Automation For Railway Gate & Track Management System Using PLC & SCADA

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Abstract- *The main aim of this project is to develop automatic railway gate & Track management system which automatically control the gate position at the crossing and by monitoring the train condition manage the railway tracks and priority wise allows to pass one train and after sometime second train on the same track. So, the accident are avoided at places where there is no person managing the railway crossing gates. Here we use the stepper motor which rotates clock wise or anticlockwise to open and close gates automatically. As a result, error due to manual operation is prevented accident at places where there is no person managing the railway crossing gates. The IR sensor is used to detect the presence of the train near railway crossing according to gate open and close.*

Consequently, this project is very expedient for providing better safety, reduce manual assistance and number of accidents.

Keywords- PLC, SCADA, IR Sensor, DC Relay , Motor, Indicator Light

I. INTRODUCTION

Track switching and signaling of trains is done by various methods where many mechanical and electrical operations are required. By various signaling system (i.e. semaphore signaling, color-Light signaling etc.) Possible route for train at station is indicated. This can be done at stations by sensing a train at track using various sensors and PLC program. Safe route for train without collision of trains can be obtained by automated track switching. And this can be monitored on screen using SCADA. Gate opening and closing is generally done manually which same can be automated by PLC program. And station lightening scheme is also controlled automatically for saving of energy by PLC program for remote station or less busy station. To simulate all this case on model we are using Allen Bradley micrologix 1200 PLC, IR sensors and SCADA (intouch).

II.SYSTEM DESCRIPTION

A. Literature Review

Railways being the cheapest mode of transportation are preferred over all the other means. When we read newspaper, 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 and the collision of two trains due to the same track. This model 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 that usually occur due to carelessness of road users and at times errors made by the gate keepers.

To avoid the accidents, sensors placed at some distance from the gate detect the departure of the train and send signal to the gate controlling system which in turn operates the motor and opens the gate. Thus, the time for which the gate is closed is less compared to the manually operated gates since the gate is closed depending upon the telephone call from the previous station. Also reliability is high, as it is not subjected to manual errors. There is no control over lighting system in past where there is a only all the light on platform can be switched OFF or ON. That can be achieved by manually only.

B. Proposed System

There is micrologix 1200 PLC with 40 I/O. 24 volt DC supply for the operation of PLC is applied through the adapter form main supply. There are Four IR sensors are connected to the input module of PLC. Two Stepper motors for gate opening closing and one for track switching are connected to the output module of PLC through DC relays. The Relays are used for forward and reverse operations of motors. For lighting scheme of the station LEDs are used which are connected to the output module of PLC. And the Sensors are fixed at certain distance on both sides of the gate.

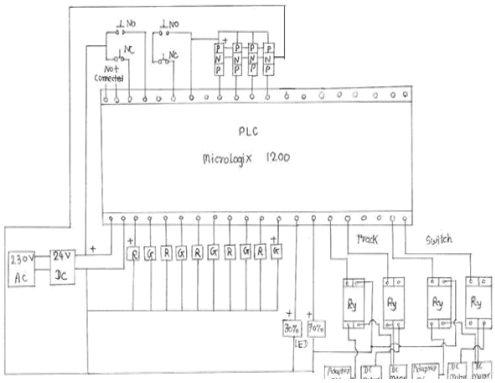


Fig. 1.Connection Diagram For PLC

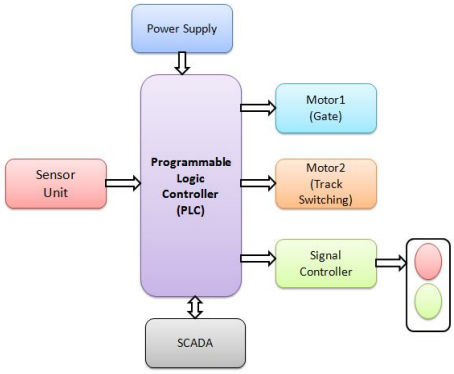


Fig.2. Block Diagram For the Proposed System

C. Gate Switching

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.

