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Arduino Based Automatic Railway Gate Control and Obstacle Detection System

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ABSTRACT: In the rapidly flourishing countries accidents in the unmanned level crossings and due to obstacle on track are increasing day by day. No fruitful steps have been taken so far in these areas. Our project deals with automatic railway gate control at a level crossing replacing the gates operated by the gatekeepers and detection of obstacle on track By employing the automatic railway gate control at the level crossing the arrival of the train is detected by the sensors placed in the side of the tracks. Hence, the time for which it is closed is less compared to the manually operated gates. Detection of obstacle on railway track deals with two things, Firstly it senses the any obstacle on the track by using sensors placed on the front end of the train and Secondly, to convey the obstacle detection message to the nearby railway station through GSM technology. The proposed system uses infra red sensors to detect the arrival and departure of trains at the railway level crossing, ultrasonic sensor to detect the obstacle on the track, GSM to convey the obstacle message to the nearby railway station and Arduino to control the opening/closing of gates and to convey the obstacle message. The review of train accidents of the last 5 years (2009-10 to 2013-14) for which the data is available indicates that a large number of accidents happen because of derailments & at level crossing. NCRB says a total of 2,547 railway crossing accidents led to 2,575 deaths and 126 injuries across the country in 2014. This motivated us to take up this project.

KEYWORDS: Arduino; GSM modem; Obstacle; Infrared sensor; Ultrasonic sensor.

I. INTRODUCTION

The place where track and highway/road intersects each other at the same level is known as “level crossing”. There are mainly two types of level crossing they are manned level crossing and unmanned level crossing. Railways being the cheapest mode of transportation are preferred over all the other means. When we go through the daily newspapers we come across many railway accidents occurring at unmanned railway crossings obstacle on track system. This is mainly due to the carelessness in manual operations or lack of workers. We, in this paper have come up with a solution for the same. Using simple electronic components we have tried to automate the control of railway gates. As a train approaches the railway crossing from either side, the sensors placed in the track at a certain distance from the gate detects the approaching train and accordingly controls the operation of the gate. As a train approaches the railway crossing from either side, the sensors placed in the track at a certain distance from the gate detects the approaching train and accordingly controls the operation of the gate. When the wheels of the train moves over the track there will be creation of vibration the sensor-1 senses the vibration and sends the signal to Arduino to indicate train arrival. The ultrasonic sensor placed at the front end of train detects the obstacle and also other train approaching from opposite side. When there is a obstacle it senses the object and send signal to the Arduino to convey the obstacle detection message to the pre-defined number through GSM technology. The accidents at railway gate level crossing and also due collusion are avoided by implementing this system.

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II. RAILWAY ACCIDENTS STATISTICS

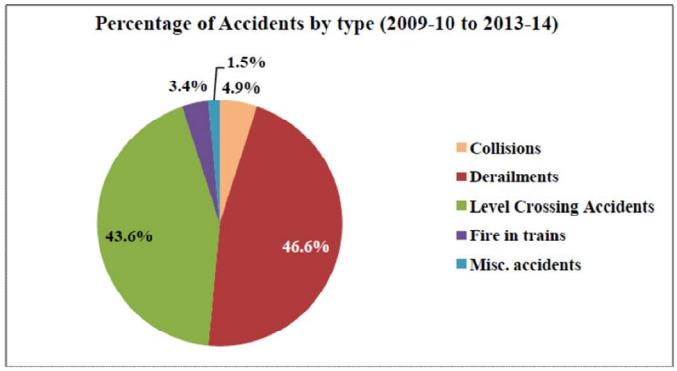

Fig 1: Illustrates the percentage of railway accidents in India due to various reasons during 2009 to 2013.

There are various reasons for railway accidents but derailments and level crossing accidents are more in terms of percentage of accidents. The percentage of level crossing accidents are more, this is due to errors made by gatekeepers and also due to unmanned level crossings. This can be avoided by implementing automatic gate system at level crossings.

III. SYSTEM DESCRIPTION

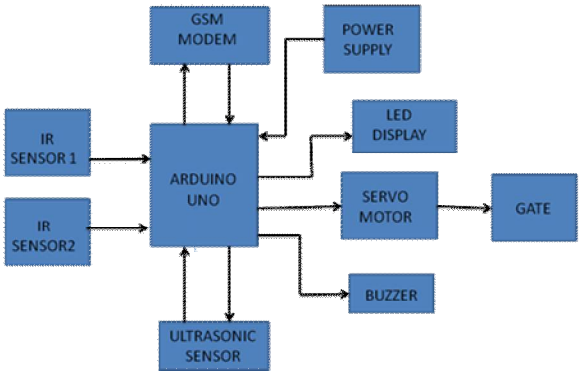

Fig 2: Block diagram of proposed system

The Arduino UNO ATMEGA328 is the main controller in this proposed system. The proposed system uses infrared sensors to detect the arrival and departure of trains at the railway level crossing, ultrasonic sensor HC SR04 to detect the obstacle on the track, GSM modem SIM900A to convey the obstacle message to the nearby railway station and Arduino to control the opening/closing of gates through servo motor and also to convey the obstacle message and indication signals to the road users (LED and Buzzer). When the arrival of the train is sensed, signals are sent to the traffic post indicating red light for the arrival of the train and at the same time gate remains closed until the train completely moves away from the level cross. When the departure of the train is detected by the second sensor, the traffic signal in the post turns green and the servomotor SG90 operates to open the gate. Thus automation of the gate operations at the railway level cross is achieved using sensors. When there is any obstacle on the track the ultrasonic sensor placed at the front end of the train will detect the presence of any obstacles and send signal to the Arduino. Then Arduino convey the obstacle detection message to the nearby railway station through GSM technology.

