

Automatic Toll Collection Using Li-Fi Technology

Snehal Rahane¹, Sanjivani Ulekar², Sarika Nikam³, Anjali Kusumkar⁴, Rupali Tornekar⁵

Department of Electronics Engineering Vishwakarma Institute of Technology, Pune.

snehal.rahane15@vit.edu , sanjivani.ulekar16@vit.edu, sarika.nikam16@vit.edu,

anjali.kusumkar16@vit.edu ,rupali.tornekar@vit.edu

Abstract—The Li-Fi is the newest technology in the Field of wireless communication. Nowadays so many people are using internet to fulfill their task by using wired or wireless technology. When the number of users is increases then rate of data transmission in the wireless network gets automatically decreases is proposed. Li-Fi uses LED light bulbs similar to those currently in use in many energy-conscious homes and offices. The high-speed wireless communication technology is uses visible light (presently using LEDs) to transmit information. Automatic Toll collection system has reduced the heavy congestion caused at toll collection in the metropolitan cities. As the population is increases day by day this results into high traffic congestions on road. Most of the people find it difficult to be a part of long queue at toll for toll collection system. This causes high fuel consumption while waiting for a payment, which is going to extinct in coming years. The given project is providing a great solution to this problem. Li-Fi is emerging technology in today's era. Here, we are using the power of Li-Fi for wireless communication to transmit user information from vehicle to toll through app. Every vehicle will be having a microcontroller and a memory connected to it. In addition, the setup will be used to send useful encoded data like vehicle number via LED. The Li-Fi receiver (Admin) is present in middle of road at tollbooth. An intelligent processor will be there at receiver side, which will automatically process the toll tax payment according to the type of vehicle through a wallet linked with vehicle number. The technology will be helpful in preserving the fuel consumption of vehicle and will create an eco-friendly environment.

Key Words—*Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Admin, visible light*

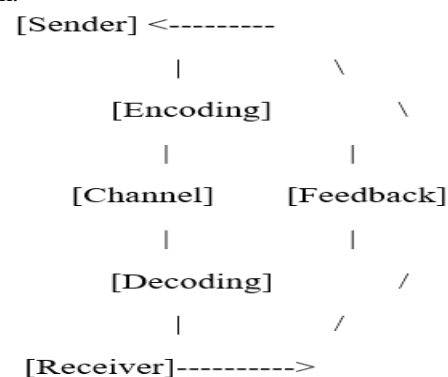
I. INTRODUCTION

In world of wireless technology, the numbers of devices access the internet growing by a second most of the devices use wireless communication access internet for sharing data between devices, this has a led to an increase in network complexity, shortage of wireless radio bandwidth and an increased risk of interference of radio frequencies put limitation on radio frequency which is used in Wi-Fi(Wireless Fidelity)[1]. The main principle of this technology is transmitting the data using light illumination by using light-emitting diodes. In Li-Fi based system we analyze its performance with respect to existing technology. To enjoy high data transfer rates we use of Li-Fi and also for relieving radio interference issues. Li-Fi technology is the future of high speed data transmission. So we use this Li-Fi technology for

our project. Li-Fi may be a new model for optical wireless technology or the superior knowledge to create unexampled Possessions inside a limited small area for the particular situation. Rising orders are designed for superior bandwidths, is to access quicker and safer information transmission additionally as environmental and doubtless human friendly technology. Li-Fi will take only for lighting services but moreover a world of fresh and awesome pioneering services and out coming best results. Developing toll plaza which is based On Li-Fi technology to save the time at toll plaza and having cash free operation [2][3]. Here are some points regarding to purpose behind choosing this topic & the requirement of this type of the project in our day to day life [4].

- Avoid the fuel loss.
- Saving of time in collecting toll.
- Avoid financial loss.
- To monitor the traffic.
- To use latest technology for higher data transmission speed.
- To make efficient digital technology

When any vehicle will be entering to that area then message sends to the admin which will be in Toll Plaza. Toll will be deducted automatically through app in which all information will be available on that app. If there is insufficient balance in their wallet, then it will follow normal procedure of toll collection. Our approach consists of integrating Li-Fi technology for toll collection system. LIFI module is integrated with vehicle of users. Another Li-Fi module is integrated on toll booth. This chart demonstrates two-way communication and feedback.



