

# IMPLEMENTATION OF AUTOMATIC METRO RAIL USING PLC AND SCADA

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**Abstract** - Metro Rail is the rapid transport system in Chennai. In Metro Rail system Automatic Train Protection and Automatic Train Operation is being employed. In this paper we are going to overcome certain disadvantages that are encountered in Metro Rail system. If a train is operated in a circular or straight path, it does not require a pilot. In order to provide this facility in Metrorail system, we are using Programmable Logic Controllers for automatic operation of Metrorail and it is monitored by using SCADA to track the location of the train. When a train meets an obstacle, the sensor installed in the Metrorail system will sense the object and reduces its speed and hence the accidents are avoided. Train accidents occur due to various reasons. It may be due to the fault of driver, signaling problems, electrical interruption and human errors. Our project is aimed at avoiding collision and accidents caused due to the mistakes of driver and also to reduce the speed when an obstacle is detected. When a train meets an obstacle in a circular or straight path, the sensor installed in the Metrorail system will sense the object and reduces its speed and hence the accidents are avoided.

**Key Words:** PLC, SCADA, IR Sensor, SMPS.

## 1. INTRODUCTION

A Programmable Logic Controller, PLC or Programmable Controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation

are typically stored in battery-back-up or non-volatile memory. A PLC is an example of a hard real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result. Train accidents occur due to various reasons. It may be due to the fault of driver, electrical interruption, signaling problems, human errors etc. In Chennai Metro Rail System Automatic Train Protection, Automatic Train Operation and Automatic Fare Collection methods are employed. These methods can avoid head to head collision and accidents caused due to the mistake of driver. Due to electrical interruption when a train gets halted train collision may occur in Metro rail. Hence after electrical interruption, automatic signal control is needed for avoiding huge accidents. By employing PLC, the automation can be achieved.

## 2. EXISTING SYSTEM

Metro network is having a single centralized operation control center, ATP (Automatic Train Protection) and ATS (Automatic Train Supervision). Automatic Train Protection is helpful for the driver. The telecommunication system acts as the backbone for signaling systems, and other systems such as SCADA and AFC are provided for operational and administrative requirements of metro network.

## 3. PROPOSED SYSTEM

PLC is used as a main tool for controlling the signals of the train and taking appropriate actions. Programmable Logic Controller is used for controlling the train signals when the train operates in a circular or straight path. SCADA is used for monitoring the signals and collecting the data of PLC. Even after

the interruption of power system Programmable Logic Controller assists in opening the emergency exit. This system can be implemented in underground as well as in flyover systems. Automatic Train Signal Control Method is being employed. This enhances the safety of Metro Rail System. Automatic speed reduction is employed while the train meets an obstacle in a circular path. IR Sensors are placed at regular intervals in the track which senses the train's movement and gives an input signal to the PLC. According to the input Signal given by IR pairs the PLC works. If in case there is an object train decreases its speed and it is given as an input to the PLC. Now PLC automatically controls the nearby signal due to the instructions given from the control room. Since it can be done no human intervention is needed for clearing the communication problem. Hence the system enhances the communication and ensures the safety of the passengers.

### 3.1 Merits

Train's location can be easily identified and the signals can be controlled even after interruption of power supply. On controlling the signals collision of trains can be avoided. Even after the interruption of power system PLC operates and helps in opening the emergency exit to get the people out of the train.

### 3.2 Operation of a PLC

The PLC activates its output terminals in order to switch things on or off. The decision to activate an output is based on the status of the system's feedback sensors and these are connected to the input terminals of the PLC. The decisions are based on the logic programs stored in the RAM or ROM memory. They have a central processing unit (CPU), data bus and an address bus. The input instructions are stored in data memory and the logic control compares the instruction of data memory with program memory. The schematic diagram for the operation of PLC is shown in below figure. The output terminals can be connected to loads like light, motor, control valve, etc. RS232 cable is used for communication purpose in PLC.

