Design & Safety of Automatic Railway Gate Control Using Wireless Sensor Network

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Abstract: The objective of this paper is to provide an automatic railway gate at a level crossing replacing the gates operated by the gatekeeper. The road users have to wait for a long time at level crossing before the arrival of train and even after the train have left. And secondly the chances of accidents that usually made by the carelessness of the road users or due to the time errors made by the gatekeepers is more. Here comes the importance of automatic railway gate control system. The 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 higher and reliable operation is required. Since, the operation is automatic; error due to manual operation is prevented. The proposed system uses RFID and Arduino microcontroller and GSM Modem. With the help of RFID technology, the arrival and leaving of the system is monitored and the gate is operated accordingly with the help of Servo Motor. One more feature of this circuit is detecting a train accurately i.e., there may be a chance that some obstacle (for e.g. some vehicle) may under the gate or on the track when gates are closed. To avoid this case, IR sensor pair is used is detect to the arrival of objects on either of train and a pressure sensor is placed on the track. Hence, safety is provided to the road users and time has been saved.
Keywords— Arduino mega, RFID, Servo motor, Pressure sensor, GSM module, LCD display.

I. INTRODUCTION

The railway system is most widely used mode of public transportation in India which makes the railway safety a crucial aspect for its operation. It is a one of those modes of transport that has to face lots of challenges due to human errors such as level cross accidents. A level cross is an intersection of a road and a railway line which requires a continuous human coordination and monitoring, the lack of which may results in accidents at this junction. Level crossings are monitored and managed by the gatekeeper and the usually gatekeeper is instructed by means of telephone from the control room. But the chances of manual error that could occur at this level are

high since it requires the detailed and actual knowledge of train time table and train running status. The delay in opening and closing of gate could lead to severe railway accidents. The accident at the railway crossing is one of the major challenges faced by the Indian railways for which the lots of ideas and efforts have been employed to overcome this major issue.

Presently no level crossing in India is automated. Some of those are manned, needs a huge labor cost of approximately 2450 cores once a year. There are also unmanned level crossing where the road user is at his own risk leading to lots of accidents. Based on survey, 42% of level crossings are unmanned; this is due to the fact that with such huge system it is difficult to keep eye on every level crossing manually. And according to statistics from 2009-2016 total 2,547 railway crossing accidents occurred in our country which led 2575 deaths and 126 serious injuries across country, also annual report of stated that 83.5% rail crossing accidents have increased when compared to 2015 [3]. This problem is increasing day by day and needs a strong solution.

II. PROPOSED SYSTEM

This block diagram represents the working of unmanned and advanced automatic crossing, in which when the coming train is detected by the RFID reader, it sends signal to microcontroller with the help of RF transceiver and RF receiver pair. The pair controls the servo motor which will let the bridge to go down and open automatically, also will warn the locale's for the arrival of train automatically with the help of alarm and LCD. IR sensors are used for obstacle detection at the gates and GSM for continuous information to control room. The IR Module is placed under the gate and pressure sensor is placed on the track. IR LED emits infrared rays continuously. When there is obstacle, the signals are reflected back to the receiver; therefore output of the sensor is high. And according to the program in Arduino operation takes place. And if there is any vehicle is on the track, pressure sensor output is high signal is send to

Arduino. This detection circuit is activated only when train is detected.

