RAILWAY LEVEL GATE CROSSING CONTROLLER USING ANDROID & GSM

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Abstract— The system is constructed so as to achieve the control over the gate crossing situated at the railway level i.e. closing and opening of the crossing gates. In current scenario the gates are mostly controlled involving manpower which is usually placed at the level crossing. Here the proposed system makes use of an android platform. The working of the gate i.e. closing and opening of the gate is controlled with the help of an android application which will be on an android smart phone or a tablet. When a train is anywhere nearby the level crossing gate a SMS will be send from an android application. The SMS will be sending to the GSM modem which will interpret the SMS and it will then forward the command to the microcontroller. Then the microcontroller will feed the output signal to the motor and motor driver is switched on. It results in closing of the gate. Then for opening of the gate other command to open the gate will be given to the microcontroller through GSM modem from android application which will forward the signal to the motor driver. Here 8051 microcontroller is been used to complete the process.. Here an LCD is been used to display the current status of the railway gate i.e. open or closed which is attached with the microcontroller.

Keywords— Android Application, Microcontroller, GSM modem, Railway Level Gate.

I. INTRODUCTION

Indian railways have been in operation for 160 years and more. India is having the world's biggest railway network. The whole of nation is connected by railways. Over 100 of railway trains are running every day all over the country. Railways are one of the most consistent modes of transportation which has a very important role. Hence safety and reliability are very critical parameters of the Indian railways. However railway related accidents are very dangerous compared with other accidents in terms of death rate, severity etc. We know that it is not possible for a running train to stop at an instant in some critical condition or when any emergency condition arises. Train accidents are having a serious impact on loss of human life, damage to railway property, injury, and etc. Considerable factors which lead to railway accidents are collision derailments, fire in trains, and Collision of trains at the level crossing.

When vehicles or pedestrians are passing the level crossing there are chances for an accident to happen. The reasons for accidents are not easy to predict given all possibilities. If the train drivers solely depend on their own eyes or on some kind of warning signals which are given by the detecting drivers then they usually don't have much time to react to any such massacre happening. Also train drivers don't have enough time to take necessary measures or precautions, thereby leading to accidents at the level crossing. So in order to avoid all harsh things there arises a need for some independent system to overcome the problems faced at the level crossing. There are two types of level crossing namely manned and unmanned. The entire railway route includes nearly 14896 unmanned and 17839 manned level crossings [4]. Railways being the most cheapest and easy affordable modes of transportation for long travelling are mostly preferred all over the country over other means. When we take a glance over our daily newspaper we come to know across many types of accidents occurring at the railway level crossing. The reason is mostly because of lack of genuine workers, or may be due to carelessness nature in manual operations. Hence in order to make this accidents undone at the railway crossing we are making use of simple electronic system and introducing android platform along with electronic components in order to control the operation performed at the railway gate crossing.

II. LITERATURE SURVEY

Indian railways are one of the most important modes of transportation of our country. Indian railways are most used transport across the whole nation. The entire country is now connected by Indian railways. It is among the largest network in the world which covers a whole route of almost 65,000 km comprising of 7,112 stations with it. Indian railways consist of around 1, 15,000 km of tracks. In 2014-15 Indian railways almost carried around 8 billion travelers per annum that comes around 23 million travelers per day [5]. The entire railway route includes nearly 14896 unmanned and 17839 manned level crossings [4]. The point of crossing of the railway track and roads or highways is known as level crossing. The basic mechanism followed at the level crossing is that when a train is about to arrive at the gate crossing then the gate should be closed so that the normal road users don't pass out so as to avoid accidents. In the earlier times such level crossings consist of a flagman who used to manually perform the gate operations. When

a train was about to approach the flagman would wave a red color flag in order to alert the road users to make them stop and clear the railway track. Then afterwards manual gates were introduced.