Two-way communication is different from one-way communication in that two-way communication occurs when the receiver provides feedback to the sender. One-way

communication is when a message flows from sender to receiver only, thus providing no feedback. This is user friendly system. Purpose of this system to use advance technology to make digital India. After implementing this concept, government will get many from toll collection system.

II. RELATED WORK

Li-Fi is a VLC, visible light communication technology, developed by the team of scientists including professor Harald Haas at the University of Edinburg and deals with by sending data through a LED light bulb that varies in the intensity which is faster than a human eye. It provides better efficiency, higher bandwidth, best security and availability with a very high velocity than Wi-Fi [5]. Authors will develop recommendations for vehicle identification/registration systems with the potential to link the tolling function to other desirable transportation system management functions [6]. The proposed system demonstrates transmission and reception of data by switching LED on and off at very high intensity which is too fast to be noticed by human eye. We can encode various data by varying the rate at which LEDs flicker and transmit it[7]. Authors design system such that it should use one or more of the following technologies: satellite positioning, mobile communications using the GSM-GPRS standard (reference GSM TS 03.60/23.060) and 5, 8 GHz microwave technology. As a result of the analysis, the system has turned out that using satellite positioning technology and mobile communications (GSM/GPRS) is the best toll solution of unique capabilities. Author will present the initial structure of GSM/GPS based Toll Collection System for Poland [8].

Li-Fi is a bidirectional, high speed and fully networked wireless communications similar to Wi-Fi. It uses visible light communication or infra-red and near ultraviolet (instead of radio frequency waves) spectrum. Visible light communications (VLC) or infra-red works by switching bulbs on and off within nanoseconds. The application of VLC includes use of Li Fi technology at traffic signals and at toll plazas. The system uses a LED which is toggling at transmitting end and a photodiode at receiving end. LEDs are used to transmit the data at transmitting end. The light received by photodiode. This light is converted to binary data and is fed to the PIC microcontroller. The microcontroller is connected to the serial port of the PC [9]. This paper focuses on faster data transmitting at toll plaza by using Li-Fi module which will reduce the problems that arise in ETC by RFID tags. The Li-Fi mechanism is implemented in every four wheelers vehicle and at toll plaza. At the toll plaza, once the vehicle's Li-Fi transmitter is paired with the Li-Fi receiver, the system at toll plaza automatically identifies the vehicle details and alcohol consumption details for fine payment along with toll fare. Incase if person is drunk then the information is sent to the nearby police station using k-NN algorithm. If user with insufficient balance approaches the toll plaza, his/her prepaid bank balance would go to negative to a certain limit and this information is stored in the main server. Next time when the vehicle arrives at the same toll plaza, a notification is sent to the concerned authorities and henceforth the vehicle could be trapped[10].Authors developed wireless optical

communication system with white colored LEDs for a wireless home link (WHL). The white colored LEDs have a high power output and are regarded as lamps for the next generation. In this device is used for a wireless home link. The proposed system is suitable for private networks such as consumer communication networks. From numerical and simulation results, it is confirmed that the proposed system is available and the problems to be solved are made clear[11].

III. BLOCK DIAGRAM:



Fig.No.1 Block Diagram of automatic toll collection system

Li-Fi: Li-Fi stands for Light-Fidelity.it provides for transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Wi-Fi is great for general wireless coverage within buildings, whereas Li-Fi is ideal for high density wireless data coverage in confined area. Li-Fi provides more bandwidth, good efficiency, availability and security than Wi-Fi. Li-Fi has already achieved by list erringly high speed in the lab. The low cost of LEDs and lighting units there are many opportunities to exploit this medium.

