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Automatic Railway System Control Using PLC

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ABSTRACT

Indian Railways safety is the main and crucial aspect of rail operation, as it is the most common & largest mode of commutation. This paper presents the different optimal solution for making the railway system automated , safe & environmental friendly. This proposed project provides three features ,automatic gate control through which unmanned railway gates is achieved replacing the manual work, automatic energy saving at station which will save upto 60-70% of the electricity, and obstacle detection which will help to detect an obstacle on the path while the train is running. The proposed project is automated by automation through PLC and visualized by SCADA.

Keywords: PLC, SCADA, proximity sensors, photoelectric sensor, DC motor.

I. INTRODUCTION

According to the surveys done on Indian railways from 2009-10 to 2014-15, 43.5% accidents occured due to level crossing and 4.7% accidents due to collisions. The signalling system provides unsafe or conflicting signal many times which results in collision between two trains or any object infront of the train thus the concept of automation system will reduce the number of accidents efficiently.
This paper includes:

1. This project is for remote area station where frequency of train is less ,if there is a no train on platform only 40% of the total lights are switched on. As the train arrives at the station then 100% lights are switched on. So in this way energy can be saved and smart lightening system is designed.
2. The proposed model deals with the reduction of time for which the gate is being kept closed and provides safety to the road users by reducing the accidents that usually occur due to carelessness of road users and the time errors made by the gatekeepers.

3. While the obstacle detection can reduce head on collisions with the train or any object by gradually decreasing the speed of the train or stopping it.

II. METHODS AND MATERIAL

A. Block Diagram

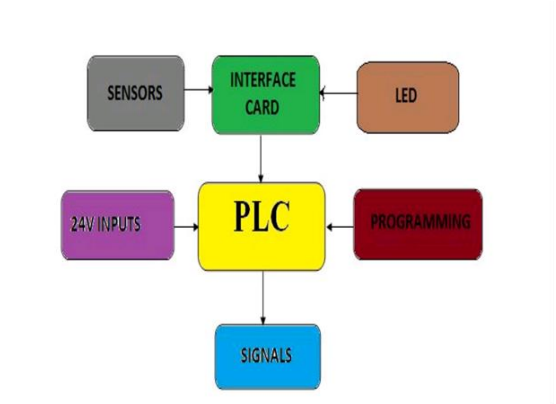

Figure 1. Block diagram of this project

Here main aim of PLC is to automate the whole system without creating any complexity. Among

different PLC's available, Allen Bradley Micro logix 1000 is used. There are six inputs and four outputs terminals of PLC and works on 24 volt DC which can be obtained directly or through SMPS. PLC works in full duplex mode and can be operated on two software i.e. RS LINX and RS CLASSIC. The programming of PLC is known as ladder logic diagram. Program can be updated several times in PLC according to the requirements.

B. Software Analysis

1. RS LINX(DRIVER SOFTWARE

RSLinx is a piece of software that communicates with Allen Bradley PLC's, HMI's, and networked VFD's. Once communications have been established in RSLinx, you can then use Allen Bradley PLC programming software to communicate with a PLC via RSLinx.

2. RS LOGIX(PROGRAMMING SOFTWARE)

The RSLogix™ family of IEC-1131-compliant ladder logic programming packages helps you maximize performance, save project development time, and improve productivity. This family of products has been developed to operate on Microsoft Windows operating systems.

3. INTOUCH (SCADA)

Wonderware InTouch is the world's most advanced, scalable, extensible and intuitive Human Machine Interface (HMI) and process visualization software.InTouch uses the most sophisticated graphical technology and is simply, the most intuitive process visualization product in the market. It offers class leading innovation, brilliant graphics, legendary ease of use and unsurpassed connectivity.

C. Hardware Analysis

1) Photoelectric Sensor:

A photoelectric sensor, or photo eye, is an equipment used to discover the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are largely used in industrial manufacturing. There are three different useful types: opposed retroreflective, and proximity-sensing .Sensing Range-10cm to 15cm.

Figure 2. Photoelectric Sensor

2) DC motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields.