Based on program in Arduino, LCD display shows the status of the gate to the road users and message is also passed to the control room through GSM Modem. Simultaneously, the buzzer is activated and red LED is activated. After this the servo motor starts operate. The gate arm which is connected to the shaft of the servomotor operates and closes for 45^0 and checks whether these is a vehicle under gate. If there is no presence of any vehicle the gate gets closes completely.
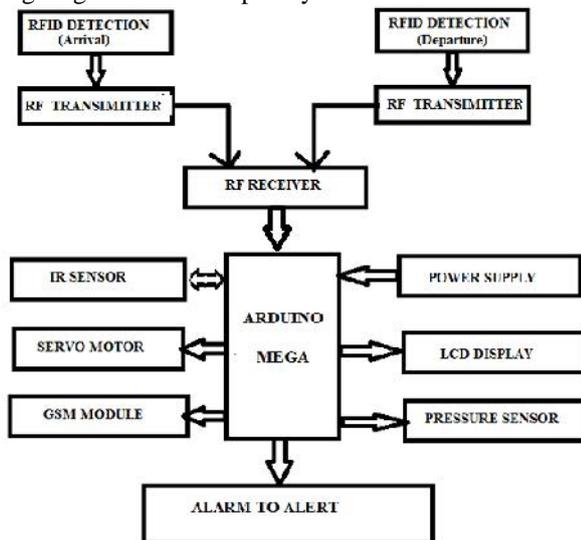
Fig.1. Basic block diagram of the proposed system
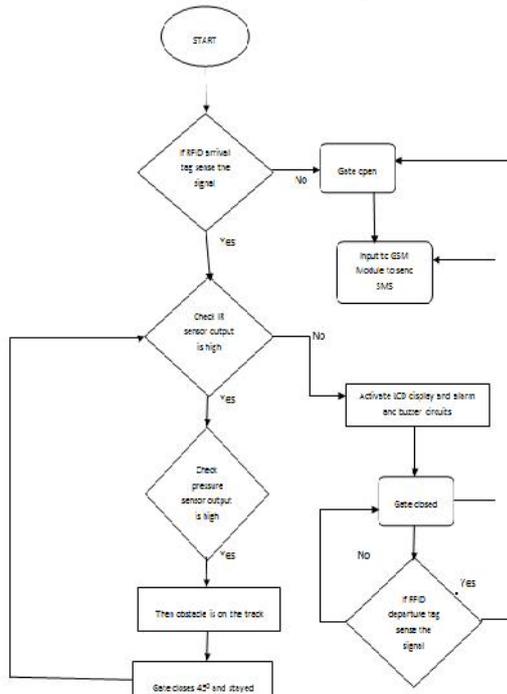
Fig.2. Flow chart

III. INTERFACING DEVICES WITH ARDUINO

A. INFRARED SENSOR INTERFACING WITH ARDUINO

Circuit diagram of infrared sensor is given below. In this circuit, infrared receiver Led and photo diode are main parts of this sensor. Photo diode emits infrared radiations which when strike to any object turn back with some angle.
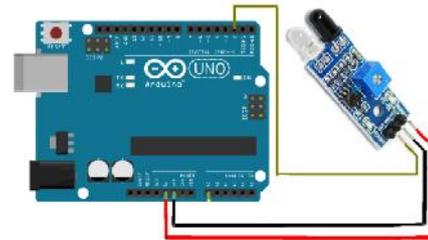

Fig.3. IR sensor interfacing with Arduino

B. RFID INTERFACING WITH ARDUINO:

Power the RFID reader from power supply for reading purpose. Now when an RFID tag is shown near the reader, electromagnetic induction will take place between the coils and this, powers the chip inside tag. This chip will send data electromagnetically to the reader.
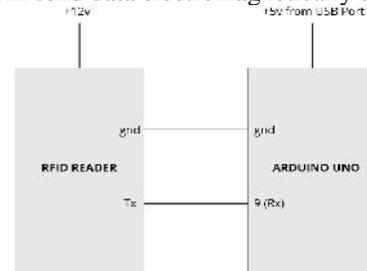

Fig.4. Interfacing RFID to Arduino

The reader will receive this electromagnetically transferred data and outputs it serially. Every RFID reader comes with Serial output pins. We can collect the read data through these serial pins using Arduino or any other micro controller. So here begins Interfacing RFID with Arduino.

