

## **Advance Railway Control System**

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### **Abstract**

*Nowadays railway transport is a very popular way of travelling in Bangladesh and the number of train travelers is increasing day by day. So we need to make railway travelling more efficient, comfortable & safe. In Bangladesh the railway controls are not still totally digitalized. Due to some natural human errors train accidents have become very common. Most of the unwanted events occur due to the lack of precise control of train engine, tracks & traffic gates/rail crossings. Accidents can be reduced if we start using automatic control systems such as, smart train engine, railway track control. This can be further extended to meet the demands according to situation like GPS monitoring. With the help of advance railway control system, railway transport can be attracted to the people & also beneficial to the national sector.*

Keywords: Railway, Engine, Track, Gate, Automatic.

### **1. Introduction**

In Bangladesh railway & trains are controlled by human hands. Due to some natural human errors train accidents have become very common. Most of the unwanted events occur due to lack of precise controlling of train engine, railway tracks & traffic gates on the rail crossings. Such accidents can be prevented towards a minimum number if we start using automatic control systems. Such as, train engine control at the stations, railway track control when to change track of the train, rail-crossing gate control etc. can be very helpful to ensure safety & also make train travel more organized.

### **2. Objectives**

The main objectives of this work are

- Controlling train engine at emergency when the driver is unaware of it.
- Changing rail-tracks more easily where there are more than two/three train roots.
- Closing the safety gate automatically at rail-road crossing.
- Prevent possible accidents due to human errors.

### **3. Smart train engine**

The project involves intelligent train speed control. The idea is whenever any engine observes a red signal on its track it will start decreasing its speed gradually and stops automatically at some distance from the signal pole. After then when it gets green signal the train will start automatically or manually started by the driver & go on. In the mean time when train has not stopped yet and a red signal becomes green then it crosses the signal pole with low speed and then driver can slowly increase the speed. Speed can also be controlled digitally.

The whole idea based on Pulse Width Modulation Technique. So now before the driver observes the red signal the engine itself observes it and automatically starts decreasing speed and then stops. The driver can feel relax in driving because he doesn't have to take care about red signal. Even if he forgets to take any action on red signal then also we can avoid accidents by the implementation of this idea. Also this technique can be used at the destination stations to stop the train automatically.

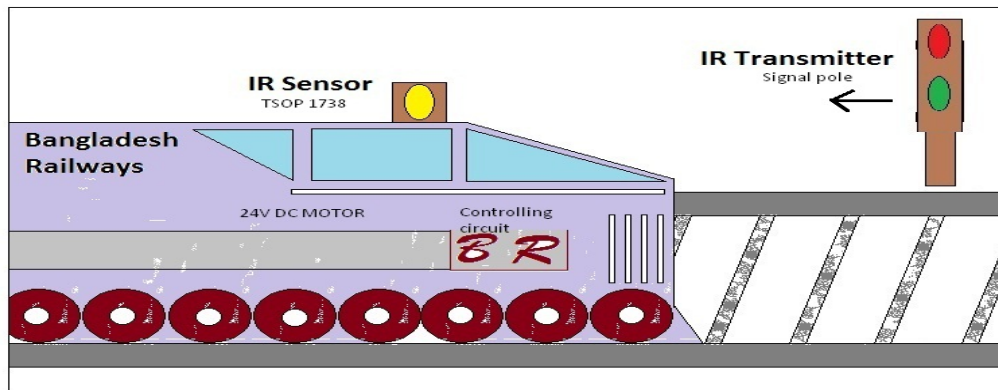


Fig. 1. Smart train engine control

### Design & working procedure

What we have to do is to attach a RF transmitter with signal pole which will start transmitting signals only when the red light is on. If the green light is on then there will be no transmission. The engine has a receiver which catches these transmitted signals and takes desired actions. Both the transmitter and receiver are RF type with minimum range of 2 Km. so that train can get enough time to decrease its speed and stop before the signal pole with minimum swapping distance of 100-200 meters.

Bangladesh railways use 480V DC Diesel-electric motors to run train engines. We have successfully controlled a 24V DC motor & the same procedure can be designed to control a 480V DC motor. The train engine motor speed can easily be varied by varying applied voltage. The 230 VAC is stepped-down to 24 VAC by 12-0-12, 2 Ampere step down transformer. Movable tapping are taken from this line and fed to the internal circuit of engine and give continuous supply to circuit. The RF sensor is placed at the top of the engine, senses the signals transmitted by RF transmitter attached to signal pole. The transmitter has to be placed about 20 ft. high signal pole on a straight line track.

