A Novel Approach in Railway System Protection Using PLC/SCADA

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***Abstract*- This paper aims to replace the manual work in railway protection system by automatically controlling and monitoring the train movements using PLC&SCADA. Nowadays even though automation plays a vital role in almost all areas but still railway system is not completely automated. Currently the railway network protection parameters like gate control, identifying track cracks, track collision, track changing and traffic light (indication) are controlled individually by their respective process either manually or semi-automatically, Even then the simultaneous control of all parameters does not exists to ensure safety operation. And at the same time the entire control is given only from control room using embedded technology which is tedious in monitoring and providing the required control under critical situations. To overcome those problems the proposed idea provides both monitoring and control of all the above said parameters with the provision of issuing automatic control in the locomotive itself using PLC. Programmable Logic Controller (Keyence) senses the input from its respective sensors and according to the ladder program it issues the necessary control automatically. The entire operation is monitored using SCADA software.**

***Index Terms*- PLC/SCADA, Track crack, Track collision, sensor, Transmitter/Receiver, Electro magnetically braking.**

I. INTRODUCTION

In recent day railway system is very common transportation system and at the same time it is often prone to accidents that are caused by a variety of mechanical and human faults. Normally due to the restless working of train drivers and due to lack of proper monitoring and alerting devices accidents are very frequently occurring in railway system.

This proposed idea overcomes the above situation by providing the automatic monitoring and controlling device in the locomotive itself to provide remedial action under track crack, track collision, track changing, traffic light indication and gate control. This idea deals with two things; one is it has to issue an automatic control signals to the parameters concerned and second is to install the control room in locomotive itself to have fast action.

The recommended automatic railway protection control system provides the overall control for the locomotive considering the above said five parameters with the help of single PLC and the entire process is monitored using SCADA. This system provides the control for automatically closing and opening the gate, and ON/OFF traffic lights indication for status of gate open and close, anti- collision of two trains at same track and identifying track crack by using ultrasonic sensor. These five parameters are automatically controlled from single control room with PLC installed in locomotive.

II. LITERATURE SURVEY

(1).R.Gopinathan and et al., proposed an "**PLC based railway level crossing gate control"**, deals with the automatic railway gate operation to avoid frequent accidents occurring in unmanned railway level crossing. It deals with two things. First is reduction of time, second is to provide safety. It is highly an PLC based managements.

(2). Krishna, et al., proposes an "**Automatic Railway Gate Control using Microcontroller".** This paper aims to control the railway accident using anti-collision techniques. Train collision occurs mainly due to the carelessness in manual operation. This model is implemented using sensor technology

(3). Elisha C Mabunda1, and et al., proposed an "**Microcontroller based model design of a train collision avoidance system".** This design comprises an apparatus for detecting the presence of an approaching locomotive within a specified limited area. The system is integrated with the braking system of the train using embedded

technology; hence rail traffic accident can be minimized.

(4).M.D.Anil and et al., proposes an **"Advanced railway accidents prevention system using sensor network"**, which includes several features to prevent trains accidents. This system makes use of IR sensor and the train speed is controlled using electric braking system.

(5) Azrulnor Bin, proposed an "**Development of a Traffic Light Control System Using PLC".** This project is divided into two parts which are hardware and software. First hardware part of this project is traffic light. Second one is software part with Omran PLC. It controls the traffic in railway track using PLC.

III. PROPOSED SYSTEM

The figure 1 depicts the overall functioning of the proposed automated railway protection system using PLC/SCADA. It comprises of various sensors like color sensor and ultrasonic sensor for sensing the parameters to be controlled and monitored like avoiding the collision, Track cracking ,Gate control and traffic light controlling, Track changing. Here all the above mentioned 5 parameters are sensed simultaneously and control will be given by PLC installed in locomotive itself. Here each and every components are connected in such a way to communicate and to do necessary control action.

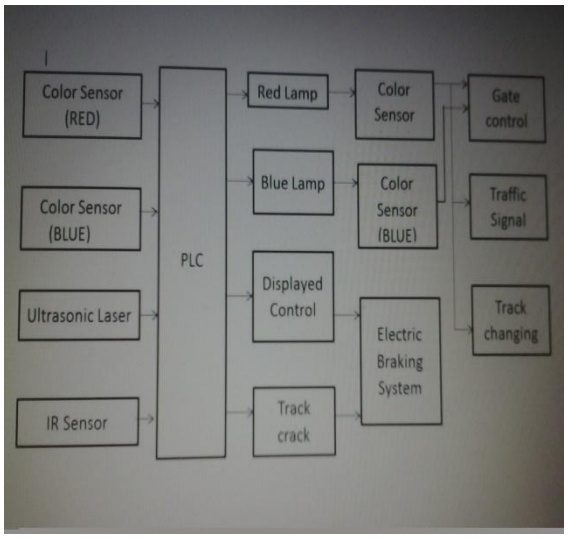

Fig1: Block diagram of proposed system.

