AUTOMATIC RAILWAY GATE CONTROL SYSTEM USING ARDUINO UNO

J.SAMPATH KUMAR, T. POOJITHA, Y. VISHAL, M. AKHIL

Assistant Professor, B.Tech Students

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ACE Engineering College, Ankushapur (V), Ghatkesar (M), Medchal(Dist)-501 301

ABSTRACT

The objective of this project is to provide an automatic railway gate at a level crossing replacing the gates operated by the gatekeeper. It deals with two things. Firstly, it deals with the reduction of time for which the gate is being kept closed. And secondly to provide safety to the road users by reducing the accidents. By the presently existing system once the train leaves the station, the stationmaster informs the gatekeeper about the arrival of the train through the telephone. Once the gatekeeper receives the information, he closes the gate depending on the timing at which the train arrives. Hence, if the train is late due to certain reasons, then gate remain closed for a long-time causing traffic near the gates.

By employing the automatic railway gate control at the level crossing the arrival of the train is detected by the sensor placed near to the gate. Hence, the time for which it is closed is less compared to the manually operated gates and also reduces the human labor. 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. Automatic railway gate control is highly economical microcontroller-based arrangement, designed for use in almost all the unmanned level crossings in the country.

1. INTRODUCTION

1.1 PROJECT OVERVIEW:

The intention of this project is to achieve automatic control at the level crossings when the arrival/departure of the train takes place replacing the manual gate control. The Automatic Railway Gate Control System detects the train approaching the level crossing and alerts the users and closes the gate. This system helps in avoiding the increased number of accidents at level crossing in India. The railway gate is automatically closed when a train passes through the railway crossing. The detection of arrival and departure of train is done by using two IR sensors. The gate opening and closing is to be done using servo motors/DC motors which is controlled by Arduino Uno. Buzzers are used to indicate the closing of gate for the people who are trying to cross the gate. This project will make the system more reliable and precise.

1.2 BLOCK DIAGRAM:

1.3 BLOCK DIAGRAM DESCRIPTION:

1.3.1 Power Supply:

Here we used +5V dc power supply. Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Conversion of one form of electrical power to another desired form and voltage, typically involving converting AC line voltage to a well-regulated lower-voltage DC for electronic devices. Low voltage, low power DC power supply units are commonly integrated with the devices they supply, such as computers and household electronics.

1.3.2 Arduino Uno:
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; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

![Arduino Uno](image1)

**Figure 2 Arduino Uno**

1.3.3 **IR Sensor:**
When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR Falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 (which is connected to the non-inverting end of comparator) gets higher than the voltage at inverting end, then the output becomes HIGH and LED turns ON. Voltage at inverting end, which is also called Threshold Voltage, can be set by rotating the variable resistor’s knob. Higher the voltage at inverting end (\(\text{\text{-}}\)), less sensitive the sensor and Lower the voltage at inverting end (\(\text{\text{+}}\)), more sensitive the sensor.

![IR Sensor](image2)

**Figure 3 IR Sensor**

1.3.4 **Motor Driver:**
L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. 18 Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

![Motor Driver](image3)

**Figure 4 Motor Driver Pin Description**

<table>
<thead>
<tr>
<th>PIN NO</th>
<th>FUNCTION</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enable pin for Motor 1, active high</td>
<td>Enable 1 2</td>
</tr>
<tr>
<td>2</td>
<td>Input 1 for Motor 1</td>
<td>Input 1</td>
</tr>
<tr>
<td>3</td>
<td>Output 1 for Motor 1</td>
<td>Output 1</td>
</tr>
<tr>
<td>4</td>
<td>Ground (0V)</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>Ground (0V)</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>Output 2 for Motor 1</td>
<td>Output 2</td>
</tr>
<tr>
<td>7</td>
<td>Input 2 for Motor 1</td>
<td>Input 2</td>
</tr>
</tbody>
</table>
1.3.5 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, train and confirmation of user input such as a mouse click or keystroke. A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboards, Perf Board and even on PCBs which makes this a widely used component in most electronic applications. There are two types of buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application. This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

Figure 5: Buzzer

2. LITERATURE SURVEY

2.1 Introduction:
The Automatic Railway Gate Control System represents a pivotal advancement in modern transportation and safety management for railway networks. As railways continue to play a crucial role in mass transit and cargo transportation, ensuring the safety of both trains and road users at railway crossings becomes paramount. Traditional manual gate control systems pose challenges in terms of efficiency, reliability, and timely response to train movements. The Automatic Railway Gate Control System addresses these issues by employing cutting-edge technology to automate the operation of railway gates, thereby enhancing safety, reducing human error, and optimizing traffic flow.

Features:
1. Automatic closing opening of bidirectional railway gate.
2. Sensing mechanism of train arrival and departure.
3. IR sensor based train detection.
5. To achieve this task using Arduino uno Microcontroller.

3. THEORETICAL ANALYSIS

3.1 Hardware Description:
3.1.1 Technical Description:
An Automatic Railway Gate Control System is a project that involves designing a system to automatically control the opening and closing of railway gates based on the arrival and departure of trains. This system ensures safety by preventing collisions between trains and vehicles or pedestrians at railway crossings.

