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FINGERPRINT BASED MEDICAL INFORMATION SYSTEM

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Abstract

Medical information implies all information related with treatment of the patient, and is, by its nature, the most sensitive and important information in terms of privacy of the individual. Recently, laws, policies, and technological standards are rapidly developing to safely protect the medical information of the individual. This model applies fingerprint recognition technology to the medical information system, to guarantee a reliable electronic medical record system which can be accessed globally. It provides an identification and denial prevention function, by applying fingerprint recognition to the access of doctors, nurses, and other medical staff. The EMR authentication system based on the proposed fingerprint recognition technology enables the user to eliminate the inconvenience of private key management, and provides security authentication that is most suitable for private networks, as external communication is not required. In particular, the reliability of the EMR system can be enhanced through disabling delegation of the private key, which is the most serious problem of electronic signature authentication.

Keywords: Electronic medical record system, Authentication system, Medical information System

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1. Introduction

A medical information implies all information related with the information of patient, and is by its nature the most sensitive and important information in terms of privacy of the individual. A medical information system comprises, storing, manipulating, and making available all clinical information to the doctors for the patient care. The system should be based on linkage of all data based on interaction of the patients with the health structures, such as general practitioners, specialists, health institutes and hospitals, pharmacies etc. Particular emphasis should be placed on the introduction of smart cards such as portable health cards, bar cords, which will contain a standardized data set and will be sufficient to access different databases found in various health services. All the final users that is, the patients in the whole network of

services involved will be monitored for the duration of the project. The new health information system that will enable patients' medical records to be shared electronically with hospitals, nursing homes and doctors' offices. But there are many disadvantages in usage of patient record system which includes the Barcode system, Smart cards and ID cards. They are:

- Chances of identity fraud
- Not applicable for emergency patients
- Need for the patient to carry the ID card
- Possibility of medical record errors
- Medical records cannot be retrieved globally.

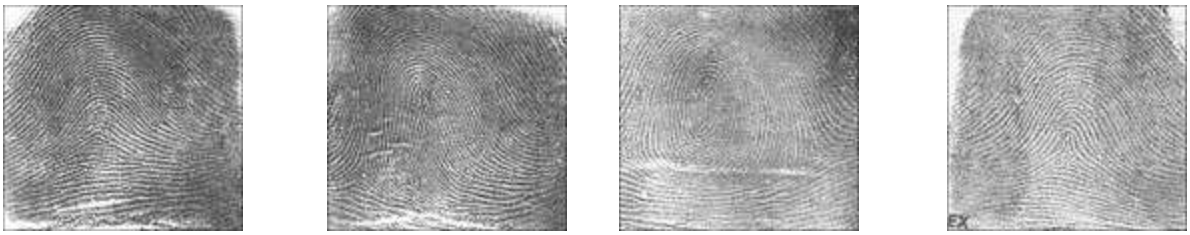
The hospitals are committed in maintaining patient privacy while sharing data to improve the diagnosis and treatment of patients, by introducing the technique of finger print in medical information system. Since fingerprints cannot be lost or forgotten like passwords, fingerprints have the potential to offer high security and more convenience for user authentication. The fingerprints are significantly more difficult to copy, share, distribute than passwords which makes fingerprint recognitions the most convenient method while maintaining sufficiently high security. Furthermore, large fingerprint data need not be memorised. The emergency data set such as his/her blood type and contact person information. It can be accessed using his/her finger in the emergency medical situation when the patient is unconscious.

The advantages of the fingerprint medical information system over other systems are:

- Low power consumption
- Improves security formats in the hospital
- We can add new patient users
- Patient database maintained individually so that we can avoid the man-made error
- Used in emergency medical situation when a patient is unconscious.

The efficient use of the fingerprint based medical system is the easy and fast data access facility leads to implementation particularly widespread in security systems. The system uses secure and authenticated data communication between clients and database servers over distributed object protocol. System is developed on Java platform by using Object oriented architecture and design patterns. This allowed physicians to make better and safer medical decisions for their patients, thus resulting in a higher quality of care and the avoidance of unnecessary invasive testing. Our long term goal is to create a sustainable, secure solution that allows doctors to more efficiently utilise patient data to improve the overall quality and efficiency of care.