IV. BENEFITS OF THE PROPOSED SYSTEM

It provides the control for all the 5 parameters like:

- ✓ Avoid the collision
- ✓ Track cracking
- ✓ Gate control
- ✓ Traffic light controlling
- ✓ Track changing

Simultaneously with single PLC**.**

V. WORKING

(1) GATE CONTROL AND TRAFFIC LIGHT INDICATION

The signal from color resistive sensor will play important role in gate control and traffic light control process. When the PLC receives the signal from the sensor 1 then it produces the output based on ladder program which is fed to stepper motor driver for closing the gate. When the gate is in closed position traffic light indicate the green signal for the train. Similarly when the PLC receives the signal from the receiver-2 it indicate the train has passed away and the PLC issue the control pulse for the stepper motor to open the gate and when the gate is in open position which is indicates that by red signal for the level crossers.

(2) TRACK CRACK

The different sensors can be used to sense the track cracks. Here ultrasonic sensor is used to find crack in the railway track. In the areas of bends or curves there is a gap between the rails of successive different paths. Even though it is a small gap, the train would get mislead and may travel in a different paths which leads to collision in most of the cases. Ultrasonic sensors are used to detect the gap. When the PLC receives the signal from sensor according to program written it produces the control signal electromagnetic braking. It is used to control train speed and the train can be stopped before 800m to 1 km. in order to avoid the train accidents.

(3) ANTI-COLLISION

Collision means two trains at the same track in opposite direction or same direction. Most of the collisions are of the types of running train colliding with the standing train types. Here IR sensor are used to detect the presence of train in some (or) opposite direction. Transmitting/Receiving circuit consisting of IR-LED driver. IR sensor is an electronic instrument that is used to sense the object and detecting the motion. IR rays are invisible to the human eye. IR sensor emits narrow beam of IR rays which is used to find the presence of any train before the running train. If there is any train running behind the train the receiving circuits receives the IR beams, it is also capable of determining relative velocity between the train and the target. Those signals are send to PLC. Then according to the program it

sends the signal to electromagnetic system. This controls train speed within certain distance.

(4) TRACK CHANGING

Collision process and track cracking is interfaced in electromagnetic braking system. Using the same principle as that for gate control a concept of automatic track changing is also possible. Considering a situation where an express train and a local train are travelling in opposite directions on the same track the express train is allowed to travel on the same track and the local train has been provided to avoid collisions. Here the switching operation is performed using a stepper motor.

VI. SIMULATION

SOFTWARE USED

1. Programmable Logic Controller (PLC)---------- **Keyence(ladder builder)**
2. Supervisory Control And Data Acquisition(SCADA)

PLC AND SCADA

Programmable Logic Controller is as 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.

PLC is a Programmable Logic Controller. A programmer written program as per client requirement, which relates to inputs / outputs of PLC. Outputs can activate the field equipment (Motor, Solenoid valve etc.) And Inputs can sense field equipment (Limit Switch, Zero Speed Sensor etc.).

SCADA is Supervisory control and data acquisition. Programmers design the animation as per PLC programming and field equipment position, and then make communication between SCADA and PLC. After successful communication between SCADA and PLC we can visualize the operation which is happen in field from Control Room.

VII. SIMULATION RESULTS

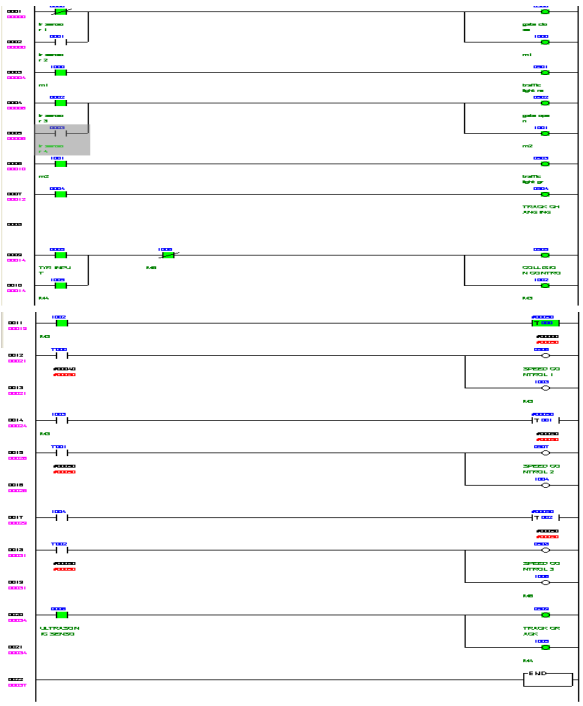

Fig:2 Ladder diagram of the proposed system.

PLC ladder diagram play important role in issuing control signal for protection purpose. This program is stored in PLC memory which performs the function according to the sequence. This ladder diagram controls the overall function for protection with help of input signals from color resistive sensor, transmitter/receiver, and ultrasonic sensors. Here dummy and timer circuit also used for controlling purpose, Dummy is used to do multiple processes in single input signal. Timer is used for delay process. The counter signal issued by PLC does not stop train suddenly, hence is used timer to reduce the train speed within certain time periods.

VIII. CONCLUSION

Nowadays the railway protection system can be done either by manual process (or) by semi-automatic process using embedded system technology. The intention of the proposed idea is to provide control for the above discussed five parameters like track change, track collision, track crack, gate control and traffic light indication using single PLC installed in locomotive itself. This reduces the drawback for having the control unit in each compartment when using embedded system. With the help of SCADA the entire sequences of operation and it can also be monitored easily by the driver hence entire control action can be assured quickly. This system provides a remarkable change in railway system for protection purpose with affordable cost.

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