

System for Advanced Locking and Ticketing (S.A.L.T)

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Abstract

Looking into the latest developments brought by the Indian government, with respect to Digital India, curbing corruption through cashless payments and importance of Aadhar cards, we intend to bring all these factors together and revolutionize the manner in which we travel in trains, by combining IoT, cloud computing and wireless communication, as they have lot of scope for research. This paper discusses the study of integrating the Cloud computing technology with IoT and wireless communication and using its general architecture and application to help in unlocking the train seat through magnetic lock. This paper details and discusses the method to improve travelling with the help of Cloud and wireless communication using protocols, service models, database technologies and algorithms which are used to improvise the model. Further this work can enhance the security and accessibility of the user information to a very high level, using a complex system that is hard to tamper with and at the same time easy for the users to use.

Keywords: Index terms • IoT • Magnetic lock • Wireless communication • Smart systems

Introduction

With the advancement in technology, everything is becoming either digitalized or automatic, basically less involvement of human beings, and we tried to bring all these factors in this project. We take up one segment of the Indian railways, which is making traveling more systematic, convenient and propose a fault-proof idea for enhancing the use of Aadhar card and making India more digitalized. Not many changes have been done in this area and we are still following the old ticketing method of booking online or offline and showing the ticket to TTE which is a very hectic and time-consuming process and many times people don't even buy tickets and there is no way to catch or check them and that's why our idea of digital locks on seats, and this being used to cross-check seat occupancy and real-time booking on the train is a very simple yet highly beneficial concept. All the problems related to revenue, corruption, and unnecessary hassle, illegal bookings can be solved and handled with this idea without making anything complex.

Methodology

Indian Railways has its own telecommunication network when it comes to communication-related to train operation. VHF i.e. Very High-Frequency walkie-talkie sets which function through VHF towers are used for communication between the guard and loco pilot of the train, and they can contact the train master via same process and all these services are managed through RAILNET network which is managed by Indian Railway for its customer service purpose, like getting the required data about train schedule, ticketing, reservation, train running information etc. The whole telecommunication network is based on a communication model or protocols, i.e. communication devices have to agree on many physical aspects of the data to be exchanged before successful transmission takes place. Popular protocols include File Transfer Protocol (FTP), TCP/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), Post Office Protocol (POP3), Internet Message Access Protocol (IMAP), and Simple Mail Transfer Protocol (SMTP).

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Starting with FTP, as mentioned by the Singh SP [1] it is a widely used application and mostly helps in transmitting files between computers over a network. The FTP server consists of two parts, one is the client and the other is server part. The client helps in installing the client application and the other laptop runs the server part. The client helps in uploading and downloading files using some login and password combination and the server keeps checking the data provided by the client for authentication. After verification of the credentials, the client can access the server and complete his/her work.

Coming to HTTP server, as mentioned by the Veerasamy BD [2], the main aim is to serve the webpage contents to clients. A webpage is a document or resource of information that is suitable for a web browser and displayed on a computer screen. There are multiple HTTP request methods, but our main focus is on GET.

GET requests are mainly used to recover data from a server, for example a webpage. The main advantage is that it doesn't change anything on the servers; it just retrieves the data from the server, without after effect. When a person opens a webpage in the browser, it takes that URL and put it in an HTTP GET request and after that sends the request to the right server using TCP. The server reads the request, checks the URL, and send the right HTTP response for that URL back to the browser. Coming to the final protocol, TCP and UDP [3], packets are the main source of communication. Transmission Control Program integrate both connection-oriented links and datagram services between hosts. The monolithic Transmission Control Program after some time was divided into a modular architecture which consists of TCP at the connection-oriented layer and Internet Protocol at the internetworking layer. Afterwards it was called as TCP/IP protocol. The TCP is a core protocol of the Internet Protocol Suite. TCP covers a wide variety of applications such as Email, World Wide Web, remote administration and file transfer. End-to-end connectivity is also provided by TCP and specifies how data should be packetized, transmitted, addressed, routed and received at the destination. This functionality is organized into four abstraction layers which are used to sort all related protocols according to the networking scope. Telnet is a protocol used on the Internet or local area networks to provide a bidirectional interactive text-oriented communication facility using a virtual terminal connection. User data is interspersed in the band with Telnet control information in an 8-bit byte-oriented data connection over the Transmission Control Protocol (TCP) [4]. On the other hand, a simple connectionless transmission model with a minimum of protocol mechanism is used by UDP. There are no handshaking dialogues, and thus is capable of exposing any unreliability of the underlying network protocol to the user's program. There are some disadvantages like, there is no guarantee of delivery, ordering, or duplicate protection.