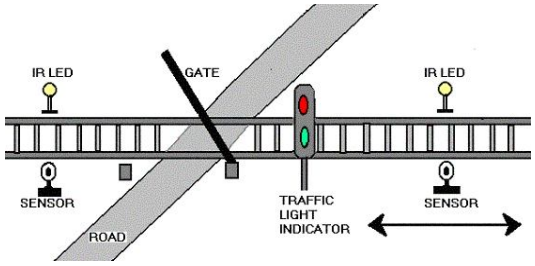


Fig. 3: Gate Switching

D. 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. 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.

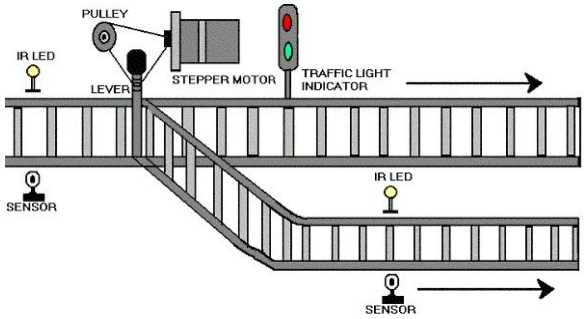


Fig. 4: Track Switching

The interrupt service routine switches the track. Indicator lights have been provided to avoid collisions. Here the switching operation is performed using a Stepper motor. Assuming that within a certain delay, the train has passed the track is switched back to its original position, allowing the first train to pass without any interruption.

E. Why automatic system concept is required?

- Reduces human error.
- Less Time consuming.
- No human resource is required.
- Energy conservation.
- Simply operated and monitored through PC.
- Reliable Transportation.
- Increasing Safety.

We are going to introduce automation in gate & signal control, track switching and energy saving. We have developed a concept of automatic track switching. For the track changing specific signaling of train is required. This can be achieved by PLC programming.

This concept of track switching can be applied at certain distance from the stations. Same way using sensors, dc motor and PLC automatic gate control and signal system for the same can be developed. For remote area station where frequency of train is less at that station if there is a no train on platform only 40% of the total lights are on. As

there is a train at the station then there is 100% lights are switched on. So in this way energy can be saved and smart lightening system can be design.

III. HARDWARE DESCRIPTION

A. PLC

Many PLC configurations are available, even from a single vendor. But, in each of these there are common components and concepts. The most essential components are: Power Supply: - This can be built into the PLC or be an external unit. Common voltage levels required by the PLC (with and without the power supply) are 24Vdc, 120Vac, 220Vac.

CPU (Central Processing Unit):- This is the computer where the ladder logic is stored and processed.

I/O (Input /Output): - A number of input/output terminals must be provided so that The PLC can monitor the process and initiate actions.

Indicator lights: - These indicate the status of the PLC including power on, program Running and a fault. These are essential when diagnosing problems.

B. IR Sensor

Infrared proximity switches work by sending out beams of invisible infrared light. A photo detector on the proximity switch detects any reflections of this light. These reflections allow infrared proximity switches to determine whether there is an object nearby. As proximity switches with just a light source and photodiode are susceptible to false readings due to background light, more complex switches modulate the transmitted light at a specific frequency and have receivers which only respond to that frequency. Even more complex proximity Acoustic sensors are able to use the light reflected from an object to compute its distance from the sensor.

Fig.5. IR Sensor

C. DC RELAY

Here 12V dc relays are used. Forward and reverse operation motor with help of relays. The terminals are COIL, COIL, COM, and NO, and NC.

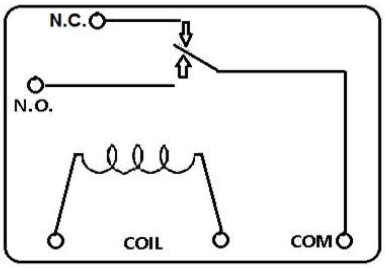


Fig .6. Terminal Of Relay

E. Motor

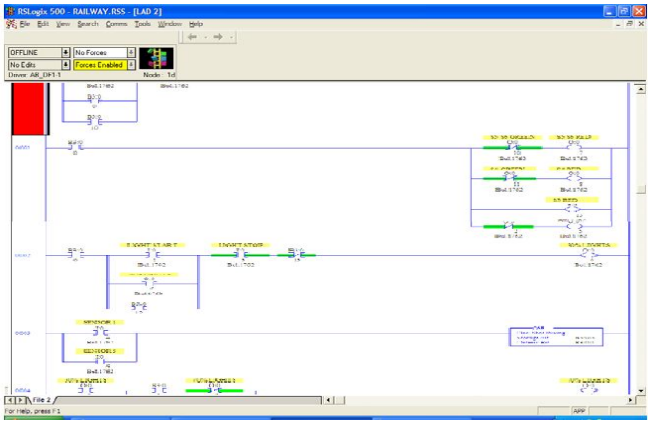
Two DC motors for gate opening closing and one for track switching are connected to the output module of PLC through DC relays. A DC motor relies on the facts that like magnet poles repel and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil.

By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°.

IV.SOFTWARE DESCRIPTION

A. PLC programming

Ladder logic is the main programming method used for PLCs. RSLogix programming packages are compatible with programs created with Rockwell Software DOS-based programming packages for the SLC 500 and MicroLogix families of processors, making program maintenance across hardware platforms convenient and easy.



