ARM-7 BASED FINGER PRINT AUTHENTICATION SYSTEM

V.SRIDHAR1  M.RAJENDRA PRASAD2  PROF. D.KRISHNA REDDY
SAI SHIVA NEETHI REDDY3  B.SRIKANTH4

1Assistant Professor, ECE, Vidya Jyothi Institute of Technology, Hyderabad
2Associate Professor, ECE, Vidya Jyothi Institute of Technology, Hyderabad
3Professor, ECE, CBIT, Hyderabad
4Final year student, ECE, Vidya Jyothi Institute of Technology, Hyderabad

ABSTRACT
A fingerprint is an impression of the friction ridges found on the inner surface of a finger or a thumb. Personal Safes are revolutionary locking storage cases that open with just the touch of your finger. These products are designed as "access denial" secure storage for medications, jewelry, weapons, documents, and other valuable or potentially harmful items. These utilize fingerprint recognition technology to allow access to only those whose fingerprints you choose. It contains all the necessary electronics to allow you to store, delete, and verify fingerprints with just the touch of a button. Stored fingerprints are retained even in the event of complete power failure or battery drain. These eliminates the need for keeping track of keys or remembering a combination password, or PIN. It can only be opened when an authorized user is present, since there are no keys or combinations to be copied or stolen, or locks that can be picked. There are several ways a security system can verify that somebody is an authorized user. Fingerprint recognition uses Minutiae Extraction Analysis to compare "real-time" fingerprints with those previously stored in a database. Fingerprint sensor captures the fingerprint images, matches the uniqueness of each print read by the sensor and compares it to the one stored in its module or local system database. The goal of this paper is to develop a finger print authentication system with the help of LPC2148. Initially we are storing user fingerprint information in fingerprint module data base. Here after pressing one switch we are scanning the finger print and we have to check with the predefined data using microcontroller. After identifying, user name is displayed on the LCD.

Keywords: ARM7, LCD, PIN, LPC2148

1. INTRODUCTION
Embedded systems are electronic devices that incorporate microprocessors with in their implementations. The main purposes of the microprocessors are to simplify the system design and provide flexibility. Having a microprocessor in the device helps in removing the bugs, making modifications, or adding new features are only matter of rewriting the software that controls the device. Or in other words embedded computer systems are electronic systems that include a microcomputer to perform a specific dedicated application. The computer is hidden inside these products. Embedded systems are ubiquitous. Every week millions of tiny computer chips come pouring out of factories finding their way into our everyday products.

Embedded systems are self-contained programs that are embedded within a piece of hardware. Whereas a regular computer has many different applications and software that can be applied to various tasks, embedded systems are usually set to a specific task that cannot be altered without physically manipulating the circuitry. Another way to think of an embedded system is as a computer system that is created with optimal efficiency, thereby allowing it to complete specific functions as quickly as possible.

Embedded systems designers usually have a significant grasp of hardware technologies. They use specific programming languages and software to develop embedded systems and manipulate the equipment. When searching online, companies offer embedded systems development kits and other embedded systems tools for use by engineers and businesses.

Embedded systems technologies are usually fairly expensive due to the necessary development time and built in efficiencies, but they are also highly valued in specific industries. Smaller businesses may wish to hire a consultant to determine what sort of embedded systems will add value to their organization.

Firmware is the name for software that is embedded in hardware devices, e.g. in one or more ROM/Flash memory IC chips. Embedded systems are routinely expected to maintain 100% reliability while running continuously for long periods, sometimes measured in years. Firmware is usually developed and tested too much harsher requirements than is
There are many different CPU architectures used in embedded designs. This in contrast to the desktop computer market which is limited to just a few competing architectures mainly the Intel/AMD x86 and the Apple/Motorola/IBM Power PC’s which are used in the Apple Macintosh. One common configuration for embedded systems is the system on a chip, an application-specific integrated circuit, for which the CPU was purchased as intellectual property to add to the IC’s design.

2. BLOCK DIAGRAM

3. SCHEMATIC DIAGRAM

4. FLOW CHART
5. CIRCUIT DESCRIPTION

The main intention of this paper is to design an ARM7 based fingerprint authentication system. In order to fulfill this application there are few steps that have been performed i.e.

1) Designing the power supply for the entire circuitry.
2) Selection of microcontroller that suits our application.
3) Selection of fingerprint module.
4) Selection of keypad.

Complete studies of all the above points are useful to develop this project.

5.1 POWER SUPPLY SECTION:

In order to work with any components basic requirement is power supply. In this section there is a one required voltage level to operate the ARM7 board. For that we are directly selecting the 9V.1Amp adaptor.

5.2 SELECTION OF MICROCONTROLLER:

As we know that there are many types of microcontroller families that are available in the market. Those are

1) 8051 Family
2) AVR microcontroller Family
3) PIC microcontroller Family
4) ARM Family

5.3 SELECTION OF FINGER PRINT:

Fingerprint recognition technology to allow access to only those whose fingerprints you choose. It contains all the necessary electronics to allow you to store, delete, and verify fingerprints with just the touch of a button. Stored fingerprints are retained even in the event of complete power failure or battery drain. These eliminates the need for keeping track of keys or remembering a combination password, or PIN. It can only be opened when an authorized user is present, since there are no keys or combinations to be copied or stolen, or locks that can be picked. I picked the fingerprint module to which I communicate serially.

5.4 SELECTION OF KEYPAD:

A keypad is a set of buttons arranged in a block which usually bear digits and other symbols but not complete set of alphabetical letters. If it mostly contains numbers then it can also be called a numeric keypad. Keypads are found on many alphanumeric keyboards and on other devices such as calculators, combination locks and telephones which require largely numeric input. In my application I want an only numeric value that’s why I selected 4X4 matrix keypad.

