Internet of Things based Door Locking System–An Architecture

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ABSTRACT

This paper presents the architecture and implementation of an Internet Of things based mobile application for a door lock security system. This implementation has two devices i.e. Mobile and the Door,both are connected to the internet. The sensors are connected to the internet (IoT) to be monitored remotely from anywhere in the world. This also make use of cloud where the door status information i.e. the lock unlock information is saved on the cloud and is displayed on the mobile application.The applicationalso includes several other security features to enhance the security level and make the key management process easy. The implementation of these security features is under development process and hence the future work.

Keywords: Internet of Things (IoT), Door lock, Android Application, Cloud

1. INTRODUCTION

The Internet of Things aka IoT is a technology that aims to put the things around us on a network. The motivation of IoT is to provide a global infrastructure that can connect objects and intelligent services over a network as discussed by Aston [1]. The intelligent services process the data collected from these objects to serve the purpose(s) for which it is implemented [1][2][3]. Here *purpose* is used in wide sense that means the wide range of usefulness and applications these services will support depending on the domain and type of information collected and processed. Physical world or the objects and the information about the objects are two things. The IoT makes the objects talking to each other via information they exchange[9]. In [17] author discusses about solutions those are smart developed around IoT. Smart home is one such application where IoT oriented solutions is being implemented to make the secure and convenient living experience. Door lock system is an essential feature in this series of Home appliances which can be remotely controlled. In [4] author discusses personal and home application of IoT. As per authors [4], the information can be sent to the only owners of the network via sensors and mobile devices can be used with well-defined interfaces to communicate with the sensors to control the home appliances.

[16] Smart devices for home access and control are in market and people are inclined to use them. The case study on the usage, affordance and limitations of three devices is presented.

Various [19] technologies have been connected which generates huge amount of information. Security is an important factor everywhere. Technology driven security system than enhances the security level of a place along with ease of operation is a necessity in today's world. One such important technology is mobile

Especially, IoT based technologies have enabled the communication between various objects and mobile devices.Mobile devices are the fastest and the easiest devices used for communication and exchanging information all over the world.

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[18] Digital door lock is a new trending system that is being used in households and corporate sectors considering its reliability and ease of usage. However with digital lock as well, security remains a concern. Many times, strangers try to get-in by bypassing such systems. [18] A Raspberry Pi based door lock system for the home security has been developed. The system developed is connected with twitter and Gmail account of the owner sending the information about visitor. A cloud based solution for smart homes using IoT is discussed and proposed by authors which make use of cloud based technologies and architecture like SaaS, PaaS, IaaS. Similarly an android based home control device is being developed in [30] wherein web services using REST is being used for exchanging between device and owner. Other architecture and technologies have also been used like in [31] author presents the use of Bluetooth device for controlling the lock via an android application. But the use of Bluetooth based implementation has limitations. Whereas in [32] SOAP and XML based home control system has been suggested which further brings complexity of parsing, suffer the slowness in response.

In this research work, we propose the design and develop a systemthatprevents such attacks exploiting the concept of IoT. The system is a three tier system based on IoT architecture using micro controller device, cloud and Android application. It aims to enhanceseveral security and monitoring featuresbased on IoT technologies.The data and information is hosted on cloud using MQTT protocol. The android based mobileapplication features a user admin platformwhich has the ability to grant and revoke permissions to users and simultaneously monitor every door lock/unlock event efficiently [19][20][21].

2.   THE ARCHITECTURE - DESIGNING OF THE DOOR LOCK SYSTEM

2.1. Main features of the door lock system

Thereare several features of the door lock system. It helps to lock and unlock the doors from mobile device with the help of an [20]androidapplication installed. It has a monitoring system, which can uniquely monitor every actions performed on the application. [19] The system can monitor the last person who locked the door to the person who shared a specific door key with another person. With such features implanted, it enhances the security system of the place. The admins can track and monitor every single activity on-the-go.

2.2. Structure of the door lock system

Figure 2 presents the architecture of the implemented door lock system. Primarily the architectureconsists of an electronic system using a [14] PCB controller that is embeddedin the physical lock, and on the mobile
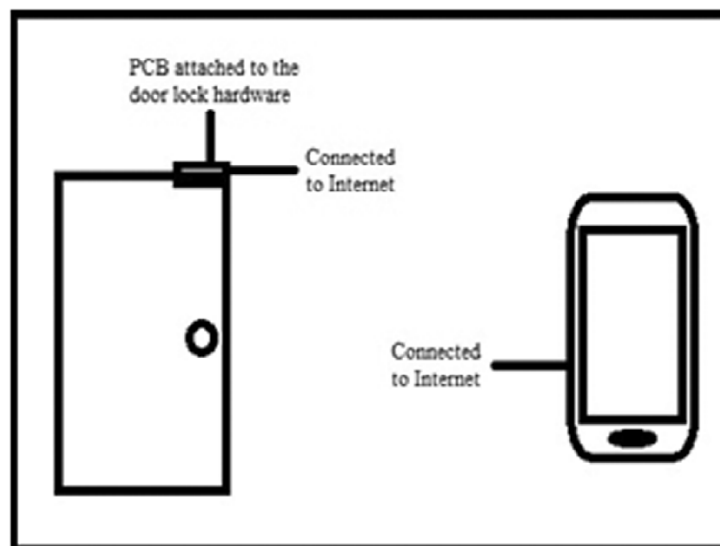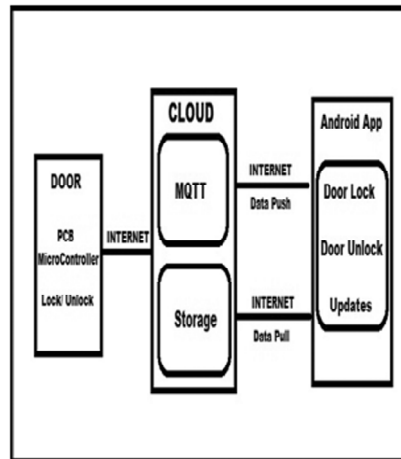

