# UNMANNED RAILWAY GATE CONTROLLER

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# UNMANNED RAILWAY GATE CONTROLLER


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# CHAPTER 1

## INTRODUCTION

Railway Crossings are controlled manually by the gatekeeper who upon signal, closes or opens the gate. Some railway crossing is not manned and is highly prone to hazardous accidents. To prevent this, an automatically controlled railway mechanism can be introduced.

In this project, we are using the two IR sensors for detection. The reflective type IR sensor has a transmitter and receiver end. If an obstacle is present between, it sends a signal which can be perceived in binary as 1. This signal response in reading and tackled using the AT89C51 microcontrollers which when receiving the signal from the sensor shall turn the motor ON with the help of the L293D motor driver IC. The second sensor will be placed after the crossing and when the train crosses that sensor, the signal is sent to the microcontroller which turns the motor and in turn opens the gate so the passing vehicles may cross.

A toy train set is used to demonstrate the working. The sensors shall be placed on either side of the road and upon detecting the arrival to departure of the train, the signal will be sent to the microcontroller to close or open the gate.

Using this method, unmanned railway gates can be controlled automatically thus ensuring safety and preventing the high probability of occurrence of one of the most hazardous road accidents.

# CHAPTER 2

## 2.1 SCOPE OF THEPROJECT

Automatic Control systems have begun to widely take a rise in society. Using unmanned reliable systems have started to be introduced. In this project we are demonstrating one such application, the use of Automatically Controlled Railway Gate System using Sensor and Microcontroller system. This technology can also be applied in many other applications as follows:

I. It can be used in security systems in museums and other exclusive protected exhibits along with verification methods required to ensure Automatic Security System.
II. It can be used in Toll Gates instead of manually controlled gates alongside security and verification procedures.
III. It can be used in other road transport systems like zebra crossings to ensure the safety of pedestrians with certain modifications.

## 2.2 OBJECTIVE

Railway gates are one of the most crucial and important structures. When a train is arriving at a crossing, the railway gate guard receives a signal and upon the receiving, he manually opens the gate and once the train is departed, he closes the gate. But not all railway gate crossings are manned. Due to this, many occurring railway accidents cannot be prevented. This is one of the most common accidents we face. Thus, the mechanism of the automatic railway gate controller can be introduced as a precautionary reliable method. By this automatic sensory method, upon the arrival or departure of the train, the signal will be automatically received by the motor-controlled gates and will open or close without manual need. Henceforth, a secure railway gate mechanism can be established.Theobjectivesof the project are as follows:

I. To study the working of 8051 microcontrollers along with the programming board.
II. To know the working of the motor and the motor driver IC L293D.
III. To study the factors and characteristic theory of IR sensors.
IV. To introduce and apply the Automatic Technology Control System on Railway Gate Control.
V. To provide and safe reliable method of Railway Gate Control reducing human intervention.

# CHAPTER 3

## 3.1 TOOLSREQUIRED

i. 8051 Microcontroller- AT89C51
ii. Reflective Type IR sensor
iii. L293D Motor Driver IC
iv. Motor
v. Programmer and Development Board

## 3.2 8051 Microcontroller

Fig 1. 8051 Microcontroller

A microcontroller is a small microcomputer-like device built using CMOS technology of low cost and low power consumption that is designed for the performance of a specific task of the embedded systems. It includes in-built memory RAM and ROM. There are different types of microcontrollers based on the number of bits- 8, 16, or 32, based on the memory component-external or embedded and based on the configuration of the instruction set- complex or reduced.

8051 Microcontroller is an 8-bit microcontroller which was designed in the year 1981 by the company 'INTEL'. The microcontroller comprises 40 pins which are aligned in dual inline packaged mode consisting of 128-byte RAM, 4k byte ROM storage, and two timers of 16-bit memory each. It is also built with four parallel 8-bit ports. The ports are not only addressable but also programmable. It also included a crystal oscillator which is possessing a crystal frequency of 12 mega Hz.

The architecture of the 8051 microcontroller shows the CPU system connected to the data bus of 8-bit, address bus of 16-bit, and bus control. It also includes the RAM and ROM memory components along with the timers, input-output, and serial ports.

