Project On

AUTOMATIC RAILWAY GATE CONTROL

SUBMITED TO

INDIAN INSTITUTE OF INFORMATION TECHNOLGY NAGPUR

Submited By :

1. Arvind Kumar Sahu(BT17CSE087)
2. Shreyansh Gupta (BT17CSE096)
3. Ravi Kumar Sinha (BT17CSE099)

Abstract :

1. Introduction
2. Block Diagram
3. Explanation of Hardware Kit
4. Working Principle
5. Algorithms
6. Circuit Diagram
6. Program Code
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Introduction :

The railway system is the most commonly used transportation mode in India. It is also one of those modes of transport that faces a lot of challenges due to human errors such as level cross accidents, collisions etc. A level cross, an intersection of a road and a railway line, requires human coordination, the lack of which leads to accidents. Level crosses are controlled by manually operated gates. In order to avoid the human errors that could occur during the operation of gates, the proposed paper introduces the concept of railway gate automation. Level crossings are managed by the gatekeeper and the gatekeeper is instructed my the means of telephone at most of the level cross from the control room. But the rate of manual error that could occur at these level crosses are high because they are unsafe to perform without actual knowledge about the train time table. Delay in the opening and closing of the gate could lead to railway accidents. The major.

challenge faced by the Indian railway system is the increasing accident rate at the level crosses. The existing system involves the manual gate operation by the gate keepers based on the signals received from the control room. The human errors such as delay in informing the gatekeeper about the arrival of the train, delay in the gate operation by the gate keeper, obstacle stuck in the level cross etc. leads to the increasing rate of accidents at the level cross.

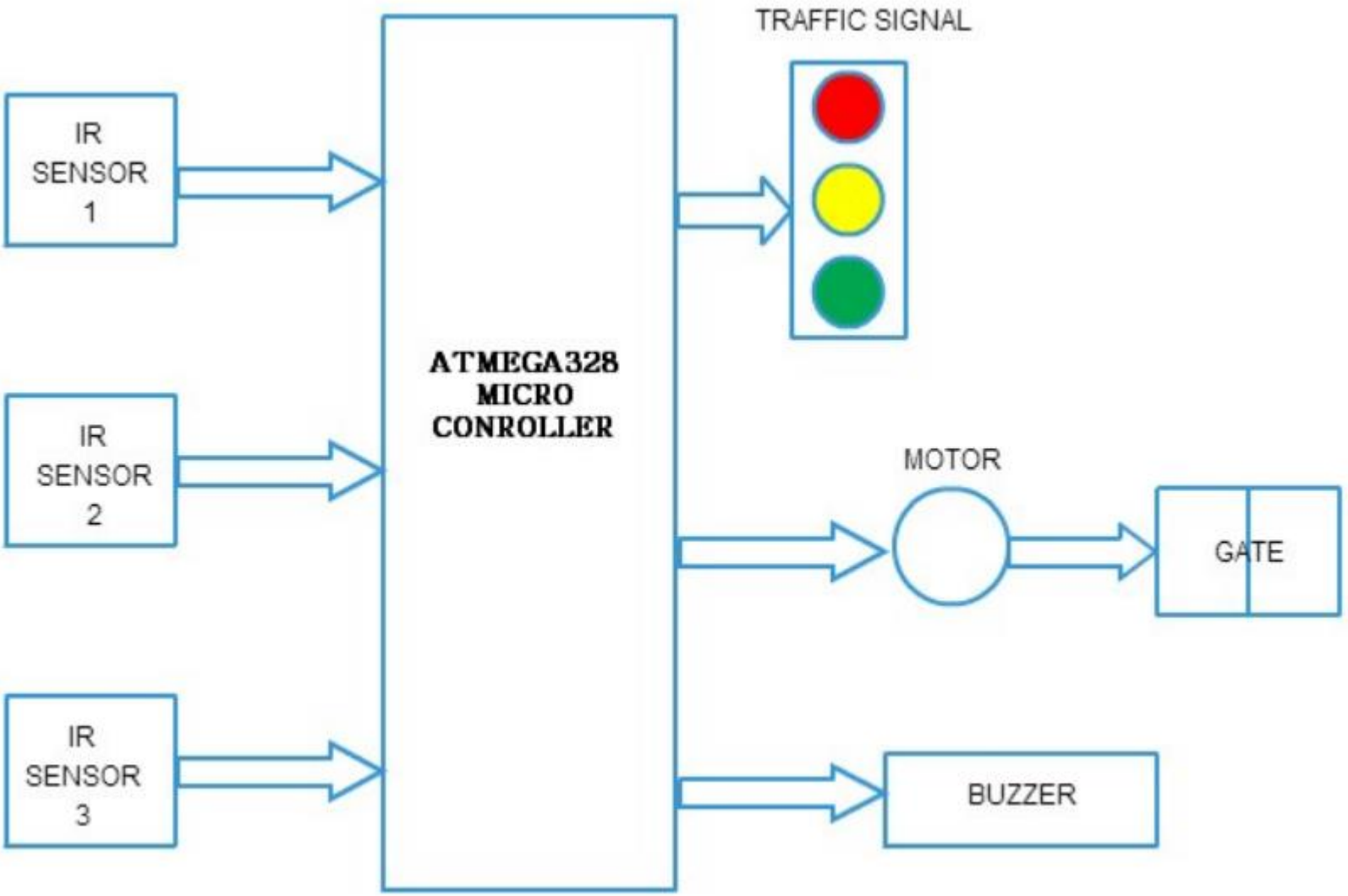
Thus the railway gate automation system aims to deal with two things. It reduces the total time taken for the gate operation at the level cross and also ensures the safety of the passengers at the level cross during when the train passes.