Transmitter: When the vehicle approaches the toll gate, initially the IR sensors placed on either side of the toll booth for detect the arrival of a vehicle as it interrupts the IR waves passing. This point of time, the gate gets closed and the vehicle's position is in such a way that the Li-Fi transceiver in the vehicle door. The Li- Fi receiver at the toll booth communicates where the former transmits the vehicle details stored in the microcontroller and the latter receives

LED (Light Emitting Diodes): The uses light from light-emitting diodes (LEDs) as a medium to deliver networked, mobile, high-speed communication. LED and photodiode are the major components of Li-Fi circuit. LED are used to transmit the data at transmitting end. At receiving side a photodiode is connected to PC which senses the data is transmitted by the transmitter. Transmitted data feed to the PC. A PIC microcontroller can be used for toggling of LED at transmitting end. At the receiving end also one whose has to use a PIC microcontroller connected to output of photodiode.

Receiver:

The receive section consists LDR as a receiver having high sensitivity. We can also use the photo detector for same purpose. LDR decode the incoming demodulates the incoming received signal. The demodulated signal is then sent to a signal conditioning unit than fed to PIC microcontroller, which decode

that signal and then given to an output device such as an LCD display.

Circuit Diagram:

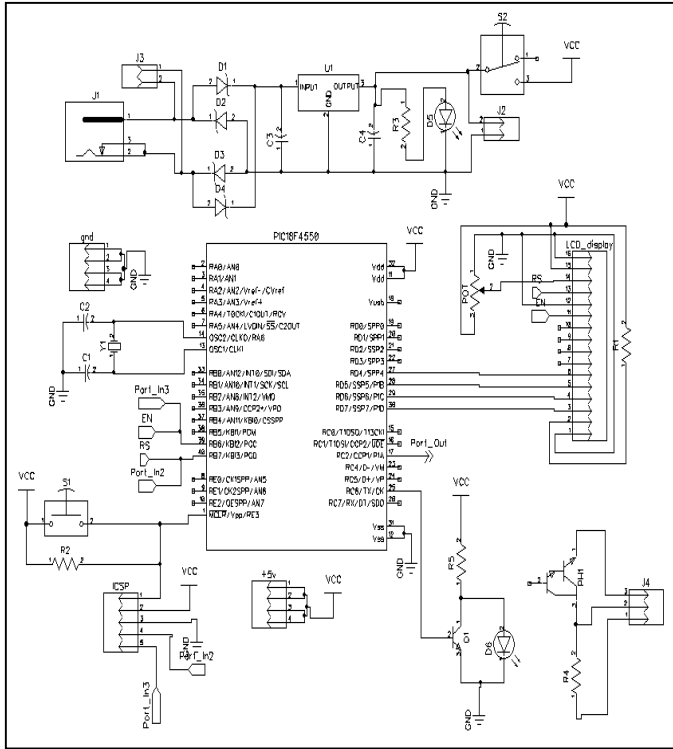
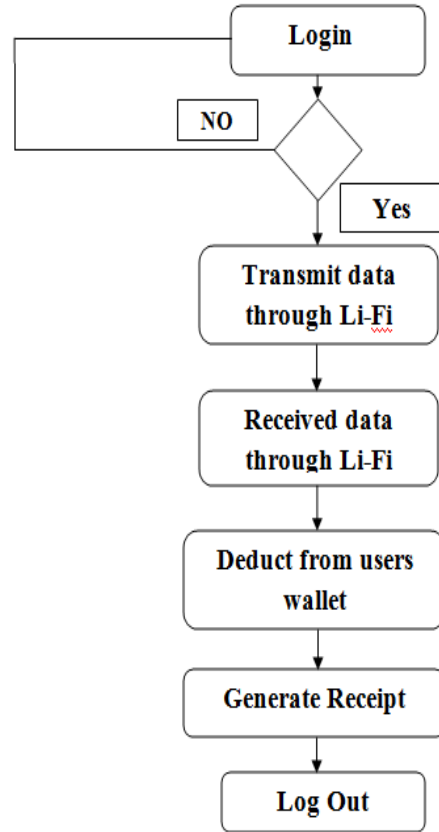


