International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

Driverless Metro Train

Divyang Kaka[1], Harshad Sonawane[2], Hemang Jani[3], Abhishek Patel[4]

[1,2,3] Students, Department of Electrical Engineering, Vadodara institute of engineering, Kotambi, Vadodara-390018, Gujarat, India
[4]Assistant Professor, Department. of Electrical Engineering, Vadodara institute of engineering, Kotambi, Vadodara-390018, Gujarat, India

---

Abstract - *Nowadays the modern technologies are helpful in all aspects of our life. Due to this lots of development done in the field of transportation. In the previous years, with the use of regular metro train accidents occur due to various reasons like the fault of the driver, signal errors and another major problem is, the human-operated metro train has no control over time, mean inaccuracy in time which affect the railway network management system. To solve this problem we have a new concept of the driverless metro train. Driverless metro train improving the management system of the railway network, reduce human errors, consume less power and it provides comfort and safety to passengers during traveling.*

Keywords: **Driverless, Metro train, IR sensor, GSM, RFID module, Arduino.**

1. INTRODUCTION

This project is developed to understand the technology used in the driverless metro train system which is mostly used by some other developed countries like Germany Japan and France [1]. It solves the problem of mass transportation as well as the high transportation cost in the metro train system. It also reduces the energy consumption by 30% [2] of the metro train as it also uses the solar panels on the top for running the accessories of the train [5]. It also gives accurate timing control of the train on station arrivals and departures [4].

The operation of the driverless metro train is controlled by a central processor unit like Arduino controller, 8051 processor or PIC controllers [6]. The train is programmed to run on a predefined path which has fixed distance of stations and the speed of the train is also predefined and it is controlled by the motor driver IC. The stoppage of the train on the stations is also predefined. The RFID sensors and RFID tags are used for stopping of the train [1]. The whole operation of the train is controlled and performed by a controller so it does not require a driver or train attendant for the operation of the train [11].

This project uses Arduino mega as the main controller of the whole system. The operation and control of the train are performed by the Arduino. The different operation or functions of the train is carried out by fetching the programs in the Arduino by using the Arduino IDE software.

Some other additional features like LCD display to give messages to the passengers, GSM-based SMS facility to know the position or location of the train and give that information to the control center by SMS service [7], alarms to give indication to the passengers for LCD messages as well as for indication of door operation, automatic door controlling, passenger counting section by using IR modules [9], solar panels, MQ2 smoke sensor [8], vibration sensor[10], emergency brake button are also included in this project.

2. COMPARISON

In the driverless metro train system, there are four types of grades of automation available. All the grades are having different features.

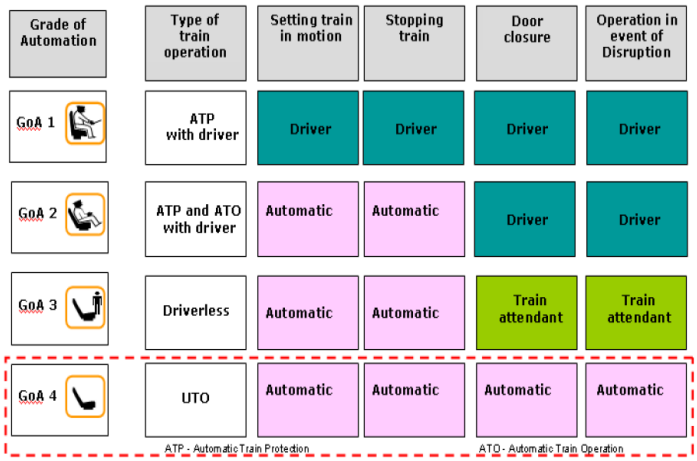

Fig-1: Comparison of the driverless metro train system [3]

GoA-1 is having automatic train protection system. The driver is required for starting of the train as well as stopping of the train and also for the door operation and for operation in the event of the disruption.

GoA-2 is having the automatic train protection and operation. The starting and stopping of the train are automatic but for door operation and for operation in the event of disruption driver is required.

GoA-3 is called as the driverless operation of the train. In that, the starting and stopping of the train are fully automatic but for door operation and in the event of disruption train attendant is required.

GoA-4 is called fully driverless train operation or also called as unattended train operation (UTO). Hence in this operation, all the functions of the train are carried out by automatically. So there is no requirement of driver or train attendant to perform operations of the train.

3. BLOCK DIAGRAM

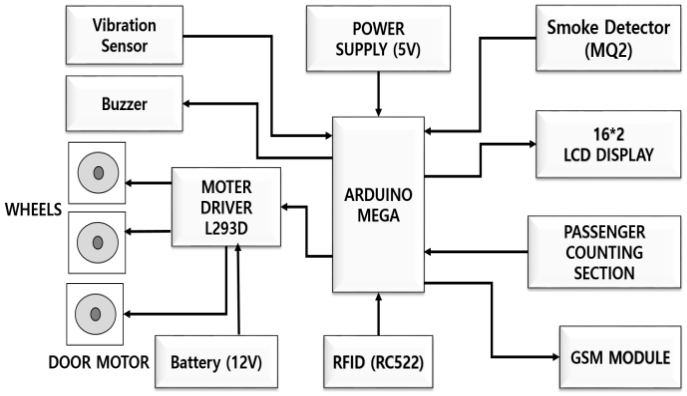

Fig -2: Block diagram of driverless metro train

4. IMPLEMENTATION

The working of the project can be understood by use of the state diagram for the arrival and departure of the train on the station [4].