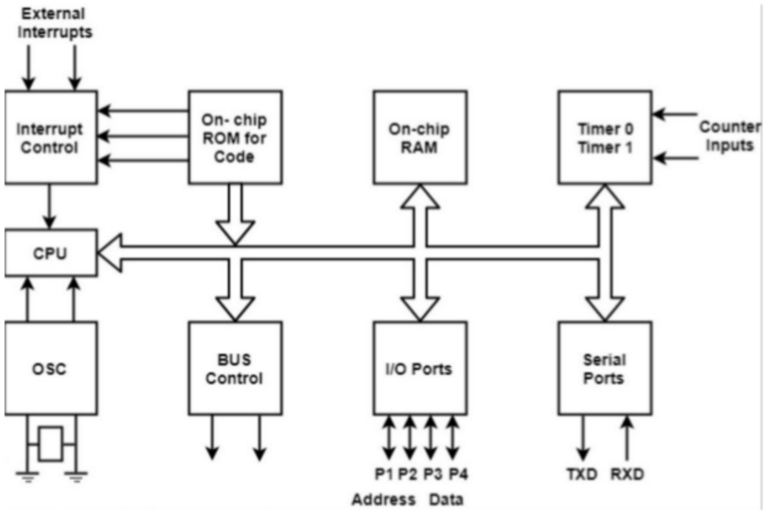


Fig 2. The architecture of 8051 Microcontroller

The pin diagram of 8051 microcontroller shows all the 40 pins including the 4 ports and sub-divisions and their purposes.

- The pins 1 to 8 represent the Port 1 and do not serve any functions.
- Pin 9 is the RESET pin which helps the microcontroller reset to initial values.
- Pins 10 and 11 are the RxD and TxD pins that perform transmission and receiving of data serially.
- Pins 12 and 13 are the interrupt control pins INT0 and INT1 for external hardware interrupts.
- Pins 14 and 15 represent timer 0 and timer 1 as T0 and T1.
- Pins 16 and 17 represent WR and RD which perform read and write operations.
- Pins 18 and 19 are the XTAL pins which are forming the connection with the crystal oscillator.
- Pin 20 and 40 are the GND or the Ground pin and Vcc or logic high supply pin
- The pins 10 to 17 represent the Port 3 pins.

- The pins 20 to 21 represent the Port 2 pins which is used for multiplexing of the address bus of a higher order.



- Pin 29 represents the PSEN pin which is the Program store enable that is used for external memory access.

- Pin 30 represents the EA or the Enable Access pin used for external memory interfacing.

- Pin 31 represents the ALE or the Address Latch Enable used to demultiplex address-data memory.

- The pins 32 to 29 represent the Port 0 pins which is used for multiplexing of the address and data bus of lower order.

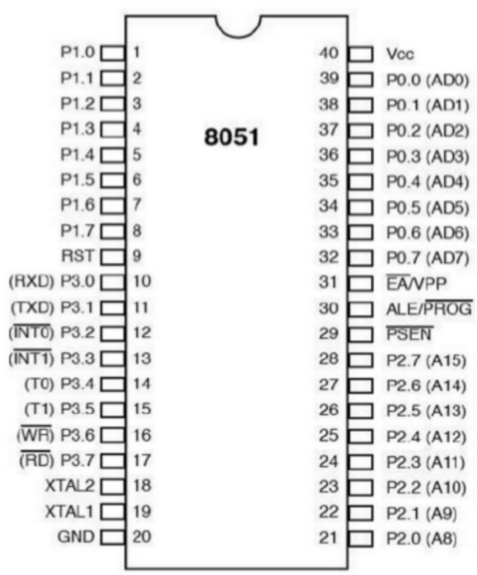


Fig 3. Pin Diagram of 8051 Microcontroller

Additionally, the 8051 microcontroller has 5 interrupts namely, INT0, INT1, IF0, IF1, and the RI/TI. The interrupts are enabled or disabled based on the EA pin.

