SELF-DRIVING METRO

Shikha Bhatia,[1] Deepali Kamthania [2]
singhshikha439@gmail.com, [1] deepali102@gmail.com[2]
School of Information Technology, Vivekananda Institute of Professional Studies, Delhi, India

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Abstract

In this paper an attempt has been made to design a driverless metro train using Arduino based controller which enables the train to run automatic from one station to another station wo 9V batteries attached in series to increase the voltage. When the train approaches to the station IR sensor detect the train and it stop on platform. A model for railway system consisting of a train, boom barriers and a station has been developed to test the model. To get the machine to work profitably, the mechanical components were made from scratch, both the subsystems were regulated by the use of Arduino as a micro controller where electrical components could be programmed. Ultrasonic and IR sensors were used to detect whether the rails were obstructed and also to detect the oncoming train at the railway junction. The model showed that automatic system can provide more safety as chances of human error reduces.
Keywords: Driverless train, Automatic train operation, Arduino, IR sensor, Timer circuit, DC motor

1. INTRODUCTION

IOT is one of the most innovative innovations in modern times. IOT provides the connection between a number of physical things or objects using various addressing schemes to be connected to the Internet. IOT technology can be used in a number of vertical markets, including manufacturing, transport, healthcare, cars, metro, smart home and agriculture. There are a number of smart chips and devices like IR sensors, ultrasonic sensors, temperature sensors, etc. in IOT which can be integrated and used as per user needs and requirements to save user time and effort. In order to meet the challenges in the 21st century, all sectors are transforming using latest technology. IOT is one such technology that is widely used these days. There has been a significant transformation of the rail transport system, beginning from the early steam engines to the most recent bullet trains [Mohammed et al (2014)]. The existing metro system infrastructure is being modernized and fitted with an automatic train control and safety system to make it more efficient. In the case of metro systems, automation refers to the phase in which train service duties are shifted from the driver to the train control system i. e. automated driverless concepts were introduced [Tambare and Jogi (2015)]. Automatic Train Operation (ATO) can increase train frequency, provides a better recovery from delays, basically an increase in ability of the system. It has been observed that in transport system maximum accidents happen due to human error, automated system can reduce error and improve the performance of the system [Sriidhar (2012), Dnyaneshwar et al. (2018)]. This proposed system is a driverless metro train and which eliminates the need onboard staff and makes the complete autonomous train using ARM 7 as CPU. When the train reaches the source or the destination station, it starts and stop automatically as sensed by the IR sensor. The door then opens automatically and the passenger may enter or exit the train and then after the specified time as set in the

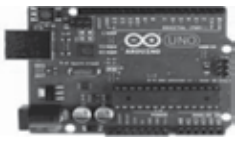
microcontroller software the train door automatically closes. [Patil and Rajshekhar (2014)]. Bharti et al. (2018) implemented a framework for a driverless train using a ATMEGA328p ARDUINO. Fizardo et al. (2017) implemented a prototype for a driverless train using PIC microcontroller. When the cabin is full, the prototype provides passenger counting and produces warning signals. It also provides the doors with automatic opening and closing. Kumar et al. (2017) presented the development process of a prototype for a driverless train implemented using a RASPBERRY PI controller using LabVIEW software for the system's circuits simulation. The hardware circuit is interfaced with actuators and sensors for automation purposes using LabVIEW. A Smoke sensor is interfaced to detect any smoke or gas present in the train. Kaka et al (2018) designed a fully automatic driverless operation with less traveling time, consumption of electricity, smoke detection etc. The overall running cost and power consumption of train is reduced by use of solar panels. Jayachitra et al. (2018) demonstrate that a processor can be programmed to avoid accidents effectively and also to minimize the effects of overloading and time delay, increase the frequency of the train and provide better medium for transport

The main aim of this project is to make a driverless train which is programmed to run between two stations. The train is a toy like prototype which follows a specific path and station on such a path, timing of the train and the distance between stations are predefined.

