

Integration of IR Sensors and Microcontroller Based System In Designing of Unmanned Train Track Barrier Monitoring System

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ABSTRACT

This article proposes a novel module design for monitoring train track barrier, based upon swift response anti- collision system .The innovative idea proposed in this article is mainly based upon the integration of Infrared Sensors along with servo motors programmed using an electronics platform based upon Arduino boardunit. The proposed system has significant applications in order to prevent large scale hazards at railway track barriers, along with the prevention of accidents in terms of train speed at the level crossing.

Key words: Anti-Collision System, Arduino –Uno, Obstacle detection, Infrared Sensors, Light Emitting diodes

INTRODUCTION

Railroad is one of the prominently used transition mode which has a vital role in moving passengers and freights .A railway crossing is the junction where a railway track intersects a road at the same level. Railroad accidents are more hazardous than other modes of transportation .Hence this paper focuses on such monitoring and controlling module designed using vibration sensors and wheel detection sensors with the purpose of curtailing casualties over railroad track barrier. In the proposed design the Arduino system is mainly taken into consideration in order to perform an overall operation based upon sensing, which not only makes the automatic closing and opening of gates but also makes this design unmanned. In this suggested structure servo motors are used for the purpose of barrier control with the electronics platform based Arduinounit. On this significance, the proposed module is more reliable and less subject to human manualerror, reason being olden days manually operated gates were dependent upon telephone calls from the previous station which are more likely to engage more manpower and are also inclined to have manual errors [1].Thus the suggested work is capable to attain high performing abilities as an unmanned sensor deployed at a certain distance from the track barrier to control the opening and closing of the barrier.

WORKING OF UNMANNED RAILWAY TRACK MONITORING SYSTEM

The proposed design consists of IR sensors, GSM Modem, Servo motors, Arduino-Uno along with Buzzer. The suggested system enables the use of IR sensors to sense the movement of

objects in the proximity of rail track and level crossing. As the wheel detecting IR sensors sense the vibration radiated in the form of heat the alert signal is generated which is transmitted by the GSM module in the form of message or alert signal can also be transmitted in the form of glowing of light emitting diode .In addition to the sensing object to the sending alert signal there are other hardware which plays a vital role in opening and closing of gates .As soon as the arrival of the object is sensed ,the alert message is sent to the traffic post and during this time the The level crossing gate is kept closed .Once the departure is detected the IR sensor transmits signal to servomotors to open the gate this is how the complete operation is achieved using sensors ,modem and motors which makes this design an unmanned controlled railway track barrier system.