## 3.2 IR Sensor

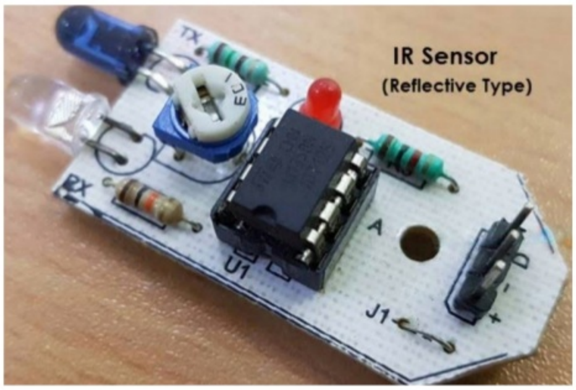


Fig 4. IR Sensor

There are different types of sensors that have been introduced for different types of obstacles. Infrared technology has been used in various studies and one of the evolving concepts to have been introduced is the use of infrared rays for sensory detection. The infrared rays have a frequency that ranges between the visible light and microwave. Using photo optics concepts and technology, the IR rays detecting sensors using photodiodes were introduced. The IR sensor emits infrared rays which are detected by the photodiodes present in the receiver.

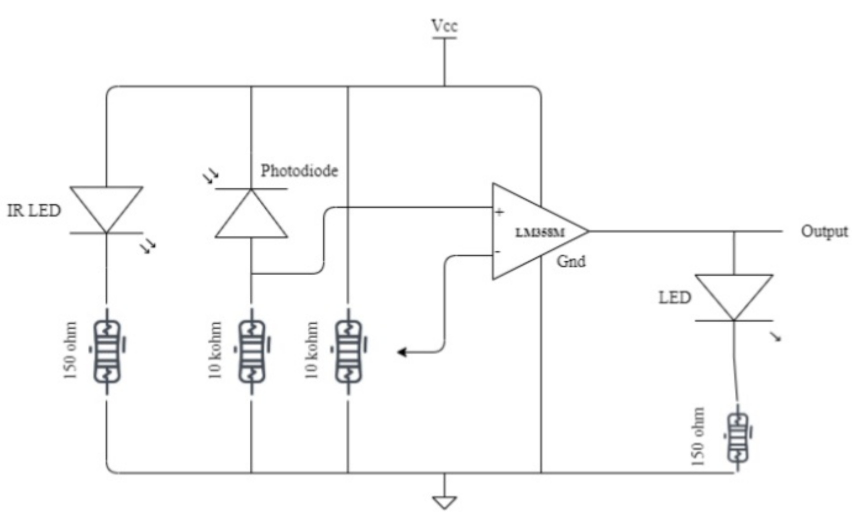

Fig 5. Circuit of IR Sensor



The IR sensing circuit includes the transmitter and receiver end. The transmitter emits the infrared rays and the receiver possesses the photodiodes which detect the IR rays emitted by the transmitter. It includes a packed resistance circuit for controlling the current. It also included the IC LM358M which is used to test light-dependent resistor acting as the voltage comparator. It has a potentiometer which helps in the calibration of the output. Based on the presence of the obstacle, another LED is connected to representation. When the light rays emitted from the LED of the transmitter falls on an obstacle, the rays bounce back and fall on the photodiodes for the receiver and is detected by the receiver.

## 3.4 L293D Motor Driver IC

Fig 6. L293D Motor Driver IC

The L293D IC is a 16-pin dual H-Bridge motor driver IC which is used to control motors as the name suggests. The IC is capable of driving two independent DC motors whose directions can be changed independently as required. It can alongside control the speed of the motors as well.


Fig 7. Pin Circuit of L293D

The pin diagram for the IC shows 4 outputs i.e., 2 pairs of outputs. Pins 3 and 6 control one motor and pins 11 and 14 control another. Equivalent to the 4 outputs, there are 4 inputs i.e., 2 pairs. Pins 2 and 7 as inputs 0 and 1, and pins 10 and 15 as inputs 3 and 4. The value of the inputs determines which motor runs and in what direction. It also comprises two Enable pins for each set of inputs represented by the pins 1 and 9. Pins 4, 5, 12, and 13 are the ground pins and the remaining two pins 8 and 16 are the Vcc pins. In this project, the motor driver IC's inputs are received from the output of the microcontroller, and based on the input values, the output is determined. We will be controlling a single motor in this case.