2. COMPONENTS

To execute this project, the devices used by IOT are: Arduino, IR sensor, Relay, Capacitor, DC motor, Power Switch Button etc. The following components are used in the design and development of the prototype.

i. Arduino



Arduino is an open-source electronics platform focused on easy-to-use hardware and software used to build electronics projects. With Arduino, you can design and create devices that can communicate with the surroundings. Arduino boards are simply a method for manipulating electronics. They are able to read inputs with their on-board microcontroller (e. g. light on a sensor, an object near a sensor) and transform it into output (drive a motor, ring an alarm, turning on an LED, display information on an LCD). However, to do this, the Arduino board need to be programmed first. A software application called Arduino IDE (integrated development environment) is used for setup. With Arduino, manufacturers and electricians can easily prototype their products and make their thoughts come alive.

ii. Motor



The engine used is called the DG01D and the DC engine is 48:1 geared. The engine has two spinning shafts that can conveniently be connected to two wheels.

iii. Micro servo



Micro-servos were used for the door operation and the function of the boom barriers. The servo, SG92, is able to spin 180 degrees with a torque of 1 kg-cm. There are three pins for the servo; ground, VCC and signal. It allows angular position, velocity and acceleration to be controlled.

iv. IR-sensor



The IR-sensor was used at the railway crossing to identify the oncoming train. It uses infra-red light through reflection to get information about how close an object is. The IR-sensor is capable of recognizing objects in a proportion of Around 10 to 80 cm. The sensor is of the GP2Y0A21K type and has three terminal connections; V0, which is the terminal connection; Output terminal voltage, ground-based GND and supply voltage VCC.

v. Relay



A Relay is an electromechanical system which can be used to establish an electrical link or to break it. It consists of a versatile moving mechanical component that can be operated electronically by an electromagnet. Essentially, a relay is like a mechanical switch, except instead of turning it on or off manually, you can control it with an electronic signal.

vi. Step down transformer:



A transformer is a type of static electrical equipment that transforms electrical energy (from primary side windings) to magnetic energy (in transformer magnetic core) and again to the electrical energy (on the secondary transformer side). In electric systems and transmission lines, a step-down transformer has a wide range of applications. A step-down transformer is a type of transformer that converts high voltage (HV) and low current to low voltage (LV) and high current values on the secondary side of the transformer from the primary side of the transformer. A step-up transformer is opposite of this.

vii. Capacitor



An electronic part that stores electrical charges is a capacitor. The capacitor consists of 2 contiguous conductors (usually plates) separated by a dielectric material. When attached to the power source, the plates accumulate electrical charges. Positive charge accumulates on one plate and negative charge accumulates on the other plate. The capacitance is the amount of electric charge deposited at a voltage of 1 volt in the capacitor. The capacitance is measured in Farad units (F). In direct current circuits (DC) and short circuits in alternating current (AC) circuits, the capacitor disconnects current.