FLOW CHART

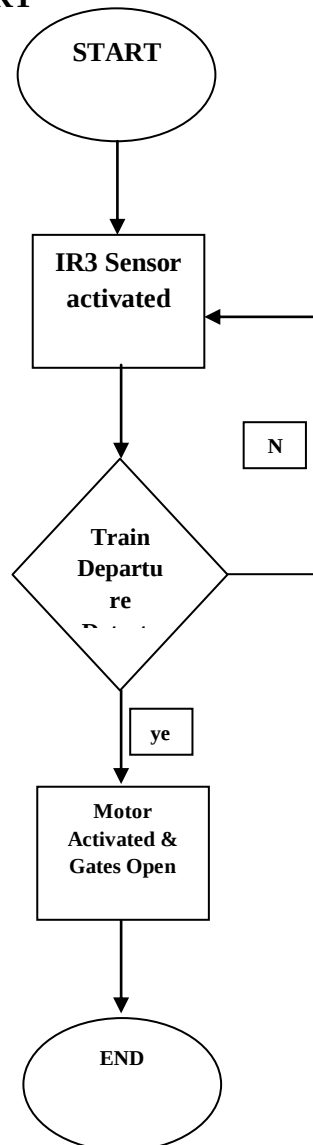


Fig. 1: Flow Diagram of gate closing

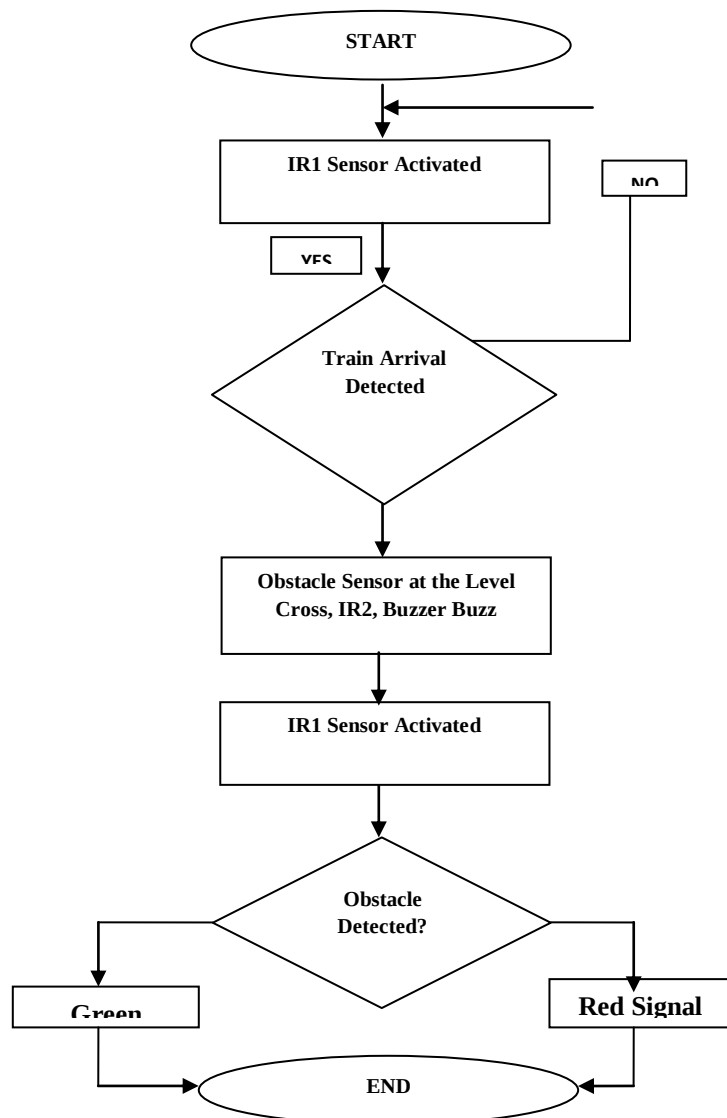


Fig. 2: Flow Diagram of gate opening

SYSTEM ARCHITECTURE

The suggested module uses three IR sensors in order to detect the motion of the train within the proximity of sensors, Here the system includes servo motors along with sensors where both former and later are programmed using Arduino UNO microcontroller

IR SENSOR

Infrared Sensors mainly consists of heat sensors which are able to detect the object on the basis of radiated heat around them[5], whereas pulsation and motion sensors works on the principle of magnetic induction, due to which when voltage is generated across the conductors in result of which current is produced by the wheel is taken into account to detect the train arrival [6]

LED

In the proposed design the LEDs are used to indicate the alert message send by the Arduino module ,later one is directly connected to IR sensors .On the basis of IR sensor detection high and low signals are sent to the microcontroller which in turn send corresponding signals to the respective LEDs for instance yellow colour LED indicates that the train is approaching the gate ,Red indicates the train has arrived the crossing whereas green LED indicates that the train has departed ,in response to the above decision the respective signals are send to servo motor to operate the gate



Fig 3: LED

SERVO MOTORS

In the suggested structure servo motors are used to operate the gate ,servo motor is operated on the basis of signal received from Arduino at pin no 9 ,if the train is approaching the gate than only yellow led will glow in this case Arduino will not send any signal to pin no 9 where the servo motor is connected ,but if red led glows which implies that train has arrived or about to arrive the gate than Arduino will send simultaneous signal to pin 9 so that servo motor rotates gate by 90 degrees clockwise .Once the green led starts glowing which means that the train has departed now Arduino will send signal to pin 9 so that servo motor rotates gate by 90 degrees anticlockwise

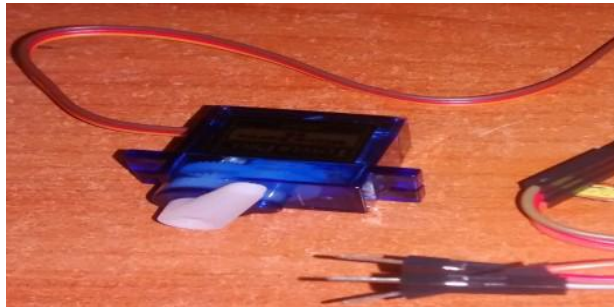


Fig 4: Servo Motors

ARDUINO UNO

The **Arduino Uno** is a board based on the Microchip ATmega328P. The board consists of sets of analog and digital input/output (I/O) pins that may be further connected or interfaced to various other circuits. Arduino UNO board comprises of fourteen digital input output pins, six analog I/O pins along with RESET and ground pins



Fig 5: Arduino Uno

BUZZER

When the Infrared Sensor number 2 detects that the train is about to reach the crossing then the buzzer starts its operation and the motor is also activated simultaneously to close the gate and the light emitting diode which is of red colour starts glowing. The buzzer rings until the IR3 senses the departure of the train and the motor is again activated to rotate the gate by 90 degrees anticlockwise.