A fingerprint in its narrow sense is an impression left by the friction ridges of a human finger. In a wider use of the term, fingerprints are the traces of an impression from the friction ridges of any part of a human hand. A print from the foot can also leave an impression of friction ridges. A friction ridge is a raised portion of the epidermis on the fingers and toes (digits), the palm of the hand or the sole of the foot, consisting of one or more connected ridge units of friction ridge skin. These are sometimes known as "epidermal ridges" which are caused by the underlying interface between the dermal papillae of the dermis and the interpapillary (rete) pegs of the epidermis. These epidermal ridges serve to amplify vibrations triggered, for example, when fingertips brush across an uneven surface, better transmitting the signals to sensory nerves involved in fine texture perception. These ridges also assist in gripping rough surfaces, as well as smooth wet surfaces. Impressions of fingerprints may be left behind on a surface by the natural secretions of sweat from the endocrine glands that are present in friction ridge skin, or they may be made by ink or other substances transferred from the peaks of friction ridges on the skin to a relatively smooth surface such as a fingerprint card. Fingerprint records normally contain impressions from the pad on the last joint of fingers and thumbs, although fingerprint cards also typically record portions of lower joint areas of the fingers.



Arch Loop Whorl Arch

Figure 1: Fingerprint Images

2. Materials and Methods

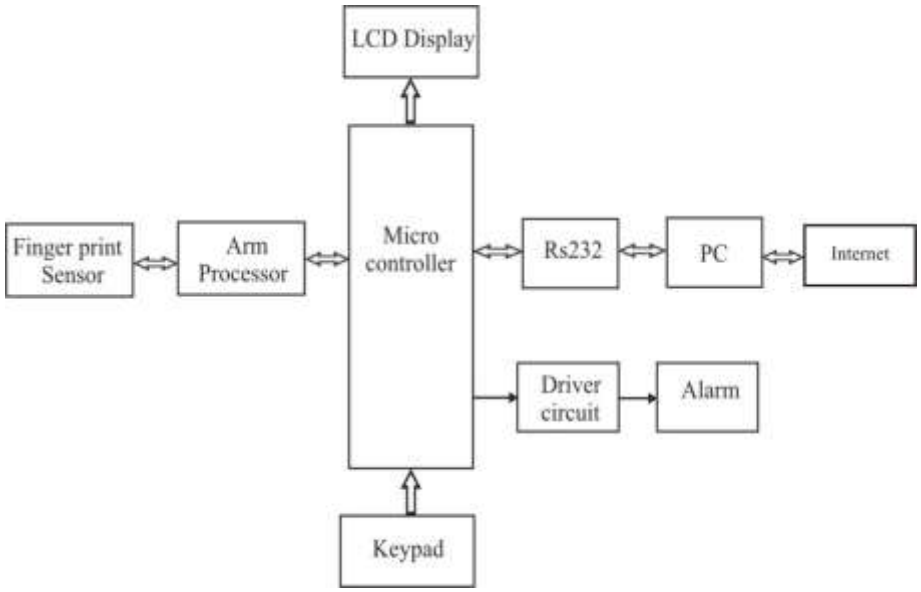


Figure 2: Block Diagram

2.1 Fingerprint Sensor and Its Working

A fingerprint sensor is an electronic device used to capture a digital image of the fingerprint pattern. The captured image is called a live scan. This live scan is digitally processed to create a biometric template (a collection of extracted features) which is stored and used for matching. This is an overview of some of the more commonly used fingerprint sensor technologies. A fingerprint scanner system has two basic jobs -- it needs to get an image of your finger, and it needs to determine whether the pattern of ridges and valleys in this image matches the pattern of ridges and valleys in pre-scanned images.

There are a number of different ways to get an image of somebody's finger. The most common methods today are optical scanning and capacitance scanning. Both types come up with the same sort of image, but they go about it in completely different ways. The heart of an optical scanner is a charge coupled device

(CCD), the same light sensor system used in digital cameras and camcorders. A CCD is simply an array of light-sensitive diodes called photosite, which general an electrical signal in response to light photons.

