it gives more clear logic to the output device. LCD is connected to the port 2. Lower 4 bits of port 2 (P20, P21, P22, P23) & (P25, P26 & P27 resp. are connected to the control lines of the LCD). Here we have shown a general pin configuration of the 8051 family controller.

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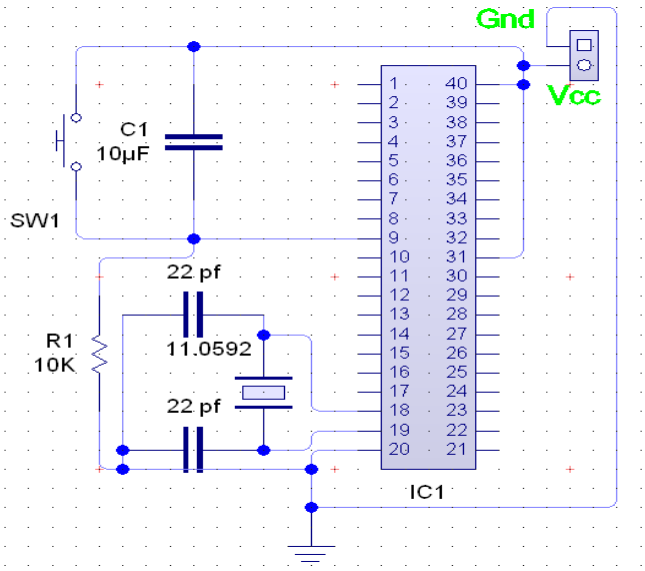


Figure 5 Circuit connections for microcontroller used

The sensor is a strong state unique mark sensor that dependably catches finger impression data. It is intended to coordinate into gadgets for improved security and accommodation. The sensor gives a dependable, speedy and easy to use the option in contrast to passwords, PIN's and different types of client confirmation. This unique mark scanner is fit for the social events and putting away remarkable fingerprints. Just hold your finger on the optical scanner, question the gadget over sequential, and you will be given an exceptional ID [4]. Utilize that ID inside installed framework to decide to get to levels, time tickers, entryway locks, and so forth.

Interesting & most important part of the paper is the programming of the module. During the programming user has to take care that which programming module he is using. Here we have used Mikro C for 8051. Initially declare the header file for the desired controller. Like: -

```
#include<regAt89x51.h> //for 51 family
#include<regAt89x51.h>     // for 52 family
```

Then declare the desired functions which are needed in the program. Like: -

```
void send_command(int data);
void send_data(int data);
void lcd_init();
void UARTinit();
void delay();
etc..
```

As it is quite different to work with the serial communication of microcontroller. Here one module is given for 8051 family for serial transmission & reception. The same can be used for the other like PIC/AVR/ARM with some modification.

For Transmission

```
TR1=1;
TI=0;
RI=0;
while(1)
 {
```


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```
transmit('M');      transmit('a');      transmit('l');
transmit('i');      transmit('k');
 }
}
void transmit (char x)
{
SBUF=x;          // place value in buffer
while(TI==0);    // wait till transmitted
TI=0;
}
```

With the use of the function transmit one can send each data byte in the form of ASCII from one to other. Initially data is placed on SBUF & then transmitted, TI interrupt will continuously check the status of last bit and responds accordingly.

For Receiving

```
char byte;
TR1=1;
TI=0;
RI=0;
while(1)
 {
        while (RI==0);
        {
        byte=SBUF;
        P3=byte;
        RI=0;
        }
}
```

The receiving module is given as above. Initially one variable is used named char, then each byte received is placed in the character byte when RI interrupt is logic 1. Then further this information can be used some where else also.

Sensor Science: -

Rx. & Tx. pins of sensor are open drain i.e. there is a need of external pull up (Typically 10 K Ohm). There are certain protocols which has to be followed to interface the sensor with micro controller. Communication is done in the form pf packets. Like: Packet head (2 bytes), Packet flag (1 byte), Packet length (1 byte), Packet contents (N bytes), Check sum (1 byte).

Module receive correct packet: -
0x4D + 0x58 + 0x30 + 0x01 + 0x01 + 0xD7
Module receive error packet: -
0x4D + 0x58 + 0x30 + 0x01 + 0x02 + 0xD8
Here 4D & 58 are the packet head, 30 is the flag, 01 is length, contents is 01 & check sum is D7.
All the communication is through the serial communication protocol. i.e. first we have to receive the all 8 bit data compare it with desired one & then processed accordingly.
All the format header of adding, deleting, modifying & searching are given in the data sheet of the sensor. One can go through the data sheet to know more about the each packet format.

Conclusion

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Eventually finger print sensor is used for security purpose using 8051 microcontroller. As specified, above modules motor, buzzer & LCD can be used some where else on the controller. But it is mandatory to use P30 & P31 pins for the sensor module. Because these pins are serial RX & TX pins of the controller. One should also go through the data sheet provided by the company for the module. Therefore, finally I would like to conclude that instead of using the I2C protocol, it is more robust to work with RS 232 technology as far as & lower end application are concern.

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