International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Baggage Theft Detection in Railways using Li-Fi Technology

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Abstract - *Railways is one of the most prominent, efficient and cost-effective means of transport. Indian Railways stands 4th among world's largest railway networks and approximately 30 million passengers travel in Indian railways every day. Most of the general public prefer railways because of the flexibility and comfort they provide to passengers. But it must be known that baggage theft is one of the major problems faced by the passengers in the train. According to a study over 55,000 cases of luggage theft has taken place in the last 3.5 years. This activity tries to provide a solution to the problem. This research gives a brief about Li-fi technology and how it can be used to detect baggage theft. The proposed model consists of a Li-Fi transmitter and a receiver kept at either ends of the wall under the seat and works under the Line of Sight condition. When the baggage is placed, the line of sight is cut and in case the bag is removed, there will be a line of sight obtained. In such a case an alarming message will be sent to the passenger informing them of the theft.*

Keywords: *Baggage theft, comfort, Li-Fi, Line of sight, Passengers, Railways.*

1. INTRODUCTION TO LI-FI TECHNOLOGY

Light Fidelity (Li-Fi) is a Visible Light Communication (VLC) based technology that makes use of light as a media of communication replacing the cable wire communication. Light fidelity is a form of bidirectional, networked, mobile, and high-speed wireless communications closely equivalent to Wireless Fidelity (Wi-Fi) [1]. According to recent market research predictions, Li-Fi technology is expected to reach the market value of 8,500 Million USD by 2020. Nowadays, there are several commercial products and a few product prototypes that seem to be in their final stages before appearing on the market. The technology seems promising and even National Aeronautics and Space Administration (NASA) recently announced plans to study Li-Fi's potential uses in space travel. Li-Fi technology offers numerous benefits, however, there are still important challenges that must be overcome before it becomes a ubiquitous part of everyday wireless communications [2]. Li-Fi enables the electronic device to connect to the internet with no wire. In order to make a communication line between node, a Li-Fi will need a transceiver to transmit and receive the data. This transceiver will have a modulation technique to make the LED enable to carry the data using the light [1]. Fig.1 represents a basic block diagram of the li-fi technology.

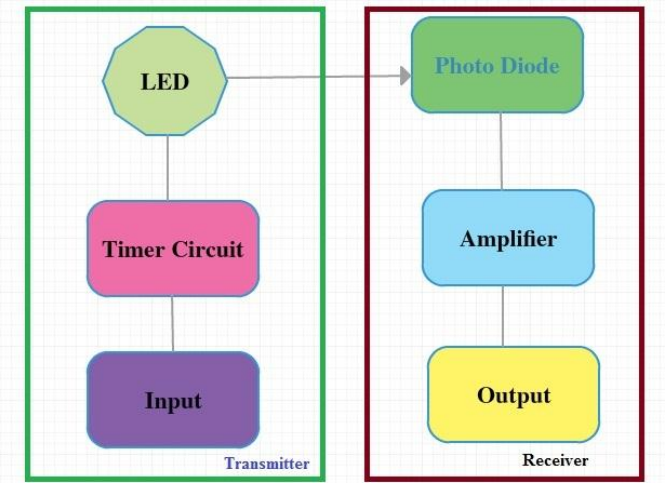

Fig.1 Block Diagram of Li-fi System

1.1 Block Diagram

Li-Fi system mainly includes two parts namely the transmitter and receiver. The input signal at the transmitter section can be modulated with a specific time period then send the data using LED bulbs in 0's and 1's form. Here, the flashes of LED bulbs are denoted with 0's and 1's. At the receiver end, a photodiode is used to receive the LED flashes strengthens the signal & gives the output. As shown in fig.1 the transmitter section includes the input, timer circuit, an LED bulb. The input of the transmitter can be any kind of data like text, voice, etc. The timer circuit in this section is used to provide the necessary time intervals among every bit, and these are transmitted to the receiver end in the form of LED flashes. The receiver section includes photodiode as well as amplifier. Here, photodiode receives the LED bulb flashesthen changes the flashes into electrical signals. Finally, the amplifier receives the signals from the photodiode and amplifies to provide the output.