Fig.No.2 Circuit Diagram of Transmitter and receiver of automatic toll collection system

Working: Now a day’s we see long queue in Toll Plaza for Toll collection and people don’t have time for that so we design a system for saving the waste of time. In this project, we design a model for automatic toll collection with the help of Li-Fi technology. Admin will register users. User will get login credentials like login id and password. Once the user has entered correct email, password in Android Login screen, he will be taken to this activity and shown the welcome message along with his name. User will be able to register using his Name, Email, Age and add money in wallet. On the successful registration, a user credentials will be stored on the data base created in our backend server. There will be a link to Android Login Screen for the already registered user to login and start the process. Admin will authenticate user. Admin will handle all activities. Phototransistor a device which function is that converts light energy into electric energy. Then transmit query to the photo receiver using Li-Fi system. At the receiver end at the toll booth update the information in the server and database and also vehicle details stored. after getting that information the fare amount (toll) deducted from wallet of the user which is notified the user via SMS.

Flowchart:



IV. PERFORMANCE AND EXPERIMENTS



Fig.No.3 Power supply and control section

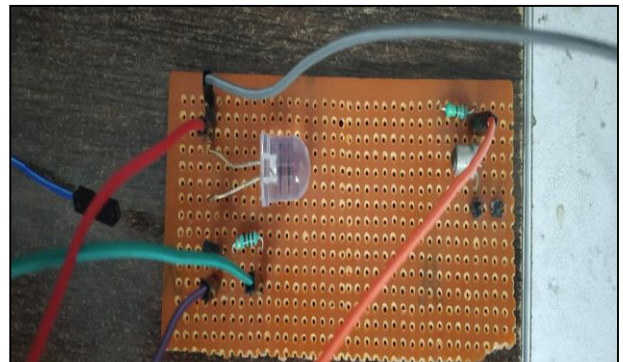


Fig.No.4 Transmitter and Receiver section

V. RESULTS

If you have to add another vehicle to Toll booth, then add vehicle in that app

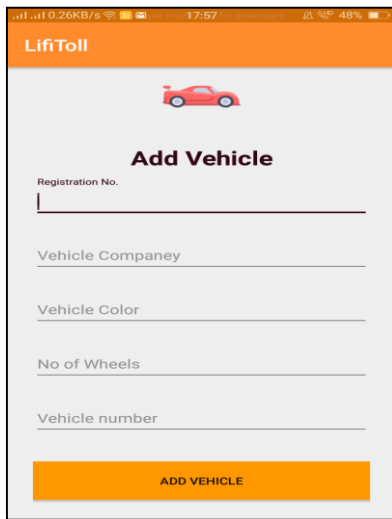


Fig.No.5 Add vehicle

If you have to travel in two ways i.e. you will be return from the same way, then update your journey i.e. one way or two ways.

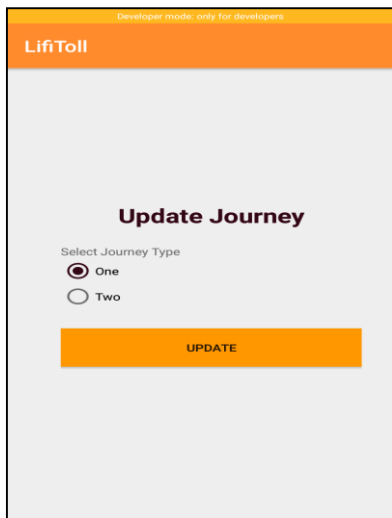


Fig.No.6 Update Journey

When you select your journey mode after that you have to pay, then transaction window looks like this.