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IV. HARDWARE SPECIFICATION

The hardware components used in this proposed system are:

A. Arduino UNO micro-controller
B. IR Sensor
C. Servo Motor
D. Buzzer
E. Ultrasonic sensor
F. GSM Modem

A. Arduino UNO

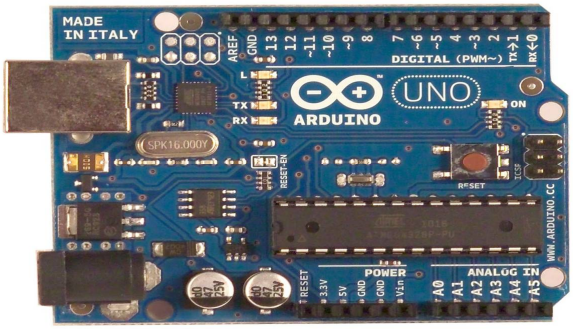

Fig 3: Arduino Uno Micro-controller

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller.

B. IR Sensor

Fig 4: Infrared sensor

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region (700nm to 1400nm), mid infrared region (1400nm to 3000nm) and far infrared region (3000nm to 1mm).

C. Servo Motor

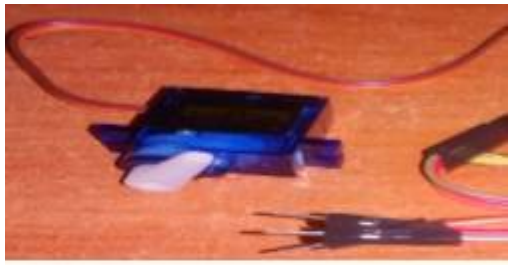

Fig 6: Servo motor

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A servo motor SG 90 is basically a DC motor along with some other special purpose components that make a DC motor a servo. In a servo unit, you will find a small DC motor, a potentiometer, gear arrangement and an intelligent circuitry.

D. Buzzer

Fig 7: Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

E. Ultrasonic sensor

Fig 8: Ultrasonic sensor HC SR04

Ultrasonic detector module has transmitter and receiver section. This sensor interface with micro controller with one output named as the trigger and one input named as echo. The working voltage is DC 5V, working current is 15mA, working frequency is 40 Hz, max range is 4m and min range is 2cm.

F. GSM Modem

Fig 9: GSM Modem SIM900A

A GSM modem is a specialized type of modem which accepts a SIM card and operates over a subscription to a mobile operator, just like a mobile phone.

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V. FLOW CHART

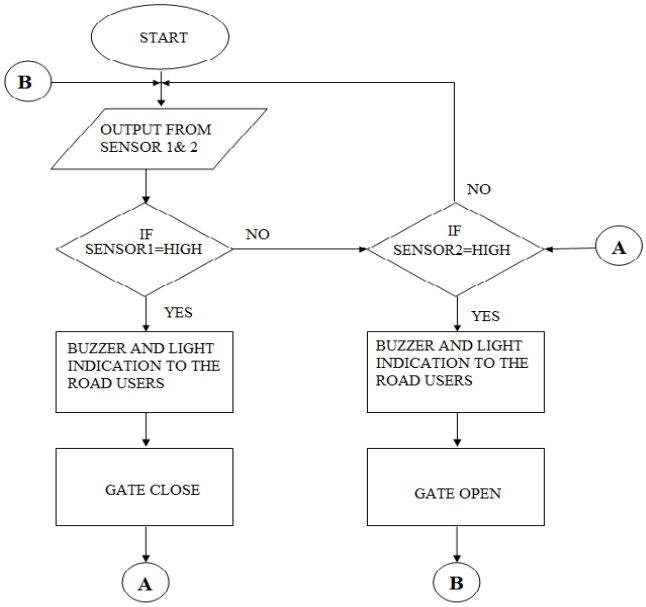

Fig 10: Flow chart for automatic railway gate control

At the beginning the IR sensor1 senses for the detection of arriving train and the output of sensor1 goes HIGH, that is when the sensor1 senses the train. Then the buzzer and light will be turned ON for the indication to the road users. And the gate will be closed by rotating the Servo motor. After the sensor2 output goes HIGH, that is the sensor2 senses the departure of train the buzzer and LED will be turned OFF and then the gate will open.