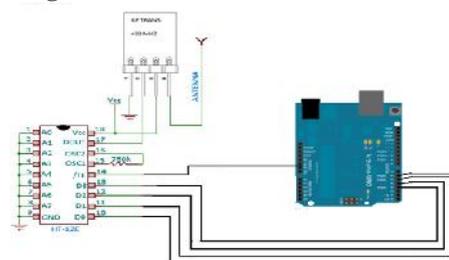### C. RF Transmitter interfacing with Arduino through HT12 encoder

Fig.5. Interfacing RF transmitter with Arduino through HT12 encoder

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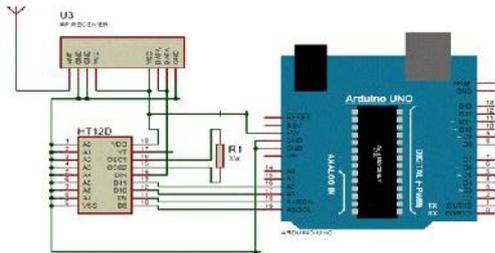## D. RF receiver interfacing with Arduino through HT12 decoder

Fig.6. Interfacing RF receiver with Arduino through HT12 decoder

E. INTERFACING GSM MODEM WITH ARDUINO

A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer).
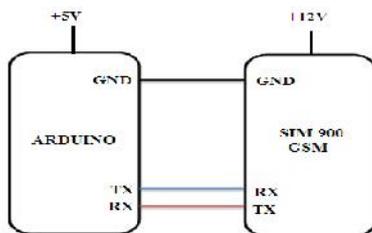

Fig.7. Interfacing GSM to Arduino

F. LCD INTERFACING WITH ARDUINO

The four data Pins D4 to D7 are connected to the four pins (0 to 3) of the Arduino. Rs (register select) and E (Enable) pins are connected to the pin4 and pin5 of the Arduino. V_{SS} pin of the LCD is connected to the ground while V_{DD} is connected to the power supply. V_{EE} of LCD is connected to the potentiometer in order to vary the brightness of the LCD. RW pin is connected to ground.
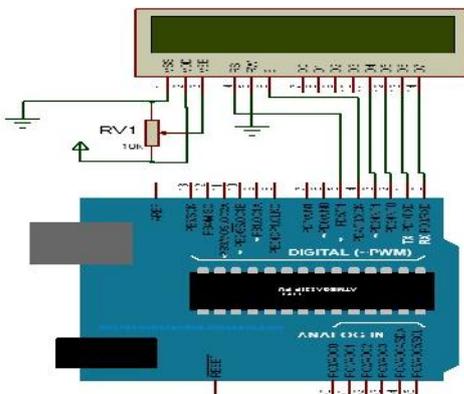

Fig.8. LCD interfacing with Arduino

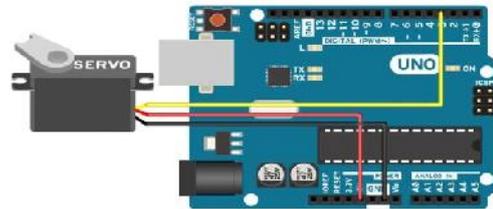## G. SERVO MOTOR INTERFACING WITH ARDUINO:

Fig.9 Servo motor interfacing with Arduino

H. PRESSURE SENSOR INTERFACING WITH ARDUINO:

Pressure sensor is basically a transducer which converts stress applied on it into some electrical energy. It produces analog voltage at the output when force is applied on the sensor, the contacts gets touch and high voltage is obtained at output
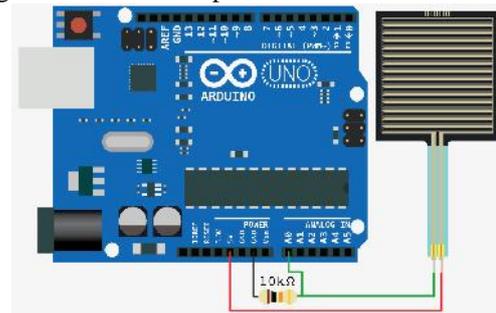