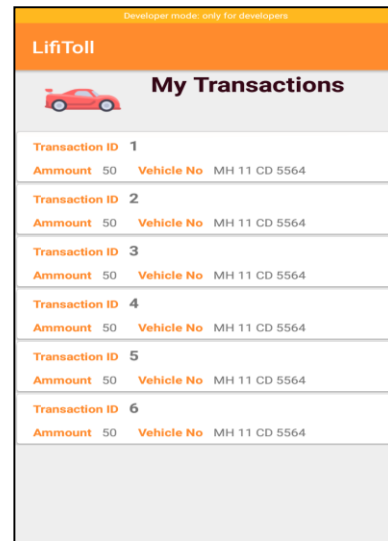


Fig.No.7 My Transactions

Automatic Toll system look like this

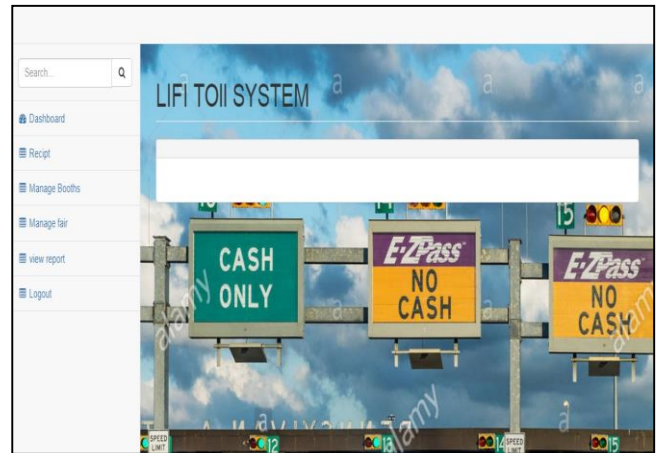


Fig.No.8 Li-Fi Toll System

When admin wants to add Tollbooth in system, then select add toll booth option.

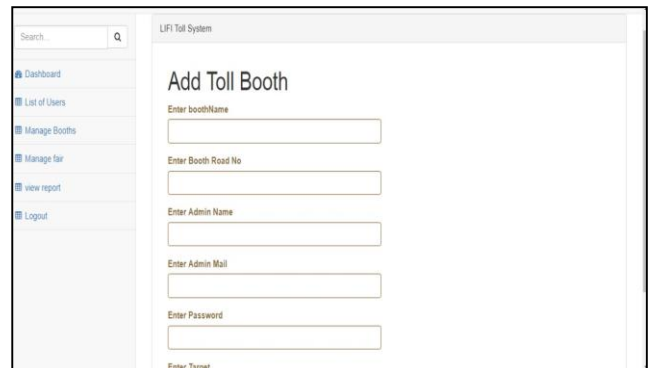


Fig.No.9 Add Toll Booth

When user pay Toll charge then receipt will be generated including their name, vehicle name, vehicle number and Toll charge.

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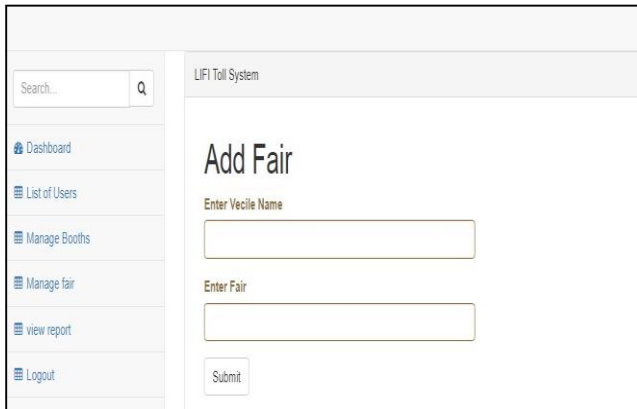


Fig.No.10 Add fair

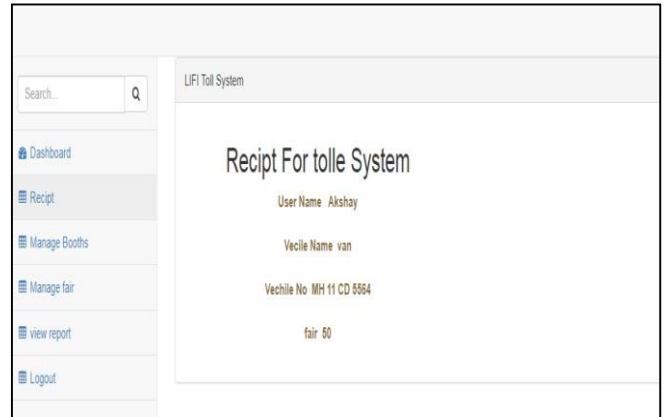


Fig.No.13 Receipt for Toll System

At the end you will see the total list of vehicle which will be gone through the Tollbooth.