Each photosite records a pixel, a tiny dot representing the light that hit that spot. Collectively, the light and dark pixels form an image of the scanned scene (a finger, for example). Typically, an analog-to-digital converter in the scanner system processes the analog electrical signal to generate a digital representation of this image. The scanning process starts when you place your finger on a glass plate, and a CCD camera takes a picture. The scanner has its own light source, typically an array of light-emitting diodes, to illuminate the ridges of the finger. The CCD system actually generates an inverted image of the finger, with darker areas representing more reflected light and lighter areas representing less reflected light.

Before comparing the print to stored data, the scanner processor makes sure the CCD has captured a clear image. It checks the average pixel darkness, or the overall values in a small sample, and rejects the scan if the overall image is too dark or too light. If the image is rejected, the scanner adjusts the exposure time to let in more or less light, and then tries the scan again.

If the darkness level is adequate, the scanner system goes on to check the image definition. The processor looks at several straight lines moving horizontally and vertically across the image. If the fingerprint image has good definition, a line running perpendicular to the ridges will be made up of alternating sections of very dark pixels and very light pixels. If the processor finds that the image is crisp and properly exposed, it proceeds to comparing the captured fingerprint with fingerprints on file.

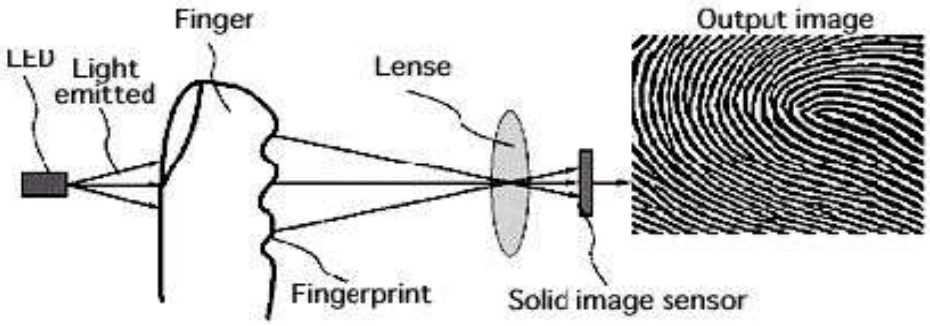


Figure 3: Working of fingerprint sensor

2.2 Microcontroller

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. Microcontrollers are smaller in size, Consumes less power and inexpensive. A microcontroller combines on to the same microchip:

- The CPU core
- Memory(both ROM and RAM)
- Some parallel digital i/o

Microcontrollers will combine other devices such as:

- A timer module to allow the microcontroller to perform tasks for certain time periods.
- A serial I/O port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.
- An ADC to allow the microcontroller to accept analogue input data for processing.

Micro controller is a stand alone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory. The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on a 8-bit microprocessor unit. In the recent

years, microcontrollers have been developed around specifically designed CPU cores, for example the microchip PIC range of microcontroller.

The microcontroller that has been used for this project is from ATMEL series. ATMEL89C51 is fabricated in CMOS (Complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. AT89C51 is the 40 pins, 8 bit Microcontroller manufactured by Atmel group. It is the flash type reprogrammable memory. Advantage of this flash memory is we can erase the program within few minutes.

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel is high density nonvolatile memory technology and is compatible with the industry standard MCS-51™ instruction set and pinout.

The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

2.3. RS232

In telecommunications, RS-232 is a standard for serial binary data interconnection between a *DTE* (Data terminal equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

For the data transmission, a high voltage indicates a bit value of 1, and a low voltage indicates a voltage of 0. This is known as true logic. Many serial protocols use inverted logic, meaning that a high voltage indicates logic 0, and a low voltage indicates logic 1. It's important to know whether your protocol is true or inverted. For example, RS-232, described below, uses inverted logic.

The RS-232 standard defines voltages and general baud rate ranges for serial communications between devices using it. We won't be getting the voltages exactly right, but for most applications, we'll be close enough. Until recently, most desktop computers had an RS-232 or similar serial port. Now, many desktop computers are shifting to other forms of serial communication such as USB, or Universal Serial Bus, and Firewire, which allow for more flexible configurations and faster data rates. The RS-232 standard is still very common in other devices, though, as it is cheaper to use than USB, simpler to implement, consumes less power, and provides more than adequate speeds for exchanging control data (i.e. data that allows one device to control another). In telecommunications, RS-232 (Recommended Standard 232) is a standard for serial binary data signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. A similar ITU-T standard is V.24.

