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RAILWAY COLLISION AVOIDANCE SYSTEM USING PATTERN RECOGNITION AND OBJECT DETECTION

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Abstract **–**In our country accidents at rail road crossings are increasing day by day and the train accidents cause severe damage to life and property. These accidents take place mainly due to human negligence, equipment failure, derailments etc. To solve these problems and to save lives unnecessarily lost we have come up with a solution of automatic railway collision avoidance system using pattern recognition and object detection algorithms. Pattern recognition algorithm developed is used for recognizing different patterns of the train and object detection algorithm is used for giving an alert to the driver about any object that is stuck on the track. Many scholars have already identified various solutions regarding this problem. But they were deficient in deriving mechanisms that predict whether the arriving object is train or not. This in turn produces wastage of energy. Also they were unsuccessful in achieving accuracy for object detection algorithms. Our proposed solution overcomes these drawbacks using pattern recognition, object detection and live video streaming using IOT modules to produce best results to the problem of accidents faced.

Keywords **– Pattern recognition, IOT, Object detection, railroad crossings, sensors, IR camera, Central server.**

1. INTRODUCTION

Accidents at level crossings is the most critical problem faced by many countries. If these crossings are automated then the rate of accidents occurring in these areas can be reduced. But designing this system involves many challenges. Many researches have proposed a solution for our problem but that solution includes various drawbacks. They have not devised any mechanisms that predict whether the coming object is train or not. This produces of wastage of energy. Also they have designed systems that does not help or save any object like an animal, a vehicle that is stuck on the track.

Our proposed system overcomes all these drawbacks and also provides an efficient solution to all railroad accidents. Our system also uses similar components like sensors, arduino board, motor receiver etc. Additionally we have fixed a camera near the gate for image processing techniques. We have developed a pattern recognition algorithm to recognize patterns of different trains with different speeds. Only if arduino recognizes the pattern of the train in the arrival object then gates close at the level crossing. Also we have designed an object detection algorithm to inform trains passing through that route about the obstacle that is stuck on the track. A live video of object that is stuck is streamed on driver's mobile using port and socket programming of IOT. Then the driver takes decision considering the lives of passengers present inside the train.

The overview of our paper is as follows: Section II deals with literature reviews. This part shows solutions proposed by many authors to our problem. Section III presents the methodologies used by us to bring an efficient solution. This section also gives a detailed description of algorithms used, block diagram, UML diagram and many more. Section IV deals with results and discussion of our system. This section involves comparison, performance and evaluation measures. Section V concludes our paper. Section VI acknowledges our project and tells about who and all encouraged us to do this project. The last section presents you with the list

of references we have referred to design our project

2. LITERATURE REVIEW

In [1], Razi Iqbal et al proposes the use of Zigbee wireless modules for wireless communication between wireless sensor networks. Due to their low power efficiency and inexpensive nature, they are being chosen to be used for proposing the system. But still, lack of funding and less data rate transmission speed has been the drawbacks to further improvise the system.

Some of the methods such as Static and Doppler methods are being implemented in [2] to automate level crossings. Rathankumar et al had proposed dynamic error correction methods also in order to implement the system correctly. Even though this sytem has many computational effective algorithms, there are several drawbacks in social as well as in economical.

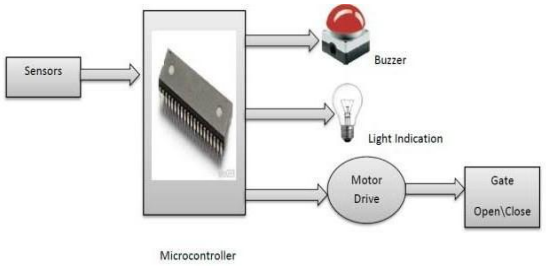
In [3], B.Brailson et al worked on designing a L-shaped cylinder in the place of servor motors for the movement of the gates where there is no need of reservoir pump. Here, Infrared detectors are used to detect train's arrival during night and daytime and send signals to the controller.

Aniqua Rahman et al used Vienna development specification language (VDM-SL) to correctly implement the system in [4]. Deterministic finite automata method was implemented to present uml and formal model of RGCS. There is still no proposed solution for this system as it consumes a massive amount of energy due to the poor awareness of train's arrival or departure.

Afsana Ahmed et al have proposed Multiple gate controlling system and also Bi-directional train tracking in [5] using an alarming system. One of the best solutions proposed here is the use of Wemos D1, a controller in which a couple of IR sensors are embedded for train detection and also the use of Think Speak server, to transmit the data to the central database. This solution can be applied to control multiple rail gate systems, but also has its own drawbacks by not using ultrasonic sensors in order for more accuracy of the train's arrival or departure in an effective way.