Sensor will detect the RF signal and gives the interrupt to Atmega32. Atmega32 will indicate the interrupt event on first (green) LED and energizes only one particular relay through ULN chip. When red light is on, microcontroller gets signal and the speed of the motor decreases because of less voltage. And after some time it finally stops. The time required is 10 second to stop the train. Now at the time the sensor becomes green the speed of the train increases gradually. The direction and speed of the train can also be controlled digitally. Now if the signal is green then train will cross the pole with same speed, but if signal becomes red in between then RF sensor will detect and interrupts the Atmega32.

Now Atmega32 will wait for some time (2 to 3 sec) and train goes on with same speed. Again if still red signal is on, Atmega32 will be interrupted and this time it will switch the operating voltage of the motor to a lower value and after 10 seconds the voltage will be zero. So now when red signal becomes green driver can reset the controller or the engine will reset automatically in 2 minutes.

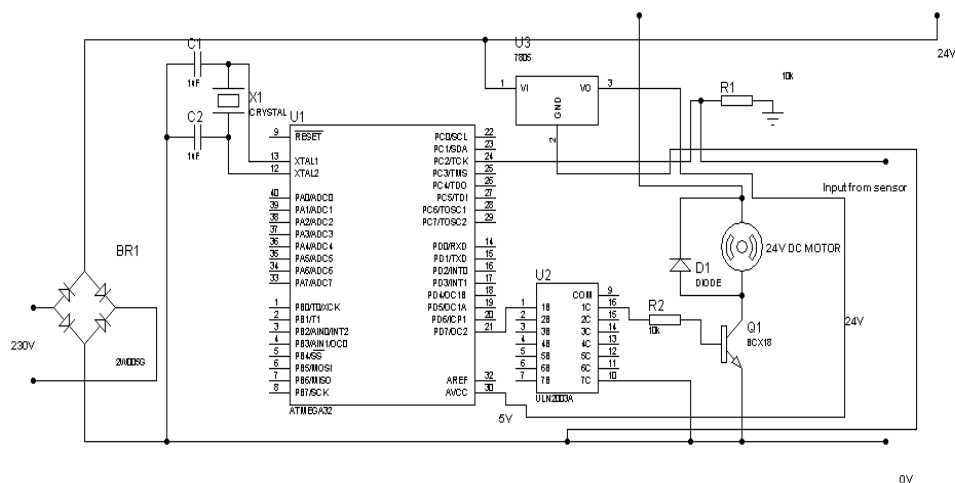


Fig. 2. Circuit diagram of smart train engine control

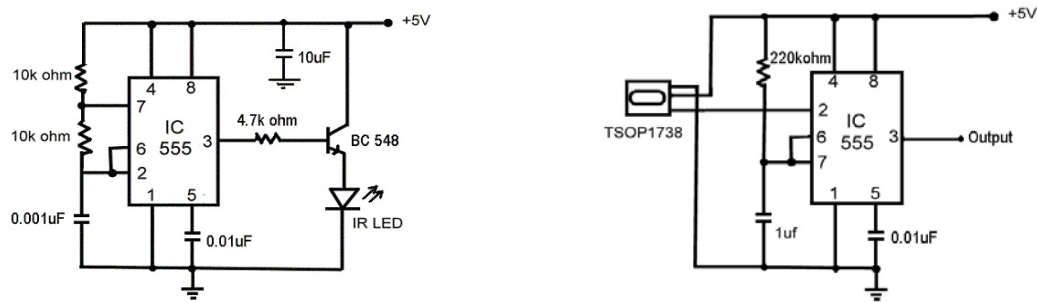


Fig. 3. RF transmitter & receiver.

