Internet of Things For Smart Railway: Feasibility And Applications

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Abstract- *The growth of the internet era has paved the way for the development of numerous applications. IoT plays a vital role in designing the devices that are very helpful to people by just a click away from the services they want to use. All the devices connected together by making use of internet connection and working for the same objective is termed to form an IoT environment. Various technologies have produced a variety of instruments and models that are used to support their lifestyle. Numerous applications can be built by making use of smart objects to make an effective IoT environment. IoT is used in various applications and has obtained immense growth in this technical era. Railways are one of the biggest backbones in India. A lot of manpower is required to maintain such a huge population and also to provide efficient transportation. In this paper, we have introduced a model that is capable of reducing the overall workload of the railway system by monitoring it. The system makes use of various IoT devices and also cloud environment to make process and analyze the information. The module is designed to be efficiently deployed in an unmanned level crossing barrier. The performance of the model is evaluated and is observed to be much efficient when compared to other traditional monitoring systems.*

Keywords- Railway monitoring System. IoT, Cloud Server, Loco Pilot, Barrier, Android Mobile

I. INTRODUCTION

IoT is an environment when all the objects are connected to each other through the internet. These objects send information to one another and work for a specific application IoT is one of the emerging technologies that is used widely in many fields. Some of them are Smart homes [1], Smart classrooms [2], Health Care [3] and lots more. IoT is responsible for communicating with numerous devices when connected to the internet [4]. Railways are one of the most important and vital backbones of our country. Numerous passengers tend to travel and use this as the main medium of transport from one place to another [5]. There are numerous accidents that tend to occur and the rate of accidents are growing higher as the increasing number of population. There is numerous loss of lives particularly while crossing the level crossing. Many people are not patient enough to wait until the train crosses and try to cross the barrier which is one of the most critical mistakes done by the public.

In order to eradicate this problem, we have designed a model that is able to use IoT devices for communicating with the android mobiles of the users through an application. With the help of the application, the user tends to know if the level crossing is closed or open and then make a decision of leaving home or workplace. A spike module is also deployed in the level crossing area that automatically comes up when the barrier is closed. This makes the commuters not crossing the barrier when a train is about to come. The proposed model could be efficiently deployed in an unmanned level crossing to reduce the risk of loss of lives. A cloud server is used for sending and receiving the information. Various parameters are used for evaluating the performance of the model and is observed to be much efficient when compared to other traditional monitoring systems**.** The rest of the paper is organized as follows. Section 2 outlines the literature review. Section 3 outlines the research methodology used in this paper. Section 4 shows the discussion of the results obtained from the proposed method and Section 5 gives the conclusion and future works can enhance the model in the future.

II. RELATED WORK

Numerous applications have been developed by using beacons to secure the systems in an IoT environment. some of the research works that make use of beacons are stated. Numerous researchers have been working on enhancing the lives of commuters using the railways as the premium model of the transportation system and also for the other users who tend to cross the level crossing as their daily routine. Alexander Gluhak [6], performed a survey on various options and facilities that could be used for performing experiments with the IoT devices and environment. The author has discussed the various challenges that are encountered while using IoT devices and all the possible solutions are given for providing an efficient system. The paper also states all the requirements that are needed for making the betterment of the

existing system. Some of the merits included the support of the solutions provided to a larger application and also stated various solutions for many applications. T. Baker [7], proposed an efficient model for routing all the information obtained from analyzing big data that efficiently made use of cloud storage for processing and analyzing. The total energy that was consumed by the entire model was very minimal and also the response to the user requests was instant without a lot of time-consuming. One of the issues faced by the model was that it lacked load balancing and also maintaining the network traffic. Sang-Soo Kim [8], proposed an inspection on various parameters and characteristics of the railway system. The inspection was done to identify the track irregularity and presence of any other damage in the railway tracks. Real-Time testing was performed by making use of the HSR-350x in a distance of about 300km/h. The overall performance of the model was observed to perform well when compared to other systems.

In [9], the author had proposed an overall power model that was designed to encounter power consumption in an IoT environment. As this study is vital for deploying various IoT devices in an environment to exactly know the actual power consumption. The model made use of wireless sensor nodes for performing various operations like communication and processing. The proposed model was of minimal cost and also could be used for a public environment. One of the challenges faced by the model was the use of high power consuming sensor nodes. Sean Dieter [10], implemented an IoT environment for monitoring various environmental conditions that could be deployed in homes. The model made use of various sensing unit and also data aggregation systems. The monitoring system claimed that it was reliable to be deployed for monitoring homes by giving an accuracy of about 76% and also was tested on to produce graphical information.