## 3.5 DC Motor

Fig 8. DC Motor

When a motor is controlled by Direct Current, the motor is said to be a DC Motor. Just like any motor, it converts electrical energy to mechanical energy, in this case it converts DC form of electrical energy. When we place a conductor carrying a certain value of current in an external magnetic field, the magnetic field produced within the conductor and the external magnetic field results in the production of a force with tends to result in the establishment of torque causing the motor to rotate. A DC Motor works on this principle. The main advantage of using a DC Motor is the fact that the speed of the motor is entirely controllable, i.e., the speed can be accelerated or decelerated.

Motors can't be driven directly using a microcontroller. It requires a motor driver IC like the L293D we will be suing in the project which acts as an interfacing device between the microcontroller and the DC Motor.

# CHAPTER 4

## PROJECTDESCRIPTION

### 4.1 BlockDiagram

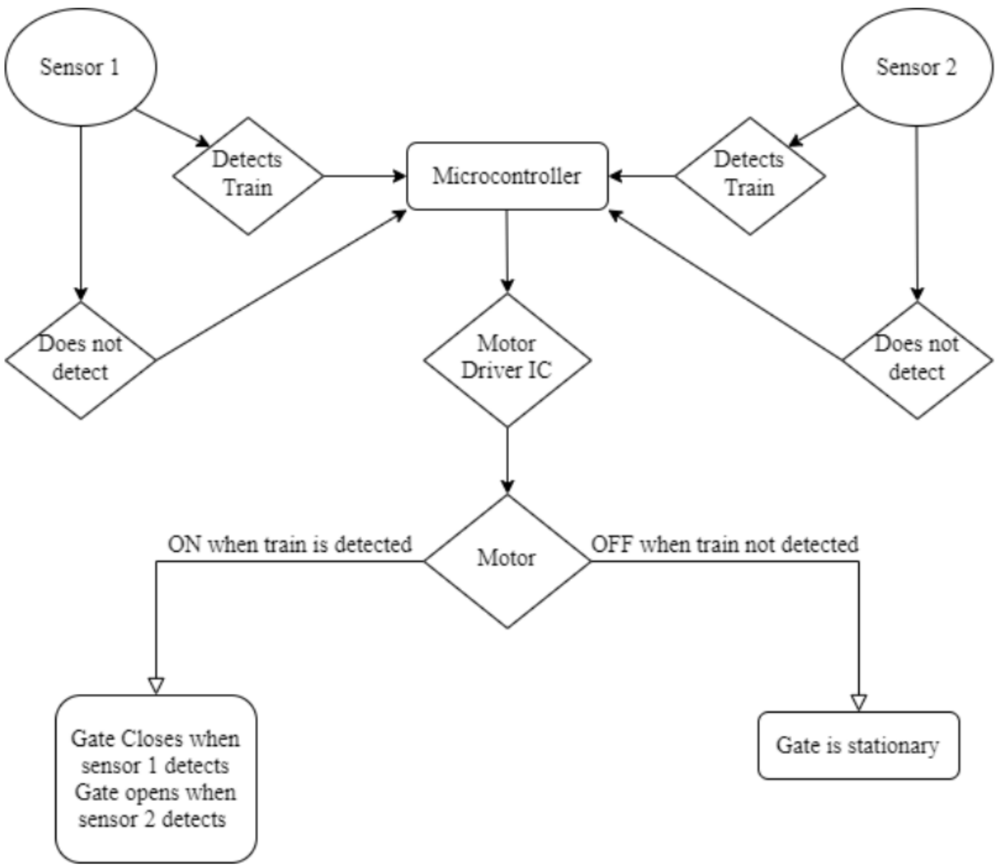


Fig 9. Block Diagram

## 4.2 CONSTRUCTION AND WORKING

### 4.2.1 CONSTRUCTION

We will be demonstrating the working of the automatic railway gate controller using a toy train set. As we have seen, in this project we will be using two reflective type IR sensors, an 8051 microcontroller along with the programmer board, the motor driver IC L293D and a motor. A piece of cardboard will be connected to the motor which we are representing the gate of the railway crossing for the road.

