Biometric Authentication using Raspberry Pi based on Cloud and IoT

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Abstract—User authentication is getting inflexible in our In- ternet of things (IOT). Current approaches for authentication such as, passwords assisted by a second factor are debatabledue to human fault as well as the improved sophisticationof further malware attacks. In this paper, a Biometric Access control system based on IOT is designed and implemented. These systems can be used for security of an environment so that, only authorized people are allowed to access the control systemto change threshold values. Biometric authentication is suited in many aspects amongst security systems as it is unique and ties personal aspects of identity. These systems are comprised of biometrics such as fingerprint, iris, etc. Fingerprint based biometric is a good combination of low cost and high accuracy. In this paper,fingerprint as biometric to authenticate the identity of an individual along with Raspberry Pi (RPi) is used to build a low cost biometric system. This paper presents a unique model for remote authentication on IOT devices integrating fingerprint biometric with centralised cloud based infrastructure. The results obtained are encouraging.

Index Terms—Authentication; Biometrics; Raspberry Pi(RPi); Fingerprint, Internet of things(IOT)

I. INTRODUCTION

The reach of Internet has extended itself to many applica- tions and such usage is now clocking at intense level. To put this into perspective, a live example is home automation whereaccessories from fridge to security locks can be controlledby integrating with mobile applications [4]. Human beings are gifted with some eccentric and irreconcilable character- istics. This feature among us can be applied intelligently to ensure security while consuming less manpower. Biometric authentication is considered to be the identity verification ofan individual using either a biological feature which possesses physiological characteristic like a fingerprint or a behavioral characteristic like a signature [2]. As human fingerprint isstable over time and unique it can most certainly be used in all applications pertaining to security or attendance over other biometrics. Many technology enthusiasts and manufacturers use this technology identification in electronic devices suchas computers and smart phones. The usage of low cost IOT device (Raspberry Pi) and its connectivity with cloud hasnow entered as new trend [4]. The proposed project is an attempt of

implementing the biometric authentication using the low cost IOT device. In this project we have proposed two types of authentication: 1) When the admin is nearby the fingerprint sensor, here authentication takes place using only fingerprint sensor and 2) When the admin is not near fingerprint sensor but wants to give access to other person, here authentication takes place using fingerprint sensor, Cloud and Mobile application. In this project we have changing threshold values of Temperature and Humidity sensors upon authentication.

II. LITERATURE SURVEY

Developments in the field of Information Technology also make Information Security a devoted part of it. In order to deal with security, Authentication plays an imperative role. In this paper, Biometrics is used for authentication. This paper also describes how biometrics can leverage clouds boundless computational resources and striking properties of exibility, scalability, and cost reduction in order to reduce the cost of the biometrics system requirements of different computational resources (i.e. processing power or data storage) and to en- hance the performance of biometrics systems processes (i.e. biometric matching). Here, Raspberry Pi is used to build a low-cost biometric system. Raspberry Pi (RPi) is a credit-sized mini-computer with great capabilities similar to a PC.In this study it is used as a remote enrollment node. The application of Raspberry Pi and cloud computing has given a new direction of research into the field of Internet-of-Things (IoT) [1]. Biometric authentication systems can be used for security of an environment so that only the authorized persons are allowed to pass or also for attendance measuring purposes. Biometric authentication is the best among security systems because its unique and personal. These systems are comprised of biometrics such as fingerprint, iris, etc. Fingerprint based biometric system is a good combination of low cost and high accuracy [2]. The biometric systems are in operation for a quite long time and their use is increasing. There is a need for low cost, scalable systems with high availability. In this paper, Authentication node is implemented on a raspberry pi, which is a low cost computer. The proposed architecture is leveragingthe

power of cloud to make the system scalable. Thus the use of Raspberry Pi makes the system low cost and portable [3]. The reach of internet has extended itself to many applications and such usage is now clocking at intense level. The IoT shows potential to delineate the means we secure devices and

