

# PLC BASED RAILWAY LEVEL CROSSING GATE CONTROL

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**Abstract—** In the rapidly flourishing country like ours, accidents in the unmanned level crossings are increasing day by day. No fruitful steps have been taken so far in these areas. Our paper deals with automatic railway gate operation (i.e.,) automatic railway gate control at a level crossing replacing the gates operated by the gatekeepers. 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 employing the automatic railway gate control at the level crossing the arrival of the train is detected by the sensors placed in the side of the tracks. Hence, the time for which it is closed is less compared to the manually operated gates. The operation is automatic so error due to manual operation is prevented. Automatic railway gate control is highly PLC based arrangements, designed for use in almost all the unmanned level crossing in the train.

**Key words—** PLC, Stepper motor, Vibration sensor.

## I. INTRODUCTION

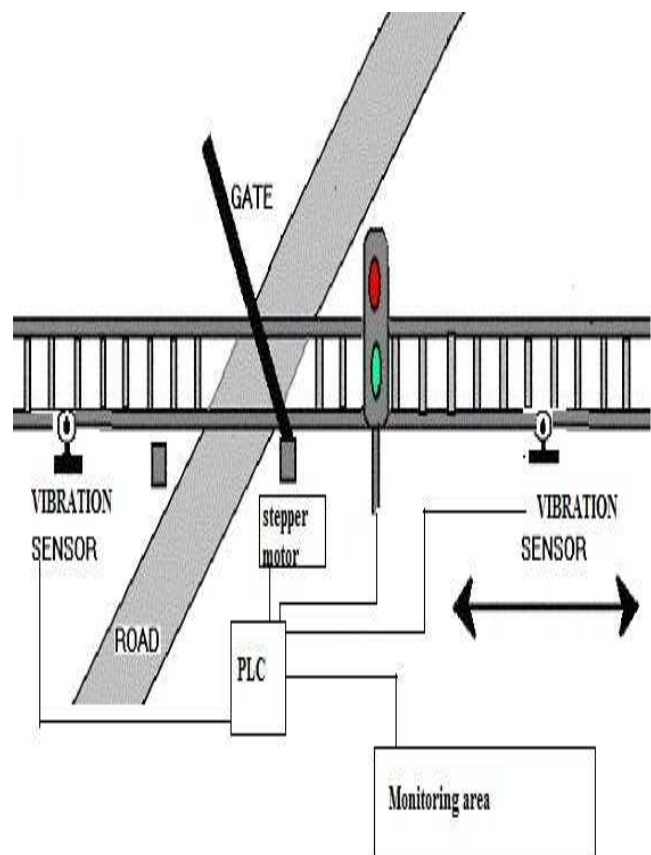
The place where track and highway/road intersects each other at the same level is known as “level crossing”. There are mainly two types of level crossing they are Manned level crossing and Unmanned level crossing. Railways being the cheapest mode of transportation are preferred over all the other means. When we go through the daily newspapers we come across many railway accidents occurring at unmanned railway crossings. This is mainly due to the carelessness in manual operations or lack of workers. We, in this paper have come up with a solution for the same. Using simple electronic components we have tried to automate the control of railway gates. As a train approaches the railway crossing from either side, the sensors placed in the track at a certain distance from the gate detect the approaching train and accordingly controls the operation of the gate. When the wheels of the train moves over the track there will be creation of vibration the sensor-1 senses the vibration and sends the signal to PLC to indicate train arrival.

## II. ACCIDENT AVOIDANCE DETAILS

When the train arrives in a particular direction the

Vibration sensor senses and generates appropriate signal, then at the same time the signal is sent to PLC to do the function according to the ladder diagram fed to PLC. At the same time PLC produces an output signal to the stepper motor to rotate in clockwise direction. When the output is from sensor-2 is sent to PLC it sends another signal to stepper motor to rotate in anti-clockwise direction.

## LINE SKETCH OF THE PROJECT



## HARDWARE IMPLEMENTATION

- PLC .
- Stepper motor.
- Vibration sensor.
- L293D (motor driver) .

III. BLOCK DIAGRAM DESCRIPTION

PLC :

PLC defines as “a digitally operating electronic apparatus which uses a programmable memory for the internal storage of instructions for implementing specific functions such as logic, timing, counting and arithmetic, sequencing to control through digital or analog input/output modules, various types of machines or processor”.