1.2 How Li-Fi works?

Li-Fi is a VLC (visible light communications) system and the speed of this system is very high [3]. As shown in fig.2 Li-Fi uses normal LEDs to allow the data to transfer and increase the speed up to 224 Gigabits/sec. The data transmission of this technology can be done via illumination. The essential devices of this system are the bright light emitting diodes. The ON/Off activity of LEDs permits a type of data transmission in the form of binary codes but the human eye cannot recognize this transform & the bulb appear with a

stable intensity. Therefore, we use Li-Fi technology for luggage theft detection. The user is intimated every time there is loss of LOS (Line of Sight).

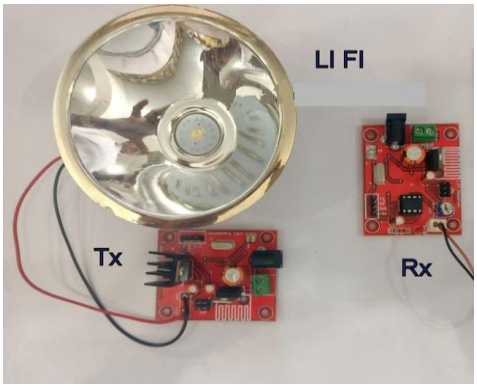

Fig. 2 Basic Li-Fi module

1.3 Advantages and Disadvantages of Li-Fi

The advantages of Li-Fi include the following:

- Speed-The speed of the Li-Fi is very high, and we can watch the videos without buffering.
- Security- The light of the Li-Fi doesn't run through the partition, therefore, it is more protected and hacking is not possible.
- Risk-free-Li-Fi utilizes light waves which are harmless.
- Consistent- The data transfer is more protected.

The disadvantages of Li-Fi include the following:

- Apart from several benefits, the Li-Fi technology is facing several problems. It requires LOS (line of sight), as well as the receiver, would not be a move in inside.
- The main problem is how the receiver will send the data back to the transmitter section.
- Another disadvantage of this technology is an interference of exterior light sources such as normal bulbs; sunlight in the lane of communication will cause intermission in the transmission.
- It doesn't work in the dim areas.

2. ABOUT BAGGAGE THEFT IN RAILWAYS

Data furnished by railway ministry under the RTI reveals that over 1.71 lakh cases of theft were reported in the last 10 years. Table I shown below represents total luggage thefts in trains in the corresponding years. In 2018, theft cases reached a peak of 36,584. In 2017, 18,936 cases of luggage theft were reported along with 415 robberies. A total of 27 dacoities took place inside trains and 155 passengers were robbed after being sedated. The police arrested 3,898 people. Similarly, in 2016, 14,619 luggage thefts took place and 441 robbery cases were reported. A total of 218 passengers were sedated and robbed and 3,331 people were arrested. While in 2015, cases of luggage theft stood at 12,592 and 555 robberies and dacoities were reported. A total of 284 passengers were robbed after being sedated and the police arrested 3151 culprits. According to officials, the maximum number of theft cases were reported from Central Railway at 3907 followed by Western Railway (2844), Northern railway (2480) and Southern Railway (2093).

TABLE I

Year	Total theft cases
2018	36,584
2017	18,936
2016	14,619
2015	12,592

From the above information it can be seen that thefts and robberies in train is increasing every year. In regard of the same, as per the direction of the National Consumer Disputes Redressal Commission (NCDRC), railways are now liable to compensate the passenger, for theft of luggage even in general class. But it must be noted that there is no measure taken for theft detection. Theft detection is important as it marks the safety of passenger's belongings and also saves on money to the government. So, this research aims on providing baggage theft detection by using the recently growing technology discussed earlier i.e. Li-Fi.

3. METHOD OF IMPLEMENTATION

Let us examine the implementation of this project in detail. Every passenger in the train will have a ticket. This ticket shall be digitalized with an RFID and linked to the contact number of the passenger. With the ticket, it is known that, the person will be allotted a particular seat. Every seat shall be allotted a particular area of space under the lower seats for keeping luggages and belongings. Our project desires to install Li-Fi modules underneath the lower berths in the coach. Every area of space will have a fixed hotspot range along with the li-fi module fixed. The transmitter, as shown in fig. 2, will be installed below the lower seat and the receiver will be mounted on the base surface. We know that Li-Fi is a

Visible Light Communications (VLC) system and such a system has two qualifying components: One device with a Photo-diode able to receive light signals and other light source coupled with a Signal Processing Unit. The VLC system signals work by switching bulbs on and off within nanoseconds such that human eyes are unable to notice it.

