

## Railway Tracking and Automatic Gate Control System

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### Abstract

Abstract - The objective of this paper is to design and develop an automatic railway gate control system at a level crossing. In conventional gate control system, the actuation of the gate at level crossing was controlled by the gate keeper. In this method the 'waiting time' of vehicle and pedestrians is uncertain as the actuation of gate is done with respect to the distance from which the train is approaching towards the gate. The automatic gate control system reduces the time for which the gate remains closed. This type of gates can be employed in an unmanned level crossing where the chances of accidents are high. The proposed system uses Matlab software along with Matlab Mobile. With the 'Automated Railway Gate Control System' the time factor is kept constant and distance factor is kept variable. So, the 'waiting time' at the gate is always constant irrespective of the speed and distance of the train traveled and also error due to manual operation is prevented.

**Key Words:** Automatic railway gate control system, actuation, Matlab, Matlab Mobile

## 1 INTRODUCTION

India is the country which is having worlds largest railway network Indian railway contains thousands of kilometers railway tracks and there are hundreds of railway crossings. Transport is an important part of India's economy but it is poor in comparison with international standards. Train Accidents in India have caused a number of deaths which is not only unfortunate but also disturbing. It raises question on Railway Safety because most common means of transport should not be dangerous and scary. Due to lack of manpower in remote areas, the railway authorities are unable to monitor all the level crossings. Secondly the manually operated railway gate crossings are prone to mechanical faults and people have to wait for long time for the gates to open. This leads to accidents at the crossings, intern results in casualties, losses of lives and losses of public time.

This paper presents an automatic railway gate control system. The model uses MATLAB software, MATLAB Mobile, Webcam. In this project the arrival of the train is detected using Matlab mobile software and the people crossing are also alerted. So if no obstacle is found on the webcam installed on the front of the train a green signal is given for the train to pass, otherwise a red signal is given to slow down. After the obstacles are cleared, the gate is closed and train is passed. The system has been designed, developed and tested. The quick response technique implemented in the system reduces the gate operation time and also the waiting time. Superior image based detection and control, quick response, database support, human attention and intervention free etc. are the merits of the system.

## 2 HARDWARE IMPLEMENTATION

The materials and components that are used in automatic railway gate control system will be discussed in the following. As in normal control design, system can be roughly divided as input, output and processing sections. The main components, software and devices of system are:

1. MATLAB software -MATLAB is a programming language

used for matrix calculations, developing and running algorithms, creating user interfaces and data visualization .The multi-paradigm numerical computing environment allows developers to interface with programs developed in different languages, which makes it possible to harness the unique strengths of each language for various purposes.

2. MATLAB mobile It is basically installing Matlab in mobile and using the sensors in the mobile to obtain the data for analysis. It helps to acquire data from built-in sensors on the device, and send the acquired data to a MATLAB session running on the computer or the Math Works Cloud for further analysis and visualization. Sensor data that can be obtained are:
  - Angular velocity on 3-axes
  - Magnetic field on 3-axes
  - Orientation (azimuth, pitch, and roll)
  - Acceleration on 3 axes
  - Position (latitude, longitude, altitude, horizontal accuracy, speed, and course)
3. Microcontroller- Microcontroller used is Arduino Uno AT-mega328 P. The Arduino is used to actuate the buzzer and light when the signal comes or the conditions are satisfied during opening and closing of the gate of the level crossing.
4. Buzzer and light signal -They are used to warn the road user about the approach of train. When the train is in the vicinity of the level crossing the buzzer will alarm the crossers that train is near and allow them to take the decision quickly.

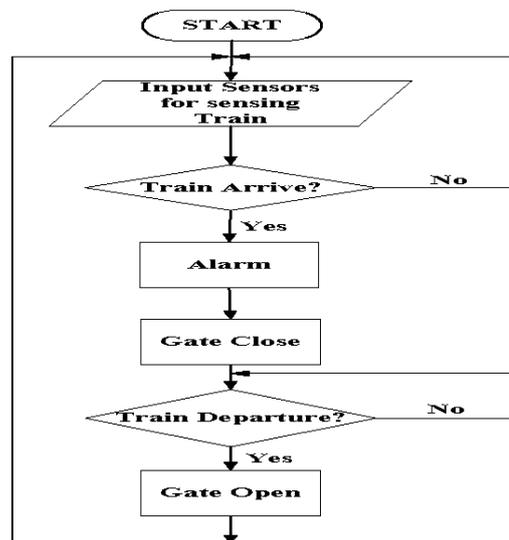


Fig. 1 flow chart for Railway Gate control system

Algorithm used in the flow chart is explained below-

- STEP 1: Start.
- STEP 2: Set the input sensors for sensing train. Establish connection with the mobile Matlab for sensing various parameters like latitude, longitude and speed etc.
- STEP 3: Check for the arrival of the train by the sensors. If the train is sensed go to step 4 and step 5 otherwise step 3. In this system we are using two parameters distance which remains fixed and speed to control the gate. The speed of the approaching train is calculated at every kilometer and compared. If the speed is slow and distance is more than the railway crossing gate is kept open where as if the speed of the train more when compared at some distance than the given value the gate closes.
- STEP 4: Make the warning signal for the road users.
- STEP 5: Close the gate. The webcam installed on the train also monitors the level crossing. When no person or vehicle is detected

the train passes the level crossing but instead if the webcam senses any moving object the train slows down and stops.

