Design and Implementation of Fingerprint Assist Vending Machine using Microcontroller

Snehal R. Bhoyar[1], R. D. Ghongade[2]

[1]PG Student, Amravati University, P.R.Pote (Patil) Welfare & Education Trust's college of Engineering& Management, Maharashtra, India

[2]Associate Professor, Amravati University, P.R. Pote (Patil) Welfare & Education Trust's college of Engineering & Management, Maharashtra, India

[1] snhlbhoyar@gmail.com, [2] rahulghongade@rediffmail.com

Abstract: In this paper we propose design and implementation technique for vending machine using microcontroller using fingerprint-based authentication. Here we implement the proposed design based on Advance Virtual RISC microcontroller and also with the help Matlab programming. The circuit is tested with the existing embedded technology. Among the various biometric traits like face, iris, fingerprint, voice, fingerprint-based verification has the best ever history and has been effectively adopted in both the forensic and civilian applications. Advances in fingerprint capture technology have resulted in new vital civilian applications. The purpose of this article is to give an overview of fingerprint-based recognition and discuss research opportunities for making these systems execute more effectively.

Keywords: Microcontroller (AVR), Fingerprint feature extraction, minutiae, Graphical User Interface (GUI), Image processing.

I.   Introduction

The purpose of vending machine is to give the instant refreshment to the customer. So making some changes and provide comfortability to the seller as well as customer, we take some steps towards our project. This is the general application of vending machine i.e. water dispersing and also by using matlab programming we have present this project.

Today for the security purpose, biometric safety is on the top. Like other techniques where we use passwords and numbers, that are needed to be remembered, in biometric techniques we use human body parts like fingerprints or even iris of your eyes and

as we know that these things are unique to all thus it makes biometric systems the most effective over others. In this project I have interfaced the user data using mat lab programming with At Mega 128 microcontroller. This module communicates over UART protocol with microcontroller.

Present vending machine requires one seller who provides drink or other thing to the customer. Present vending machine is operated by a seller manually and play roll of moderator between machine and customer. So, there is direct contact between vending machine and customer. In recent decades, VLSI technique has driven the increase of the processor performance.

The fingerprint of an individual is unique to that person. This is the best tool i.e. fingerprint based authentication systems used for identifying individuals. In practice, however, various sources of variability can confuse this uniqueness information and may take wrong decisions. So we use fingerprint based authentication for validation purpose. Which gives the information about the customers and clear the confusion about the customer that is the person is authorized person or not.

II. Related Work

While going through the earlier studies some uses Systematic methods for the computation of the directional fields and singular points of fingerprints by using the very efficient algorithm in which the extraction of singular points from the high-resolution directional field was done, the algorithm is based on the Poincare A index and provides a consistent binary decision [1].Other explained about the Fake Finger Detection by skin distortion analysis [2]. Another was the Fingerprint quality indices for predicting authentication performance, in this paper; two new quality indices for fingerprint images are developed. The first index measures the energy concentration in the frequency domain as a global feature, the second index measures the spatial coherence in local regions [3].In [4] they proposed the design of Vending Machine Using Verilog HDL.

In this work, a methodology for easy design and real implementation vending machine using micro-controller is proposed, in order to provide customers with a user-friendly tool with the help of matlab programming where the database is stored which is required for the matching purpose. Simple designs using micro-controllers are exposed to the customers at the beginning, raising the complexity gradually toward a final design with microcontroller integrated in a vending machine.