systems. It represents the ability of machines to gather data and leverage its use. Because of its extensive applications and advantages it is evolving as adoptive concept. Biometric authentication is one of the popular technologies. This biometric identification includes fingerprint, iris and face recognition etc. Fingerprints, one of the oldest and most wildly used biometric. Many technology enthusiasts and manufacturers use this technology identification in electronic devices such as computers and smartphones. Many technology enthusiasts initiated working on mainly with existing biometric technology to a cloud platform. This appropriates the scalability. The usage of low cost IoT device (Raspberry Pi) and its connectivity with cloud has now entered as new trend. The proposed project is an attempt of implementing the biometric authentication using this low cost IoT device on to the cloud platform [4]. There are two types of systems that help automatically establish the identity of a person: 1) authentication (verication) systems and 2) identication systems. In a verication system, a person desired to be identied submits an identity claim to the system, usually via a magnetic stripe card, login name, smart card, etc., and the system either rejects or accepts the submitted claim of identity (Am I who I claim I am?). In an identication system, the system establishes a subjects identity (or fails if the subject is not enrolled in the system data base) without the subjects having to claim an identity (Who am I?) [5]. The present technological era is demanding reliable and cost- effective personal authentication systems for a large number of daily use applications where security and privacy performance of the information is required. Biometrics authentication tech- niques in combination with embedded systems technologies give a demanding solution to this need. This paper explains the hardware-software co-design responsible for matching two fingerprint minutiae sets and suggests the use of reconfigurable architectures for Automatic Fingerprint Authentication System [6].
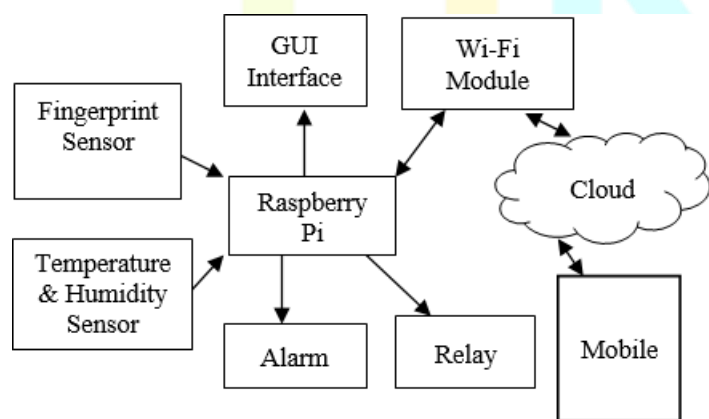
III.   SYSTEM ARCHITECTURE

Fig. 1. Block Diagram

In our proposed model we are using GT511-C3 as finger-print sensor, where it has its own database. Once verification and enrollment is done it will notify raspberry pi. We are using

DHT22 as temperature and humidity sensor, where reading of temperature and humidity is sent to cloud every 1 sec. Buzzer is used as an alarm when the current reading is more than threshold values buzzer is turned ON and relay is switched OFF which turns OFF LED indicating the system is turned OFF. Raspberry Pi is a heart of the system, where it communicates with every component of the system. It has its own Wi-Fi module to communicate with cloud for uploading temperature and humidity values continuously. It will create a graphical user interface (GUI) which allows users to interact with the system through graphical icons and visual indicators. It compares threshold values with current reading if it exceeds threshold value, raspberry pi will turn ON led and Turn off relay.

We have used firebase as a cloud for keeping track of temperature and humidity values and threshold values. It also holds OTP required for comparison which is received by Raspberry pi. In mobile application we are displaying temperature and humidity values as well as threshold values continuously. Here we are generating random number as a OTP and is sent as message to another person who needs remote access and the same is uploaded to cloud.

IV.   PROPOSED SYSTEM

In Proposed system we have chosen Fingerprint Sensor GT511C3, the model is an optical sensor having 32bit CPU and can store up to 200 templates. In our system we are using Raspberry Pi has it supports python which is helpful for interfacing the Fingerprint Sensor. The model uses DHT 22, which provides digital output of both temperature and humidity, it has better accuracy over DHT 11.

For Cloud Implementation we have made use of Firebase for storing and retrieving user data and to hold OTP and also to provide live update of temperature and humidity in the App. The App was developed using MIT APP Inventor.

A. Hardware Implementation

Fingerprint sensor GT511C3 is interfaced to Raspberry Pi using UART pins. The fingerprint sensor has own memory and notifies on authentication. DHT 22 is interfaced using GPIO which gives digital output, used for monitoring temperature and humidity. We have interfaced monitor screen for User interface. Buzzer and relay along with LED is interfaced to show system conditions.

B. Software Implementation

Firebase holds User data, login credentials required for App, OTP generated through mobile App for verification purpose. Firebase connects the Hardware with mobile app which provides live temperature and humidity and threshold levels which is set to red and provides warning in App when levels are exceeded. Mobile App was developed using MIT App inventor using block coding language. We have developed Graphical user interface (GUI) that allows users to interact with all the components through graphical icons and visual indicators.

V.   EXPERIMENTS

The Biometric authentication system designed have been prototyped for an industrial application to manipulate temper-ature and humidity values only on fingerprint authentication. The authentication system has three Process that are Enroll-ment, Authentication and Remote Authentication.
The Buzzer is Turned ON and Relay is turned OFF when

current temperature and humidity readings exceed threshold levels.

A. Enrollment Process

In Enrollment Process Admin has to give authorization to allow others to get enrolled into the system.
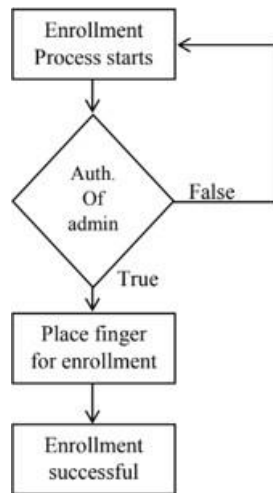

Fig. 2. Registration

B. Authentication Process

In Authentication process the admin of the system can directly manipulate the threshold settings by performing fin- gerprint authentication.

C. Remote Authentication Process

In Remote Authentication process the admin when not in place can give access to other person who has his fingerprint registered by sending a 10 digit OTP code. The Code is Random and unique generated using the admin's mobile App which is sent as SMS to the person for access and simultaneously is sent to cloud for Verification. This Code will be valid only for short time in our project it is 30secs, post that it is replaced with garbage values.