Gate keepers were placed at such level crossing gates. These level crossing gates were operated by means of oral communication that took place over the telephone which was used to detect the train location and railway crossing gates were operated. When the train is about to arrive and when it is at a certain distance from the crossing gate then the gatekeeper placed has to manually close the railway crossing gate. The gates used consisted of full barriers which covered the whole width area of the road so as to prevent pedestrians, road users, even animals from crossing the gates and entering on railway tracks. Such operations that have been carried at the railway level crossing are very much unreliable. The reason is that it involves very long delay for the pedestrians, road users for them to pass through the level crossing. In order to avoid the delay some users try to cross the gate which in turn results into accidents occurring at the level crossing. Other reason could be that there may be timing errors of the gatekeepers. All this happens due to the manual operations which are performed by the gatekeepers resulting into injury and deaths.

Nearly 17% of the total accidents due to railways occur at the level crossings. The year 2013-14 has witnessed around 4 very critical accidents which occurred at the railway gate crossing [6]. Many different types of systems have been put forward and some of them have been practiced but they are having some inefficiency. Some of them are not stable in performance while some others utilize active sensors which are having inefficiency including instability, short reliability life cycles which in turn requires restoration in every coming years and making the whole system cost inefficient.

III. WORKING MODEL

The 8051 microcontroller is used as an main component for implementing railway gate crossing system. It consists of four 8-bit ports. They are basically called as input/output ports.

- PORT P0: This port acts as a general purpose input/output port, when no external memory is present. But when the external memory is present, then it functions as a multiplexed data and address bus. Basically it performs dual role.
- PORT P1: This is 8-bit port normal I/O port. This port is useful for different interfacing activities. It doesn't perform dual functions.
- PORT P2: This port also is very similar to PORT P0, this port is also useful as a general purpose port when no external memory is present but when the external memory is present then it works in conjunction with PORT P0 as address bus. This is also an 8-bit port performing dual functions.
- PORT P3: PORT P3 completely behaves as a dedicated I/O port.

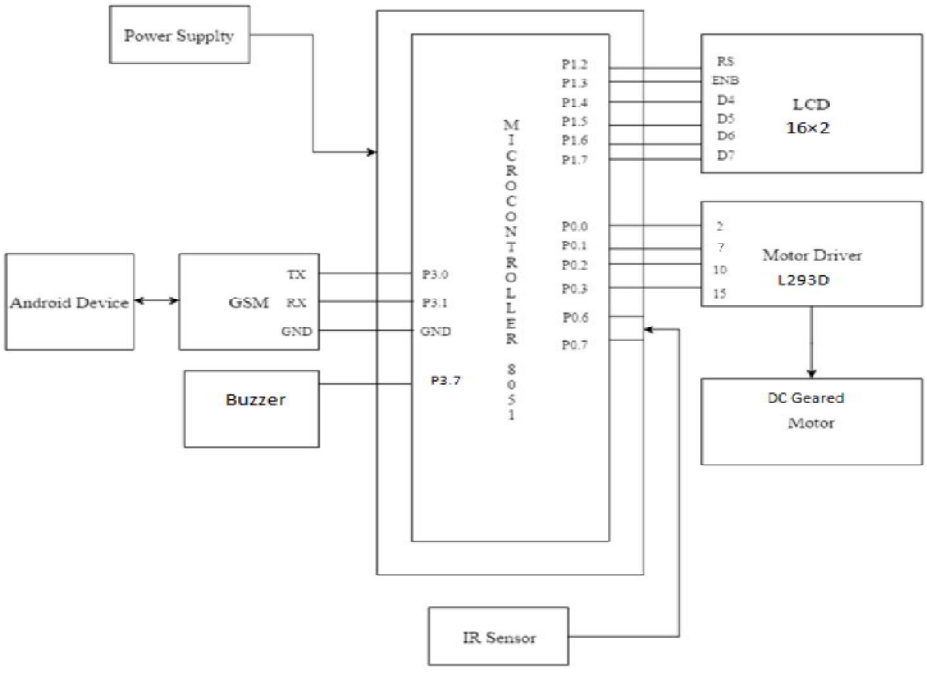

Figure 1. Block Diagram of Working Model

First, there are sensors which are being placed at both the sides of the gate. The sensors are placed at a certain fixed distance from the railway crossing gate. They are mostly used to sense the train running on the railway track. An IR senor can measure and detect the motion as well as heat of objects. Such type of

sensors detects only infrared radiation. Here an IR LED acts as an emitter and an IR photodiode acts as a detector. One sensor say S1 is connected for closing of the railway crossing gate and the second sensor S2 is placed opening of the railway crossing gate.