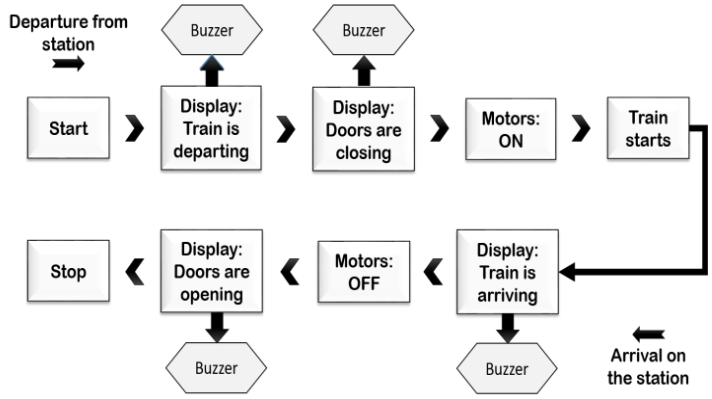

Fig -3: State diagram of train during departure and arrival on the station.

We have used Arduino Mega as the main controller. The supply of 5V to the Arduino is given by a source like power bank. All the components which are used for the different operation of the train are connected to the Arduino.

At first, the train will get supply from a source and gets ready to move. Here we have used the 12V battery for giving supply to the motor driver IC and door motor. But before that, the LCD will display the message that "The train will depart from the station in few minutes". The buzzer operates for every LCD message and for door operation.

The passenger counting section came into action and count the passenger by use of IR modules and display it on the LCD. Then the LCD will display the message that "Doors are closing" with buzzer operation. The state of the motor is changed from off state to on state and the train starts moving and departs from the station.

When the train is arriving on the station, the LCD will display the message that "Train is arriving on the station in few minutes" with buzzer operation. The state of the motor changes from on state to off state by use of RFID sensor and RFID tags. RFID sensor is fixed on the train and RFID tags are fixed near the station. By detection of RFID tags by RFID sensor, the train changes its state of motors from on state to off state. Then the LCD will display the message that "The doors are opening" and the door control will open the door. The whole operation of departure and arrival is repeated on every station during the train operation.

This project also contains some additional features like GSM based SMS service. We can track the position of the train by using this system and send the information to the control center by using this service.

This train is having a solar panel on the top for running the auxiliaries of the train like LCD displays, mobile charging sockets, lighting, fans etc. The produced solar power can be converted into AC power according to the requirement by the inverters. The use of solar panels reduces the power consumption of the train.

This project also includes smoke detection via the MQ2 smoke sensor for the protection purpose. When there is some problem in the train due to system failure or electric shocks, smoke is produced which is detected by the smoke sensor and give the signal to the Arduino for protection of the train. It protects the train against fire as well as short circuits in the train.

This project also consists an emergency braking button placed on the train. It is used at the time of emergency for apply brakes on the train. We have also used vibration sensor for the protection purpose. When the emergency occurs in the train due to any type of failure, that causes vibration and so vibration sensor senses it and gives an indication to control center by GSM facility.

5. RESULTS

We have demonstrated this project by built a prototype model of driverless metro train. We have used DC gear motors and connected it to the wheels. A simple CD drive is used for automatic door operation. A DC motor is used for door operation. It is to be noted that a buzzer will operate at every door operation function.

By running this prototype model we got results as getting messages like the name of the station, the number of passengers and door position on LCD display. The passenger

counting is completed by using IR module and displayed on LCD.