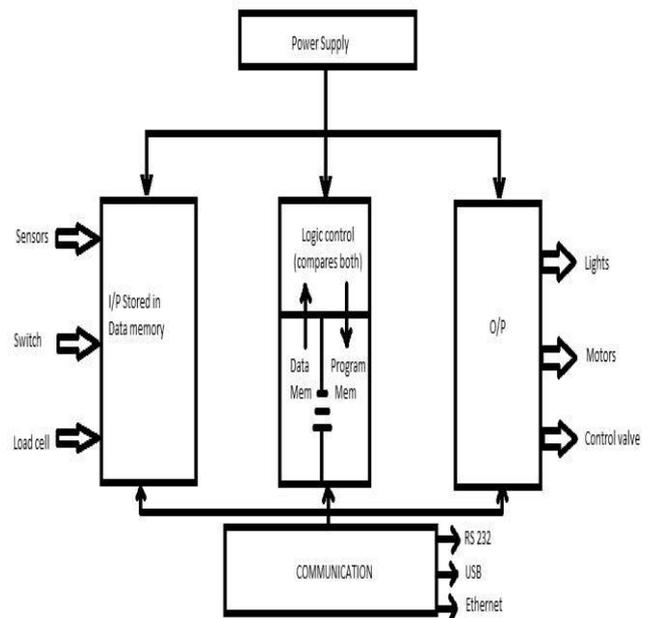


Fig -1: Operation of PLC

### 3.3. Functional Block Diagram

It consists of an IR sensor, station, power supply and an emergency stop in input side whereas train and SCADA are connected to the output of the PLC. When the PLC gets an input signal it produces the corresponding output signal as per the instructions which are programmed. If there is any object in the specified track of the train, then the sensor installed in the track senses the signal and sends the signal to PLC which stops the train. Once the object is removed from the track, then the train continues its operation. In practical, the Metro-Rail cannot be stopped immediately and so the speed of the train can be reduced if there is any detection in object. Now, as the PLC gets the signal from input station, the train stops in that station for a particular time delay. The door is opened for a particular time which is programmed in PLC (here 15 seconds) and then the doors are closed, engine will be started to move. This cycle is repeated in the provided path. When the PLC gets emergency stop signal as the input then the entire system will be stopped as the output. The whole operation and maintenance of the train is done automatically without any human intervention.

The train stops and starts automatically and the doors are closed and opened automatically. The start/stop operation with respect to the doors open/close is performed repeatedly until there is any detection in object. When the train meets an obstacle, the sensor starts conducting and a interrupt signal is given to the PLC. Here three stations are connected to the PLC through the motor drive and thus the above operations are executed repeatedly. This operation can be monitored and can be controlled using SCADA. The representation of functional blocks in proposed system is shown in below figure.2.

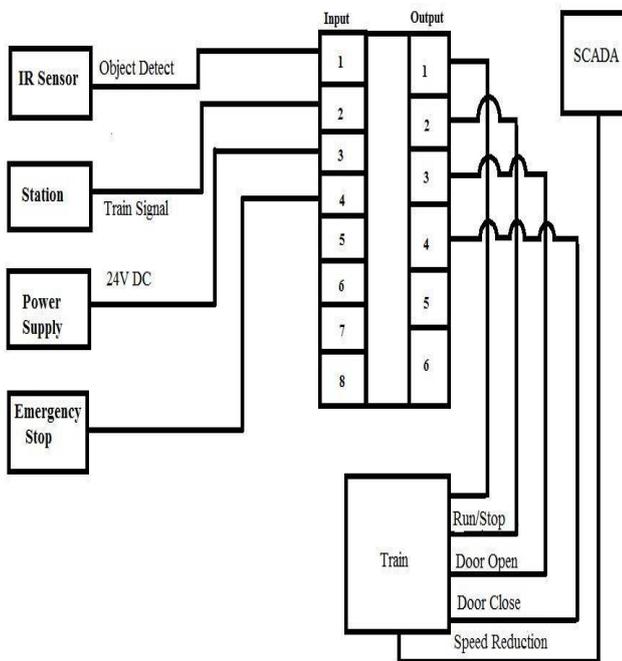


Fig -2: Block Diagram of Proposed System

#### 4. CONCLUSION

By determining the train’s movement the signals can be controlled automatically which will avoid train accidents. This system also provides other safety measures such as, Speed reduction if any obstacle is sensed by the sensor and Inter Passage Door opening for assuring the safety of Passengers by avoiding human errors. This arrangement increases the safety of passengers and it strengthens the communication of the train.

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