3. METHODOLOGY

Our project includes three modules namely embedded coding which uses pattern recognition algorithm, image refining which uses object detection algorithm and video streaming. These modules are implemented using the domains of image processing and IOT. Image processing techniques were used for refining the image by removing



the blurr and noise occurrences. Also they were used for detecting the object on the screen by enclosing the object within square boxes. IOT methods were used for connecting the driver's mobile to central server. The embedded module involves the working of sensors and arduino.

4. MOTIVATION:

The increasing number of accidents in railway tracks is increasing day by day. Before it was happening once in two years like that but now its happening once in six months. We wanted to do something to stop these accidents and save all innocent lives. So we came up with this paper and also if approved by the government we can help you to implement the same system in real time. Our system with less cost and with less energy consumption can stop all railway accidents that are happening or going to happen.

5. EXISTING SYSTEM:

The components required for building this system are sensors, motor, arduino board etc. The actual working of this system is depicted as follows, sensors read the data of the arriving train and send those datas regularly to arduino. Arduino inturn sends signals to the motor receiver fixed on the gate. Depending on these signals the gate opens or closes for a particular time. This is the system devised by many persons using different algorithms. The drawbacks that occur while implementing this system are we cannot predict whether the arriving object is train or not. Here a huge amount of energy is wasted unnecessarily. Also this system does not support any vehicle or human or an animal that is stuck on the track. So this actually leads to loss of many innocent lives.

6. PROPOSED ALGORITHMS AND SOLUTION :

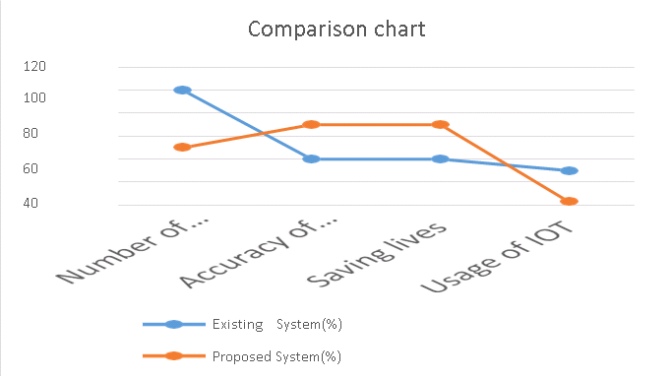
Pattern Recognition:

This algorithm is designed for recognizing patterns of movement of trains with different speeds. The software we have used here is sketch. We have developed this

algorithm by going through the data of various samples recorded when trains passes through the sensors. Initially we got values in analog form that is in the range of 500-1000 etc. Then we converted that to digital form which describes every signal as either on or off that is 0 or 1. We pasted two stickers at the start and end of a compartment and designed our algorithm in such a way that we made the sensors to recognise the pasted portions as 1s and the other portions as 0s. Then we counted the number of 0s and 1s for various arrival and departure of trains with different speeds. Finally we recognised the pattern and developed our algorithm in such a way that only when trains arrive the gate closes else it does not. We have recognised a simple pattern which works for all types of trains with different speeds.

Object Detection:

This algorithm is designed to detect objects that is stuck on the track and inform details about that object to the driver. The whole algorithm is designed using open cv libraries and python idle environment. We have implemented this algorithm using various image processing techniques. Usually it is difficult to detect objects using infrared camera because of noise and brightness present in the atmosphere. We have used functions like Gaussian Blurr to remove blurriness caused by dust particles and noises in the surroundings, Contour Area to set the screening limit of camera and Cvt to convert the image recorded to gray colour. We proceeded first by converting the screen to gray and only if motion of an object is detected that motion is shown by white dot pixels joined by lines. Only if object size is greater than a certain value that object's image is sent to the driver. Train's haulting is not easy so driver should take decision to hault only if the size of objects stuck is large. So using contour area function we have set values to the camera. We have also used threshold function to focus the object even when brightness is too high. Once object's motion is captured in the camera the camera simply focuses the object removing all impurities and sends it to the driver's phone with good clarity. The object is also shown clearly to the driver enclosed within square boxes. This we have implemented by setting boundaries to objects captured using python idle software inbuilt functions.



Video Streaming:

This module involves the working of port and socket programming. This programming is derived from the concepts of IOT. The major part here is the working of xampp server which is operated in central server. The camera sends its video to the central server only when any motion is detected in the track and also its size is large. Rest of the time the server is informed with the message of nothing to update. Object detection update is sent to the driver only when the train is arriving near the gate and the gates are closed. When the train is away from the gates the driver is intimated with the message of nothing to update. This mechanism is implemented by connecting IP addresses of central server with driver's mobile phone. Only trains which are passing through this route will receive alerts because those trains pnr numbers are stored in central server's database.

