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DESIGN AND IMPLEMENTATION OF FINGERPRINT ASSIST VENDING MACHINE USING MICROCONTROLLER

Snehal R. Bhoyar*, R. D. Ghongade, A. U. Trivedi

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

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

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

ABSTRACT

In this paper we propose an implementation technique vending machine for customer using fingerprint-based authentication. We implement the proposed design based on Advance Virtual RISC microcontroller. The circuit is tested and compared with the existing embedded technology. Among the various biometric traits (e.g., face, iris, fingerprint, voice), Fingerprint-based authentication has the longest history, and has been successfully adopted in both forensic and civilian applications. Advances in fingerprint capture technology have resulted in new large scale civilian applications. The purpose of this article is to give an overview of fingerprint-based recognition and discuss research opportunities for making these systems perform more effectively.

KEYWORDS: Microcontroller (AVR), Embedded Technology, Real time processor, Fingerprint module, Fingerprint feature extraction, finger print individuality.

INTRODUCTION

The main purpose of vending machine is to give the instantaneous refreshment to the customer. So making some changes and provide a flexibility to the seller as well as customer, we take a some step towards our project. This is the general application of vending machine and also by adding some extra circuitry we have present this project.

In today's secure world biometric safety is on the top. Unlike other techniques which make use of passwords and numbers, that are needed to be remembered, biometric techniques make use of 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 a very popular fingerprint scanner R305 with AtMega 128 microcontroller. This module communicates over UART protocol with microcontroller i.e. it makes use of Rx and Tx pin of microcontroller to interact with it.

Present vending machine requires one seller who provides beverage 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, two forces have driven the increase of the processor performance. Firstly, advances in very large-scale integration (VLSI) technology.

The fingertip pattern of an individual is unique to that person. This is the central premise of fingerprint based authentication systems used for identifying individuals. In practice, however, various sources of variability can confound this uniqueness information and cause erroneous decisions to be made. A central problem in fingerprint analysis, therefore, is to determine the amount of information in a fingerprint and assess the extent of uniqueness. These problems can be addressed by eliciting statistical models that adequately capture the different sources of variability.

In this work, a methodology for easy design and real implementation of micro-controller is proposed, in order to provide customers with a user-friendly tool. Simple designs using micro-controllers are exposed to the customers at the beginning, rising the complexity gradually toward a final design with microcontroller integrated in a vending machine.

PREVIOUS SCHEMES FOR FINGERPRINT ASSIST VENDING MACHINE

There are many techniques developed for fingerprint assist vending machine some of these are:

1. Bazen, A.M. and Gerez, S. H. [1] "Systematic methods for the computation of the directional fields and singular points of fingerprints". The first subject of this paper is the estimation of a high resolution directional field of fingerprints based on principal component analysis, same as averaged square gradient method and second one important point is singular point detection for **classification of fingerprint**. A very efficient algorithm is proposed that extracts singular points from the high-resolution directional field. The algorithm is based on the PoincareA index and provides a consistent binary decision.

2. Antonelli, A., Cappelli, R., Maio, D. and Maltoni, D.[2]"Fake Finger detection by skin distortion analysis". This paper introduces a new approach for discriminating **fake fingers** from real ones, based on the analysis of skin distortion just by using scanner . The user is required to move the finger while pressing it against the scanner surface. scanner capable of capturing and delivering frames at proper rate.

3. Chen, Y. Dass, S. and Jain, A. K. [3] "Fingerprint quality indices for predicting authentication performance". The performance of an automatic fingerprint authentication system relies heavily on the quality of the captured fingerprint images. 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. These paper provide framework for evaluating and comparing quality indices in terms of their capability of predicting the system performance at three different stages, namely, image enhancement, feature extraction and matching. Both quality indices are effective in predicting the matching performance, and by applying a quality-based weighting scheme in the matching algorithm, the overall matching performance can be improved.