3. WORKING OF THE PROPOSED SYSTEM

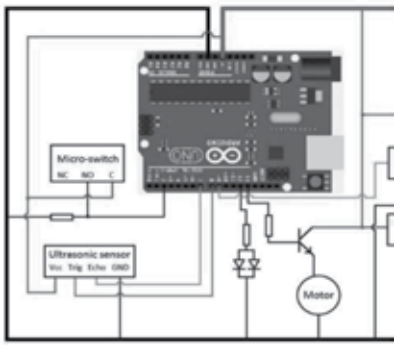


Figure1: Block Diagram

The self-driving metro train is equipped with a controller that allows the train from one station to another to run automatically elimination driver's need. DC socket has been used to give power supply. The self-driving metro train is equipped with a controller that allows the train from one station to another to run automatically. This proposed system is an autonomous train and eliminates any driver's need for it. We use a DC socket to supply power. It stops automatically, as sensed by an IR sensor, whenever the train arrives at the station. Two circuit Arduino and timer has been used. The power button is used for on and off. Timer circuit is installed so that the train can be stopped as desired. The DC motor is used to raise and drop the boom. Step down transformer convert 220 voltage to 12 voltage ac. To operate the station 1.5 volts call is used and to control the signal 9 volts battery is used. The resistance that is non polar is used and is read with the colored lines on it. The work of diode is to convert ac into dc and it control the reverse voltage shuts off. Relay or electronic switch is used for on and off. The three IC has been used one is gate IC i. e. IC CD4011, another IC is timer IC CD5438. Regular IC 7805 to make 5 volts. IR sensor signal the circuit which controls the motor. The emitter-based collector supplies the large section of majority charge carrier. The emitter is always connected in forward biased with respect to the base so that it supplies the majority charge carrier to the base along with the capacitor. Until deployment, the roles of both sections were checked and validated and required modifications were done. When all subsystems worked, several experiments were conducted on the whole machine until a complete working device was ready.

4. SYSTEM IMPLEMENTATION

The train, the station and the railway crossing system were built from scratch. The materials used were plastic and metal. The boom barriers and the warning lights appears as realistic as possible. The barriers in green with red tape stripes and the diodes consisting of one black and two red are attached on a triangular plate along with the train station, consisting of a grey floor and a transparent wall. A couple of sensors along with one Arduino were used to get the train to move forward and to get the various functions to work. A circuit diagram was drawn before welding, as is shown in Figure 1. The engine, the battery, the ultrasonic sensor, one micro-switch, two diodes and a micro-servo were all operated by this device. On a circuit board, it was connected and welded. The engine starts when driven, and two diodes located on the front of the train are illuminated simultaneously. When the front-mounted ultrasonic sensor senses any obstructions, the engine responds by automatically shutting down. When pressed upon arrival at the station, the micro-switch mounted on the side of the train gets triggered.



Figure 2: Train and Arduino Connection

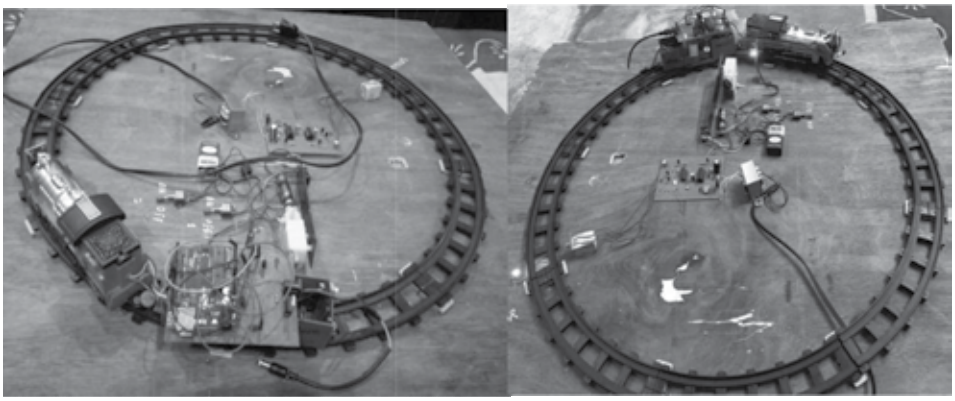


Figure 3: Metro Train Prototype

Fig. 3 shows an Arduino based metro train prototype having driverless metro train. To control the automatic driverless train, it is equipped with CPU and is programmed for specific path. ARDUINO 382 as CPU. The stoppage time of the train and distance between the two stations is predefined for each station. The 220 volts is attenuated by 12 volts by transformer and then the 9 v is regulated by 7805. To filter the DC voltage 1000 micro farad capacitor is used. The DC socket checks the flow of power supply. The motion of the train is controlled by the DC Motor in the train. IR sensors has been used at proper locations with respect to each station, an IR transmitter is situated. Whenever a train travelling between stations, a relevant IR signal is decoded and preparation to stop at the coming station is started.

4. CONCLUSIONS

The project shows implementation of an automated train system. It will help in monitoring the train without a driver and will be controlled by the sensor. It will reduce the manpower and will increase the security for both rails and passengers. The GPS system will be used instead of cable line.

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