III. PROPOSED APPROACH

The proposed model is designed to be effectively deployed in the railway level crossing bridge. Raspberry Pi 3 is used for connecting all the components. The major components of the proposed model are Camera, PIR sensor, Signal Module, and Metal detector. The camera is deployed to capture the images or pictures of the current scenario to the Raspberry Pi module in order to process the captured images. The PIR sensor is used to detect the motion of any moving objects. When the PIR senses any objects moving around when the railway level crossing gate is closed it sends the signal through the single module to the camera for capturing the images. The images are then sent for processing. The entire model is connected using a Wi-Fi connection and the signal are sent to the buzzer. The buzzer rings when any movement is recognized. In Fig. 1, the entire block diagram of the proposed model is depicted.

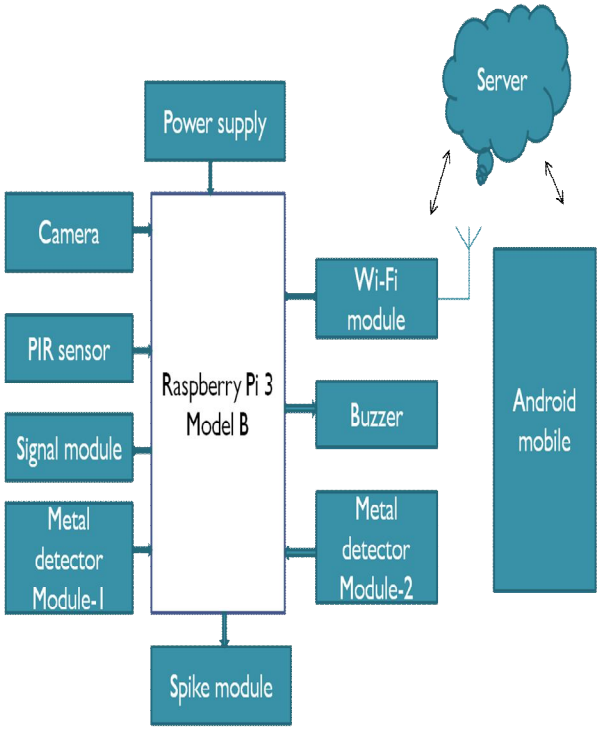

Fig. 1 Block Diagram of Proposed Model

The model is connected to a Spike module that is open when there is any movement recognized. All the information are sent to the cloud server from where the information is processed and analyzed. The data is used by making use of the android application from smartphones. When a user wants to cross the railway level crossing he can use the application to find if the barrier is open or closed. BY this he can make a decision whether to move or stay till the gate opens.

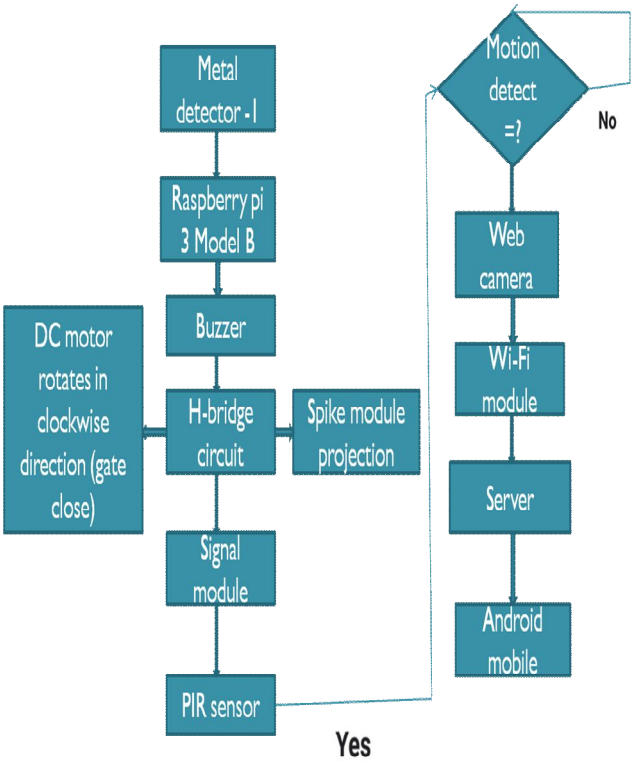

Fig. 2 Flow of the Proposed Model (Gate Closed)

There are two flows in which the entire model is operated. In Fig. 2 the flow of the model when the gate is closed is depicted. First, a DC motor is used to rotate the gate in a clockwise direction to close the level crossing so that no one crosses it when the train comes. Here a metal detector is used for placing a Raspberry Pi module so that all the process could be analyzed. The PIR sensor senses any movement in the surrounding if so the camera gets on immediately to capture the image and send it to the Loco pilot to take necessary actions. In case if someone also tries to cross the level crossing the spike module gets opened that punctures the wheels of the vehicle crossing so that it cannot further cross the level crossing. In Fig. 3 the flow of the process when the gate is open is depicted. As soon as the Gate pens by the DC motor, the signal module receives the signal and then automatically sends the information to the spike module. The spikes that are present on the roads disappear so that the vehicles could move and cross the level crossing.