Rao VR and Selvamani K [5] the author discusses the solutions to those are smartly developed around IoT. One such application is a smart home, to have a secure and convenient living experience IoT oriented solutions are being

implemented and we are expanding it to the Indian Railways. Especially, IoT based technologies have enabled the communication between various objects quite easy. IoT can be seen into five different layers [5] with distinguished functionality. In these communication between layers, a huge amount of highly secured data is transferred at all the stations to the cloud, there will come security issues and IoT adopting Cloud services could complicate this situation and raise more security concerns. Within a cloud context, no matter public, private or hybrid, data security management involves secure data storage, secure data transmission and secure access to the data. During transmission, the Transport Layer Security (TLS) cryptography is widely used to prevent threats. During processing, the cloud service provider applies isolation between different consumers. The isolation is applied at different levels such as operations system, virtual machine or hardware [6].

Cook A, et al. [7], the author explained the digital door locking system using Arduino, and the same concept will be used in our project. The 5V power supply will be given to Arduino and the LCD to energize them. Whenever the password will be given to the keypad, the signal will go to the Arduino. In Arduino UNO, the project program is written in the AVR RISC controller and is also used to continuously monitor the keypad in case of any match with the already stored passwords in the flash memory and also to provide digital and analog signal to the devices. The microcontroller will check if the input password by user is correct or not, and if the password matched then the Arduino will send a signal to the LCD display which display that access granted. The mechanism to unlock the door will start and if the entered password is wrong then wrong password will be displayed on the LCD [8-11].

Main features of S.A.L.T

There are many unique and important features of SALT but the main focus is on unlocking the train seat using Aadhar number which is described as “the most sophisticated ID programme in the world”. The sub-process which lead to the unlocking the seat is related to exchange of data, which was done using Wi-Fi module ESP8266 and Arduino Uno.

Main components used:-

NodeMCU ESP8266: The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. It is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers.

Arduino Uno: It is an open-source prototyping platform based on easy-to-use hardware and software. It consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

Keypad: A keypad is a miniature keyboard or set of buttons for operating a portable electronic device.

LCD display: It is used to see whether the entered password is correct or not. It is also used to interface with the project to output lock status.

Magnetic lock: It is a locking device that consists of an electromagnet and an armature plate. When the electromagnet is energized, a current passing through the electromagnet creates a magnetic flux that causes the armature plate to attract to the electromagnet, creating a locking action.

Block diagram and description

A NodeMCU Wi-Fi module is used to implement all Server related exchanges. There are two servers, one for password storage and the other to monitor the status of the seat-locked or unlocked. For this project’s functioning, Google Firebase has been used as the cloud server. The Wi-Fi module fetches the password from the cloud and sends it to the Arduino UNO. The Arduino compares it with the password entered via the keypad and decides whether the seat is to be locked or unlocked (Figure 1).

Alongside, this seat status is pushed to a database. Google Sheets has been used as it allows better synchronization with Firebase. This is done by utilizing a third-party application called Pushing Box. The NodeMCU triggers the API of the Pushing Box by generating an HTTP GET request. This pushes the data in the pre-formatted HTTP request in Sheets. The GAS code has been created such that it processes the incoming data from Pushing Box and creates a new row, by extracting the necessary characters. The GAS script also establishes a link with the concerned Firebase console. It creates a JSON object to enter the data in the Firebase in the required format. On the basis of a preset trigger (Time-based or Edit-based) the Sheets pushes the entries to the Firebase and removes duplicate entries of the seat. The Firebase reflects these changes on its servers (Figures 2 and 3).