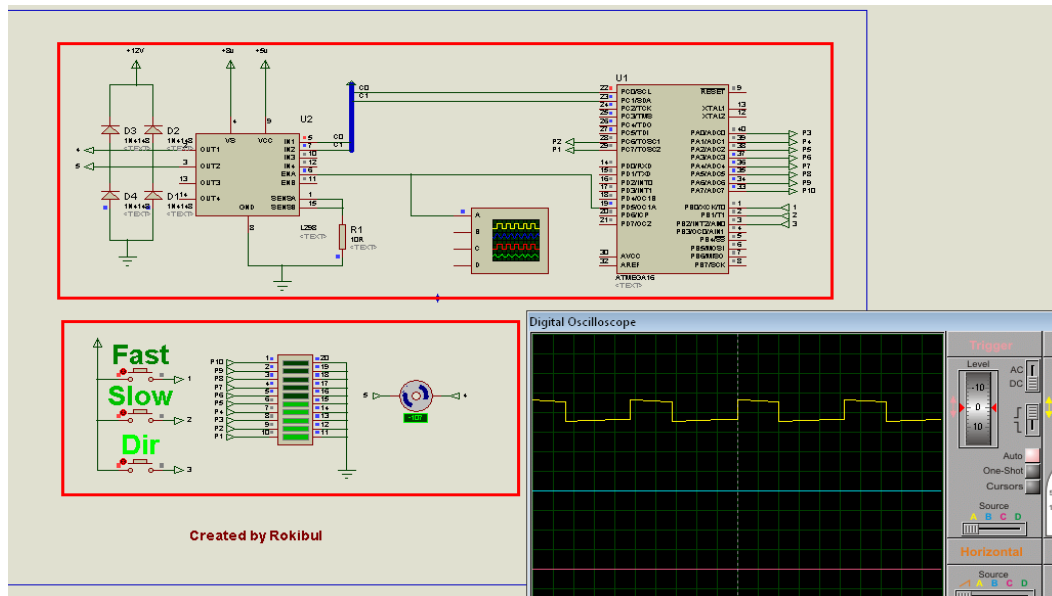


Fig. 4. ISIS simulation

#### 4. Automatic railway gate & track control

Aim of this project is to control the unmanned rail gate automatically using embedded platform. Today we see in news papers very often about the railway accidents happening at un- attended railway gates. Present project is designed to avoid such accidents if implemented in spirit. This project is developed in order to help the railways in making its present working system a better one, by eliminating some of the loopholes existing in it. Based on the responses and reports obtained as a result of the significant development in the working system of railways.

This project can be further extended to meet the demands according to situation.

This can be further implemented to have control room to regulate the working of the railway system. Thus becomes the user friendliness. Using the same principle as that for gate control, we have developed a concept of automatic track switching. Considering a situation where in an express train and a local train are traveling in opposite directions on the same track; the express train is allowed to travel on the same track and the local train has to switch on to the other track. Indicator lights have been provided to avoid collisions.

##### Design & working procedure

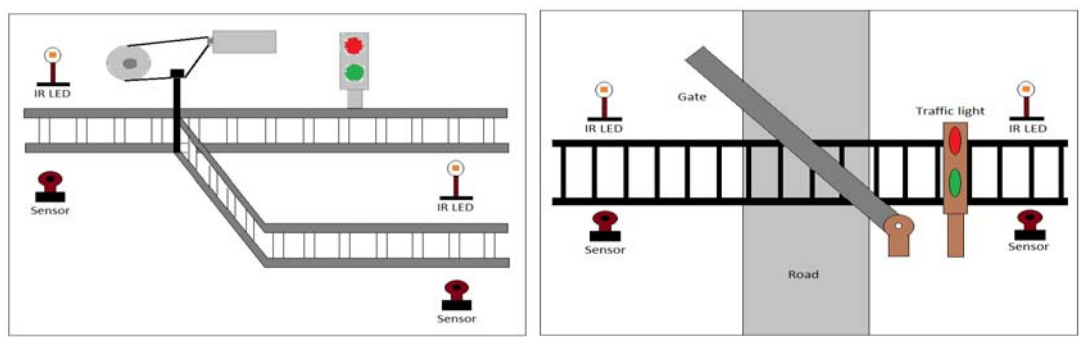
We have used AT89c51 Microcontroller Integrated Chip in this project. The program for this project is embedded in this Microcontroller Integrated Chip and interfaced to all the peripherals. Stepper motors are used for the purpose of gate control interfaced with current drivers chip ULN2003 which is a 16 pin IC. When foreside sensor gets activated, interrupt is sent to the microcontroller the microcontroller then instructs the gate motor to be turned on in clockwise direction and the gate is closed, the motor is stopped by limiting switch and stays closed until the train crosses.

When the foreside sensor is interrupted the same time the buzzer and traffic signal for the road users set on. After the train passes through the gate and reaches aft side sensors. The aft side sensor gets activated and sends signal to microcontroller which indicates the motor to turn in anti-clockwise direction and gate opens and motor stops.

