Driverless Metro Train Shuttle between Stations

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Abstract – *Metro train is rapid and convenient mode of transportation system in the world. In past, with the use of regular metro train many accidents occur due to various reasons like the fault of the driver, signal errors and also public interference on track. Also, human regulated metro train has no control over time, means inaccuracy in time which affects the entire railway network management system. The proposed solution for these issues is driverless train system which exclude the need of driver. Thus, chances of any human error is negligible. Another proposed system is to increase security of passengers on the platform by creating glass wall boundary across the platform to avoid any type of accident. By this system there is less consumption of power and it provides comfort and safety to passengers during travelling. Control and monitoring of train is done by PLC and HMI.*

Key Words: PLC, Station, HMI, IR Sensor, VFD

1. INTRODUCTION

This design of railway system consisting of a Train and a station. By using PLC, all electrical components could be programmed and become the control of all subsystems. Ultrasonic sensor is used to detect if any interruption has located on the track. To increase safety, a glass wall will be built on the platform boundary with doors to prevent people from crossing the tracks on station. Whenever the train reach at the station it stops automatically, as sensed by IR sensor. The platform door opened and closed simultaneously with the door on the train. Train is equipped with a passenger counting device, which counts the number of passengers leaving and entering in coach. After enough passengers getting into the train the doors will be automatically closed. There should be passenger limit on each coach because more weight can increase the load on motor and it may damage. The passengers count and display on LCD display interface with Arduino. Then the door closes and the train starts as prescheduled time. (The time limit is preset how much times train stops at each station). Speed of the train is controllable by variable frequency drive which is controlled by PLC. Buzzer warn to passengers before starting the train and closing the door. As the train reach the

destination the process repeats. The status of the train in display has the parameters like train name, number, expected arrival and departure time etc. We can control the motor and other safety equipment by WI-FI module in case of emergency.

2. EXISTING SYSTEM

The existing metro system required more manpower. It require separate department for each activities like security department, time management and central observation department, signaling and communication department. Existing system has high maintenance cost like salaries of many employs, maintenance for every separated departments, manually observation of systems and security of passengers on the platform.

3. PROPOSED SYSTEM

This idea has mainly focused on driverless train and automated station. PLC is mainly used for controlling all electrical component. Once program is upload in PLC, whole railway system start working in order with program. The speed control of train is done by variable frequency controller which is fully controlled by PLC. By changing frequency the speed of motor is increase and decrease according to it. This system is use to prevent the sudden changes in speed of motor. Ultrasonic sensor is located in front of train to detect interruption on track. If it detect any interruption on track, sensor send command to PLC to decrease speed of train. In the train emergency stop button is use to stop train in case of emergency and it also send emergency signal to control room by GSM module. HMI is use to observe live status of system and give command to system program. For automated and secure station, the

glass-wall can be install to prevent passengers from crossing the track. In the glass-wall there are automatic doors connected with IR sensors which will open after arriving of train at station and detect it.

3.1 ADVANTAGES

Ultrasonic sensors can be a solution to increase the breaking times of trains in spite of the long braking distance. Sensors can be programmed and implemented to detect objects in train's paths much quicker than the human eyes can allow.
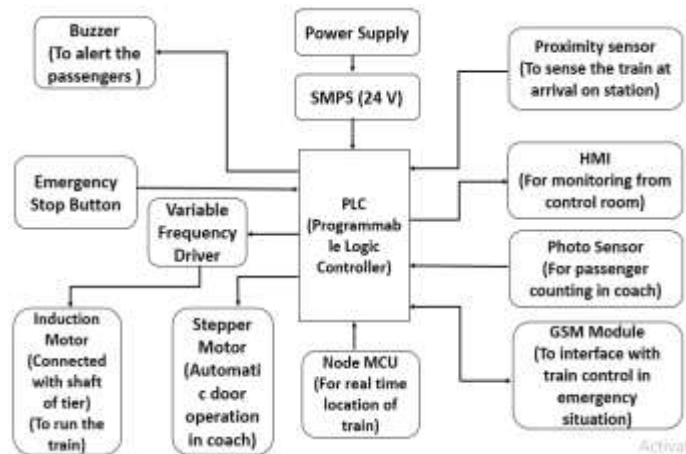
4. BLOCK DIAGRAM

Fig -1: Block diagram of system connection

It consist of PLC, HMI, VFD, Proximity sensor, IR sensor, GSM Module and induction motor. PLC is work as main controlling unit of entire train system. It control the buzzer, proximity sensor and VFD to control the speed of induction motor. Stepper motor driver control the stepper motor which is use for operation of station door. Proximity sensor sense unexpected object in front of train and send emergency stop command to PLC to stop train and manual emergency button also work as mention above. In both of above situation PLC send message to control room by GSM module. HMI is use to observe and control train manually in this type of situation.

5. OPERATION FLOW OF TRAIN

At station 1 train has stoppage time of 3 minutes (Variable time duration). During this time passengers settle in train and buzzer give indication of train is ready for departure. After that doors are close and motor of train ON. By VFD speed of train increase gradually and start running at preset speed.
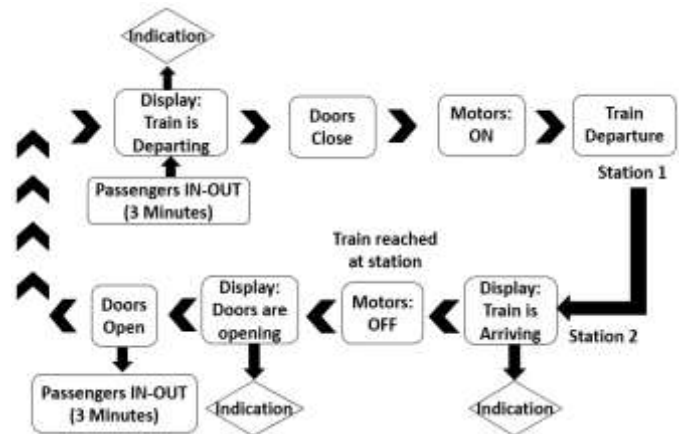

Fig -2: Operation flow diagram of train on path

When train reach at its destination, speed of train decrease gradually and train stop at station 2. Motor of train stop and doors of train and station open for passengers. After predefine time doors close and depart from station 2 to next station and process will continue.

6. RESULT

We demonstrated this method by making prototype model and testing it approximately similar to real time system. We connected 3 phase induction motor with shaft of tire and motor is control by VFD. We use proximity sensor for open close operation of door in station.

By testing this prototype model we successfully controlled the speed of train. Acceleration and deceleration of train was achieved by VFD without any measure problem. Doors of coach and station opened and closed synchronously.

By interfacing HMI with PLC, It can control the parameters of train in emergency time and GSM module pass in test of sending message in emergency time.

6. CONCLUSION

To conclude, driverless train with automated station provide safety to passengers in train as well as on station. Glass wall covered station offer convenience and reduce traffic at gate of coach. In emergency situation, authority can access the control of train by HMI. Driverless train is also time efficient which is beneficial for passengers and authority of railway system for better management.

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