COMPUTERIZATION OF RAILWAY GATEWAYS USING PLC

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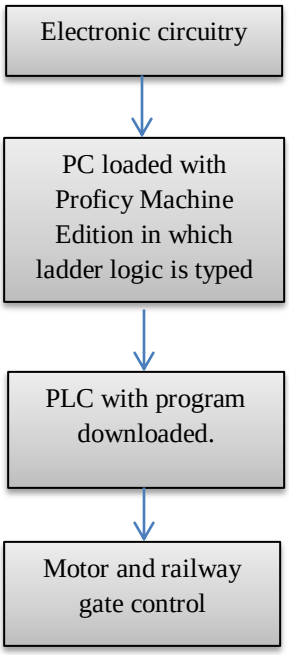
Abstract — The railway crossings are vulnerable to large number of accidents which are often deadly. In India, most of the railway crossings are manually operated by gatekeepers. In order to overcome this problem, automatic level crossing has been introduced by replacing the gatekeepers operating the gates using a Programmable Logic Controller.
Firstly it deals with decrease in time for which the gate is being kept closed and secondly it provides protection to the road employers by dipping the coincidences. By retaining the automatic railway gate control near railway crossing the arrival of the train is identified by the sensors placed 2 Km away from the gate. The process is automatic error due to physical operation is prevented. The time for which the gate is closed is less compared to the manually operated gates.

Keywords— Programmable Logic Controller (PLC), General Electrical (GE), Infra-Red (IR), Light Emitting Diode (LED, printed circuit board (PCB).

I. INTRODUCTION

A Programmable Logic Controller, PLC or Programmable Controller is a special form of microprocessor based controller that uses programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting, and arithmetic in order to control machines and processes. It is designed to be operated by engineers with perhaps a limited knowledge of computers and computing languages. They are not designed so that only computer programmers can set up or change the programs. Thus, the designers of the PLC have preprogrammed it so that the control program can be entered using a simple, rather intuitive form of language. The term logic is used because programming is primarily concerned with implementing logic and switching operations. Input and output devices in the structure is being controlled and associated to the Programmable Logic Controller. The worker then arrives a sequence of directions, a program, into the memory of the PLC. The controller then monitors the input and output according to this program and transmits out the control rules for which it has been programmed.
The Programmable Logic Controllers have the great advantage that the same elementary controller can be used with a extensive range of control systems. To change a control system and the rules that are to be used, all that is necessary is for an operator to key in a different set of instructions. There is no need to rewire. The result is flexible, cost effective system that can be used with control systems, which fluctuate quite extensively in their environment and complication.

II. Block Diagram Implementation



The prototype uses microprocessor based PLC, namely Versa Max from GE. The ladder logic is downloaded. On detecting an obstruction the IR sensor operates and when two consecutive IR sensors designated for gate opening are operated the gate is closed combined with a siren and LED indicator. When the latter IR sensors entitled for gate opening

are operated the gate is opened. Alongside the buzzer and the LED are turned off. The working of the IR sensor is such that at any point of time the adjacent two sensors designated for opening are operated on AND logic and the latter two also operate on AND logic. This is done so as to ensure that the gate does not open for any tiny obstructions which do not need to be accounted for such as a bird or human being etc.

For the above model the electronic circuitry involves the relays and IR sensors used here as it is needed to step up the +5 volts given by the IR sensor to the PLC, the relay does this job. The output from the PLC is also given to the motor driver from the relay, since further the +24 volts from the plc needs to be stepped down to match the rating of the motor and correspondingly keep the limits of the motor driver. Variation in the speed of gate opening can either be done by using appropriate timer design or by means of voltage control given to energize the field of the motor.

III. SOFTWARE

Algorithm:

1. Go to start, next databases, then choose GE Fanuc and then choose Proficy Machine Edition.
2. Choose logic designer - PLC theme.
3. Ok.
4. Select the suitable selection to open a project.
5. Select from the list the project that you want to open.
7. Ok.

To enhance a target to a project:

1. Use project flap of the navigator, right-click on project node and point to target.
2. Go to GE Fanuc Remote Input/output.

