An Efficient Multistage Authentication System

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Abstract: This paper proposes a multilayer security system, which can be used at domestic, organization and industrial level as a strict safety and regulatory measure to prevent thefts and unauthorized access. Here, we incorporate the three best measures into one multilayer security which is a sequence of RFID, Biometric and Password module system. These modules are controlled through Arduino (UNO r3) microcontroller based board. If the RFID tag content, password and fingerprint image confirmation are matched, then only the user will be allowed to access to the organization. We propose a more efficient and reliable system that can provide multilevel security which would be difficult to breach and a system that would digitize that particular organization.

Keywords—RFID, Arduino UNOr3 Microcontroller, Fingerprint sensor

I. INTRODUCTION

India is moving towards a more digitized era with both the urban and rural population having access to digital technologies. This demands safety and security as the first measures for successful advancement and continuation of the same. In India, domestic households still install hand locks or alarm system (ringing bells) in their respective areas and utmost CCTV cameras. But these are insufficient measures to safety as one need to be present there physically to take action in those regions. At few industrial and organization level an additional step is used, RFID cards. Cards with radio frequency identification (RFID) system allow entry to any individual. It is to be noted that just having ID card, does not guarantee authenticated access as anybody can steal and use it by replacing the photo in the ID. This may lead to security as well as intellectual threats. We proposed to design a feasible, secure and less expensive security system than other systems that can use RFID, biometric technology and password authentication in a multilayer design. This system allows only authorized persons to enter the organization with authenticated RFID tag, fingerprint and their unique password.

An RFID system consists of an antenna, a transceiver (with decoder) and a transponder (RF tag) which is electronically programmed with unique code. There are many types of RFID systems which are categorized based on their frequency ranges. Passive tags which are lighter and cheap than the active tags are used here. The RFID reader reads the unique code that is the ID number from the passive tag and sends it to the micro-controller, if the id number is valid then only it gives the access to the fingerprint scanner otherwise it stops the process. If the fingerprint is matched then the micro-controller asks for password and if this also matches then the Arduino sends the message to the LCD to display that the entry is secure.
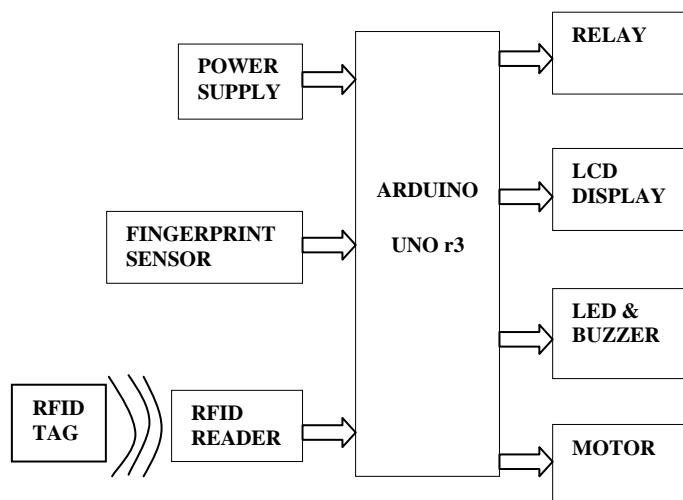

Figure-1. Block Diagram of proposed Multistage Authentication system

This system is more secure than other systems because two technologies are used for verification. Automatic fingerprint

identification system mainly involves image collection, pre-treatment, feature extraction, and feature matching. Figure-1 shows the block diagram of an efficient multistage security system.