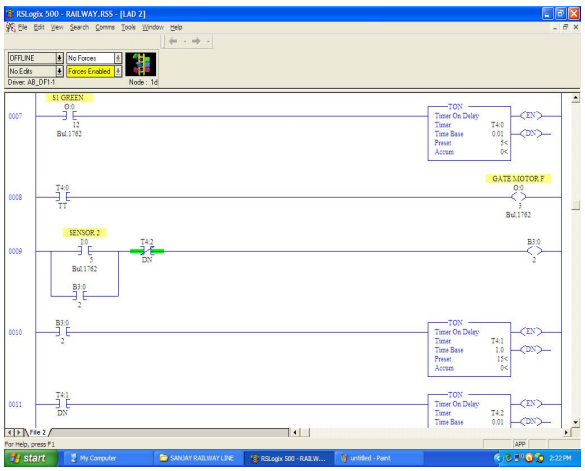


Fig. 7.Ladder Logic

B. SCADA Communication

SCADA systems are used not only in industrial processes: e.g. steel making, power generation (conventional and nuclear) and distribution, chemistry, but also in some experimental facilities such as nuclear fusion. The size of such plants range from a few 1000 to several 10 thousands input/output (I/O) channels. However, SCADA systems evolve rapidly and are now DOS, VMS and UNIX; in recent years all SCADA vendors have moved to NT and some also to Linux Penetrating the market of plants with a number of I/O channels of several 100 K we know of two cases of near to 1 M I/O channels currently under development. The fig. shows the SCADA Screen of the prototype model.

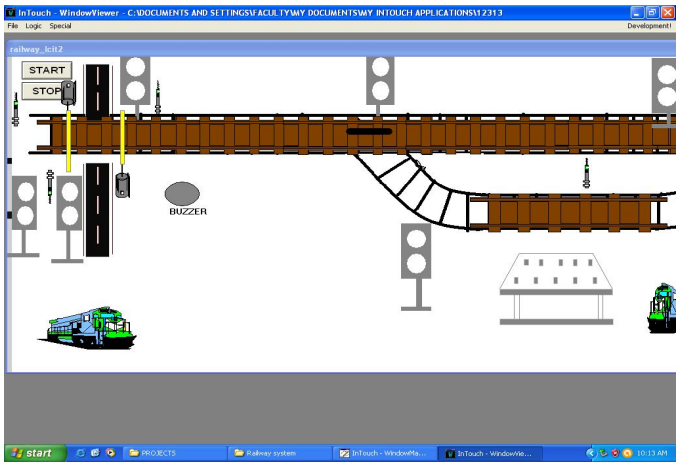


Fig .8.SCADA Screen

V.RESULTS

We have constructed model of railway track a shown in figure. We have placed 4 PNP sensor two sensors are placed on either side of gate which can be referred as foreside sensors (S1) and backside sensors (S2) respectively.

Now backside sensor is placed near the station so the same sensor can be used as station sensor. One sensor (S3) is placed on track 2 and one sensor (S4) is placed at end of station.

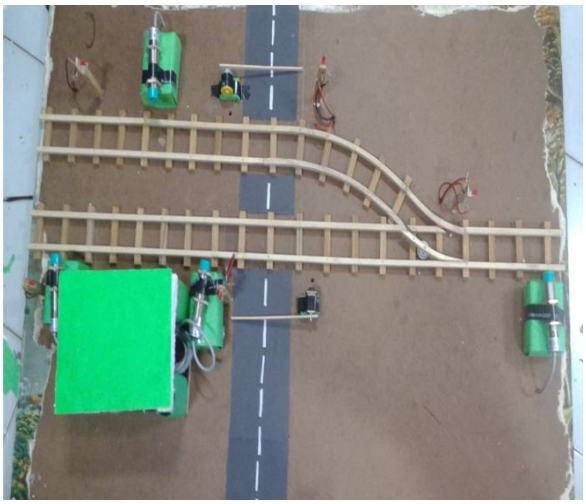


Fig .9.Hardware Implemented

VI.CONCLUSION

Hence we can conclude that concept of automation in Railway system has a very wide scope in very near future in Indian Railway. This kind of project based on relay is already implemented in Railway system of Ratlam Division. 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.

ACKNOWLEDGMENT

Thanks to Prof. (Dr.) Vipul A. Shah, Professor & Head, Department of Instrumentation & Control Engineering, Faculty of technology, Dharamsinh Desai University, Nadiad, for providing necessary academic support for representing the project. I am grateful to all my faculty members of Instrumentation & Control Engineering Department, for their suggestions and constant encouragement.

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