The two sensors will be placed in the two ends leaving a gap between the gate representing the safety time for the gate closing before the train arrives. In real life, the sensors are places considering the longest train in the route and the fastest speed in that route. This ensures the exact place where the sensor has to be placed and the buffer time between the actual closure of the gate and the exact time of arrival of the train at the crossing. The microcontroller setup will be placed centrally along with the motor driver IC. The connections will end up with the motor to which the gate is connected.

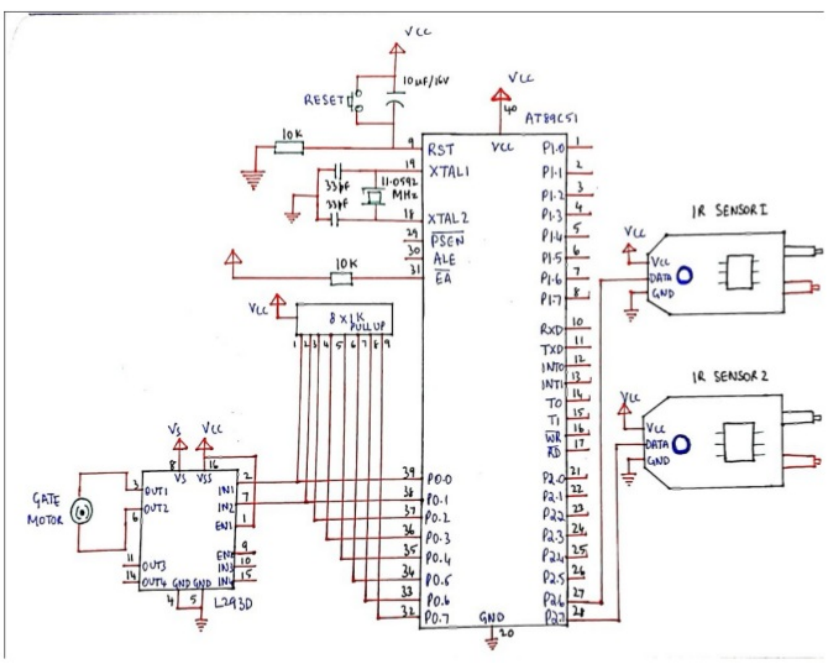


Fig 10. Circuit Connection

## 4.2.2 Working

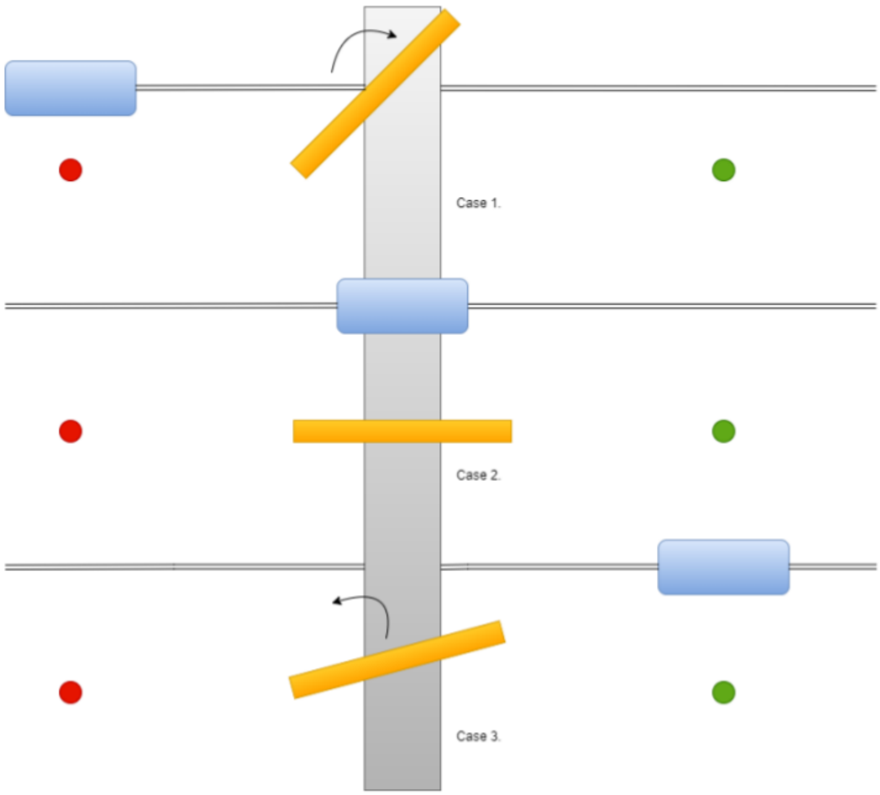


Fig 11. Working

When the train approaches the sensor 1, the Infrared ray emitted by the transmitter strikes the obstacle and bounces back reaching the photodiodes present in the receiver and this shall be sent to the microcontroller where the message is received that the train is passing by. With the help of the motor driver IC L293D, the microcontroller enables the motor to run which in turn closes the gate. When the train crosses the sensor 1, there is no reflection of the IR rays and hence the message is received by the microcontroller to turn the motor OFF. By then, the gate is closed and the motor is OFF and the train reaches the crossing and crosses the junction safely. When the train reaches the sensor 2, the infrared rays emitted by the transmitter reflects the obstacle and reaches the photodiodes of the receiver, and the message is sent to the microcontroller to turn the motor ON again but this time in the other direction and this causes the gate to open. Again, as the train crosses the sensor, there is no further obstacle between the transmitter and receiver, and the

the message is received by the microcontroller to turn the motor OFF. By this time, the gate is open and the vehicles can securely cross the railway crossing.