7. SEQUENCE DIAGRAM

Train: The train will consist of a monitor or a screen in a position that is visible to the driver, so that any alert can be indicated. Database of the train is stored in the central server using IOT.

Ultrasonic Sensor: These sensors are embedded in arduino in order to detect train's arrival or departure through electronic waves being transmitted from the sensors to the train and vice versa. The ultrasonic sensors play a vital role in PATTERN RECOGNITION. Main advantage of using ultrasonic sensors to IR sensors is that these sensors can transmit data in a larger scale of upto 100km.

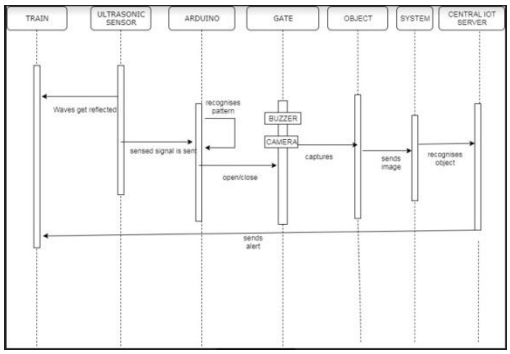
Arduino: The Arduino plays a crucial role in controlling the system by receiving the signals from the sensors and instructing to open or close the gates. It sends the detection to the servo motor to operate the gates.

Gates: The gates are controlled by the Arduino and the servo motor where they open and close according to the train's arrival or departure and to the speed and frequency of the train on the tracks. The gate will consist of an infrared camera and a buzzer to capture any arrival of objects and train and buzzer is used to alert the incoming new objects for the train's arrival.

Object : Objects such as animals, vehicles etc that trespass through the rail gates are being captured by the camera and the information is then sent to the train's monitor to activate the buzzer or to alert them if any object is stuck on the tracks. Objects greater than 2000 pixel size are only detected and alert is sent.

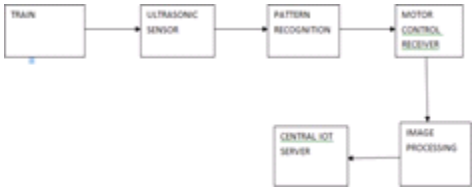
System: The central system recognizes the object and sends the particular information to the Central IOT server.

Central IOT Server: Data from the system is received by the central server and is stored in a database and this information is being passed to the train's monitor ,display in the particular object being stuck on the track so that the driver will be aware and will take necessary precautions. This information is sent via an IP ADDRESS of the server to the train's monitor, displaying the object and also with an alarm sound.



8. BLOCK DIAGRAM

Our proposed algorithm works in three different phases.



Pattern recognition:

The waves from the ultrasonic sensor get reflected by the train. And then a pattern is created in the form of zeros and ones from the processed signal.

Object detection:

The object is detected by the means of a camera. This is further processed using image processing techniques and the final image of the object detected is obtained .

Central IOT server:

The central IOT server contains the PNR numbers of the trains passing in that route. Hence the processed image from this server is sent to the mobile phone of the driver.

9. RESULTS AND DISCUSSION

After performing all the above discussed methods, we were able to accomplish the desired output. The training of the objects names resulted in failure but we resulted in displaying the image of the object itself which is even more helpful to the driver as if only the name is the driver cannot decide the type and size of the object perfectly.Moreover, the time lapse between the train's arrival and the object in danger is high

The above graph shows the comparison of existing system with the proposed one. In our system gates open or close only on train's arrival not for any other object. So number of times gates open or close is very much less compared to the existing system. If our system implemented in real time it can save the amount of energy used. Also when an object's motion is detected it is immediately informed to the driver with an accurate image. That much accuracy is not obtained by the existing system. Existing system has not been devised to save the life of objects or living things that is stuck on the track. To the maximum it can save only 30-40% of the lives whereas our system can almost save 70% of lives of objects or animals that is stuck on the track by image processing and IOT. Efficient communication between the devices is not established in the existing system because they have not used the concepts of IOT. But we have used the concepts of IOT which establishes strong and lossless communication between the devices.

10. CONCLUSION

This paper mainly employs three primary parts namely embedded, Image processing and IOT. Of which embedded part involves pattern recognition. Image

processing finds use in various fields including medical, geographical, communication, robotics etc. Though automated railway gate control system had been implemented already in foreign countries, all major drawbacks has been overcome in this paper by adopting two prominent technologies, pattern recognition and object detection. Thus after being involved in deep research and witnessing numerous errors in the process of conducting trials we were able to achieve our proposed system with due perfection and clarity.

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