STEP 6: Check for the train departure by the sensors. If the train sensed go to next step. Otherwise repeat STEP 6. The speed of the train is checked at every certain fixed distance when the train is arriving, similarly when the train is far enough the gate again opens.

STEP 7: Open the gate.

STEP 8: Go to STEP 2

### 3 FORMULA USED

Haversine formula -The formula determines the great circle distance between two points on the sphere if we know the details of their longitudes and latitudes.

Important in navigation, it is a special case of a more general formula in spherical trigonometry, the law of haversine, which relates the sides and angles of spherical triangles.

$$d = 2r \arcsin\left(\sqrt{\sin^2\left(\frac{\phi_1 - \phi_2}{2}\right) + \cos(\phi_1) \cos(\phi_2) \sin^2\left(\frac{\lambda_1 - \lambda_2}{2}\right)}\right) \quad (1)$$

Where -

- d is the distance between the two points (along a great circle of the sphere; see spherical distance),
- r is the radius of the sphere,  
item[•]item[•]  $\varphi_1, \varphi_2$ : latitude of point 1 and latitude of point 2, in radians
- $\lambda_1, \lambda_2$ : longitude of point 1 and longitude of point 2, in radians

### 4 WORKING

In this model mobile Matlab app is used to acquire the data such as speed, time, latitude and longitude using the sensors of the phone

and GPS technology. The distance between the train and the crossing is calculated based on the haversine formula using the latitude and longitude we obtained from our mobile. The data obtained from the mobile and the distance is fed to the MATLAB software and the parameters are compared. The speed of the train is compared at every 1 Km when the train is 10 kilometers from the crossing and conditions are established in the software based on that.

Hence based on the above diagram if the distance is less than 3 Km and speed is above 60 Km/hr.the gate will close. Similarly the gate will close if the speed at each 0.5 kilometer interval is greater than the input valve. If the speed is zero and distance is less than 1 kilometer then the gate will open and the people do not have to wait for the train to pass. On the other hand the gate will open if the above given conditions are not met.

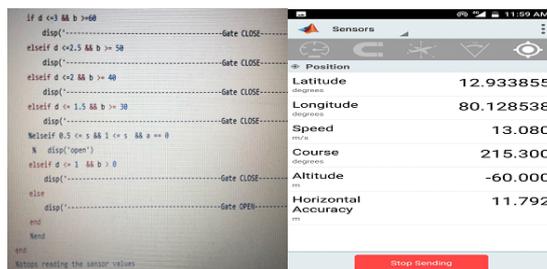


Fig. 2 conditions for controlling the gate Fig. 3 data obtained from the MATLAB mobile

## 5 TESTING

The model as explained have been tested from various places and the readings are very appropriate. One such tests involved the checking of the distance and speed from two different station and assuming that one station is the crossing level. The two stations which are selected are approximately 20 km apart. The map obtained is shown below it indicated that the red area is the place where the train is very slow or have stopped and the yellow area mean that the train speed is sufficient . Based on the Map or the parameters the speed vs time graph is also obtained as shown below. The x axis shows the time in seconds and y axis shows the

speed in meters per second. Based on the graph it is clearly seen that at what distance the train is slow and it is also shown that as it reaches the destination station the speed of the train slows down and based on the conditions set we can open or close the gate.

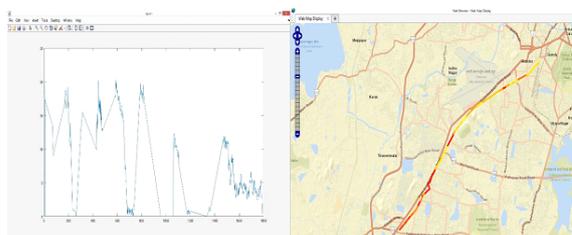


Fig. 4 speed (Km/hr.) vs time (sec) Fig.5- Map based on the speed of the train

## 6 CONCLUSION

Automatic gate control system offer an effective way to reduce the occurrence of railway accidents. By using android app and MATLAB software we can find current longitude and latitude position of train in caves and high altitude without restriction of distance. The results also showed that the system successfully differentiates between objects such as person. Thus it proves the importance of camera based sensors and the image processing technique in perfect identification of the object.

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