A new target appears in the Project tab of the Navigator. When expanded, the new target contains a default Hardware Configuration, logic blocks, and miscellaneous components.

To confirm a target:

Project flap of the Navigator, right-click a target and choose validate.

Logic developer - PLC checks all items below the target for syntax errors. Any errors noticed are noted in the build tab of the feedback zone.

To go online to a GE Fanuc PLC:

1. In the Project flap of the Navigator, ensure that all the target PLCs are offline.
2. Right-click the target and choose Set as Active Target.
3. Do one of the following:

■ Right-click the active target and choose Go Online.

To start a GE Fanuc PLC:

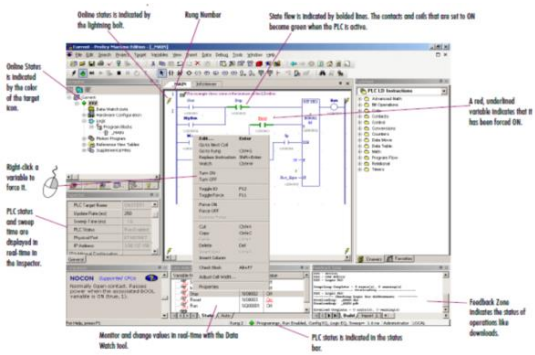
In the Project flap of the Navigator, right-click a target, point to online commands, and then choose Start PLC.

The target PLC begins executing its program.

To stop a GE Fanuc PLC:

1. In the Project tab of the Navigator, right-click a target, point to Online Commands, and choose Stop PLC.
2. Select an option.
3. Click OK.

The target PLC stops executing its program.



GE Proficy Machine Edition

IV. HARDWARE

Infra-Red Sensor: Fig: 1 is the Infrared sensors include the infrared source like blackbody radiators, tungsten lamps, and silicon carbide. In case of active IR sensors, the sources are infrared lasers and LEDs of specific IR wavelengths. Infrared transmission, which includes vacuum, atmosphere, and optical fibers. Optical components such as optical lenses made from quartz, CaF2, Ge and Si, polyethylene Fresnel lenses, and Al or Au mirrors, are used to converge or focus infrared radiation. Likewise, to limit spectral response, band-pass filters are ideal.

Finally, the infrared detector completes the system for detecting infrared radiation. The output from the detector is usually very small, and hence pre-amplifiers coupled with circuitry are added to further process the received signals.

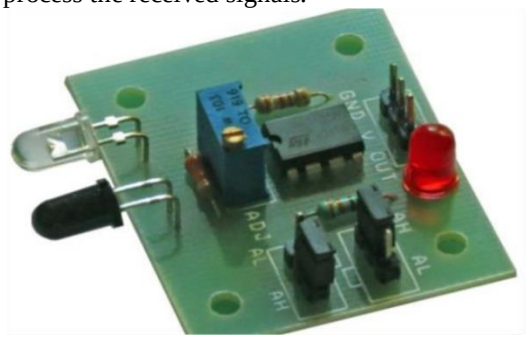


Fig:1 Infrared Sensor

Motor Driver: Fig; 2 Which 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.
Enable pins 1 and 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.

Fig :2 Motor Driver

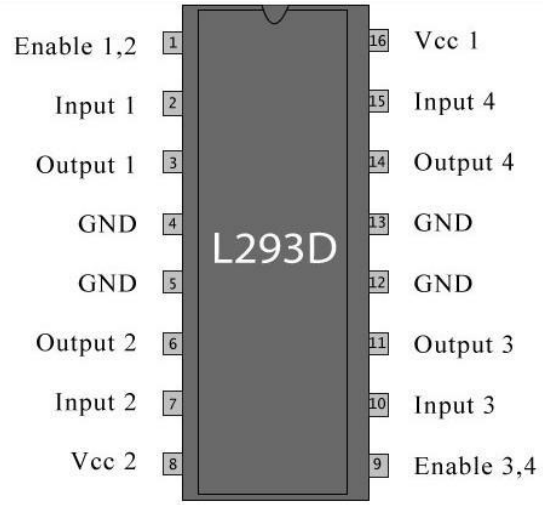


Fig 3: Pin Diagram

Fig 3 is L293D is a H-dual 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.