The reduction in the direct human intervention during the gate operation in turn helps to reduce the collision and accidents at the level cross. Since the gate operations are automated based on the sensors, the time for which the gate is closed is less. The

paper thus intends to develop an automatic railway gate control system which is reliable and secured than the existing manual systems. Sensor based railway gate automation system is developed to automate the process of opening and closing of gate at the railway level crosses. The system detects the arrival and the departure of train for the gate operation using different types of sensors. The train detectors act as the major component in the train automation system. The proposed system uses three infrared sensors to identify the arrival and departure of trains. The system also implements obstacle sensor which detects any obstacle on the track and controls the operation of the train. Sensors and servo motors are programmed using Arduino microcontroller. Our project is designed using ATMEGA328P microcontroller to avoid railway accidents happening at unattended railway gates. This project utilizes two IR trans-receiver pair; one pair of IR trans-receiver is fixed at one side of the railway gate and similarly the other pair is fixed at the other side of the railway gate. Whenever a signal from any of the trans-receiver is detected a buzzer is sounded for say five seconds and then the gates are closed we will be using DC geared

motor to open and close the gates. Now when the train is again detected at other IR trans-receiver the gates are opened. We will be using L293 driver IC to control the motor i.e., open and close the gates. 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.

Block Diagram :



Explanation Of Hardware Kit :

1. Aurdino UNO
2. IR Sensor
3. LED
4. Servo motor
5. Buzzer
6. Bread Board
7. Train Kit
8. Aurdino Software installed on PC
9. Wires