II.   RELATED WORK

The hardware configuration of the control system is a combination of RFID reader, fingerprint sensor, a relay driver circuit and a microcontroller (Arduino Uno). The complete circuit diagram is shown in Figure 2.
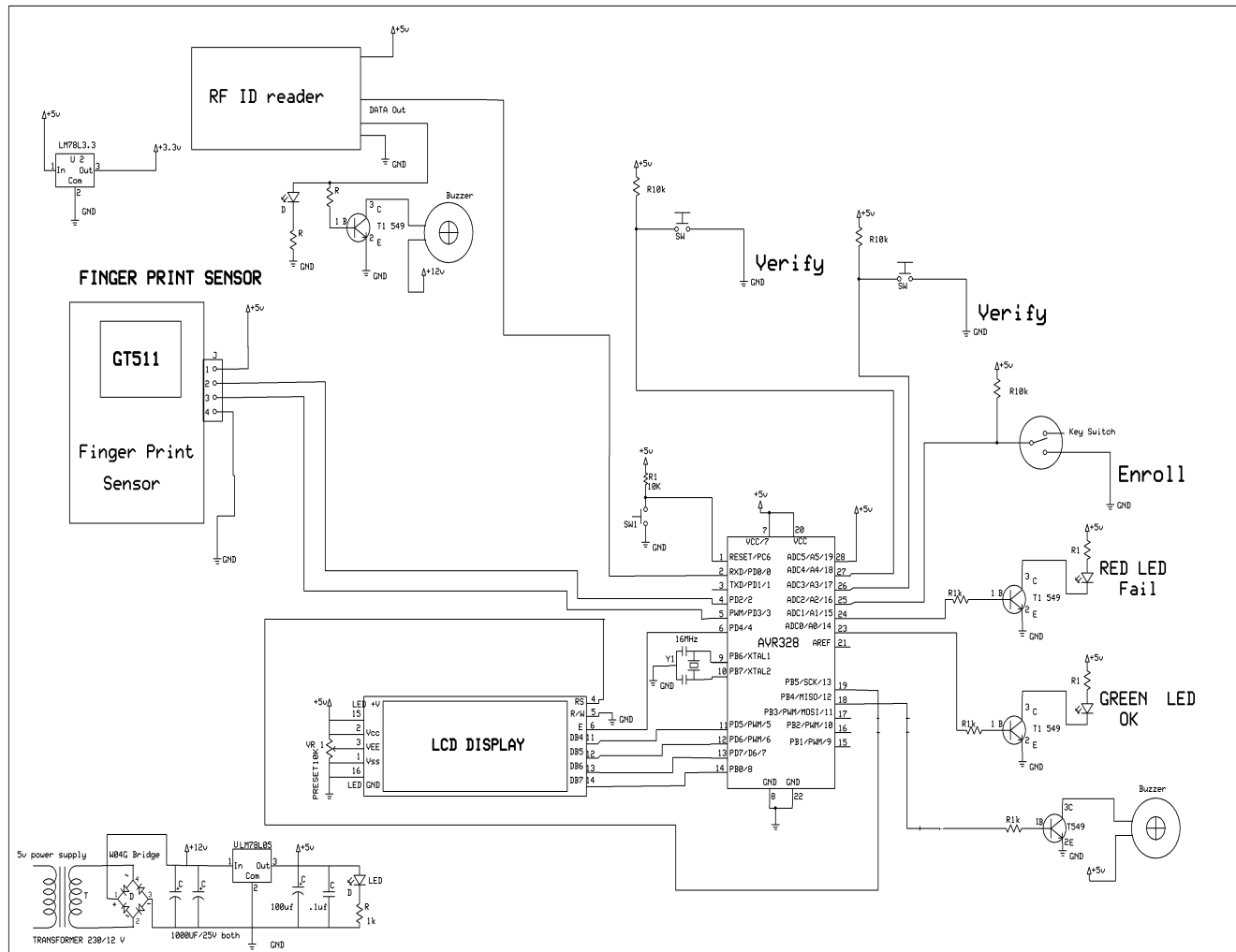

Figure- 2. Circuit diagram of the system

Radio Frequency Identification (RFID)

RFID reader is the central part of the RFID system. In this system, EM-18 RFID reader module is used. It reads tag's data through the RFID antenna at a specific frequency. The reader translates the tag's radio signals through antenna, depending on the tags capacity. RFID reader receives RF transmissions from an RFID device and transmits to a host system for processing. The reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag[3]. The Figure-3 shows the RFID tag(passive) and EM-18 Reader module.The specification of the EM-18 RFID reader is:
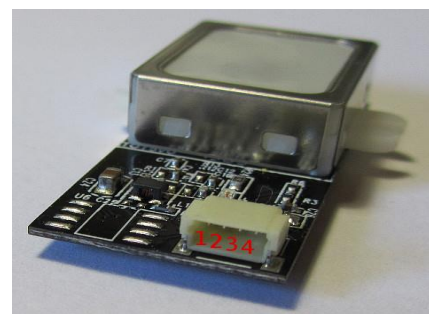

Figure-3. RFID Tag and Reader Module

- 5VDC through USB (External 5V supply will boost range of the module)
- Current: <50mA
- Operating Frequency: 125Khz
- Read Distance: 10cm
- Size of RFID reader module: 32mm(length) * 32mm(width) * 8mm(height)

Finger Print Module

Finger print module is an input device used for Fingerprint processing which includes fingerprint enrolment and fingerprint matching (1:1 or 1: N). When enrolling, user needs to enter the finger two times [2]. The system will process these two images, generate a template of the finger and store it. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1:N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure. The following Figure-4 shows GT-511c3 fingerprint module.