III.   System Design

In system design, the working of fingerprint assist vending machine with the help of its block diagram and flow chart in detail is given below.
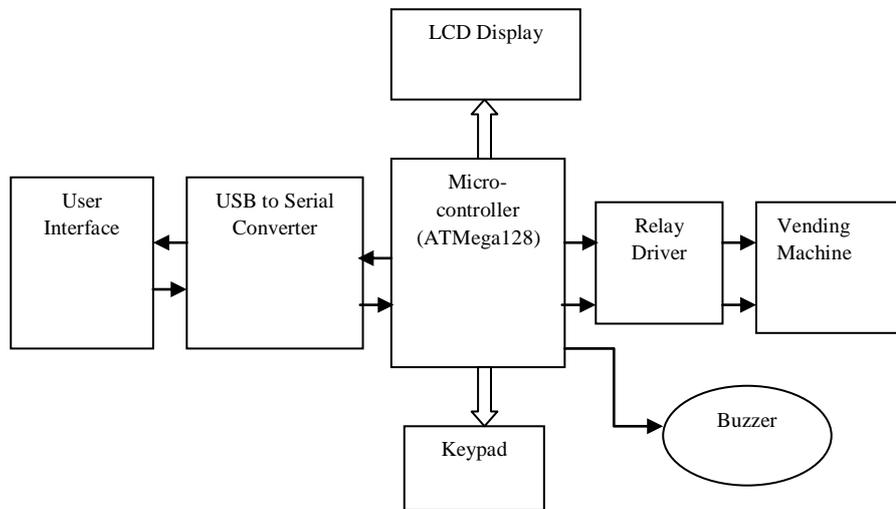
A.   Block Diagram of a Proposed System

Fig.2 Block Diagram of Fingerprint Assist Vending Machine

First, click on the input image box on GUI window then select one of the image from database (which contain both authorized and unauthorized person's fingerprint) after that the mat lab programming is done where extraction of features like minutiae from arbitrary fingerprint is done and compare the given image with every fingerprint in the database and gives the percentage of matching of given image which should be greater then 50% if it get match it will show on the command window and also on GUI window that match fingerprint or not match. After that the decision is send to the microcontroller in the form code such as 'xx' for match and 'yy' for not match .If the fingerprint match the microcontroller gives permission to disperse the water otherwise the buzzer will ON which indicates that the fingerprint is not matched and water will not disperse. Here we use keypad to give the input or to enter how much water we want. We use three key of keyboard as start, increase, decrease. Relay driver is nothing but the IC which is used to drive the vending machine relay. It has the voltage rage from 5V to 12 V.

Here we use ATMega128 because it has enough memory with suitable peripherals and low power consumption and high processing speed. It also has the following features: It has 128Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 4Kbytes EEPROM and SRAM and as it has seven ports from A to G there are 53 general purpose I/O lines, 32 general purpose working registers, also it has Real Time Counter (RTC), four flexible Timer/Counters with compare modes and PWM, 2 internal USARTs, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator, an SPI serial port, also used for accessing the On-chip Debug system and programming and six software selectable power saving modes.

With the help of mat lab programming the fingerprint is matched with user data then whatever the decision is taken is given to microcontroller through USB to serial converter which is serially connected, and other peripheral are connected in parallel. For the serially connection we have to initialized the UART which has the baud rate of 57600bit/sec.

A UART is usually an individual (or part of an) integrated circuit (IC) used for serial communications over a computer or peripheral device serial port. The Universal Synchronous/Asynchronous Receiver/Transmitter (USART) also supported synchronous operation. The universal asynchronous receiver/transmitter (UART) takes bytes of data and transmits the individual bits in a sequential fashion.