Pin description

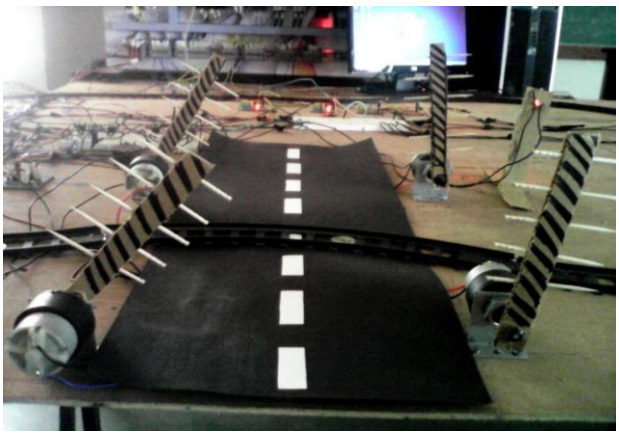
Pin No	Function	Name
1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	Vcc 2
9	Enable pin for Motor 2; active high	Enable 3,4
10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	Vcc 1

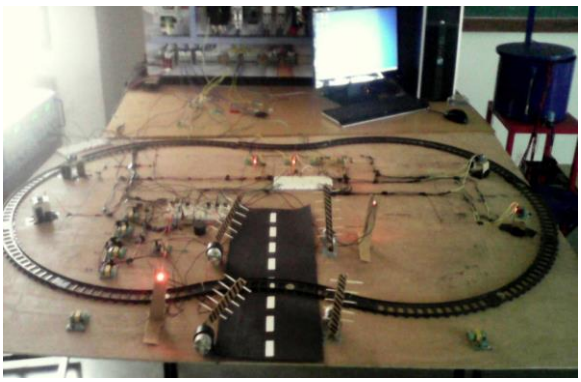
Permanent magnet DC motors: It has similar characteristics of DC shunt wound motors in terms of torque, speed, reversing and regenerative braking characteristics. However, PM DC motors have starting torque several times that of shunt motors and their speed load characteristics are more linear and predictable. Torque varies a lot with speed, ranging from maximum to zero torque at maximum. An increase in torque requires a decrease in angular velocity and vice versa.

V RESULTS and DISCUSSION

It has been observed that as the engine approaches the first sensor it receives an obstruction and gives a +5 volts output to the relay, simultaneously as the engine reaches the next sensor and the last bogie reaches the preceding sensor , the latter sensor also gives a +5 volts output to another relay. The two outputs are logically ANDED. A NC relay is activated and a voltage of 24 volts is given to the PLC. Based on the ladder program given to the PLC one of the 8 output pins are activated, in turn activating the buzzer and the LED. Alongside, as the engine approaches the second sensor the gate is closed by the second output of the PLC triggering the NC relay, which in turn triggers the motor driver rotating the motor shaft.
Next as the engine approaches the 3rd sensor through an LED light the vehicles are signaled that the gate is going to be opened and on reaching the last sensor the gate is opened. Yet again the output of each

sensor i.e. +5 volts is given to two relays and then to the PLC. The output of the PLC is given to the relay and motor driver. Finally the gate opens due to the rotation of the motor in the opposite direction.
The gate has been designed with lower obstruction so as to prevent low heighted vehicles specifically 2 – wheelers from trespassing below the barricades.
Certain important parameters have to be kept in mind during the programming and set up, namely:
1. The timing between the gate opening and closing.
2. The sequence in which the gates have to be closed so as to have traffic control.
3. Accurate siren and LED indication
4. Sensitivity calibration of the sensors and their housing.
Distance between the corresponding pair of IR sensors and appropriate timing of gate opening and closing play a crucial role in determining the accuracy of the unmanned railway gate operation.
The prototype model has been successfully implemented with a gate delay between gate operations for three seconds. The corresponding pictures have been attached below.





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