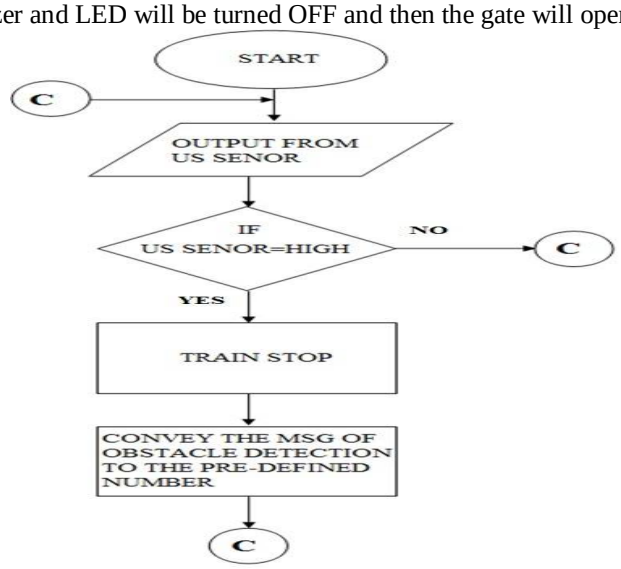

Fig 11: Flow chart for obstacle detection system

The ultrasonic sensor placed at the front of the train will sense for the obstacle on the track. The output of the ultrasonic sensor goes HIGH when the obstacle is detected. Then according to the flowchart the train will be stopped and the message of obstacle will be sent to the nearby railway station so that it can be cleared.

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VI. MODEL OF PROPOSED SYSTEM

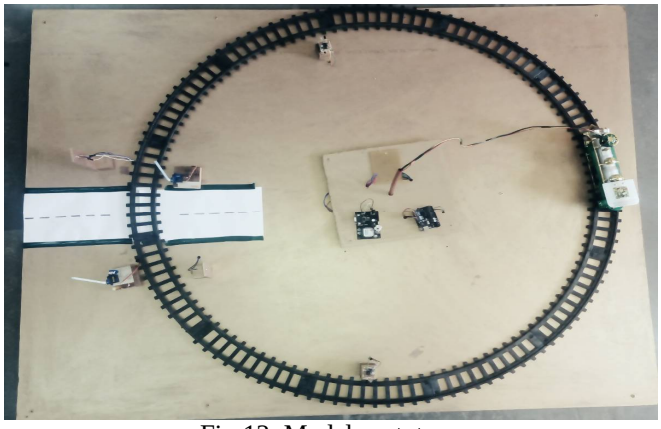

Fig 12: Model prototype

VII. EXPERIMENTAL RESULTS

The proposed system is practically experimented as a working model prototype. The major components used in the model are an 80cm diameter railway tracks, a toy train, two IR sensors, Ultrasonic sensor, a servo motor with which the gate operates, 4 LEDs as the traffic signals, GSM Modem to convey message and buzzer to indicate the arrival of train to the traffic.

Gate operation: An IR sensor is placed at a distance of 25cmon either side of the level crossing. The toy train passes the first sensor and when it is detected by the sensor, a RED LED glows at the level cross indicating the traffic that the gate is about to close and closes the gate with the help of servo motors. When the second sensor senses the departure of the train the LED will turn off and the gates will open.

Obstacle detection: Any obstacle on the track is detected by placing an Ultrasonic sensor on the frontend of the train and the presence of obstacle on the track is notified by a signal at the control room. The train movement is then controlled based on thpresence of the obstacle on the track and obstacle detection message is conveyed to the nearby railway station through GSM technology.

VIII. CONCLUSION

Automatic railway gate control system is centered on the idea of reducing human involvement for closing and opening the railway gate which allows and prevents accidents near level crossing. The railway gate is a cause of many deaths and accidents. Hence, automating the gate can bring about a ring of surety to controlling the gates. Human may make errors or mistakes so automating this process will reduce the chances of gate failures and reduces the errors made by gate keepers. The accidents are avoided at place where there is no person to manage the railway crossing gates. Here we use the servo motor to open and close the gates automatically when it rotates clockwise or anticlockwise direction to operate the gate automatically.

In the obstacle detection part the ultrasonic sensor sensed the obstacle and the train stops as soon as the obstacle detection message is conveyed to the nearby railway station as well as for the train operator. So through this system any obstacle on track can be detected and accident can be avoided and also the message as been conveyed to the concerned.

IX. FUTURE WORK

The accidents due to railway level crossing and the obstacle can be avoided in real time by implementing this system and the whole process is completely automatic. In future the features like wireless system can be implemented in the real time operation. In real time operation vibration sensors can be used in place of IR sensors for the detection of arrival and departure of train. So the vibration sensor serves better when compared to the IR sensors for the real time.

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And also the GPS system can be implemented and interfaced with the circuitry. GPS system ensures that the correct location of the obstacle can be sent to the nearby railway station through GSM modem. This helps to get the exact location of the obstacle so that the work for the clearance of obstacle can be done faster.

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