

## Advance Mechanized Metro Train

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**Abstract:** The project is a prototype project and this project is to demonstrate the technology used in all advance metro train system. However, the technology is already adapted in most of the developed countries. The additional features have been added in this project electronically and mechanically as well, so to achieve high safety, quick delivery without any traffic congestions. The train runs between two predefined stations without having any driver inside in it. The most significance attributes of this prototype project is its safety system. This project makes use of microcontroller AT-Mega 328p as central processing unit which control every functions of the train. This Advance Mechanized Metro Train perform automatic open and closing of door in each station and collision avoidance whenever the two train lies on the same track. The train is highly sensitive to any obstacle that comes into the track. The train will automatically stop when any obstacle is detected to prevent from being happening of any casualties.

**Keywords:** Block Diagram, Circuit Diagram, Working Principle.

### I. Introduction

Nowadays, the metro train transportation system is one of the fastest and the safest means of transportation which is economical to public transport system. The metro train system also helps in connecting two major cities with providing high speed transportation system. The main approach of this prototype project is to allow the train completely unmanned and operates precise and errorless. The concept of driverless metro train was first recorded and implemented in London underground Victoria line in 1967. Thus the aim of any train is to provide secure, consistent, efficient and high quality services to passengers. Since many conventional train systems fail to provide sufficient facilities to the passengers and the only automation system is left to maximize the operational performance of train services system. Furthermore, the automation system also reduces the wear and tear of train which need no frequent maintenance. Since there is negligible friction between each wheels of the train and track due to its stiffness which leads to lower power consumption. Hence this system is comparatively lower power consumption in contrast to other conventional train system. It is knowing that the Metro Train can carry approx. 1K passengers by having 6 to 8 bogies. This means that there is high risk of losing human lives in case of crushing. Here in our project, we are deeply concentrated on safety system. We connect the wire between each bogie, whenever that conducting wire get cut, the train will stop automatically. This project also overcome the loss in control by driver.

### II. Proposed Methodology

Initially, we have designed and testing the circuit of proposed prototype system on software level. Designed schematic circuit is printed on PCB and fix each location for mounting of hardware. Selection of proper and suitable components are done and most appropriate software compiler is also selected. Soldering of all the hardware components on its respective location with the help of soldering iron. Now the next step is to develop code using C language for various functions of the proposed prototype system. Compilation of all programs with the help of software compiler called Arduino IDE and proper executed programs are then burn into the flash code memory of micro-controller AT-mega 328p. Then the testing of various programs with hardware level for the proper working of the system.

### III. Block Diagram

System Architecture of our project is depicted below in Figure 1. Below diagram shows all hardware interfacing with micro controller. The central processing unit we used here is ATmega328P Microcontroller. The significance reason that we choose ATmega328P here is due to its comprising of both analog and digital pin out. Though this controller give better features than that of other controller like 8051 etc. This highly equipped Automated Mechanized Metro train system consisting of Temperature sensor, Ultrasonic Sensor, IR sensors, DC Motors, LCD screen and Buzzer, where all are interfacing with microcontroller. The system is drive

by 12V dc power supply which is fitted inside the train. One DC motor is there for locomotion of train and another motor for open and close of the door. The system is giving output in both analog and digital aspects. Digital output like LCD screen is using here and analog output like driving of DC motors, Buzzer etc.

These makes passengers easier to get notifications about train during their journey. Temperature sensor and Ultrasonic sensors are installed in the system for safety purpose. This 28 pins controller gives our desired features and also makes easier to program. This system has the capable of operate under temperature in range between -40C to +85C which is far enough.

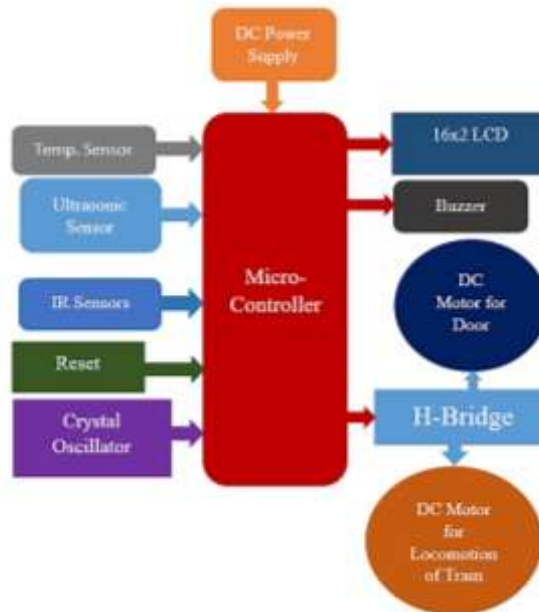


Figure 1. Block Diagram

#### IV. Circuit Diagram And Explanation

The circuit depicted in Figure 2. Comprises of one CPU ATmega328p microcontroller being interfacing with 5 IR sensors, 1 Ultrasonic sensor, 1 Temperature sensor. For the locomotion of train, we use dc motor having 100rpm. There motors are interfacing with L293D IC. PB0, PB1, PB2 and PD7 of microcontroller are connected to Pin No. 9, 1, 15 and 10 of L293D IC. IR1 connected to PD2, IR2 connected to PB3 and IR3 connected to PB4 of Atmega328p controller. IR4 sensor and IR5 sensor are connected to input01 and input 02 of L293D IC. The IR sensors connected with H-Bridgeare responsible of monitoring the track during journey and the IR sensors connected with Microcontroller are used for station detection, entry and exit detection of passengers.