Figure 1: The overall view of the system

Figure 2: Overall Architeture of the Door Lock system

device of the user. Every single record is stored in a [4] database and it is hosted on firebase database [5], which can be queried through the android app. A door can be opened or closed remotely. The stored records can also be queried for further information.

3.   IMPLEMENTATION

A PCB controls the door lock and communication between the lock and the application happens through the internet. [3] C programming language is used to write the commands for the controller and the data is stored in the firebase database [5] .
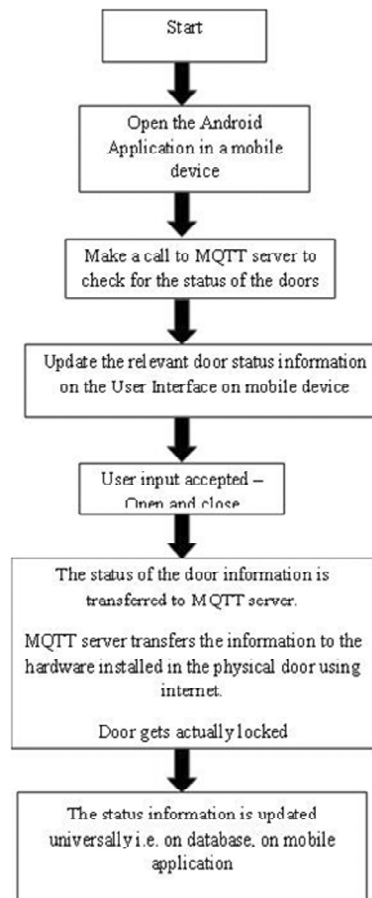

Figure 3: The working steps of the Android application for the mobile device of the system

[16] The electromagnetic door lock and the microcontroller are in a complete set and interconnected. The mobile app and the PCB are connected to the internet through WiFi. The [1, 2] MQTT protocol is used for communication between the PCB of the door lock and the android app.

Part one consists of the door which has the micro-controller and it is connected to the internet via the wifi. The micro-controller controls the locking and unlocking of the door.

Part two consists of the cloud system, which uses the [1, 2, 17] MQTT protocol just like the [3] HTTP and FTP in web, to connect to the android application. The database is being hosted on the cloud using the firebase's services [4]. Updates and logs from the android application and the door are stored on this database [5].

Part three consists of the android application, which is installed on the user's [6] android phone. The android application receives updates from the door over the internet. The changes made by a user get stored on the firebase's database [5] as logs.

Figure 4: Android applicationUI displaying the status of three doors

The [9] user interface in figure 4consists of three doors that are being used for testing. The application runs on the background and updates on any change. [8] The doors can be locked or unlocked upon a single tap. It also updates the UI automatically upon any physical interaction with the door. The [4] database logbook is under development which will display all the door interactions and the users operating it.

4. FUTURE WORK

The implemented system is anelementary system. There are several other features those will be integrated in the future aiming to solve many problems and advancements. The features to be integrated in future isan impact detection sensor, which is capable of detecting any kind of physical impact made on the door and raising an alarm on the admin's mobile device. [10] The person who will have the administrative rights for a door can share the door's key with other people for a given time period.There will be sensors that will work on real-time to unlock the door when an authorized person is 1feet near the door. The super-admins of a workplace will have access to all doors. Users can add new doors or remove them accordingly.It eliminates the hassle of carrying several keys and more importantly the problems of losing keys. Further the scope of this system is not only meant for doors, it can also be implemented on several other electronic appliances for automation and ease.

5. CONCLUSION

We have designed an electronic door lock system that can be operated remotely by harnessing the power of IoT (Internet of things), which has better security features and is user friendly.This systemhas the capability to lock and unlock doors over the internet enabling keyless entry and solves the problem of losing a key.It improves user convenience by allowing the user to lock and unlock the door remotely, along with enhanced security and sharing features. [10] The door lock system is in the process of being commercialized into a security system for corporate sectors and households. It is expected to be far better than already existingdoor lock systems.

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