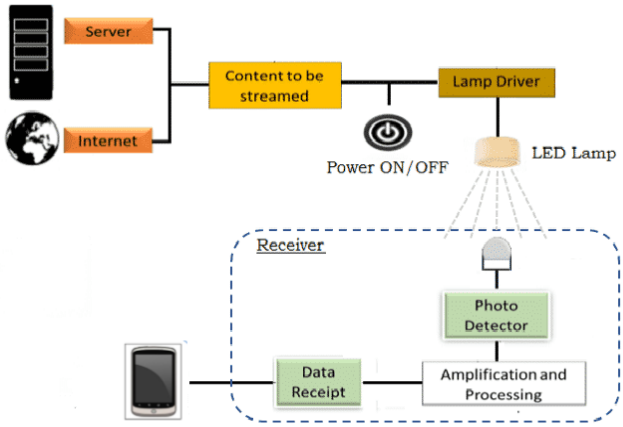

Fig. 3 Li-Fi working principle

High brightness white LED acts as a light source i.e. as transmission source. A silicon photo-diode with good response to visible light is the receiving element. LEDs are switched on and off to generate digital strings of combination of 1s and 0s. This the way li-fi is generally used. We have used the concept slightly differently. We adopt the concept of line of sight (LOS) between the transmitter and the receiver.

Fig.3 represents the setup and working of the Li-Fi module. There is a main server linked to the transmitter via internet. It stores the details of passenger such as the name and the phone number. The main power ON/OFF switch can be used to enable or disable the module. This helps in saving the energy required to run all the modules. The transmitted light from the transmitter LED is encoded with a set of characters. This light when received by the receiver will be decrypted to obtain back the same characters. Contents to be streamed consists of this information. Assume that there is a bag kept in between the lamp and the photo detector in the fig.3. This bag completely blocks the light from reaching the receiver. In such a case the there is no alarming message sent to the passenger as the bag is safe. In case if anybody tries to take the bag away from its allotted space of area or out of the hotspot range then, once the bag is moved there will be a direct LOS contact of light between the transmitter and receiver. When LOS is present a binary 1 is generated and when there is no LOS a binary 0 is generated. This signal is amplified and processed. Based on whether a '0' is received or '1'is received the further process is done. In case of '0' no action is taken and in case of '1' an auto generated message is sent to the traveler's phone. Hence, once the photo receiver is exposed to light, it assumes loss of bag. Therefore, an awakening message will be sent to the responsible passenger, so that he can be made aware of the theft. This process of implementation works well for thefts at nights and is best suited for sleeper coaches.

4. RESULTS AND CONCLUSIONS

The proposed project enables the handling of a complex problem i.e. baggage theft detection in railways which is still an unsolved problem in Indian railways. This system is very reliable and prevent heavy loss of belongings using Li-Fi modules which are mentioned above. It also improves the passenger comfort and trust by providing baggage theft alerts. This project i.e. baggage theft detection using Li-Fi technology has merits as well as some demerits. The shortcomings of this project are digital tickets and power supply for so many modules. It is necessary for the ticket to be linked to the contact number and also be able to scan for using the allotted luggage space. Power required may increase with the installation of numerous modules. Therefore, using solar panels on train tops to generate energy is the best way to overcome this demerit. The following are the advantages of this project. It is highly reliable as the passenger is notified every time the bag is moved out of its region. Usage of Li-Fi module makes it cost effective and also guarantees easy implementation in the coaches and marks the usage of a modern tool. Since this method makes use of led lamps they serve as a source of night lamps in the coaches. Moreover, theft detection saves on a lot of money for the government as they will not have to provide refund in case of loss of belongings and also it increases the passenger trustworthy. Altogether this project attempts to provide a complete solution for train thefts using Li-Fi technology thereby contributing to the society as well as Indian railways.

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