Fig.10. Pressure sensor interfacing with Arduino
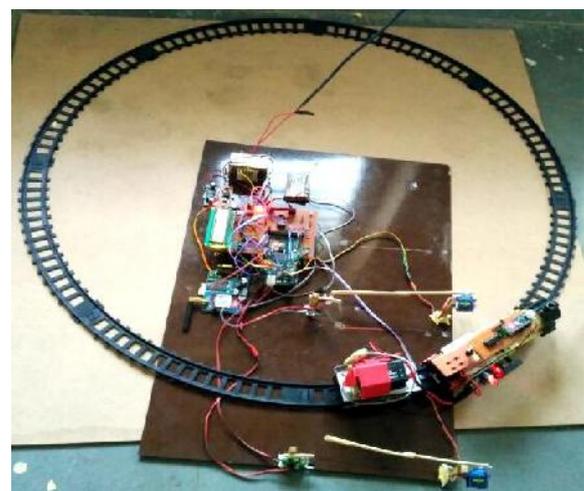
IV. EXPERIMENTAL RESULTS

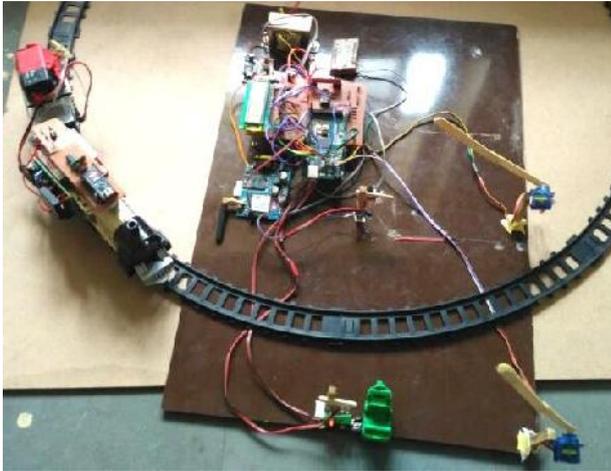Fig.11.When train arrival is detected, gate gets closed

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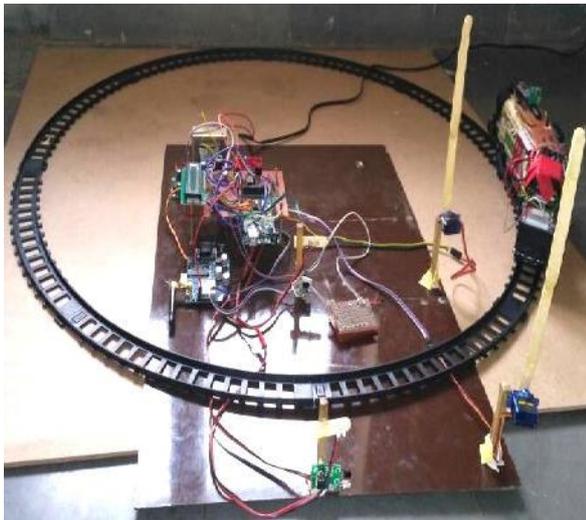Fig.12. When IR Sensor is activated during gates closing, gates stops at 45^0.

Fig.13. After train departure, gate gets opened.

V.CONCLUSION

Using simple electronic components such as RF reader-tags, RF Transmitter-Receiver pair, IR sensors , Pressure sensor, Servo motor, GSM Modem and microcontroller which can be useful to come up with a setup comprising of sensing of arrival of the train, automatic opening and closing of level crossing gates, displaying arrival of train at the gate for common man's convenience and an intruder-alarm circuit as a safety feature of our real time system is done. Finally as the operation being automatic; there are less chances of error due to manual operation and is time efficient, which is main crux of our project. High performance Radio Frequency Identification (RFID) system was designed for automation of unmanned level crossings in Indian railways. By automating the level crossings the number of accidents in the level crossings can be brought almost near to Nil. For detecting the fast moving objects i.e. the train, RFID is the most efficient and comparatively cheaper option. Hence this system is chosen.

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