4. P.Pradeepa1, T.Sudhalavanya1, K.Suganthi1,N.Suganthi1, M. Menagadevi [4] "Design And Implementation Of Vending Machine Using Verilog HDL". Here in this paper, they proposed an efficient algorithm for implementation of vending machine on FPGA board. The vending machine accepts coins as inputs in any sequence and delivers products when required amount is deposited and gives back the change .The proposed algorithm is implemented in Verilog HDL and simulated using Xilinx ISE simulator tool. The design is implemented on Xilinx Spartan-3A FPGA development board.

SYSTEM DESCRIPTIONS

A) Advanced Virtual Risc

AVR microcontrollers can be termed as a minicomputer with all peripherals on the chip. A typical AVR microcontroller can contain peripherals like RAM, EEPROM, Flash memory, Input-Output (I/O) pins, Analog to Digital converters, PWM channels, Timers etc. It also has a CPU for processing, but not as fast and complex as the one within a computer. These AVR microcontroller (from now on termed as µc's) is an 8-bit microcontroller and based on Reduced Instruction Set can transmit and receive data in a set of 8 bits. Atmel manufactures 3 variations of 8-bit microcontrollers.

- TinyAVR
- MegaAVR
- XmegaAVR

Fig. 1 : Different types of AVR Microcontrollers

These various types of AVR microcontroller are distinguish based on their physical size, memory size, number of inbuilt peripherals and their applications. MegaAVR is the most popular one with enough memory for our basic projects with suitable peripherals.
The ATmega128 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega128 achieves throughputs approaching 1MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.
The AVR core combines a rich instruction set with 32 general purpose working registers.
All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.
The ATmega128 provides the following features: 128Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 4Kbytes EEPROM, 4Kbytes SRAM, 53 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), four flexible Timer/Counters with compare modes and PWM, 2 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.
The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or Hardware Reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping.
The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the Crystal/Resonator Oscillator is running while the rest of the device is sleeping. This allows very
fast start-up combined with low power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.
The device is manufactured using Atmel's high density non-volatile memory technology. The On chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the application Flash memory. Software in the Boot Flash section will continue to run
while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega128 is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.
The ATmega128 device is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger / simulators, in-circuit emulators and evaluation kits.

B) RS232 Standard
Information being transferred between data processing equipment and peripherals is in the form of digital data which is transmitted in either a serial or parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computers and other peripherals. Serial transmission involves the sending of data one bit at a time, over a single communications line. In contrast, parallel communications require at least as many lines as there are bits in a word being transmitted (for an 8-bit word, a minimum of 8 lines are needed).Serial transmission is beneficial for long distance communications, whereas parallel is designed for short distances or when very high transmission rates are required. In addition to communications between computer equipment over telephone lines, RS-232 is now widely used for direct connections between data acquisition devices and computer systems. As in the definition of RS-232, the computer is data transmission equipment (DTE). However, many interface products are not data communications equipment (DCE).Null- modem cables are designed for this situation; rather than having the pin-to-pin connections of modem cables, null modem cables have different internal wiring to allow DTE devices to communicate with one another.RS-232 cables are commonly available with either 4, 9 or 25-pin wiring. The 25-pin cable connects every pin; the 9-pin cables do not include many of the uncommonly used connections; 4-pin cables provide the bare minimum connections, and have jumpers to provide "handshaking" for those devices that require it.