Circuit diagram

The below given circuit diagram explains the mechanism used to make

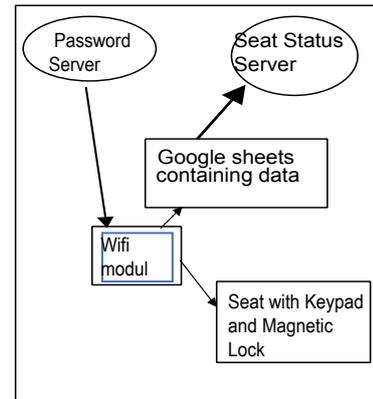


Figure 1. Block diagram.

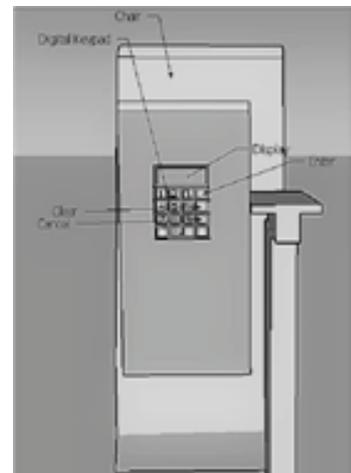


Figure 2. Locked seat with keypad.

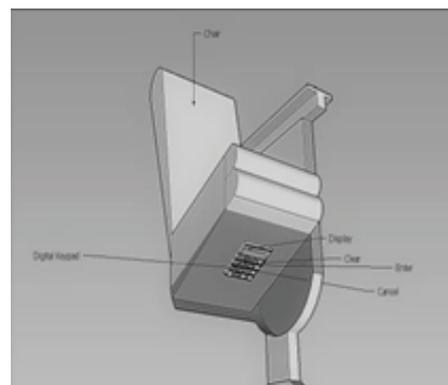


Figure 3. Unlocked seat.

The above cases completely eradicate the chances of any corruption and unnecessary hustle as the work is completely digitalized and does not require any third party, which was the main motive of our idea.

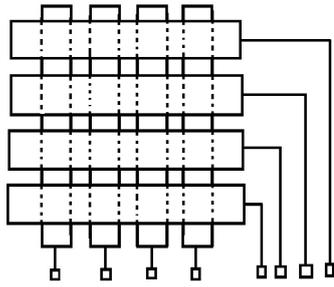


Figure 4. Keypad circuit diagram.

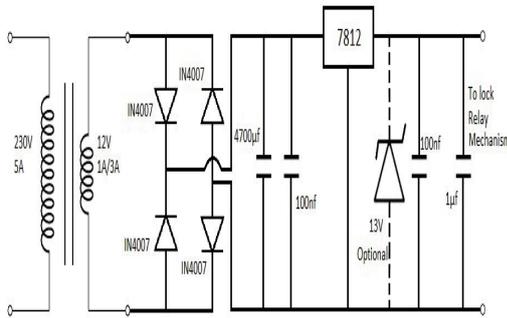


Fig. 1 Power Supply

Figure 5. Power supply for lock.

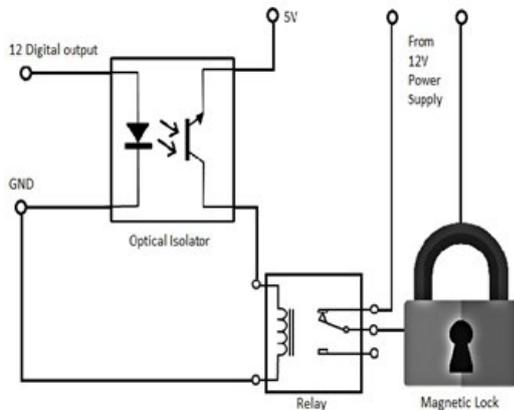


Figure 6. Magnetic lock.