The motor driver IC driven by the microcontroller on the command of the sensor 1 will be operating the motor to revolve in the clockwise direction for closing the gate and on the command of the sensor 2 will be operating the motor to revolve in the anticlockwise direction for opening the gate.

A reflective type IR sensor is a light-based sensor. The sensor includes two terminals, namely the IR transmitter end and the other is the IR receiver end. The infrared light emitted from the transmitter end is received by the receiver. When an obstacle is placed between the terminals, the infrared light transmitted is received by the photodiodes of the receiver. There are hence two possible scenarios:

1. When no obstacle is placed, IR rays are not received by the receiver.
2. When an obstacle is placed, IR rays are received by the receiver.

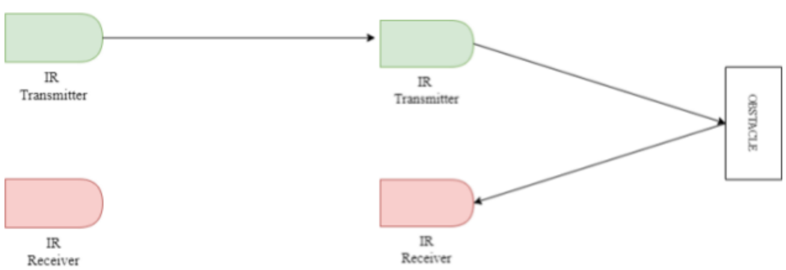


Fig 12. Working of IR Sensor

When an obstacle is present, the infrared rays sent out by the transmitter gets reflected by the surface of the obstacle and bounces back to be received by the photodiodes in the receiver.

Based on these two scenarios and the condition of the receiver, the signal can be perceived by the microcontroller. Depending on whether the receiver received the IR light, the motor mechanism can be turned ON or OFF. When the first sensor detects the presence of an obstacle, it will send the signal to the microcontroller and in turn the microcontroller will turn on the motor. As soon as the train passes the motor, the gate will close and the motor has turned off. When the sensor detects the train, the motor is ON and during this time, the gate closes. When the train has crossed the crossing and approaches the second sensor, the sensor detects the obstacle. This will in turn be sent as a signal to the microcontroller which will turn the motor ON again and this time in the opposite direction which enables the gate to be opened. By the time the obstacle. i.e., the train has passed, the gate is open and the sensor is free of the obstacle hindrance and with that, the microcontroller will turn OFF the motor.