1. Aurdino UNO pins specifications

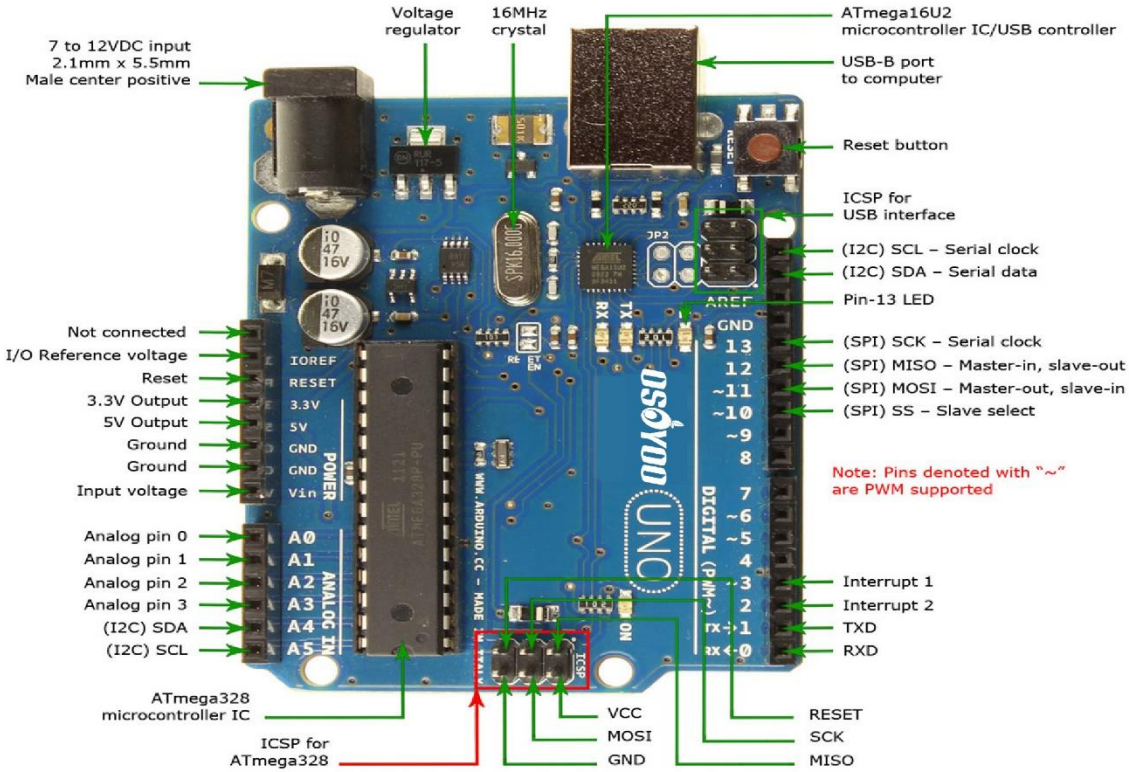


Table 1. Specifications of Arduino Board

Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB of which 0.5KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	68.6 mm
Weight	25g

2. IR Sensors

Pin Configuration :

VCC - Power Supply input
GND - Power supply GND
OUT - Active High output

IR Sensor Module Features

1. 5VDC Operating voltage
2. I/O pins are 5V and 3.3V compliant
3. Range: Up to 20cm(It is adjusted accordingly)
4. Adjustable Sensing range
5. Built-in Ambient Light Sensor
6. 20mA supply current
7. Mounting hole

Working of IR Sensor :

IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feets, it depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. IR LED white or transparent in colour, so it can give out amount of maximum light.

Photodiode Receiver

Photodiode acts as the IR receiver as its conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Photodiode looks like a LED, with a black colour coating on its outer side, Black colour absorbs the highest amount of light.

LM358 Opamp

LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. the comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

Photodiode's series resistor voltage drop > Threshold voltage = Opamp output is High

Photodiode's series resistor voltage drop < Threshold voltage = Opamp output is Low

When Opamp's output is **high** the LED at the Opamp output terminal **turns ON** (Indicating the detection of Object).

Variable Resistor

The variable resistor used here is a preset. It is used to calibrate the distance range at which object should be detected.

How to Use IR Sensor Module?

The 5 VDC supply input is given to the VCC pin and the supply negative is connected to the GND terminal of the module. When no object is detected within the range of the IR receiver, the output LED remains off.

3. LED Specifications :

LED stands for **Light Emitting Diode**. It is a two-lead semiconductor light source. It is a pn-junction diode which emits light when activated. It is a very important electronic device because it is used in a lot of electrical and electronic devices now a days.

I-V **Characteristics of LED**

There are different types of light emitting diodes are available in the market and there are different **LED characteristics** which include the color light, or wavelength radiation, light intensity. The important **characteristic** of the **LED** is color.

LEDs are extremely energy efficient and consume up to 90% less power than incandescent bulbs.

Since **LEDs** use only a fraction of the energy of an incandescent light bulb there is a dramatic decrease in power costs.

4. Servo Motor :

TowerPro SG-90 Features
Operating Voltage is +5V typically
Torque: 2.5kg/cm
Operating speed is 0.1s/60°
Gear Type: Plastic
Rotation : 0°-180°
Weight of motor : 9gm
Package includes gear horns and screws

SG-90 Servo Motor Equivalent
MG90S Metal Gear, MG995 High Torque Metal Gear, VTS-08A Analog Servo

5. Buzzer :

Buzzer Features and Specifications

Rated Voltage : 6V DC
Operating Voltage : 4-8V DC
Rated current : <30mA
Sound Type : Continuous Beep
Resonant Frequency : ~2300 Hz