In figure1, we can see the sensors are connected to the microcontroller 8051. The sensors are connected on the port 0 of the microcontroller. Sensor S1 is connected to the pin P0.6 of port0. When the train is approaching towards the railway crossing gate then it is detected by the sensor S1 and it sends an output. Here the sensors output will be in the form of notification which will be sended to an android application. These notification notifies the android application user i.e. station master or train driver regarding the arrival of the train. When the train has passed through the crossing gate then again it will be detected by the other sensor S2 which will be placed on the other side of the gate. The purpose of this sensor is to detect departure of the train. This sensor is connected to the pin P0.7. Once the train is sensed by sensor S2 then again a notification will be send on the android application notifying that the train has departed. Once the sensor S1 detects the train arrival, then a RED signal is also turned ON. This will act as a warning to the road user informing about the arrival of the train at the railway crossing gate. Also when the train has departed from the gate then it is sensed by sensor S2 and then the RED signal is turned OFF.

We are using an android platform for improving the performance of our system. An android application is being built which will control the main operation of the crossing gate. Figure 3. shows the layout of our application built on android platform. The functions performed by the android application are:

1. Receives a notification regarding the arrival and departure of the train at the railway crossinggate.
2. Sends the SMS i.e. to open or close the railway crossing gate.

On receiving the notification regarding the arrival and departure of the train at the railway crossing gate, the train driver or station master will give the respective commands/SMS for opening and closing of the railway crossing gate. These SMS will be forwarded to the GSM modem connected.

A GSM modem is being used to perform the mechanism. Here the GSM modem is interfaced with the microcontroller. AT commands are used to communicate with GSM modem. These commands are sending to the GSM modem from the microcontroller which gets activated and required operations are performed. 4 pins of GSM modem are used for connection. Figure 1.illustrates the interfacing of microcontroller and GSM modem. The port 3 is used for interfacing. The transmitter pin Tx of GSM modem id connected to pin P3.0 of microcontroller, the receiving pin Rx of GSM modem are connected to pin P3.1 of microcontroller. The other two pins of GSM modem are Ground and for power supply. GSM modem has sim300 module. These are wireless modem used to communicate with the microcontrollers and other devices. Operations of GSM modem are as follows.

1. Initially the connection is made to microcontroller.
2. Power supply is switched ON.
3. Now an SMS is send from android application to SIM present in GSM modem.
4. On receiving the SMS it forwards the commands to microcontroller.

A 16*2 LCD module is been used in the system. The LCD is been used which will display the status of the gate i.e. whether the railway level crossing gate is opened or closed.16*2 LCD module has 16 rows and 2 columns. It has 16 pins. As shown in Figure 1. Pin P1.4 to P1.7 of the microcontroller are connected to D4 to D7 pins of the LCD module. Through this path data goes to the LCD module. Pin P1.2 and P1.3 of microcontroller are connected to RS, E of module and signals are transferred along this route. The high logic of RS pin selects data register and low logic selects command register. If RS pin is high and put data in 4 bit data line (D4 to D7) LCD recognize it as data for displaying. If RS pin is low and put data, then LCD module recognizes it as command. E pin is for enable. A high to low transition will enable the module at this pin. Actually there are 8 data pins, but only 4 pins are connected to microcontroller. D4 to D7 are used to display the data and command instruction on these pins is placed.