Item	Specification
Power Voltage	AC receiving power 100/110/120V AC (50/60Hz), 200/220/240V AC (50/60Hz)
	DC receiving power 24 V DC
Power voltage fluctuation range	85 to 264 V AC wide range
	21.6 to 26.4 V DC
Allowable instantaneous power failure	85 to 100V AC : for a momentary power failure of less than 10 ms, operation continues 100 to 264 V AC : for a momentary power failure of less than 20 ms, operation continues
Operating ambient temperature	0 to 55 °C (Storage ambient temperature -10 to 75 °C)
Operating ambient humidity	20 to 90% RH (no condensation) (Storage ambient humidity 10 to 90% RH (no condensation))
Vibration resistance	Conforming to IEC (EN) 61131-2 (147m/s <sup>2</sup> , 3times in each of 3 directions X, Y, Z)
Noise resistance	<ul style="list-style-type: none"> <li>Noise voltage 1,500Vpp Noise pulse width 100 ns, 1 μs (Noise created by the noise simulator is applied across the power supply module's input terminals. This is determined by this company's measuring methods.)</li> <li>Based on NEMA ICS3-304 (with the exception of input module)</li> <li>Static noise : 3,000V at metal exposed area</li> </ul>
Insulation resistance	20 MΩ or more between the AC external terminal and case ground (FE) terminal (based on 500V DC mega)
Dielectric withstand voltage	1,500V AC for 1 minute between the AC external terminal and case ground (FE) terminal
Grounding	Class D grounding (ground with power supply module)
Usage environment	No corrosive gases, no excessive dust
Structure	Open, wall-mount type
Cooling	Natural air cooling

STEPPER MOTOR :

The stepper tutorial deals with the basic final stage drive circuitry for stepping motors. This circuitry is centered on a single issue, switching the current in each motor winding on and off, and controlling its direction. The circuitry discussed in this section is connected directly to the motor windings and the motor power supply, and this circuitry is controlled by a digital system that determines when the switches are turned on or off. This section covers all types of motors, from the elementary circuitry needed to control a variable reluctance motor, to the H-bridge circuitry needed to control a bipolar permanent magnet motor. Each class of drive circuit is illustrated with practical examples, but these examples are not intended as an exhaustive catalog of the commercially available control circuits, nor is the information given here intended to substitute for the information found on the manufacturer's component data sheets for the parts mentioned.

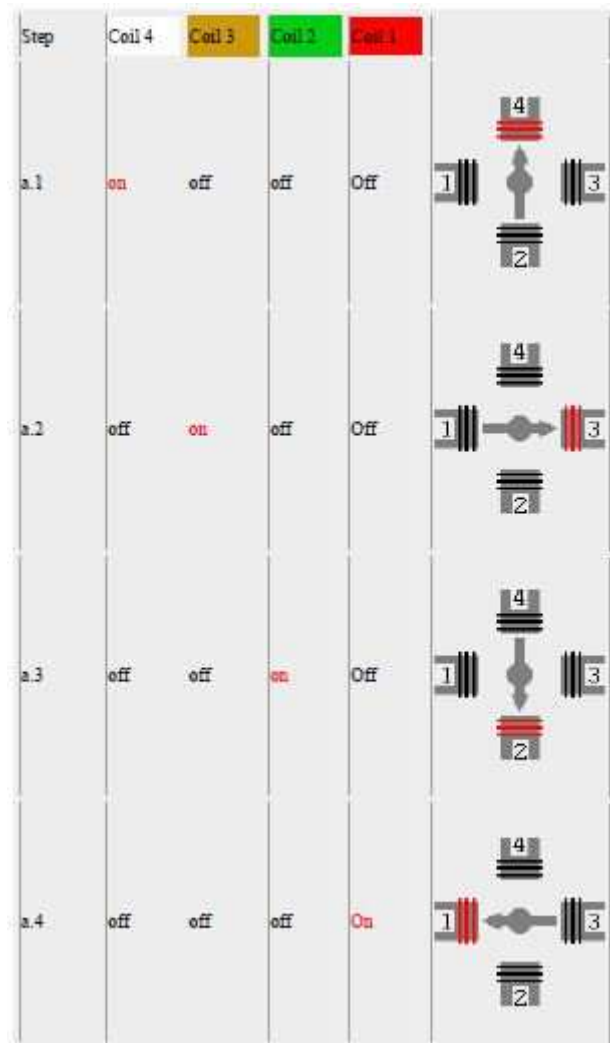
This section only covers the most elementary control circuitry for each class of motor. All of these circuits assume that the motor power supply provides a drive voltage no greater than the motor's rated voltage, and this significantly limits motor performance. The next section, on current limited drive circuitry, covers practical high-performance drive circuits.

This is used to open and close the gates automatically when it is rotated clock wise or anticlockwise direction.