B. *Flowchart of the system*

Software programming is done in the following way the flowchart shows the steps of overall project.

```
                          ┌──────────┐
                          │  Start   │
                          └────┬─────┘
                               ▼
              ┌────────────────────────────────┐
              │     Initialization of Port      │
              └────────────────┬───────────────┘
                               ▼
              ┌────────────────────────────────┐
              │   Initialize UART at 57600bit/sec│
              └────────────────┬───────────────┘
                               ▼
              ┌────────────────────────────────┐
              │         Initialize LCD          │
              └────────────────┬───────────────┘
                               ▼
              ┌────────────────────────────────┐
              │      Input image to Mat Lab     │
              └────────────────┬───────────────┘
                               ▼
              ┌────────────────────────────────┐
              │  Check for matching image in    │
              │           database              │
              └────────────────┬───────────────┘
                               ▼
                          ◇ Is Fingerprint ◇ ──No──┐
                          ◇    match?      ◇        │
                               │Yes                 │
                               ▼                    ▼
              ┌────────────────────────────┐  ┌──────────┐
              │         Show on LCD         │  │ Buzzer   │
              └────────────────┬───────────┘  │ will ON  │
                               ▼              └────┬─────┘
              ┌────────────────────────────┐       │
              │ Input the quantity of water │       │
              │   in ml. from keypad        │       │
              └────────────────┬───────────┘       │
                               ▼                    │
              ┌────────────────────────────┐       │
              │        Turn on relay        │       │
              └────────────────┬───────────┘       │
                               ▼                    │
              ┌────────────────────────────┐       │
              │       Dispersed water       │       │
              └────────────────┬───────────┘       │
                               ▼                    │
                          ┌──────────┐              │
                          │   Stop   │◄─────────────┘
                          └──────────┘
```
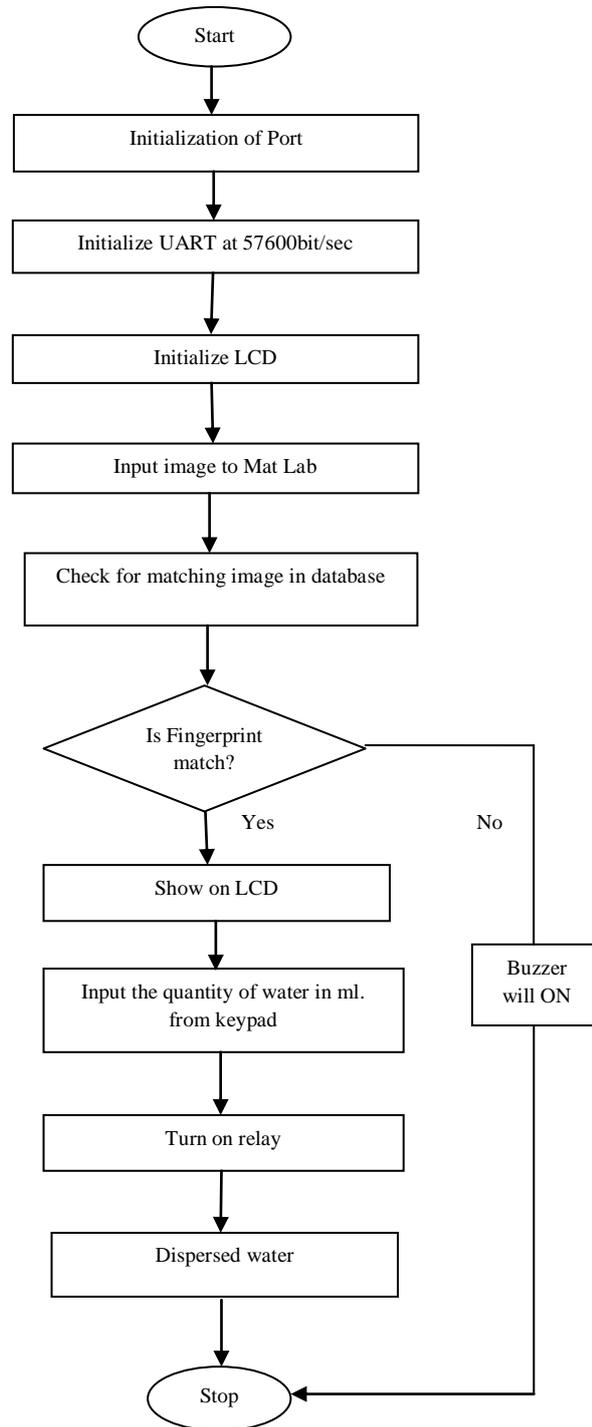
Fig.3 Working of Proposed Vending machine

At the starting we have to initialize the ports for serial communication. Because whatever the decision is taken in mat lab is given to the microcontroller in the form of coding. The communication is done through UART whose baud rate is 57600bit/sec. After that we have to initialize the LCD which interface with the microcontroller through the port C and port G. The microcontroller decision is shown on the LCD display. Now the input is given simply by clicking on input image box on the GUI window, then the process is start for the checking of authorized person's fingerprint from the database. If the fingerprint is match then result is shown on LCD and controller gives the permission to enter quantity of water in ml. We can increase or decrease the quantity of water through keypads which connected through port B. As we enter the quantity of water the relay will ON which also connected to port B and vending machine start to disperse the water for particular time period which is 3 sec. for 100ml. here and after 3 sec. the process will stop automatically. And if the fingerprint will not match the buzzer will be ON which indicates that the person is unauthorized and process will stop.