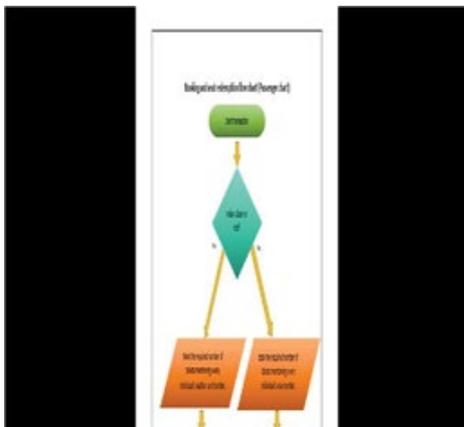


Figure 7. Booking and Seat redemption flow chart.

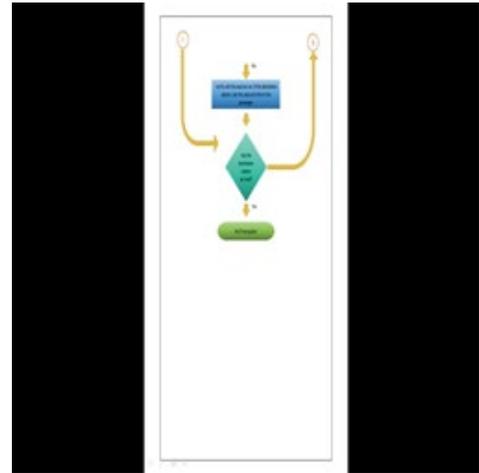


Figure 8. Flowchart for unlocking a seat.

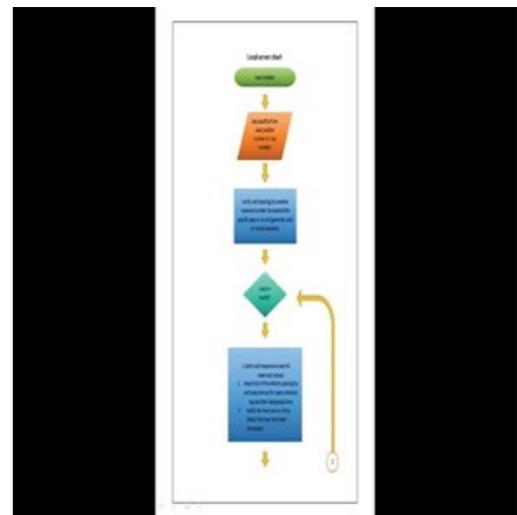


Figure 9. Local server flow chart.

digital lock and keypad that will be used in the train seat (Figures 4-6).

Implementation: (Figure 7-9).

Results and Discussion

The project is being tested on the real time and the seat is unlocking only after inputting the correct password on the keypad. There are some cases that are considered for the proper simulation and to avoid any glitch. They are explained below:

- This project does not even require expensive components, only basic components for lock and keypad and most the data exchange is done on cloud, which the Indian Railways can easily afford.
- In case a person forgets his/her Aadhar card, the seat can be unlocked by going on the UIDAI official website and choosing the retrieve option from the menu, and after filling all the required information required to redeem the Aadhar number, a verification will be send to the registered mobile number and the persons.
- Aadhar number can be get even on the train with the available Wi-Fi connection.
- In case the person does not have a smart phone, the above-mentioned process can be done with the help of railway employees, as they will have the required gadget to do the same.

Conclusion

The research has a wide scope in future. While the initial proposal is of implementing such a system in the chair cars, later implementation can also be executed in sleeper coaches. The real-time seat monitoring can allow an app-based seat booking in addition to the pre-existing web-based booking of the Indian railways. Since the role of TTE is seat checking is removed, more investments can be made on security and coach attendants. They can be shown the seat status via an app to ensure unreserved seats are locked. The same app can also be used for pantry, cleaning, bedding or complaints in general, made by the passengers using their mobiles. In long term this idea will have unparalleled profits. The lower portion of all seats, which is relatively less prone to tamper, has such a plausible possibility to encourage sponsors who would like to put up their advertisements. This shall allow not only making up for the excess expenditure of the locks but, in the long run, resulting in profits.

The project's successful implementation allows several new opportunities to the way Indian railways have functioned till now. It leads to more digitalization with the help of the Aadhar card, which is mandatory while traveling and most of the population of India have it.

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