Stepping Sequences for a Four-Phase Unipolar Permanent Magnet Stepper Motor

This kind of motor has four coils which, when energized in the correct sequence, cause the permanent magnet attached to the shaft to rotate.

There are two basic step sequences. After step 4, the sequence is repeated from step 1 again.

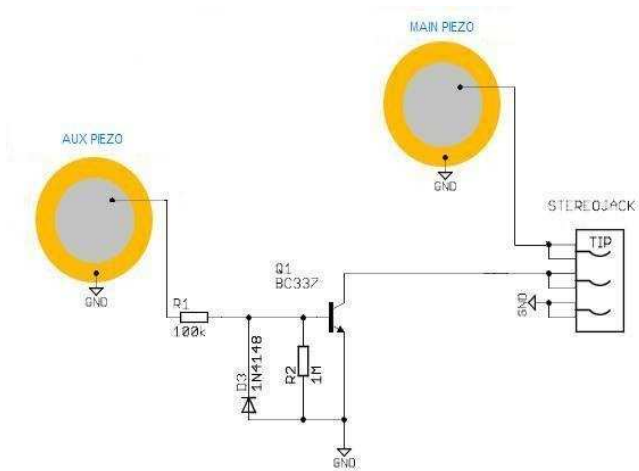


Reversing the order of the steps in a sequence will reverse the direction of rotation.

Here are some possible connection diagrams and some software.

VIBRATION SENSOR

An accelerometer is a device that measures the vibration, or acceleration of motion of a structure. The force caused by vibration or a change in motion (acceleration) causes the mass to "squeeze" the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration.



SENSOR DISTANCE CALCULATION

Here the distance of sensors from the gate is taken as 2KM

Timing calculation:

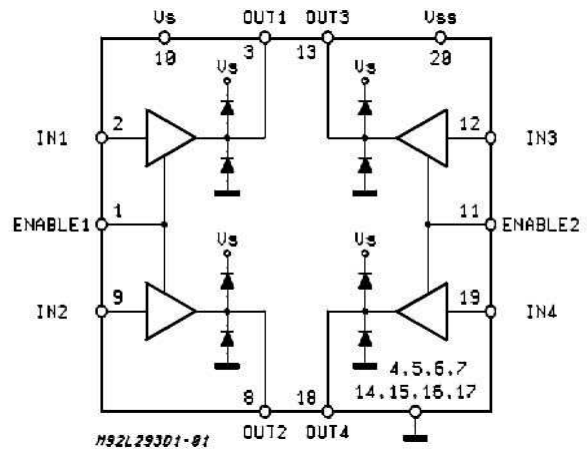
- Maximum speed of train in level crossing gate = 80Km/hr
- Average speed of train in level crossing gate = 40Km/hr
- Minimum speed of train in level crossing gate = 20Km/hr
- Execution time:

- At maximum speed total time of execution : 1min 30 sec
- At average speed total time of execution : 3 min
- At minimum speed total time of execution : 6 min

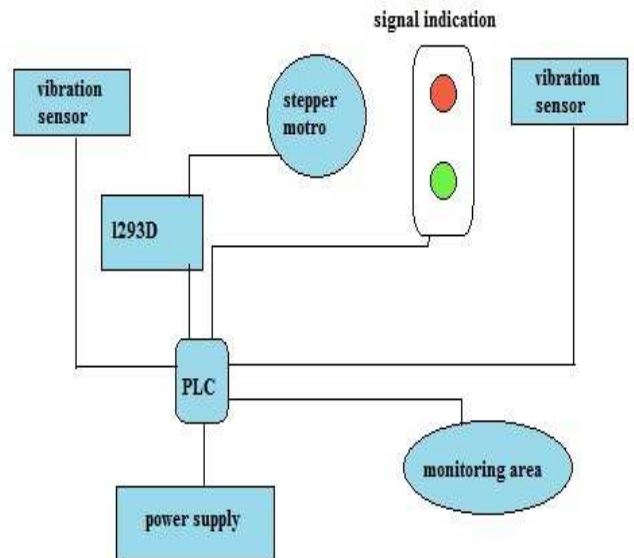
L293D PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking.

The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heat sinking.