IV.   Results

For the validation purposes, we collect the Fingerprints of nine people in different angel i.e. total nine fingerprint and eight images per fingerprint so there are total 72 images. We have extracted the features from images and also calculated the percentage of matching of given image with the database. Thus when we click on the input image on GUI and select one of the image from database which we have (Both authorized and unauthorized person) then firstly software programming is done where matching percentage indicates it get match or not (it should be above 0.5), after that it will be send to the microcontroller then microcontroller decides to disperse the water or not. And later on microcontroller ask for the quantity of water in ml. (up to 1500 ml.) It will display on LCD display. Then enter quantity of water through keypad and then vending machine disperses the water.   In this way vending machine disperses the water. If the fingerprint match result is as shown in fig.4 the green dot shows the fingerprint get match and if fingerprint not match result is shown in fig.5 where green dot is not shown which indicates that the person is unauthorized and fingerprint not match.
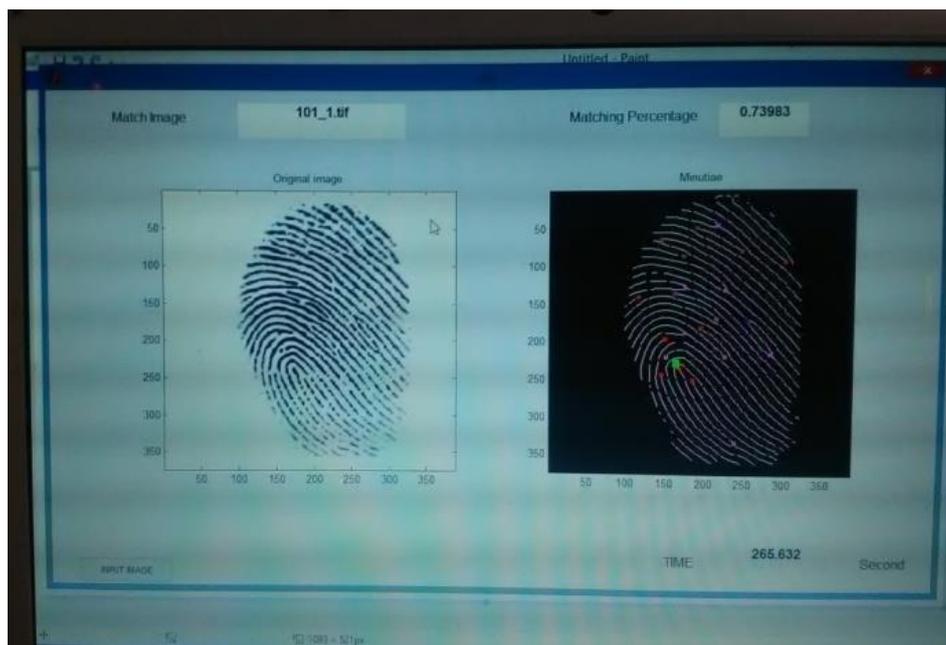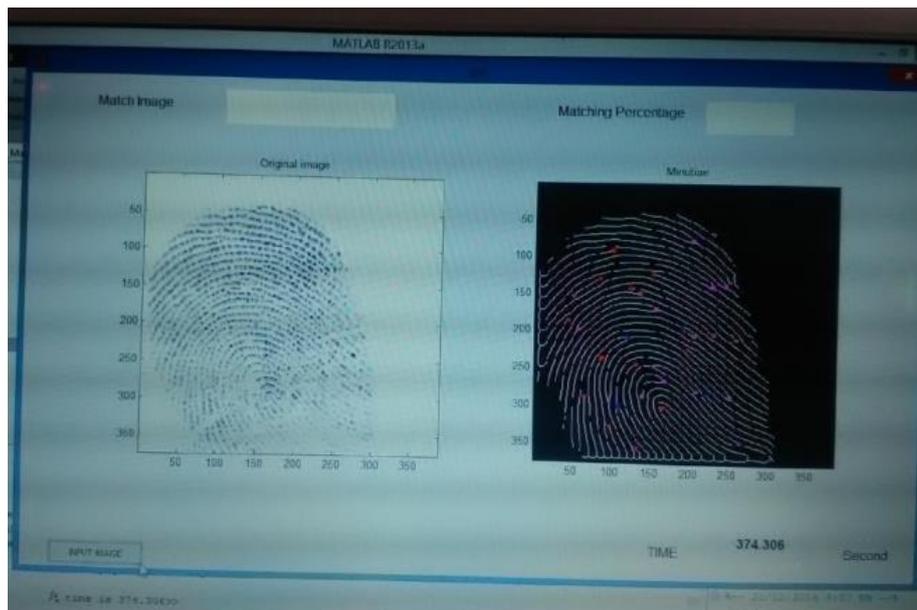