Figure 3. DC motor

3) Inductive Proximity Sensor

A Inductive proximity sensor can detect metal targets approaching the sensor, without physical contact with the target.

Figure 4. Inductive Proximity Sensor

The proximity sensors used here are of following specification:

Voltage range: 6-36 V
DC Current: 200 mA
Type: PNP type
Sensing Range: 4mm

The sensors are placed pretty near the tracks so that it could detect the train. The two terminals of sensors are connected with +24V DC and -24V DC supply and one is used as input therefore connected to the

PLC inputs. The similar is being done with all the three sensors.

4) PLC

The MicroLogix 1000 programmable controller is a packaged controller containing a power supply, input circuits, output circuits, and a processor. The controller used here has 32 I/O configurations.

Figure 5. PLC

Advantages of PLC

1.Smaller in size.
2.Easier and faster system change.
3.They designed for the rugged industrial environment.
4.Immediate documentation.
5.Centrally available diagnostics.
6.Faster and less costly duplication of application.
7.Easy to find fault in logic
8.Single set-up used for multiple applications
9.Less development time.
10.They are attractive on Cost-Per-Point Basis.
11.These Systems are upgraded to add more Intelligence and Capabilities with dedicated PID and Ethernet Modules.
12.Less power consumption

5). Relay

Relays are switches that open and close circuits electromechanically or electronically.Two Relays are used for opening and closing the railway gates as the train passes through sensors and as per the ladder diagram given in PLC. Relay of 24vDC is used in this model

Figure 6. Relay

D. Working of the proposed model

When the train is not at the station or near to the station , only 40% lights are “ON” at the station while the railway gates are open. Proximity sensor 1 is placed at a certain distance away from the railway gates. When the proximity sensor 1 senses the train , the gate motor rotates in forward direction and gate closes after few seconds giving time to the vehicles to clear out the area. As soon as the sensor 1 senses the train the 100% lights at the station is turned “ON” automatically indicating that the train nearby the station.

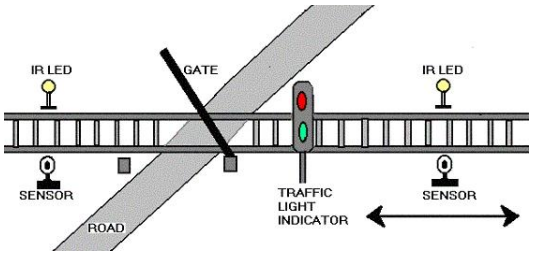

Figure 7. Automatic gate control representation

After the railway gates at a certain distance another proximity sensor 2 is placed so that when train crosses the railway gates and reaches the sensor 2 , the gate motor will automatically start rotating in reverse direction and the gates will be opened. The train will stop at the station until the traffic lights turn green.

Another proximity sensor 3 is placed at a certain distance after the station so that when the sensor 3 senses the train , the lights at the station will again return to 40% lights indicating that there is no train at the station or the train has left. Thus by saving energy at the stations.

While Obstacle Detection is done through photoelectric sensor which is placed on the train. It will detect any obstacle on the path and work according to the ladder instruction given in the PLC.

III. RESULTS AND DISCUSSION

A. Hardware result

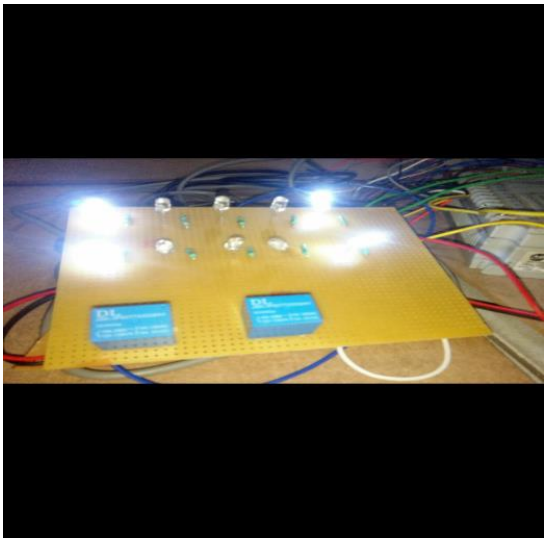

Figure 8. only 40% lights are on at station when there is no train whereas relays are used for the gates.