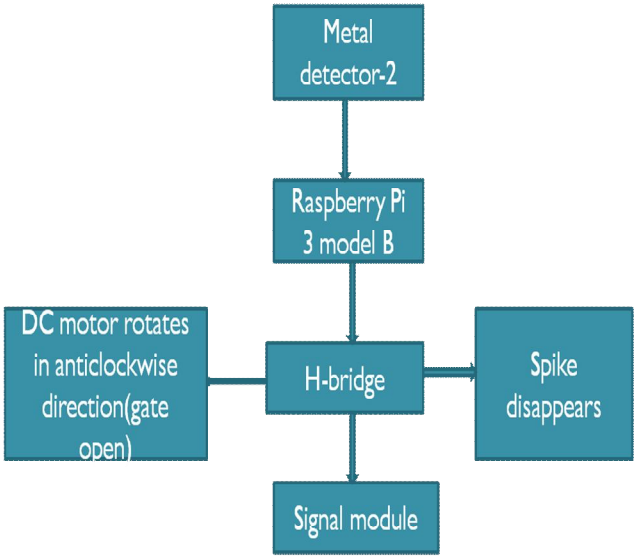

Fig. 3 The flow of the Proposed Model (Gate Open)

IV. EXPERIMENTAL RESULTS

The experimental evaluation was performed on the designed model. Various parameters were used for evaluating the model. Spike Module that is used to puncture the wheels of the vehicles depicted in Fig. 4. The module is depicted when the level crossing is closed. At that time the spikes are open such that any vehicle crossing the spike module will automatically get punctured. In Fig. 5, the spike module is depicted when the gate is open. While the gate is open, the commuters are free to cross the railway level crossing and hence the spikes are also closed that makes the vehicles move without causing any damage to the wheels.

Fig. 4 Spike Module when when Gate is open

Fig. 5 Spike module Gate is closed

The entire model is made using LINUX and uses ARM Linux GCC 4.4.6 for compiling the data. Python and OpenCV are used for coding purposes. The overall performance of the proposed model is shown in Fig. 6. The

performance measures observed while working with the proposed model states that the overall model is flexible and could be used for continuous monitoring of the level crossing bridges when there are no security or guards in the level crossing and it is unmanned.

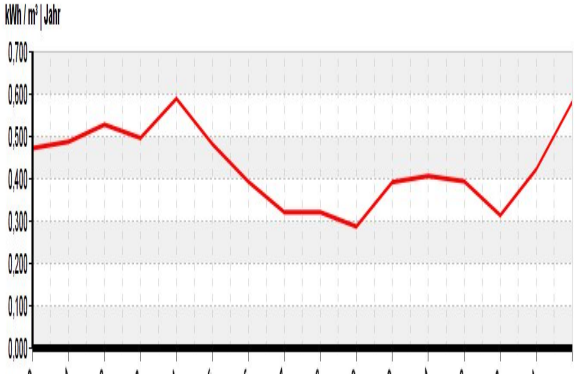

Fig. 6 Efficiency of Proposed Model

This system can effectively reduce the number of manpower required for maintaining and securing the railway crossing. The cloud is used for storing and processing the information and is directed to the user applications. The buzzer serves to be very helpful by ringing that makes the people in the area to know that the gate is closed and they think of crossing the gates.

V. CONCLUSION

Railway's os one of the biggest network of India. In this highly populated country, it is very difficult to monitor the entire system. There are numerous accidents that tend to occur due to poor monitoring. In this paper, we have proposed a model that is capable of communicating with all other connected devices in an IoT based environment. The mode comprises of PIR sensor that effectively communicated if there is any movement in the railway crossing while the gate is closed. When movement s are detected the camera captures the images and sends to the loco pilot. Spike module is also used to puncher the vehicles when they tend to cross the level crossing when it is closed. The buzzer is also used to give a signal to the commuters that the railway crossing is closed. The android application is also used for checking the opening and closing time of the gates. The performance of the model was evaluated and was observed that it performed well than the other traditional models. Future work could include the use of machine learning techniques to automatically detect the movements around the railway crossing.

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