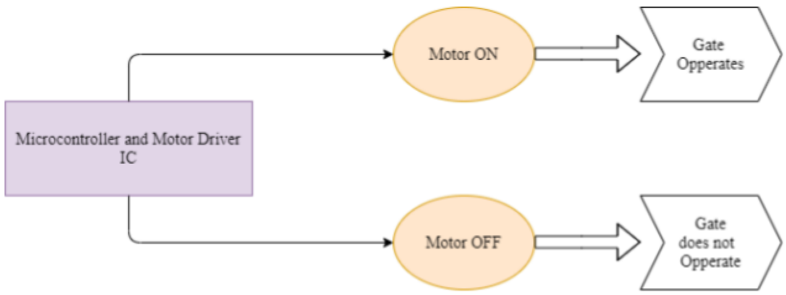


Fig 13. Motor Operation

This control mechanism of the motor by the microcontroller is guided by the motor driver IC. The L293D IC received the output from the microcontroller and based on the output, it will turn ON or OFF the motor. Alongside, based on the output binary code, it will rotate the motor in a clockwise or anticlockwise direction.

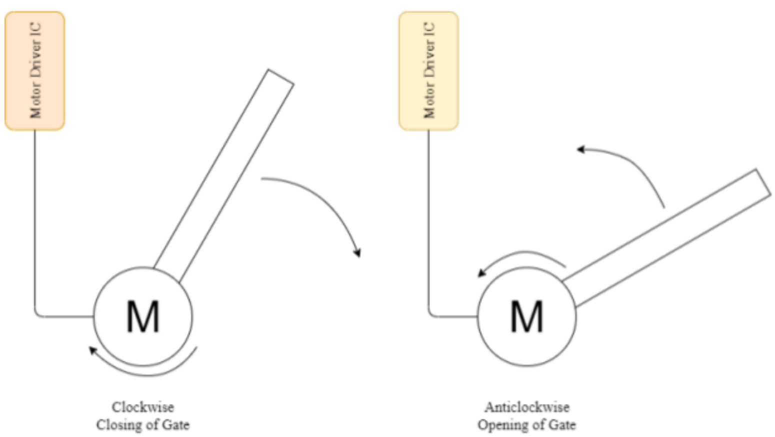


Fig 14. Gate Operation

# CHAPTER 5

## 5. ALGORITHM

1. The program receives the condition of the IR sensor.
2. If sensor 1 detects the train, the motor is set 1.
3. When sensor 1 doesn't detect the train further, the motor is set 0.
4. The motor rotates clockwise closing the gate.
5. Gate is closed between the conditions of motor 1 and 0.
6. If sensor 2 detects the train, the motor is set 1.
7. When sensor 2 doesn't detect the train further, the motor is set 0.
8. The motor rotates anti-clockwise opening the gate.
9. Gate if closed between the conditions of motor 1 and 0.

# CHAPTER 6

## 6 CONCLUSIONS AND FUTURE SCOPE
## 6.1 CONCLUSION

Railways are one of the most crucial and important modes of transportation in our country with a huge employment contribution. However, this important mode of transportation doesn't assure a hundred percent safe travel. One of the major reasons for this contribution is the failure of a secure railway gate system. Some of the railway gates are unmanned and without this safety, many hazardous accidents killing lives have resulted. To ensure the safety of people, the introduction of an automatically controlled Railway System will rest assure safety and advancement at the same time.

The world isn't new to the concept of automation and certainly not new to the concept of Railway gate automation. The methods and necessities have been installed and started securely in countries like the USA. The advancement of the cities has taken into consideration how important automation shall be in the Railway Gate system. The introduction of such a system in India will be highly beneficial for the country. Moving towards automation may not be easy but in cases like these where the requirement is very high will be very helpful and not forget, safe.

## 6.2 FUTURE SCOPE

One of the major drawbacks and the highly asked question is the level of safety of an automatically controlled railway gate system. Even though the unmanned system works precisely well, the biggest default will be the detection of a vehicle if it has accidentally landed in the path of the train and has no way out with the gates closed on either side. However, this drawback can be easily sorted into two options: -

1. Another sensor system can be introduced to keep a check on the path of the track and alerting the train upon an obstruction.
2. Another sensor system can be introduced to provide traffic light alert.

The second will be a rather more civil and rest assured method. In this defensive system, another pair of IR sensor is to be used. They will be placed close to the other two sensors but one a little more ahead and the other a little further.