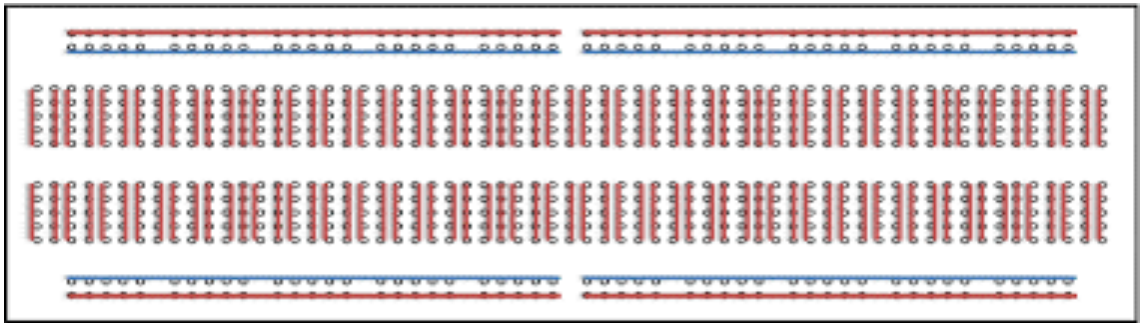
* Small and neat sealed package
* Breadboard and Perf board friendly

Pin Number	Pin Name	Descriptions
1	Positive	Identified by (+) symbol or longer terminal lead. Can be powered by 6V DC
2	Negative	Identified by short terminal lead. Typically connected to the ground of the circuit

Equivalents for Passive Buzzer

Piezo Electric buzzer, Speaker, Active Passive Buzzer with Module

6. Bread Board



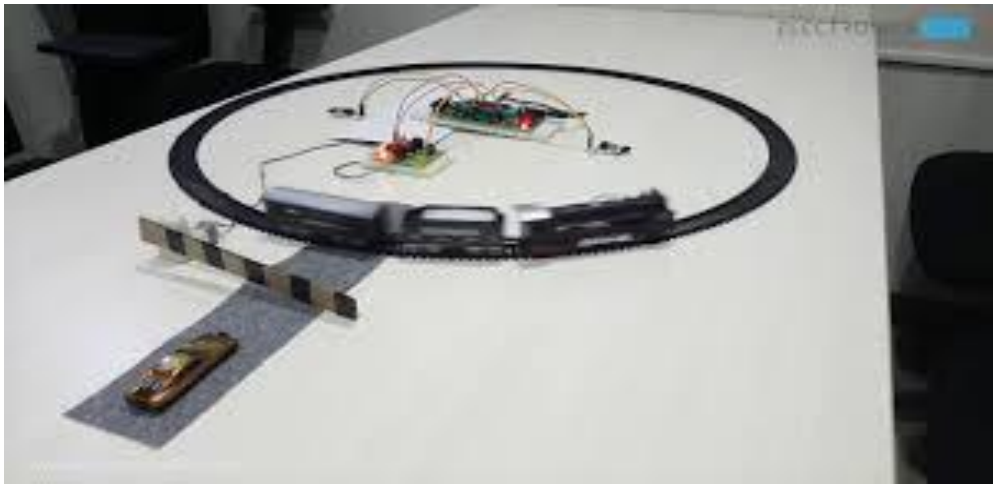
A **breadboard** is a construction base for prototyping of electronics. Originally the word referred to a literal **bread board**, a polished piece of wood used for slicing **bread**. In the 1970s the solderless **breadboard**

7. Train Kit :

This is a simple toy train with track on which we will demonstrate our project, When it will run on the track then our demonstrated automatic railway crossing gate will open and close the track accordingly as we have implemented.

4. Working Principle :

- In India the maximum speed at which a train moves is 160km/hr and the minimum speed of a passenger/goods train is 59km/hr. Hence the ideal distance at which the sensors could be placed to detect the arrival of the train is 5km from the level cross and the departure of the train is 1km and thus the gate will not be closed for more than 6 minutes . Our project proposes a system which uses three IR Sensors (IR1, IR2), a Light Dependent Resistor and one buzzer (B1). In real time, the IR Sensors are placed on the track at a distance of 5km on both sides of the level crossing. The LDR is used to detect the presence of an obstacle between the railway gates. The system also uses Servo motors to control the operation of the gates. The buzzer is used to indicate the arrival of the train within a stipulated time . IR1 detects the arrival of a train red led



starts glowing. Once it detects a train, it sends a signal to red led and servo motor, and starts count down for delay (it will set accordingly), Servo motors are powered on and gate is closed. After the train passes the gates and nears IR2, a signal is again sent to the servo motors and the gates open and green LEDs are switched on for the road traffic to pass. The proposed system architecture is shown in Fig below.