VI. RESULT ANALYSIS

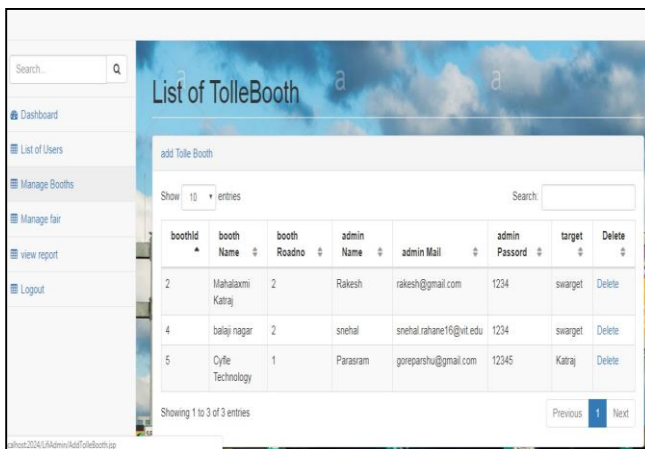


Fig.no.11. List of Tollbooth

As shown in fig.No.5, fig.No.6, fig.No.7 when new vehicle enters into the toll booth area then add the new user into the app, then there is facility for travelling one way or two-way journey and also all the truncations are shown into the given app. Then as shown in fig.No.8, fig.No.9, fig.No.10 here is one admin which control all the process and add the new toll booth, fig.No.11, fig.No.12 we can add number of toll booth and also see the list of added toll booth.

Finally, as shown in fing.No.13 User will get login credentials like login id and password. Once the user has entered correct email, password shown the welcome message along with his name. At the receiver end at the toll booth update the information in the server and database and also vehicle details stored. After getting that information the fare amount (toll) deducted from wallet of user which is notified the user via SMS and receipt will generate. all the process of toll collection, money will have deducted and receipt will generate.

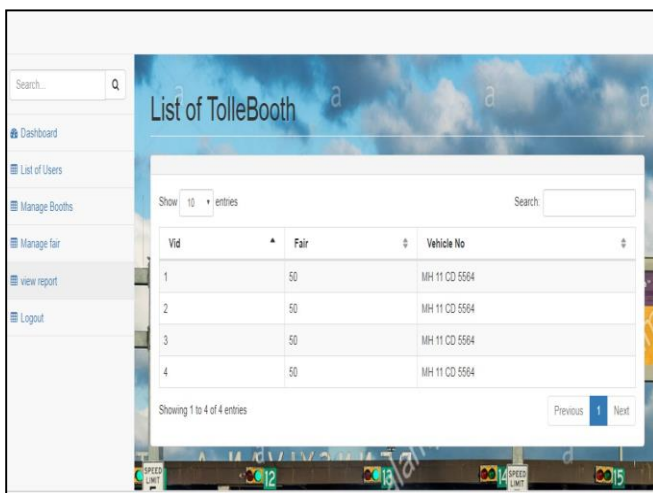


Fig.no.12 List of Tollbooth

VII. CONCLUSION

The Li-Fi based Toll Collection system, a design scheme was put forward. It is high security, far communication and efficiency, etc. It not improves the passage ability of expressway but also improve the technology level of charge. Toll collection system using Li-Fi is an effective measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station. In the design of the proposed toll collection system, real time toll collection and anti-theft solution system have been designed. This will reduce the manual and delays that often occur on roads. This system of collecting tolls is eco-friendly and also it will have increased toll lane capacity. And also an anti-theft solution system module which prevents passing of any defaulter vehicle is implemented, thus assuring security on the roadways.

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