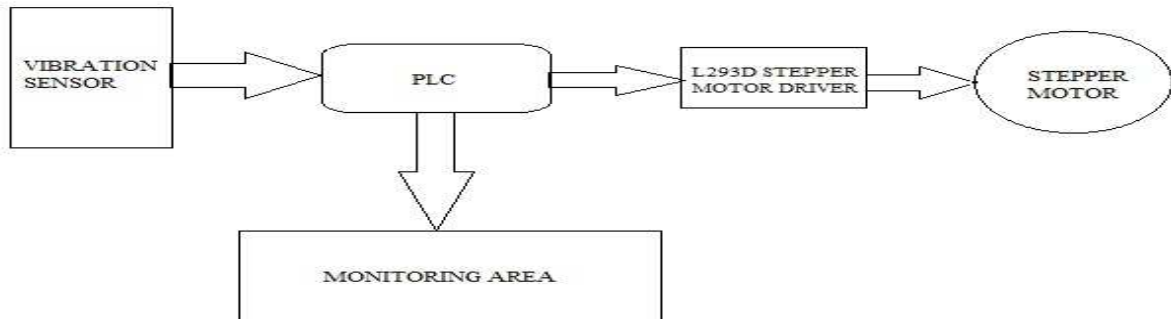


IV. BLOCK DIAGRAM



The above architecture shows the arrangement of the components and connected in such a manner. Here each and every components has connected in such a way to communicate and to do control function of all the comonents. By having a monitoring area all the process can me monitored at a single place. PLC is placed in central because it does all the functions according to the sensor inputs.

V. SYSTEM ARCHITECTURE

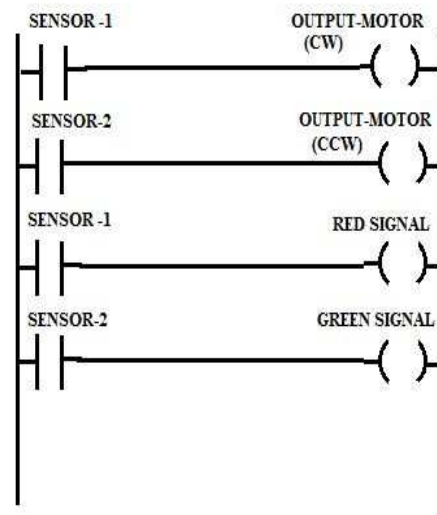


Here we can see the complete flow process of the project the signal from the vibration sensor will play a major role in complete process as an initial state the signal is sent to PLC then it produces the output based on our ladder program the it is fed to L293D driver to drive the stepper motor because stepper motor only needs the pulses. As a monitoring area we will have some display arrangement to monitor complete process. Here signal to the monitoring area will be taken from the PLC.

VI. PLC LADDER DIAGRAM FOR UNI -DIRECTIONAL CONTROL

PLC ladder diagram plays an important role here without it no function is possible. Here PLC diagram means the program for the PLC which is stored in it to do the function according to the diagram.

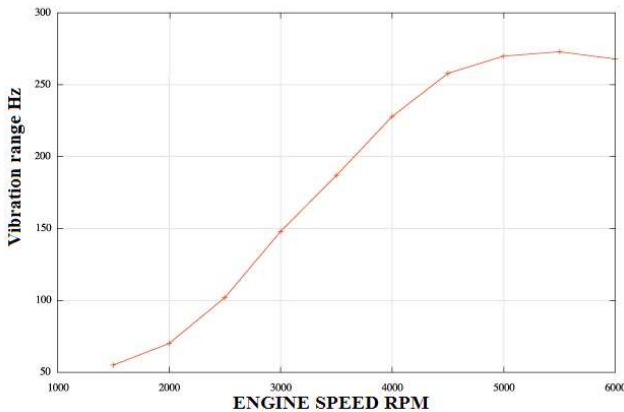
LADDER DIAGRAM



This is the ladder diagram to control the gate with the help of input signal from the sensor.  
 This diagram shows the control ladder for uni-directional passage of train.

VII. OUTPUT GRAPHS

Speed Vs Vibration range



This figure shows the range of vibration range created with respect to the engine speed. Here when the speed of the engine raises the output frequency will also raises. So what we decided here is to take an average value of speed. In normal case the range of vibration created in the railway track is of ( 25 to 250 Hz) at a speed of (30 to 60 Km/hr).

APPLICATIONS

- Real time transport system

ADVANTAGES

- Accident avoidance.
- Human safety.
- Quality and accurate service.

VIII. CONCLUSION

The accidents are avoided at places where there is no person to manage the railway crossing gates. Here we use the stepper motor to open and close the gates automatically when it rotates clockwise or anticlockwise direction to operate the gate automatically. When the train arrives in a particular direction the vibration sensor senses and generates appropriate signal, then at the same time the PLC provides certain output signal to the stepper motor to function. When the signal from PLC is sent to the stepper motor rotates to function open/closes the gate according to the signal output from sensor.

XI. ACKNOWLEDGMENT

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