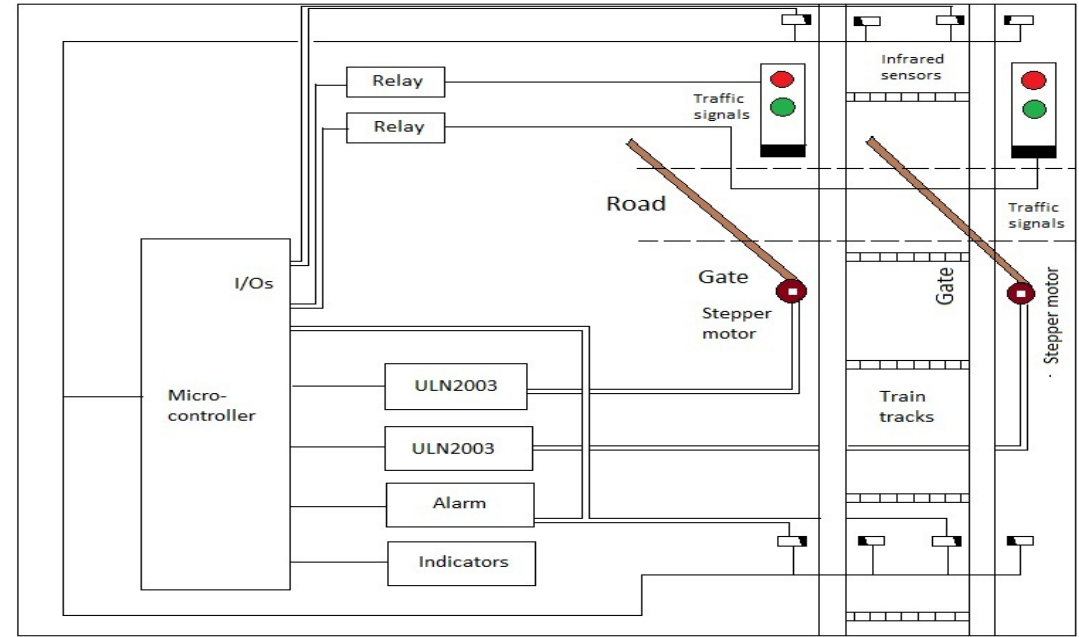
After the aft-side sensor is activated the microcontroller stops the buzzer and turns the traffic signal light to green. Using the same principle as that for gate control, we have developed a concept of automatic track switching. Considering a situation where in an express train and a local train are traveling in opposite directions on the same track; the express train is allowed to travel on the same track and the local train has to switch on to the other track. Indicator lights have been provided to avoid collisions. Here the switching operation is performed using stepper motor. In practical purposes this can be achieved using electromagnets. Two sensors are placed at the either sides of the junction where the track switches.

If there's a train approaching from the other side, then another sensor placed along that direction gets activated and will send an interrupt to the controller. The interrupt service routine switches the track. Signal light for train 2 is turned red. Here the switching operation is performed using a Stepper motor. After the Train passes on to the switched track the Train is detected by a sensor on the switched track. The stepper motor rotates in anti-clockwise direction and the track switches back to normal and the train signal turns green.

Thus the train passes on the other track. Sensors are fixed at 1km on both sides of the gate. We call the sensor along the train direction as 'foreside sensor' and the other as 'aft side sensor'. When foreside receiver gets activated, the gate motor is turned on in one direction and the gate is closed and stays closed until the train crosses the gate and reaches aft side sensors. When aft side receiver gets activated motor turns in opposite direction and gate opens and motor stops. Buzzer will immediately sound at the fore side receiver activation and gate will close after 5 seconds, so giving time to drivers to clear gate area in order to avoid trapping between the gates and stop sound after the train has crossed.



**Fig. 5.** Automatic railway gate & track control



**Fig. 6.** Circuit diagram of automatic railway gate & track control

## Algorithm

STEP 1 : Start.

STEP 2 : Set the variables.

STEP 3 : Make initial settings of the signals for the train and road users.

STEP 4 : Check for the arrival of the train in either direction by the sensors. If the train is sensed go to step 5 otherwise go to step 4.

STEP 5 : Make the warning signal for the road users and set the signal for the train.

STEP 6 : Check for the presence of the obstacle using sensors. If there is no Obstacle goes to step7 otherwise repeat step6.

STEP 7 : Close the gate and stop the buzzer warning.

STEP 8 : Change the signal for the train.

STEP 9 : Check for the train departure by the sensors, if the train sensed to next STEP. Otherwise repeat STEP 9

STEP 10: Open the gate.