5.5 CIRCUIT DESCRIPTION:

The goal of this paper is to develop a fingerprint authentication system with the help of LPC2148. Initially we are storing user fingerprint information in fingerprint module data base. For this enroll we have to develop one application program in embedded-c. Here after pressing one switch from the keypad we are scanning the fingerprint and we have to check with the predefined data using microcontroller. After identifying, user name is displayed on the LCD.

6. ARM7

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high-performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory.

The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

• The standard 32-bit ARM set.
• A 16-bit Thumb set.

The Thumb set’s 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM’s performance advantage over traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system. The particular flash implementation in the LPC2141/42/44/46/48 allows for full speed execution also in ARM mode. It is recommended to program performance critical and short code sections (such as interrupt service
routines and DSP algorithms) in ARM mode. The impact on the overall code size will be minimal but the speed can be increased by 30% over Thumb mode.

7. FINGER PRINTS

7.1 HISTORY OF FINGERPRINTS:
Human fingerprints have been discovered on a large number of archaeological artifacts and historical items. In 1684, the English plant morphologist, Nehemiah Grew, published the first scientific paper reporting his systematic study on the ridge, furrow, and pore structure. In 1788, a detailed description of the anatomical formations of fingerprints was made by Mayer. In 1823, Purkinji proposed the first fingerprint classification, which classified into nine categories. Sir Francis Galton introduced the minutiae features for fingerprint matching in late 19th century.

7.2 FORMATION OF FINGERPRINTS:
Fingerprints are fully formed at about seven months of fetus development. General characteristics of the fingerprint emerge as the skin on the fingertip begins to differentiate. Flow of amniotic fluids around the fetus and its position in the uterus change during the differentiation process. Thus the cells on the fingertip grow in a microenvironment that is slightly different from hand to hand and finger to finger.

7.3 FINGERPRINT SENSING:
Based on the mode of acquisition, a fingerprint image is classified as
- Off line image
- Live-scan image

There are a number of live-scan sensing mechanisms that can detect the ridges and valleys present in the fingertip Examples are: Optical FTIR, Capacitive, Pressure-based, Ultrasound

7.4 FINGERPRINT EXTRACTION:
- Fingerprint pattern, when analyzed at different scales, exhibits different types of features
  - global level - delineates a ridge line flow pattern
  - local level – minute details can be identified
  - Very fine level – intra-ridge details can be detected
7.5 DIFFICULTY IN FINGERPRINT MATCHING:
- Fingerprint matching is a difficult problem due to large variability in different impressions of the same finger.

Main factors responsible for intra-class variations are: displacement, rotation, partial overlap, non-linear distortion, variable pressure, skin condition, noise and feature extraction errors.

7.6 FINGERPRINT MATCHING: A three class categorization of fingerprint matching approaches is:
- Correlation based matching
- Minutiae based matching
- Ridge feature based matching.

7.7 DESIGNING FINGERPRINT RECOGNITION SYSTEMS:
The major issues in designing the fingerprint recognition system includes:
1) Defining the system working mode  
2) Choosing the hardware and software components
3) Dealing with exceptions
4) Dealing with poor quality fingerprint images
5) Defining effective administration and optimization policy

8. RESULTS

The aim of the paper is to study and implement the hardware design and software programming required for a fingerprint authentication system. This paper includes both the hardware interfacing design and the software programming in embedded C language for LPC 2148 Philips microcontroller. When the fingerprint detector detects any finger on its screen, it scans it, and checks for the user id of the fingerprint if already present in its database. If the fingerprint is detected, then prints the user id on the LCD screen, authenticating the person is valid.

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Authors Biography:

M. REJENDRA PRASAD obtained his B.E and M.E Electronics and communication engineering and digital systems from OSMANIA UNIVERSITY, Hyderabad. He has 11 years of experience in embedded and telecom research and development. He is currently working as an associate professor, ECE, DEPARTMENT, VIJT, HYD. He published international journals. His main interests are embedded systems, wireless protocol, and RTOS.

VARADALA SRIDHAR is from HYDERABAD, ANDHRA PRADESH. Completed M.TECH in ECE with specialization (WIRED AND MOBILE COMMUNICATION SYSTEMS) from vardhaman college of engineering affiliated by JNTUH in 2011. He has completed M.Sc (IT) from Nagarjuna University, guntur, Andhra Pradesh, and B.TECH in ECE from vidya jyothi institute of technology affiliated by JNTUH in 2007. Currently he is working as an Assistant professor in ECE department at Vidya Jyothi Institute of Technology, Hyderabad from 2010. He published international journals and also conference papers. His areas of research interests include Wireless and Mobile communication systems, Digital signal processing, Image processing, Telecommunications, communication systems, Signal processing, Embedded systems. He is Lifetime Membership of ISTE, IETE.

D. Krishna Reddy was born in November 1966 at Gudipadu, Andhra Pradesh. He obtained his B.E. from Andhra University in 1990 with distinction and M.E. and Ph.D from Osmania University in 1995 and 2008 respectively. Presently he is working as Professor in CBIT, Hyderabad. He has 21 years of teaching experience. His present areas of interest includes 3G, data communications, LBS and GPS. He is MIEEE, Fellow of IETE, India and LM of ISTE and SEMCE.

C. sai Siva Neeti reddy is from hyd, presently she is final year student of vidya jyothi institute of technology, aziz nagar, ECE branch. Her areas of research interests are include VLSI DESIGN, EMBEDDED SYSTEMS, AND COMMUNICATION SYSTEMS.

B. SRIKATH is from hyderabad, presently he is final year student of vidya jyothi institute of technology, aziz nagar, ECE branch. His areas of research interests are include VLSI DESIGN, EMBEDDED SYSTEMS, AND COMMUNICATION SYSTEMS.