2.4 Alarm

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Sonalert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the pair of switching transistors (BC 547). The buzzer is connected in the Q2 transistor collector terminal.

When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and close the collector and emitter terminal so zero signals is given to base of the Q2 transistor. Hence Q2 transistor and buzzer is turned OFF state.

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and buzzer is energized and produces the sound signal.

2.5 Keypad

A numeric keypad, or numpad, is the small, palm-sized, seventeen key section of a computer keyboard. The numeric keypad features digits 0 to 9, addition (+), subtraction (-), multiplication (*) and division (/) symbols, a decimal point (.) and Num Lock and Enter keys.

Numeric keypads usually operate in two modes: when Num Lock is off, keys 8, 6, 2, 4 act like an arrow keys and 7, 9, 3, 1 act like Home, PgUp, PgDn and End; when Num Lock is on, digits keys produce corresponding digits. These, however, differ from the numeric keys at the top of the keyboard in that, when combined with the Alt key on a PC, they are used to enter characters which may not be otherwise available: for example, Alt-0169 produces the copyright symbol. These are referred to as Alt codes.

2.6 LCD Display

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer are pasted outside the two glass panels. This polarizer would rotate the light rays passing through them to a definite angle, in a particular direction.

When the LCD is in the off state, light rays are rotated by the two polarizes and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating / highlighting the desired characters. The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCD does not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range.

3. Result and Discussion

The Patient database representing the Medical Information System is created. The following parameters are included in the database creation:

- Patient's personal details
- Age and Gender
- Blood group
- Family History
- Type of Disease
- Symptoms
- Tests done and results obtained
- Doctor's comments
- Medicines prescribed

Figure 4: Patient database

Advantages of using this medical information system are:

- Database can be used during emergency condition
- High security of using fingerprint
- More convenient for user authentication
- Online accessibility
- Reduction of Medical record errors

4. Conclusion and Future Scope

In our project, fingerprint verification is considered to protect the medical information transmitted and to guarantee both the integrity and the confidentiality of the data. Patient data can be stored and retrieved by connecting to the hospital database, and thus it can be accessed globally. The main advantage of this project is online accessibility of patient database. Another crucial advantage is that it is applicable during emergency conditions. The patient need not carry the ID card with them as such there is no possibility of losing them. Medical record errors can be reduced using the finger print technique. Since fingerprint cannot be lost or forgotten like passwords, fingerprints have the potential to offer high security and more convenience for user authentication. The fingerprints are significantly more difficult to copy, share, distribute than passwords which make fingerprint recognitions the most convenient method while maintaining sufficiently high security. Furthermore, large fingerprint data need not be memorized. The emergency data such as his/her blood group and type and contact person information can be accessed during his/her finger in the emergency. Our long term goal is to create a sustainable, secure solution that allows doctors to more efficiently utilize patient data to improve the overall quality and efficiency of care. In future, the Patient database can be modified with images like X-ray, CT, MRI and graphs such as ECG, EEG, EMG, etc.

5. Snap Shot of the Project Model

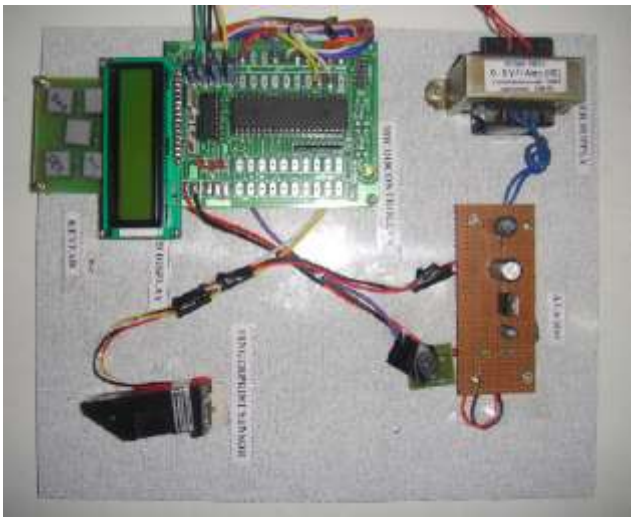


Figure 5: Project Model

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