Figure-4. GT-511c3 fingerprint sensor module in the Multistage authentication system

III.   RESULTS AND DISCUSSION

Figure-5 shows the working stages of the overall system. The first stage is the RFID tag verification stage. The RFID reader will read the data from the tag & compare it with the data present in the system. If this data matches with the previously stored data, then message will be displayed as:"Please enter your password", which is the second authentication stage. After entering the password from the keypad if the password matches with the stored data for the respective tag then the message will be displayed as "Place Fingerprint". This is the third stage that is the finger print verification stage [1]. This is done in two steps, the first step is finger print enrolment and the second is finger print matching. During enrolment, the user has to place his finger twice. The module will process the finger images and will create a template and store it in a memory slot. In the second

stage of matching, 1: N matching is done in which the user enters the finger print onto the optical sensor, a template is generated and is compared with all the templates stored in the memory slots. After matching the result is displayed on the 16*2 LCD screen as success or error. If the result is success, the person gets entry. According to the result, the buzzer will buzz based on whether it is a authorized entry or an unauthorized. Thus one has to go through these three stages to get an entry into the respective area. Thus this system is highly secured and efficient. The Table-1 depicts the high level security of this system.
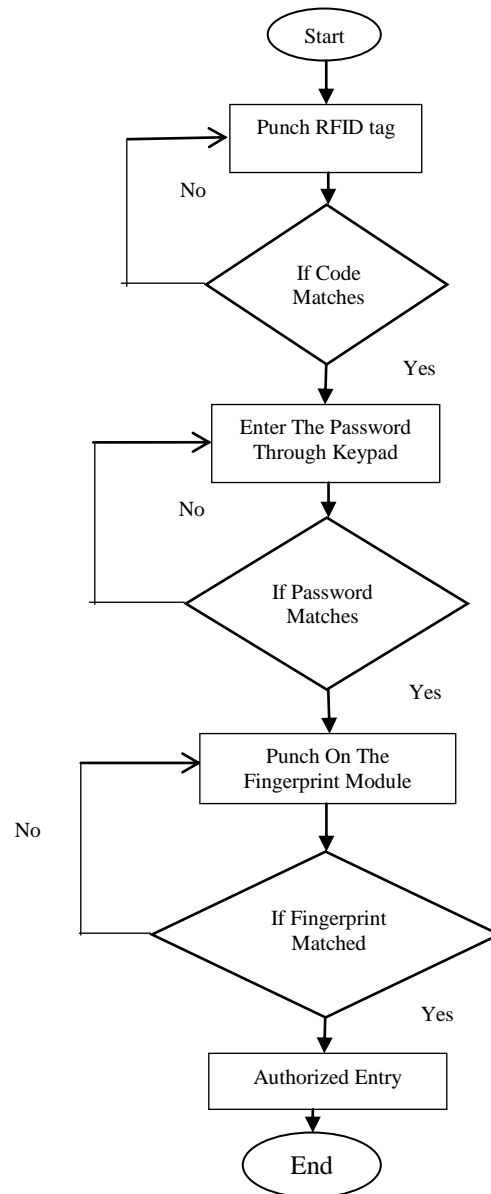

Figure-5. Flow Chart[1]

IV.   ADVANTAGES

- More secure and fast responded.
- Works without line of sight.
- Arduino is easy to access, user friendly, accurate and works very quickly.
- Fingerprint feature eliminates the proxy use of RFID tags and adds more security.

V.   APPLICATIONS

- Access Control
- Payment Systems
- Attendance monitoring
- Healthcare
- Voting system
- Personal Identification
- Car Parking system

Table-1. Comparison of Existing and Proposed Authentication System[1]

Method Used	RFID based	Password based	RFID+ Password based	Biometric based	RFID+ Password + Biometric based
Authentication	Low	Low	Medium	Medium	High

VI.   CONCLUSION AND FUTURE SCOPE

This paper proposes a highly secured RFID, Fingerprint (Biometric) and password based authentication system. It is thus concluded that only after passing through these stages one get an entry in an organization, and hence that particular organization can be digitized. Hence this proposed system can be useful as a tool for access control application. This paper can be improved by increasing the range of reader. This system can also be modified by using it as two different security system based on a specific application. This system can be enhanced by applying the potential uses of RFID module in Real Time Location Systems(RLTS) wherein by using Active RFID tags, people can be tracked from a central location using LAN, and accordingly messages can be delivered by the speakers based on the results obtained.

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