Figure 9. Overall 100% lights gets on as the train arrives the station.

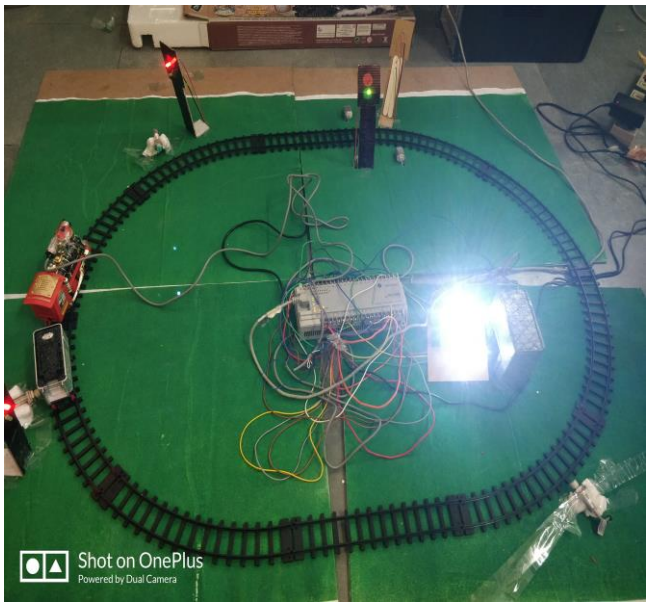

Figure 10. Complete Project

B. Resulting SCADA Representation

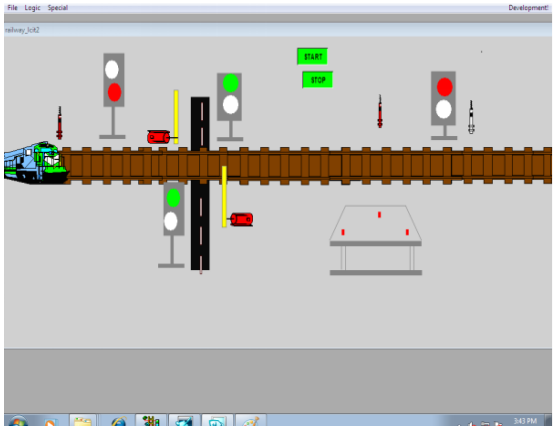

Figure 11. SCADA Representation

Table.1

DEMO	REAL TIME
Relay of 24vDC is used.	Contactor will be used instead of relay.
DC motor of 5V.	3-phase AC motor 230v/440v will be used.
Photoelectric Sensor of range 10-15cm.	Photoelectric sensor upto 1km range can be used
Inductive Proximity sensor of range 4mm.	Ultrasonic sensor or proximity sensor upto 20 foot will be used.

Small train coaches of 30cm is used.	Standard 24 coaches train or less will be operated i.e 600m.
Time delay needed to close the gate will be 1 second.	Time delay needed to close will be kept 3 min or more.
Second sensor is placed at 40cm distance from gate.	Second sensor will be placed at 650m distance from gate for safety issues.

5.1 Real time specifications of this project

IV. CONCLUSION

The concept of automation in Railway system has a very wide scope in very near future in Indian Railway.

Future Expansions of this concept are:

Automatic Switching of Multi Railway Track. Automation of Railway Station having more than one platform.

Speed Control of Railway Engine.

Collision of Two Trains on same track can be avoided by automatic braking system using PLC.

The main advantage of this concept is that all operations are based on PLC program which can be modified to change any operation in system. In this way it provides great flexibility of operation.

Applications of this project are :

Automatic unmanned railway gates control Automatic track switching preventing accidents between two train. Obstacle detection on railway tracks. Energy savings at stations is achieved. Other than Railways , this project can be used in apartments, military etc.

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