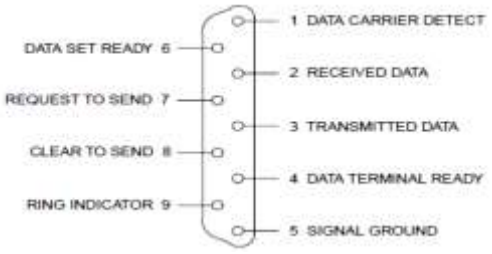

Fig. 2 : RS232 port

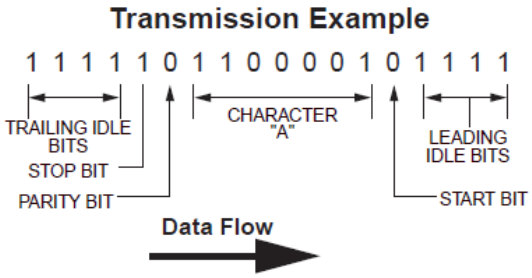

Fig. 3 : Data flow in RS232

C) LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

D) Fingerprint Module

Now talking about this module, it comes preloaded with scanner as well as detection section and we are left with 4 pins for connections. These 4 pins are: VCC, GND, Rx and Tx. It works over 3.3 to 5V supply and its Rx and Tx pin is connected to Tx and Rx pin of the microcontroller respectively. The mode is semi duplex asynchronies serial communication and the default baud rate is 57600bps but it can be changed between 9600~115200bps.

E) Working Project

Now, there are two types of customer for our newly modified vending machine.

I. Authorized person:

This is that type of customer whose data is stored in vending machine with the identification of fingerprint. If that person place thumb or ID fingerprint scanner of vending machine, the scanner scan his finger and will take decision to dispersed bottles or not.

II. Unauthorized Person:

This is that type of customer whose data is not stored in vending machine with the identification of fingerprint. If that person place thumb or ID fingerprint scanner of vending machine, the scanner scan his finger and will take decision not to dispersed bottles.

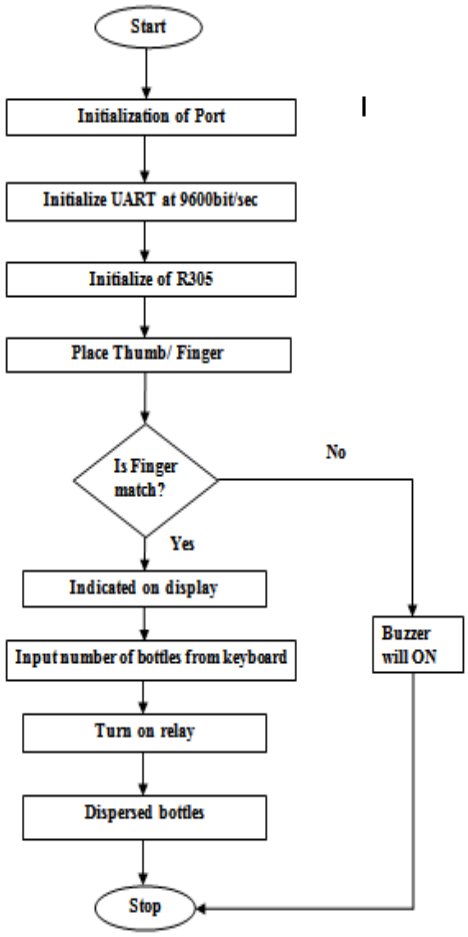

Fig.4. Working of Proposed Vending machine

CONCLUSION

In today's secure world biometric safety is on the top. Unlike other techniques which make use of passwords and numbers, that are needed to be remembered, biometric techniques make use of 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 a very popular fingerprint scanner R305 with AtMega 128 microcontroller. In this project we have provide more security than previous one.

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	**Snehal R. Bhoyar** Received Bachelor of Engineering in Electronics & Telecommunication from SGB Amravati university & Pursuing Master of Engineering in Electronic and Telecommunication Engineering P.R.Pote (Patil) Welfare & Education Trust's college of Engineering& Management, Amt., Maharashtra, India.
	**Prof. R. D. Ghongade** presently pursuing Phd and receivedM.E.in Electronics**.** He is now Assistant Professor at P. R. POTE (PATIL) Welfare & Education Trust's college of Engineering & Management, Amt. , Maharashtra, India.
	**Prof. A. U. Trivedi** (M.E. Digital Electronics) He is now Assistant Professor at P. R. POTE (PATIL) Welfare & Education Trust's college of Engineering & Management, Amravati , Maharashtra, India.