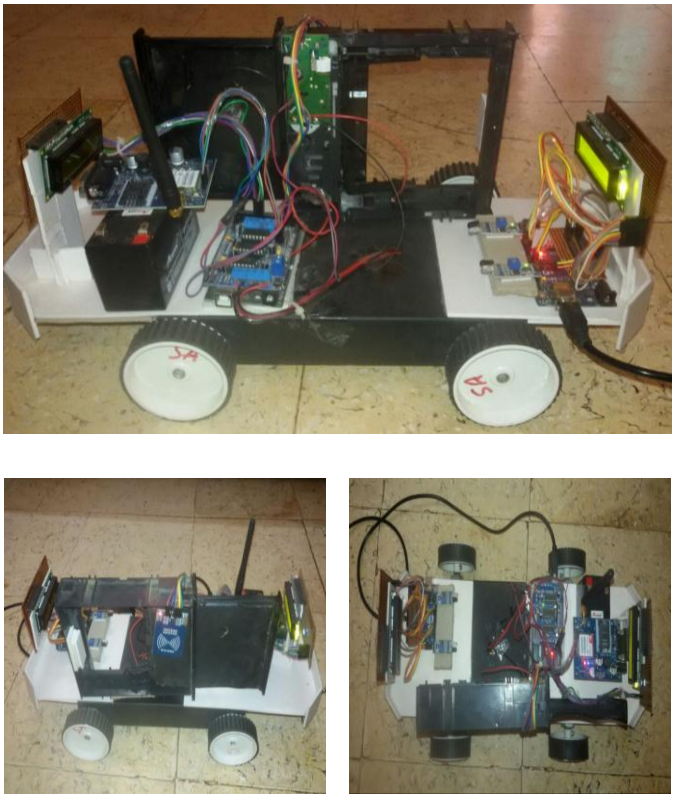

Fig -4: Prototype model of driverless metro train

The speed of the motor is controlled by the motor driver IC and the supply to the motor driver IC and door motor is given by battery of 12 volts.

The door is automatically open and close with detection of the station by RFID sensors. There is some delay is provided between opening and closing of the doors by means of programming.

Detection of the station is done by sensing RFID tags by RFID sensor and it gives a signal to change the motor state from on state to off state.

The solar panel on the top of the train is used to supply the train auxiliaries. We are using an LED as load or auxiliary of the train. It reduces the overall power consumption of the train.

The train on which station is detected by the RFID sensor by sensing the RFID tag on that station. So we can get the location of the train on the particular station by GSM system.

The vibration sensor has come into action when the vibrations in the train due to some fault is exceeded from the predefined limit. It sends the signal to Arduino and that signal can be sent to control center by using GSM module.

6. CONCLUSION

Our driverless metro train project provides the unique features like it provide fully automatic driverless operation with less traveling time, less consumption of electricity, smoke detection etc. Driverless metro system provides better quality services as well as exact timings of the train for arrival and departure. It reduces the overall running cost of the system and by use of solar panels, it also reduces the power consumption of the train. One advantage of this system is to transport more people than the normal metro train services. This system makes a better way to build smart cities as well as to provide better metro rail services to the society.

REFERENCES

[1] Bhosale Smita Vijayanand, Pansare Pooja Balaso, Shinde Pooja Sanjay, Prof. Sukeshkumar Borate, RFID based metro train system, International Engineering Research Journal (IERJ), Volume 2 Issue 8 Page 3008-3010, ISSN 2395-1621, April 2017.

[2] Factsheet, how does a driverless metro system works? , Siemens, Germany, Munich, April 2012.

[3] UITP Press kit, Metro automation facts, figures and trends, http://metroautomation.org

[4] Efficient Real-Time Train Operation Algorithms With Uncertain Passenger Demands, Jiateng Yin, Student Member, IEEE, Dewang Chen, Senior Member, IEEE, Lixing Yang, Tao Tang,and Bin Ran, IEEE transactions on intelligent transportation systems

[5] Solar powered train, https://economictimes.indiatimes.com › Industry › Transportation › Railways

[6] Full Automation in Driverless Trains: A Microcontroller-Based Prototype, Thabit Sultan Mohammed, Wisam Fahmi Al-Azzo, Mohammed ,Ahmed Akaak, Mohammed Laheeb Suroor, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN (Online): 2278 – 8875, Vol. 3, Issue 7, July 2014.

[7] Requirements Of GSM Technology For The Control Of High Speed Trains, CCsar Briso, Carlos Cortks, F. Jose ArquCs', JosC I. Alonsoz, ' Universidad Polit6cnica de Madrid, EUIT Telecomunicacibn, %a\ Valencia Km 7,2803 1, Madrid, Spain, Universidad Politkcnica de Madrid, ETSI Tei&imunicacion, Ciudad Universitaria sn, 28040, Madrid, Espaiia,

[8] Automatic Fire Initiated Braking and Alert System for Trains, Sumit Pandey1, Abhishek Mishra1, Pankaj Gaur1, Amrindra Pal1, Sandeep Sharma1 #1Department of Applied Electronics and Instrumentation, 2015 Second International Conference on Advances in Computing and Communication Engineering.

[9] The New Approach for Passenger Counting in Public Transport System, Antons Patlins, Nadezhda Kunicina Faculty of Power and Electrical Engineering, Institute of Industrial Electronics and Electrical Engineering, Riga Technical University, 1 Kalku Street, The 8th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications 24-26 September 2015, Warsaw, Poland

[10] The Design of an Optical Wireless Sensor Network Based Train Vibration Monitoring System, Walid Abdallah and Noureddine Boudriga Communication Networks and Security Research Lab., University of Carthage, Tunisia, ICTON 2017

[11] Model-based development of an Automatic Train Operation component for Communication Based Train Control, Mariano Di Claudio, Alessandro Fantechi(*), Giacomo Martelli, Simone Menabeni, Paolo Nesi DISIT Lab, DINFO, Dep. of Information Engineering, University of Florence, Italy; (*) DINFO, University of Florence, 2014 IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) October 8-11, 2014.