Fig 6: Buzzer

CIRCUIT/ PIN DIAGRAM DESCRIPTION

The circuit diagram of the proposed module consists of Arduino Uno microcontroller, IR sensors, LED, Resistor, and Servo Motor. Here Arduino UNO is the fundamental unit of this design

In the given circuit diagram pin no 3, 5, 6 are connected with Infrared Sensors i.e. IR1, IR2, IR3 respectively, where sensor IR1 is connected at a more distance from railway crossing in comparison to the IR2, reason being IR1 sensor are deployed at a far distance just to sense the motion of train whereas IR2 sensors are connected nearby the crossing to indicate that the train has arrived. In the Arduino Uno microcontroller pin no 11, 12, 13 are connected to LEDs of yellow, red, green colour respectively, which are further connected ground via resistor in order to complete the circuit. Furthermore servo motors are connected to pin no 9.

To summarize the above description the block diagram can be drawn as follows

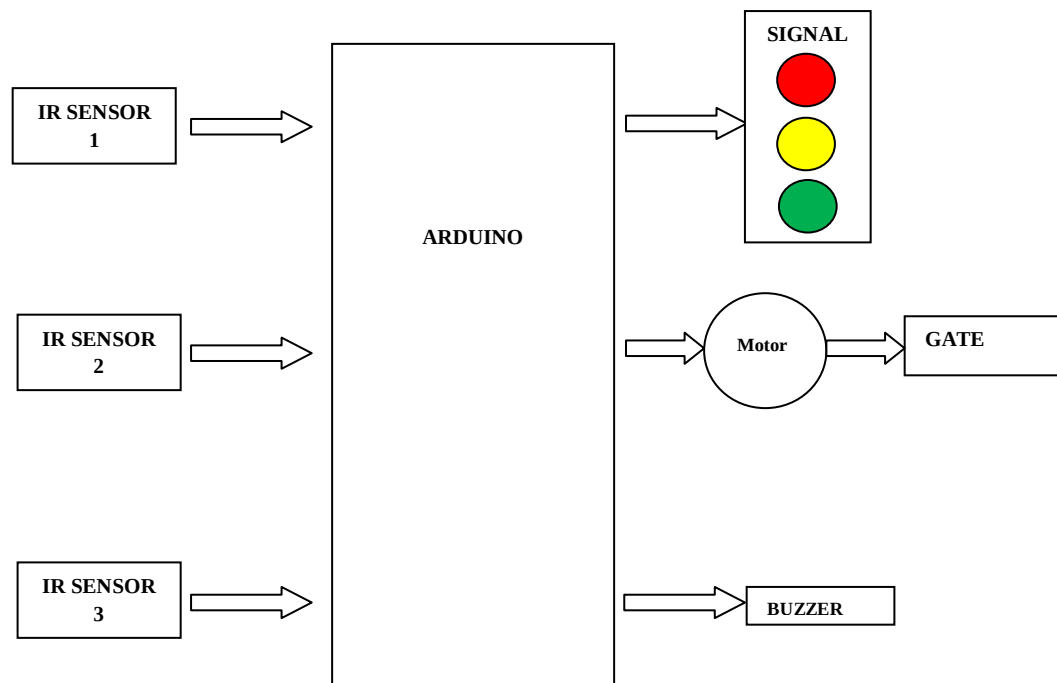


Fig 7: Block Diagram

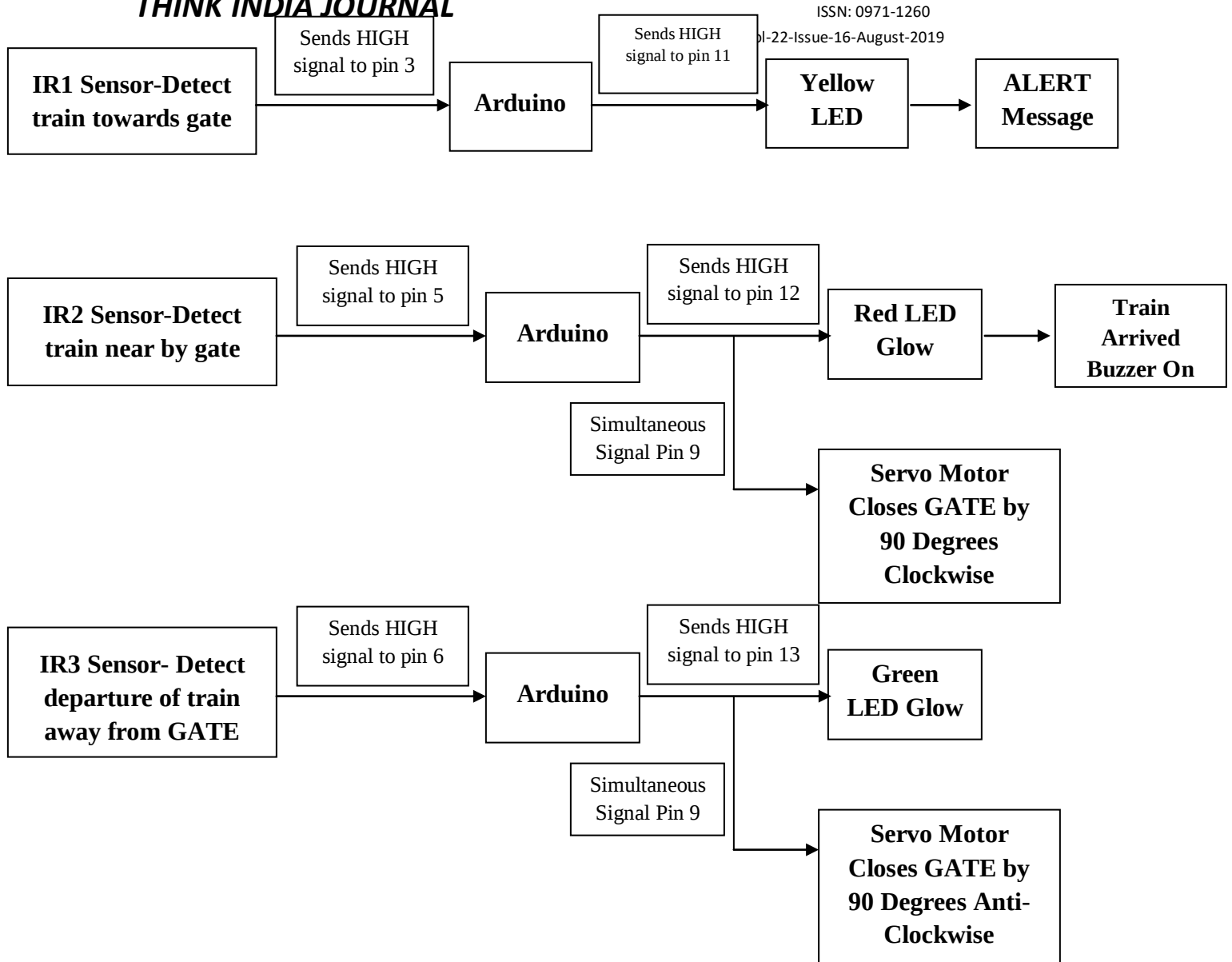


Fig 8: Pin connection block diagram

CONCLUSIONS AND FUTURE SCOPE

Automated train track barrier monitoring system based on Arduino, is centered on the idea of decreasing human involvement for opening and closing the railway crossing gate, so as to design a final product which is not only unmanned but also prevents automobiles and humans from trespassing the railway tracks. The limitation of this design is the usage of Infrared sensors, which works on the principle of heat radiated from any object or body, which means it will detect all the objects creating obstruction in the path of sensors. Another important limitation is that this project only controls the gate motion but does not control the motion of automobile or human across track to combat these problems. Pressure sensors can be used as an extension to the present work, while doing research on the above said limitations, I came across the solution that utilizes the piezoelectric pressure sensors which measure pressure, and force by the conversion

of the corresponding quantity into the electrical charge. hence the generated electricity is known as the piezoelectricity which is directly proportional to the pressure exerted on the crystal made up of piezoelectric material .These sensors are completely sealed from the environment and are weatherproof as well and can also withstand the damage and are resistant to heavy use.

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