Gate closing and opening

- Fig. shows the flow chart of the gate closing operation. After the train is detected and the gate is closed the next immediate operation is to detect the departure of the train from the level cross. The sensors IR1 detects the departure of the train and the motor is then operated to open the gate. The servo motor is programmed to operate with the specified speed. Fig. shows the the flow chart of the gate opening operation.

5. Algorithms :

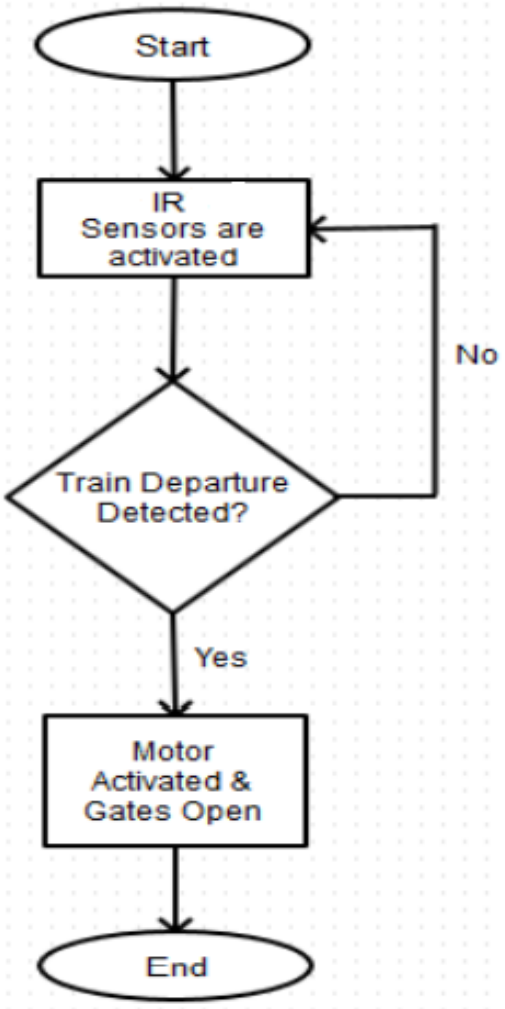


Fig. 2: Flowchart of closing the gate

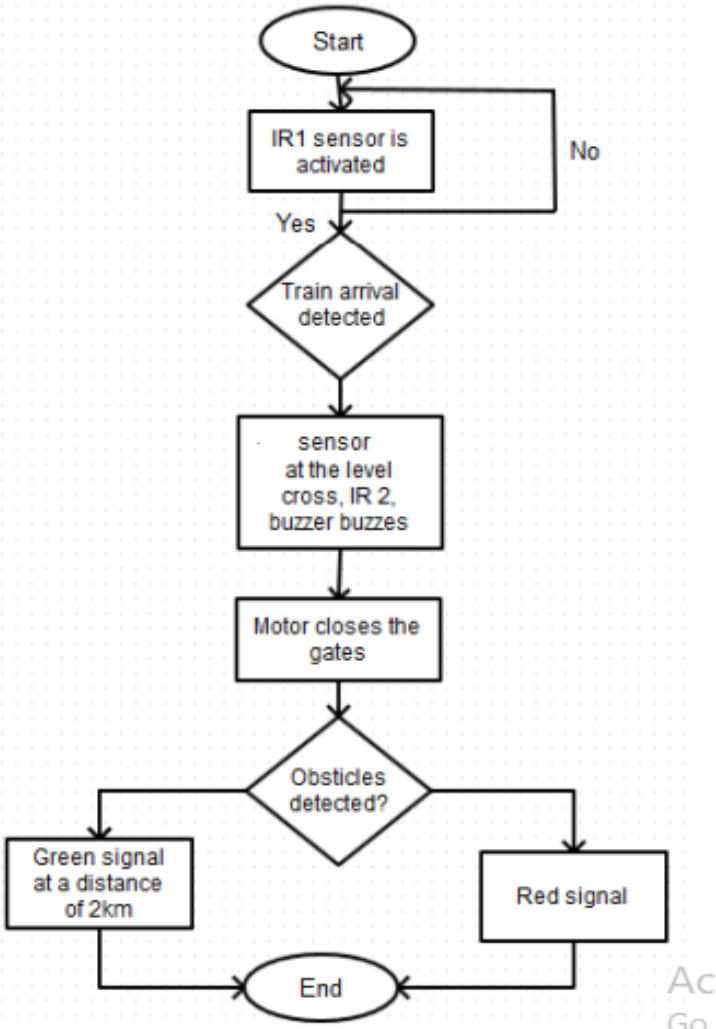
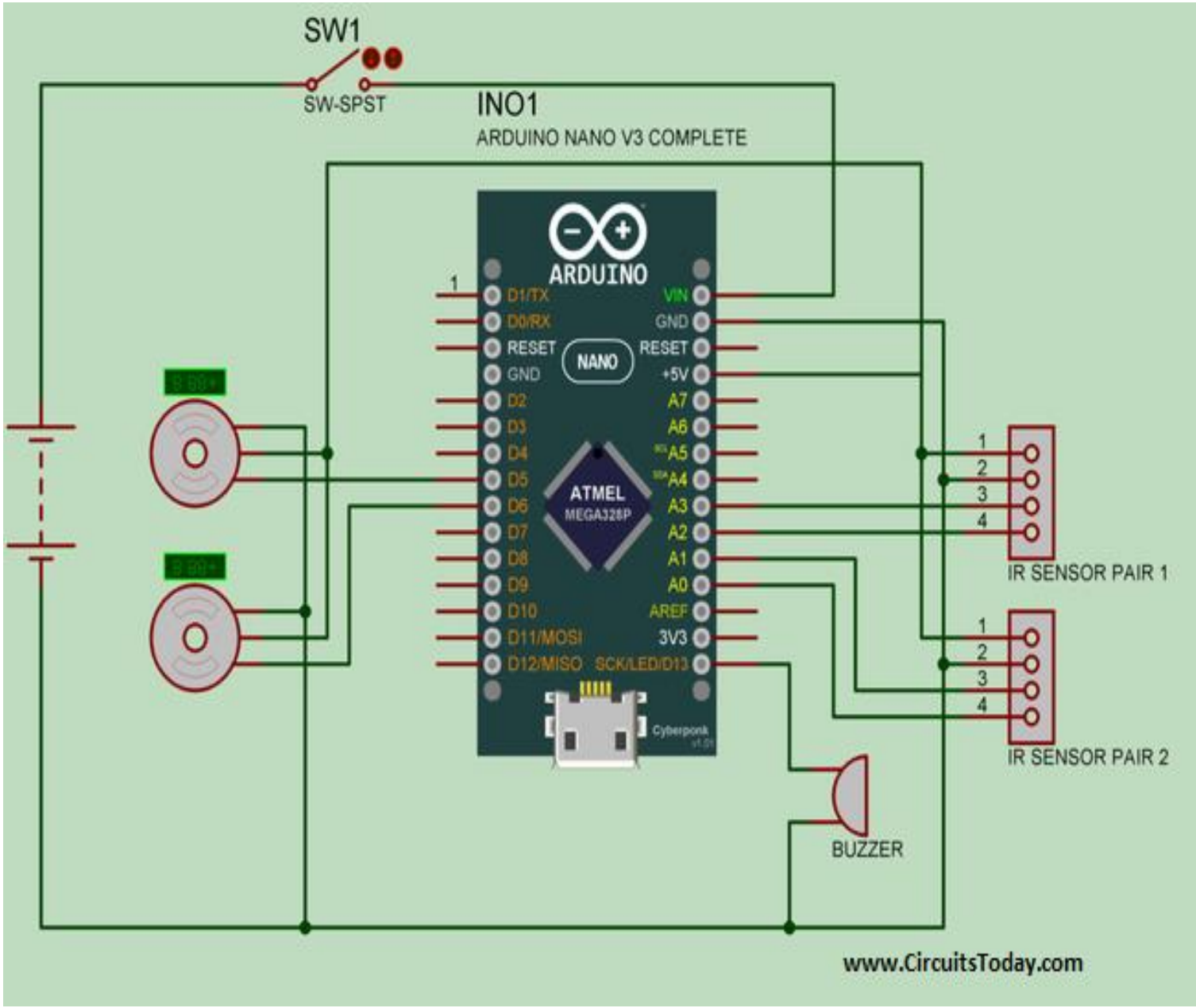