L293D motor driver is been used in the system. Since output of 8051 is limited so motor having high required voltage need some drivers so as to give them desired input voltage. L293D takes input from the output pins of8051 microcontroller and these are forwarded of higher voltage which is required by DC motors. L293D is a 16 pin IC is used to control set of two DC motors. Two DC motors are controlled using single L293D IC. 4 pins of L293D are used, pin 2,7 on the left and pin 15,10 on right. Left input pins will adjust the rotation of the motor on left side and the right input for motor on right side. The motors are rotated according to the inputs across input pins as LOGIC 0 or LOGIC 1. This logic is used for rotating the motor in clockwise or anticlockwise direction. Logic 1 && Logic 0 means Clockwise direction. Logic 0 && Logic 1 means Anticlockwise direction. Logic 0 && Logic 0 and Logic 1 && Logic 1 means Idle. As shown in figure1. The pins 2, 7, 10, 15 of L293D is connected to Port0 of microcontroller i.e. P0.0 to P0.3. For motor to be in operation we need a powers supply of 9V. L293D uses this to drive motor which is applied at VSS. A Buzzer is being used in order to alarm the road user about the train arrival at the railway level gate crossing. The buzzer is connected to the pin P3.7 of the output port 3 of the microcontroller. As soon as train is detected it will raise an alarm. Also it will be use to raise an

indication for transferring the SMS from android application to GSM modem.

IV. IMPLEMENTATION

When the train is approaching the railway level crossing from one of the two side, the sensors will be placed at both the sides which will be at a certain distance from the railway gate detects the train approaching. There is an indicator light which has been provided so as to alert about the approaching train. This will help in reducing the accidents at the railway gate crossing.

Initially the signals are kept OFF alerting the road users that the gates are also opened so as the road users can traverse through the tracks to reach the respective other sides. Then if any train is appearing towards the railway gate crossing then it will be detected by the sensors. Immediately, it will send a notification informing about the train arrival to the train driver/ station master on android application. The android application layout is shown in figure 3. The train driver/ station master will be using the android application. This notification send will help the user in knowing that the train is about to arrive at the railway gate crossing. Also the signals will be turned ON once train is detected by sensor thereby alerting the road users. Then the train driver will send the SMS to close the gate from the android application resulting in closing of the railway crossing gate.

The crossing gate will be kept closed until the train completely passes through the railway crossing. Once train has completed passed the railway crossing then the sensor which is placed on the other side will detect the train departing. Once again a notification will be passed on android application to the train user informing him about the departure of train. Then again the train driver will send the open SMS for the gate to open resulting in opening of the railway crossing gate. Now the signals will once again be turned OFF indicating the road users that train has departed and now they can traverse through the railway crossing. The total work flow is been illustrated in figure 2. The system works whenever the train is detected by the sensors and the respective operations are carried out in a sequential manner.

A. ALGORITHM:

1. Start
2. Make the initial setting of the signals for the train and gate.
3. Check arrival of train by sensor. If train is sensed go to step 4
4. Else go to step 3.
5. Change the signal to alert the road user.
6. Send notification to android application about the train arrival.
7. Send SMS to close the gate from android application.
8. Gate is closed.
9. Check departure of train by sensor. If train is detected go to step 9
10. Else go to step 7.
11. Send notification to android application about the train departure.
12. Change the signal for road user.
13. Send SMS to open the gate from android application.
14. Gate is opened.
15. Go to step 3.
16. Stop