VI. RESULTS AND DISCUSSIONS

Enrollment Window is the GUI window for enrolling new users on Authentication of Admin.

Authentication Window is the GUI window where the Admin can manipulate threshold values with his Fingerprint. Remote Authentication is the GUI window where the other person can manipulate threshold values with their Fingerprint and received OTP.
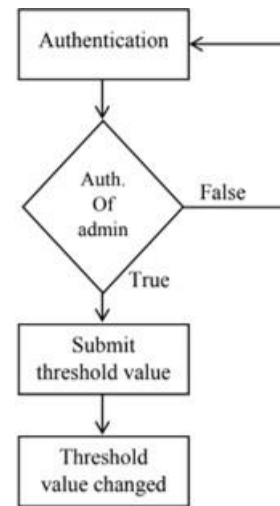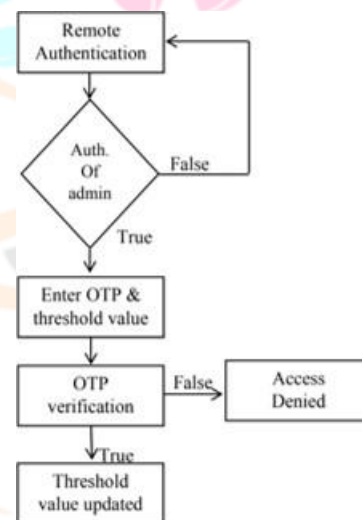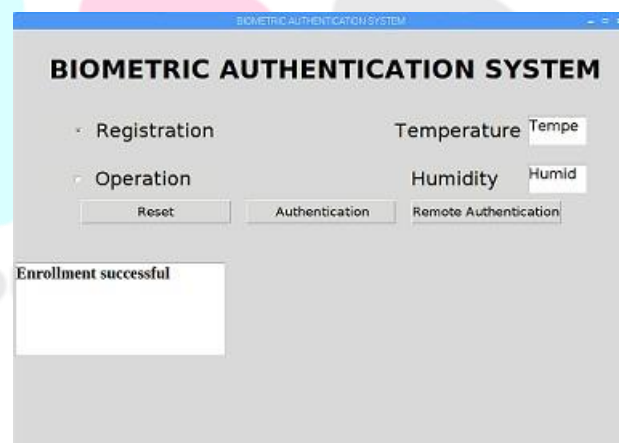

Fig. 3. Authentication

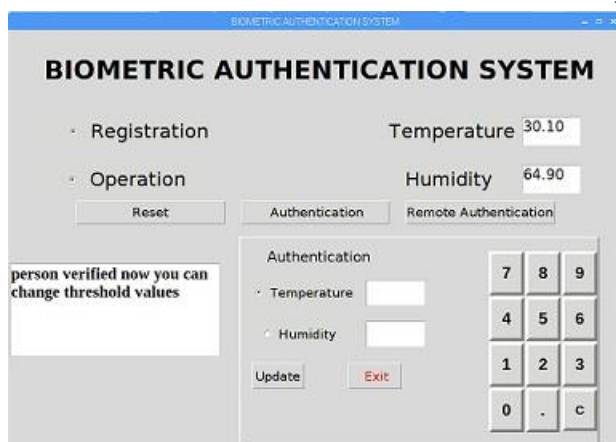Fig. 4. RemoteAuthentication

Fig. 5. Enrollment Window
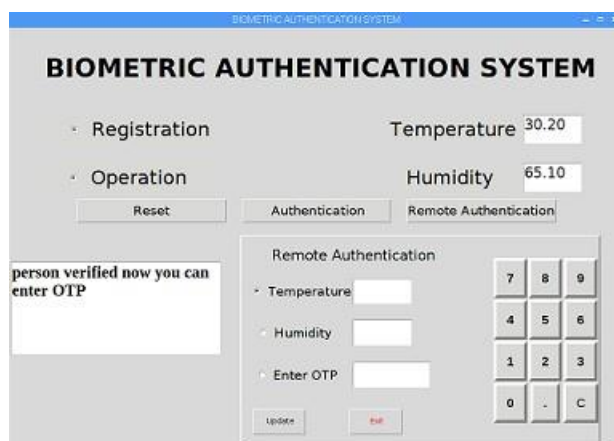
Fig. 6. Authentication Window

Fig. 7. Remote Authentication Window

VII. CONCLUSION AND FUTURE WORK

The presented model is low-cost IOT based Biometric architecture with the use of Raspberry pi. The proposed system is efficient / secure and can be used in securing access control mechanisms and can be implied in any areas where authentication is essential. The model has been designed for an Industrial application i.e. the temperature and humidity thresholds can be changed on authentication. Similarly, this can be easily adopted or implemented for any access control systems.

In future remote authentication may be provided by integrat-ing fingerprint authentication From the app itself. Fingerprint module can be isolated and many such fingerprint modules for different systems can be made to communicate with one Raspberry Pi using Wi-Fi modules. Biometric access System can be enhanced by using one more Biometric like iris or face recognition along with Fingerprint Authentication, which provides more security.

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