Fig. 3: Flowchart of opening of gate

Circuit diagram

Fig. 10 shows the circuit diagram of the proposed system. An Arduino UNO is the base of this circuit and all the other components are connected to this board. Three IR Sensors, IR1, IR2 , are connected to pins 2, 1 of Ardiuno UNO. LEDs, 2-red, and 2-green, are connected at pin (12 and 7) and (11 and 6) respectively. Each of these LEDs are grounded through 1kΩ resistor. 2 servo motor are connected to pin 8 and 9. A buzzer is also connected at pin 3.

When IR1 detects the train coming, it sends a high signal to pin 3. As soon as the Arduino UNO detects a high signal, it raises the signal at pin 11 and the components connected to this pin shows an output i.e. the yellow LED glows and the buzzer buzzes. IR2 sends a high signal to pin 5 when the train is detected by it. This sends a high signal to pin 12 and pin 9. Hence, the red LED glows and servo motor rotates 90 degrees. When IR3 senses, it sends a high signal to pin 9 and pin 13. Thus, the green LED glows and the servo motor moves another 90 degrees. Fig. 11 shows the block diagram of the system.


SW1
SW-SPST
INO1
ARDUINO NANO V3 COMPLETE
ARDUINO
NANO
ATMEL
MEGA328P
D1/TX
D0/RX
RESET
GND
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11/MOSI
D12/MISO
VIN
GND
RESET
+5V
A7
A6
A5
A4
A3
A2
A1
A0
AREF
3V3
SCK/LED/D13
IR SENSOR PAIR 1
IR SENSOR PAIR 2
BUZZER
www.CircuitsToday.com

7. Program Code :

```
#include <Servo.h>

const int ProxSensor=8;
const int ProxSensor1=9;
int inputVal = 0;
Servo myservo;
Servo myservo1;

void setup()
{
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT); // Pin 12 has an LED(red) connected on most Arduino
boards:
  pinMode(11, OUTPUT); // Pin 11 has an LED(blue) connected on most Arduino
boards:
  pinMode(7, OUTPUT);  // Pin 7 has an LED(red) connected on most Arduino
boards:
  pinMode(6, OUTPUT);  // Pin 6 has an LED(blue) connected on most Arduino
boards:
```

```
pinMode(ProxSensor,INPUT);    //Pin 8 is connected to the output of proximity sensor
  pinMode(ProxSensor1,INPUT);   //Pin 9 is connected to the output of proximity
sensor
  Serial.begin(9600);
  myservo.attach(2);
  myservo1.attach(4);
}

void loop()
{
  if(digitalRead(ProxSensor)==LOW)      //Check the sensor output
  {
    digitalWrite(12, HIGH);// set the LED on
    digitalWrite(11, LOW);
    digitalWrite(13, HIGH);
    digitalWrite(7, HIGH);
    digitalWrite(6, LOW);
    myservo.write(90);
    myservo1.write(90);
  }
```

```
 if(digitalRead(ProxSensor1)==LOW)      //Check the sensor output
  {
    digitalWrite(11, HIGH);   // set the LED on
    digitalWrite(12, LOW);
    digitalWrite(13, LOW);
    digitalWrite(6, HIGH);
    digitalWrite(7, LOW);
    myservo.write(0);
    myservo1.write(0);
  }           // wait for a second
}
```

CONCLUSIONS AND FUTURE SCOPE :

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 cars and humans from crossing railway tracks. 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. Automation of the closing and opening of the railway gate using the switch circuit reduces the accidents to a greater extend. The obstacle detection system implemented reduces the accidents which are usually caused when the railway line passes through the forest. Most of the times greater loss has been caused when animals cross the tracks. The limitation of this project is the use of IR sensors. Hence, any obstacle in the way of the sensor will be detected. Another important limitation is that this project does indeed close and open the gate but it cannot control the crossing of cars and vehicles. It only controls the gate. To combat this problem pressure sensors can be used as extension to the present work. We are using IR sensors but it is better to use load sensors. We have not used load sensors because it was not economically feasible. As a future scope of work, our system can be implemented in real time by fixing the current limitations using new technologies

References :

Mostly taken help from friends having electronics branch,
Indian Railway information,
and also taken help from yutube and google.