3.1.2 Working:
1. The main controlling device of the whole system is ARDUINO.
2. IR sensors, Buzzer, Servo Motor is interfacing to the Arduino microcontroller.
3. When the IR sensors detects the train, this data process to the Arduino then Arduino will open and close the gate along with buzzer automatically.

Table 1: Motor Driver Pin Description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Supply voltage for Motors; 9-12V (up to 36V)</td>
</tr>
<tr>
<td>9</td>
<td>Enable pin for Motor 2; active high</td>
</tr>
<tr>
<td>10</td>
<td>Input 1 for Motor 1</td>
</tr>
<tr>
<td>11</td>
<td>Output 1 for Motor 1</td>
</tr>
<tr>
<td>12</td>
<td>Ground (0V)</td>
</tr>
<tr>
<td>13</td>
<td>Ground (0V)</td>
</tr>
<tr>
<td>14</td>
<td>Output 2 for Motor 1</td>
</tr>
<tr>
<td>15</td>
<td>Input 2 for Motor 1</td>
</tr>
<tr>
<td>16</td>
<td>Supply voltage; 5V (up to 36V)</td>
</tr>
</tbody>
</table>
4. Servo motors works as a gates.
5. To achieve this task using Arduino UNO microcontroller loaded program written in embedded C language.

3.1.3 Procedure:
1. Take all the components required.
2. Connect two IR sensors to left and right sides of Arduino 5V pin.
5. Write Arduino code to read sensor data, control the gate mechanism, and implement safety features.
6. Observe the closing and opening of gate with respect to train arrival.

3.1.4 Schematic Diagram:

Figure 6: Schematic Diagram

Block Diagram

Figure 7 : Block diagram of ATmega

Comparison Between ATmega48PA, ATmega88PA, ATmega168PA and ATmega328P

<table>
<thead>
<tr>
<th>Device</th>
<th>Flash</th>
<th>EEPROM</th>
<th>RAM</th>
<th>Interrupt Vector Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATmega48PA</td>
<td>4K Bytes</td>
<td>256 Bytes</td>
<td>512 Bytes</td>
<td>1 instruction wordvector</td>
</tr>
<tr>
<td>ATmega68PA</td>
<td>6K Bytes</td>
<td>512 Bytes</td>
<td>1K Bytes</td>
<td>1 instruction wordvector</td>
</tr>
<tr>
<td>ATmega168PA</td>
<td>16K Bytes</td>
<td>512 Bytes</td>
<td>1K Bytes</td>
<td>2 instruction wordvector</td>
</tr>
<tr>
<td>ATmega328P</td>
<td>32K Bytes</td>
<td>1K Bytes</td>
<td>2K Bytes</td>
<td>2 instruction wordvector</td>
</tr>
</tbody>
</table>

Figure 8: Comparison between ATmega48PA, ATmega88PA, ATmega168PA, ATmega328P

The ATmega48PA, ATmega88PA, ATmega168PA and ATmega328P differ only in memory sizes, boot loader support, and interrupt vector sizes. Table 2-1 summarizes the different memory and interrupts vector sizes for the three devices.

AVR CPU Core Overview

This section discusses the AVR core architecture in general. The main function of the CPU core is to ensure correct program execution. The CPU must therefore be able to access memories, perform calculations, control peripherals, and handle interrupts.

Figure 9: Block Diagram of AVR Architecture

4. EXPERIMENTAL RESULTS

The project “Automatic railway gate controlling system using Arduino UNO and servo motor” was
designed an automatic railway gate control system using IR AND ARDUINO. The main controlling device of the whole system is ARDUINO. IR sensors, Buzzer, Servo Motor is interfacing to the Arduino microcontroller. When the IR sensors detects the train, this data process to the Arduino then Arduino will open and close the gate along with buzzer automatically. Servo motors works as a gate. To achieve this task using Arduino UNO microcontroller loaded program written in embedded C language.

5. ADVANTAGES, DISADVANTAGES AND APPLICATIONS

- **Advantages:**
  - Avoid Manpower
  - Reduce operation cost
  - Easy to use
  - Performance is high
  - Portable
  - Accuracy is high
  - Automatic operation
  - Low power consumption

5.2 Disadvantages:
- As the IR obstacle sensor can sensor all objects come in front of it, it might send false signal even if there is any object other than a train.
- So in real-life, we recommend to use the frequency of the railway lines when a train appears as the signal to control the gate.

5.3 Applications:
- Railways gate controlling
- Parking gate controlling
- Toll gates
- Industries
- Schools and college junctions

CONCLUSIONS & FUTURE SCOPE

Conclusion:
Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC’s with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

Future Scope:
- By Using this project we can control Railway gate system.
- We can give voice communication to road users.
- LED displays at railway crossing gates can also be achieved.
- We can add railway track power generation to this project.

BIBLIOGRAPHY
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3. www.microchip.com
4. www.howstuffworks.com

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