In the figure, the yellow circles depict the traffic light sensor and the violet circles depict the gate control system. Another microcontroller is used to control the sensor system for a traffic light. The first yellow sensor detects the train and sends a signal to the microcontroller to set the traffic lights. The red-light signal will be delivered. The vehicles will be alerted that a train is in the vicinity of arrival and by the time the train reaches the first violet senor than closes the gate, the vehicles are in a red light stand-by. When the train crosses and reaches the second violet sensor, the gate opens and then it reaches the yellow sensor when a green light signal shall be sent and vehicles are safe to go ahead.

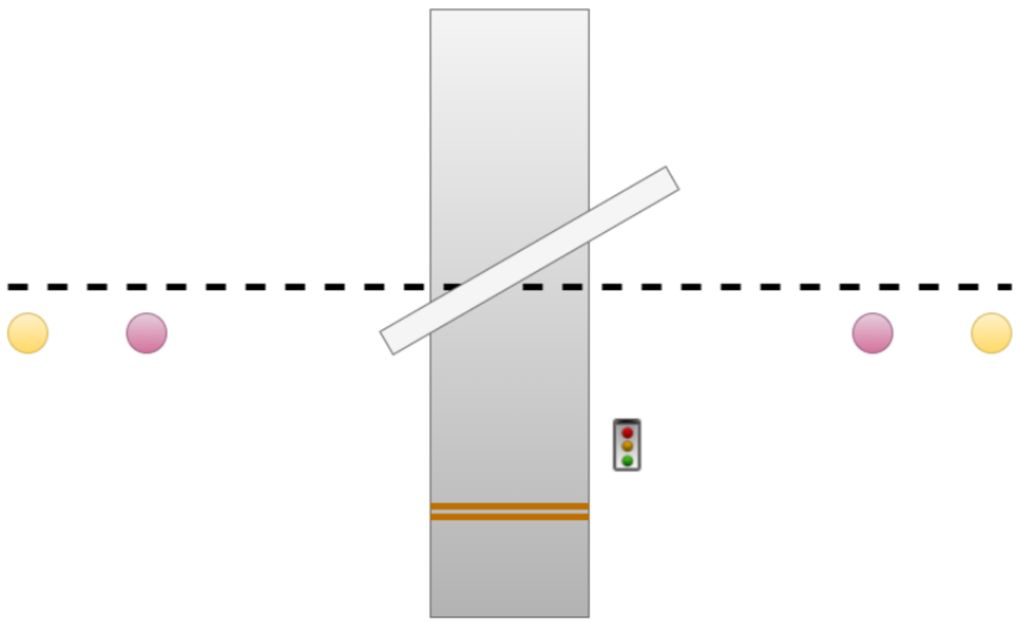

Fig 15. Advancement of Railway Gate Control System

This method can be used to prevent any possibility of vehicles being trapped on the way of the fast-moving train. Modifications can be made to ensure a hundred percent safety rate on the unmanned control of railway gates which provides reliability and advanced technology implementation.

# CHAPTER 7

## 7. PROGRAM

```
#include<reg51.h>
sbit s1=P2^6;
sbit s2=P2^7;
sbit mot1=P0^0;
sbit mot2=P0^1;
void delay (int);
void delay (int d)
{
        unsigned char i=0;
        for(;d>0;d--)
        {
                for(i=250;i>0;i--);
                for(i=248; i>0;i--);
        }
}
void main()
{
        int tep=1;
        P2=0x00;
        P3=0x00;
        while(1)
        {
                while((s1==0 && s2==0) ==1);
                if(s1==1 && tep==1)
                {
                        mot1=1;
                        mot2=0;
```

```
                delay(200);
                        mot1=0;
                        mot2=0;
                        while(s1==1);
                        tep=0;
                }
                else if(s2==1 && tep==0)
                {
                        mot1=0;
                        mot2=1;
                        delay(200);
                        mot1=0;
                        mot2=0;
                        while(s2==1);
                        tep=1;
                }
                //while((s1==0 && s2==0)==0);
        }
}
```

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| 2 | Nasreldin M.A. Mohamed, Abdalgfar A.A. Abdalaziz, Alfatih A. Ahmed, Abdelrahman A.A. Ahmed. "Implementation of a PID control system on microcontroller (DC motor case study)", 2017 International Conference on Communication, Control, Computing and Electronics Engineering (ICCCCEE), 2017<br>Publication | <1 % |

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