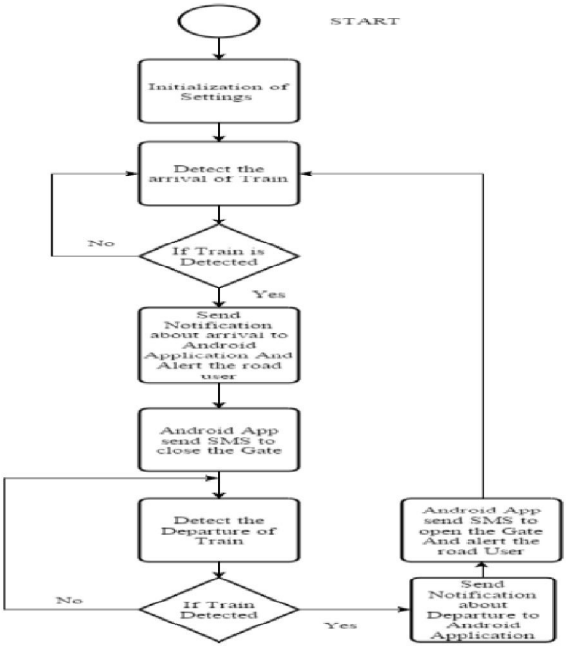

Figure 2. Flowchart for railway level gate crossing

V. RESULTS

The android application is being used to control the working of railway crossing gate. Figure3 illustrate the android application layout which has commands for opening and closing of railway crossing gate.

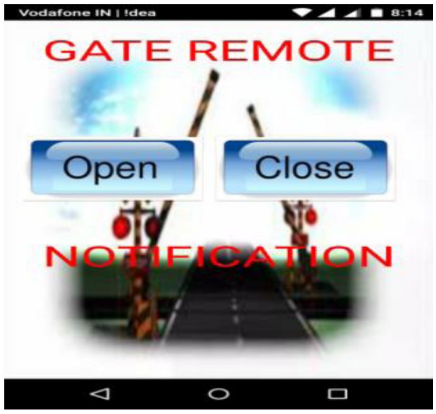

Figure 3. Layout of Android Application

Figure 4. depict that the train is about to arrive at the railway crossing once it is been detected by the sensors. Train driver will give command through

android application for closing of gate. The railway gate is kept closed when the train is passing the railway crossing. Also the signal is turned ON to alert the road users about train motion.

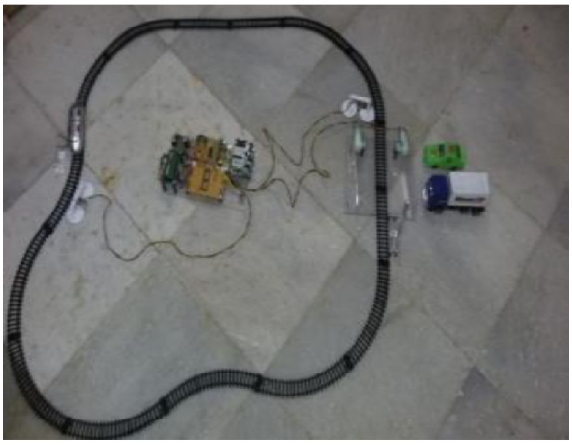

Figure 4. View of model when the Gate is closed

Figure 5. View of model when train is passing

Figure 5. illustrates that the road users are kept waiting till the train has completely passed the railway crossing. Once the train has completely passed the railway level crossing then the command to open the gate is given from train driver through android device. Figure 6. depicts that the gate is now opened after the train departure and the signals have turned OFF and the road users are traversing through the railway crossing to the other side of the road.

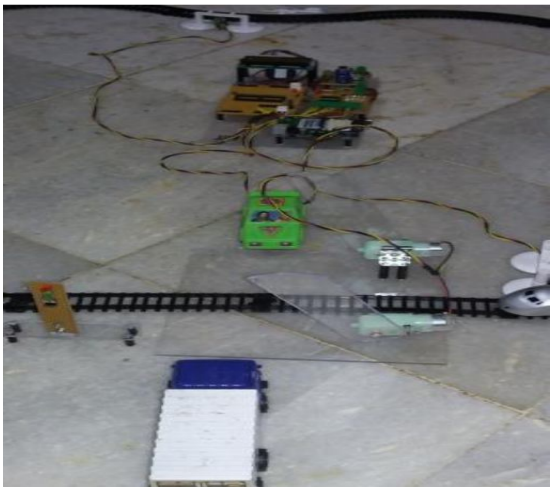

Figure 6.View of model when gate is open

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