STEP 11: Go to STEP 3

STEP 12: Stop

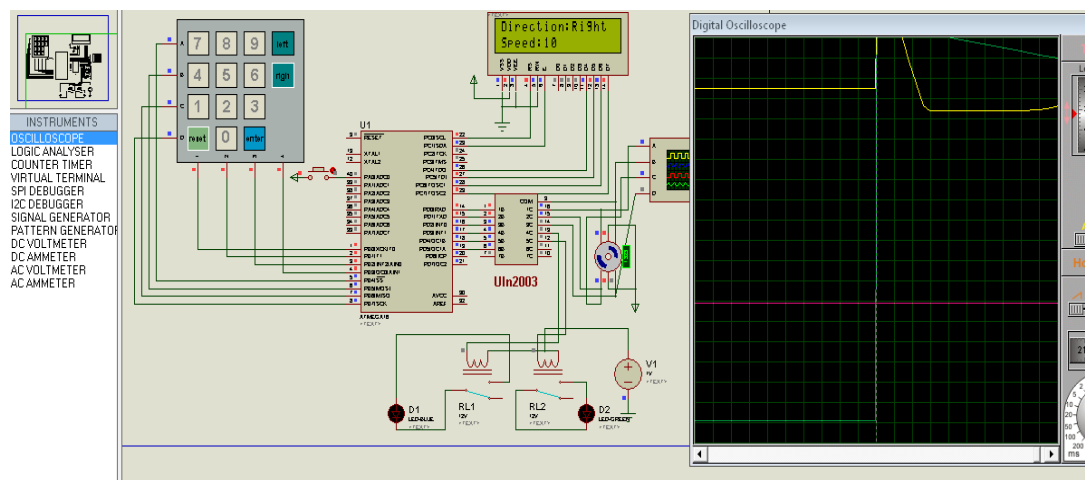


Fig. 6. ISIS simulation.

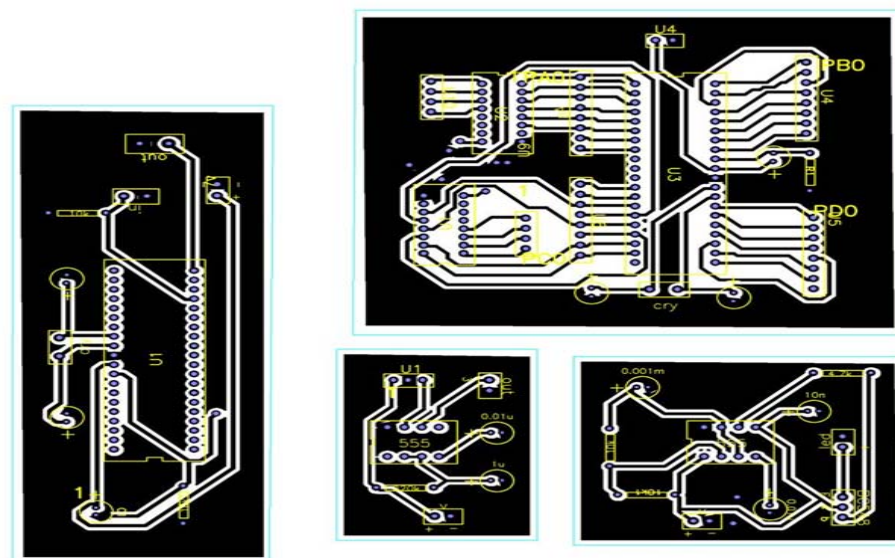


Fig. 7. PCB of the circuit.

## 5. Conclusions

From the above discussion and information of this system we, up to now surely comes to know that it is highly reliable, effective and economical at dense traffic area, sub urban area and the route where frequency of trains is more. As it saves some auxiliary structure as well as the expenditure on attendant it is more economical at above mentioned places than traditional railway crossing gate system. It also provide human work reduction, better efficiency, no operation time lag & manageable from remote place.

The mechanism works on a simple principle and there is not much of complexity needed in the circuit. We know that though it is very beneficial but it is also impossible to install such system at each and every places, but it gives certainly a considerable benefit to us, thereby to our nation.

## 6. Future work

In our technique though it has many merits, but still the power supply of 223V AC power is required for functioning of the motor. It can be avoided with the help of a battery charged by a Solar Cell. Since solar energy is an inexhaustible natural source of energy. Instead of using IR sensor, weight sensor can be used for better accuracy. Also with the help of GPS technology & computerized system simultaneously on line monitoring of railway system can be possible.

## 7. Acknowledgement

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