Fig.4 Fingerprint match

134

Fig.5 Fingerprint not match

V.   Conclusion

Today for the security purpose, biometric safety is on the top. Like other techniques where we use passwords and numbers, that are needed to be remembered, in biometric techniques we use human body parts like fingerprints or even iris of your eyes and as we know that these things are unique to all thus it makes biometric systems the most effective over others.

So we use here the fingerprint for the security purpose. In this paper, we have presented a new approach to identify the authorized person. Our work utilizes basic image processing operation for the extraction feature of image and by calculating the percentage of matching we have successfully decided whether the person authorized or not. In this way we can provide the security.

VI.   Future Work

For future research, this method can be extended toward the real time using the Fingerprint sensor, which will reduce the scanning time, also compact the design of system. There is one another technique to centralize the data of customer on monitor which is IOT (Internet of thing). Also by using the Raspberry pie development board the size of the system will reduce and it will be portable.

Acknowledgement

References

[1] Bazen, A.M. and Gerez, S. H. (2002) Systematic methods   for the computation of the directional fields and singular points of fingerprints. IEEE Transaction on pattern Analysis and Machine Intelligence, 24, no. 7, 905-919.

[2] Antonelli, A., Cappelli, R., Maio, D. and Maltoni, D. (2006)"Fake Finger detection by skin distortion analysis". To appear in the IEEE Transaction on Information Forencis and Security.

[3] Chen, Y. Dass, S. and Jain, A. K. (2005) Fingerprint quality indices for predicting authentication performance. Proc. Of Audio- and Video-based Biometric Person Authentication (AVBPA), 160-170.

[4] P.Pradeepa1, T.Sudhalavanya1, K.Suganthi1,N.Suganthi1, M. Menagadevi (2013)"Design And Implementation Of Vending Machine Using Verilog HDL". IJAET/Vol.IV/a Issue I/Jan.-March., 2013/51-53.

[5] George E. Getz, Cincinnati, OH "Thumb/Fingerprint Activated Pill Dispenser".

[6] Bhanu, B. and Tan, X.(2003) Indexing based on novel features of minutiae triplets. IEEE Transaction on the Pattern Analysis and Machine Intelligence, 25, no. 5, 616-622.

[7] Chang, J. and Fan, K. (2002) "A new model for fingerprint classification by ridge distribution sequences. Pattern Recognition", 35, 1209-1223.

[8] T. Khan and P. Ramuhalli , " A recursive Bayesian estimation method for solving electromagnetic NDE inverse problems," IEEE Trans. Magn., vol.44, no.7 , pp. 1845-1855, Jul. 2008

[9] Chandana, Surendra Yadav, Manish Mathuria "Fingerprint Recognition based on Minutiae Information", IJCA vol. 120 – no.10, June 2015