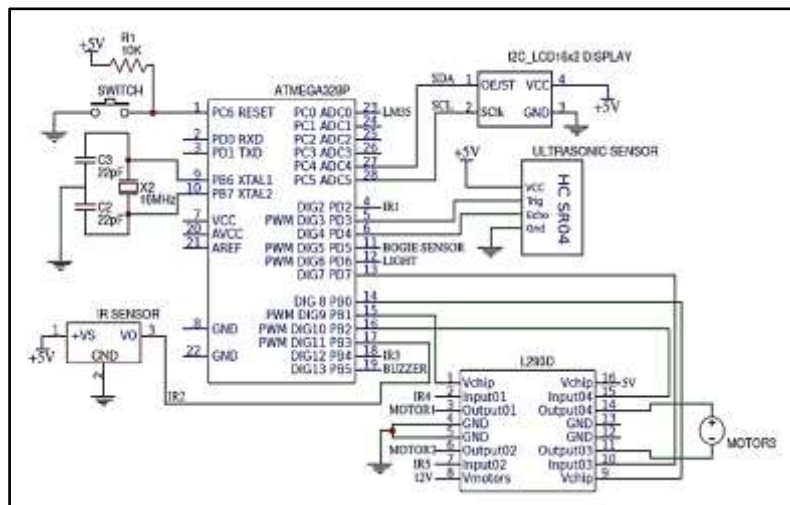


Figure 2. Circuit Diagram of Advance Mechanized Metro train

Ultrasonic sensor (HC-SR04) interfacing with microcontroller through Port no. PD3 and PD4 (see Figure 2.) is responsible for collision avoidance and object detection. This sensor keeps the train away from collision detection. The temperature sensor LM35 connected to PC0 ADC0 i.e. pin no. 23, temperature sensor sense the present wheel temperature and send information to the microcontroller. The Microcontroller then display every information as notification through LCD display. Here, 16x2 LCD is interfacing with I2C and then two pins of I2C is connected to PC4 ADC4 and PC5 ADC5 i.e. pin no. 27 and 28 of microcontroller. The two pins of I2C is known as SDA and SCL. In this system, we are using three dc motors each of 100rpm. Motor1 is connected to output pin no. 3 of L293D IC, Motor2 is connected to output pin no. 6 of L293D IC and Pin No. 14 and 11. The controller is clocked by 16MHz crystal oscillator and this oscillator has to connect externally (see the above circuit diagram). Reset switch is connected to pin no. 1 of microcontroller which is responsible for generation of RESET signal when power is applied to the system. This signal makes sure of device to start operating in a known state.

The ultrasonic sensor can detect the object from comparatively longer distance than IR sensor, thus it is used to detect the object that comes into the track. Since the ultrasonic sensor works in sound wave mechanism hence, it can perfectly sustain both day and night. In contrast, the IR sensor's working may slightly different when it comes to change in object color. These significance reasons make use of both sensors for different purpose.

## **V. Working Of Project**

In this project, we are using 12V dc power supply. As soon as the power supply is feed to the Microcontroller, the train gets ON and automatically starts giving service. The train gives beep sound and light gets ON once before it moves.

Temperature sensor which is interfacing with Microcontroller will sense the current temperature of wheel bearing of the train and then display it to LCD screen. This sensing mechanism is continuously monitor the temperature entire duration of journey. When temperature of wheel bearing reach its heating limit, then train will stop before any casualty happen.

Train will stop for few seconds at its predefined station, the door will automatically open and close. After that, train will leave for another station and the same process goes on till it reach the final destination. Whenever any obstacle comes into the track, the Ultrasonic sensor detect that object and train will stop before any collision occurs.

This Advance Mechanized Metro Train have Track Monitoring sensor interfacing with microcontroller continuously check the track during journey. If there any break in track is detected, the train will automatically stop: for this is the significant step lead to safety system of the train.

The sound absorbent material fitted inside the bogie absorb the sound so to reduce the amount of noises present inside the bogie. This features makes the passenger more comfort during the entire journey. One last but the most important working of this system is its bogie monitoring system. There is joint between two bogies in the train. That joint has certain range of flexibility which help in taking turn during the movement of the train. The function of this monitoring system is to sense whether this joint is properly connected or not. Whenever this joint break, the sensor will send the message to controller and the controller then stop the train instantly.

## **VI. Conclusion**

A Moving out from so many steps over the entire journey of making this project, here we come into conclusion with many advantages and some non-negligible disadvantages. The advantages we found here in our project is quite relevant to safety purpose, quick delivery, no traffic congestion etc. We focused on automation system where the train had to control everything automatically under single controller i.e. microcontroller ATmega328p and we made it successfully. Some of the significance advantages of this train is –not committing human error, most efficient in case of power consumptions, high capacity carrier with quick delivery, eco-friendly, highly sophisticated in terms of safety. Since we tried reducing every limitation which today's ongoing Metro train suffers from. Thus our project incline towards good cause to every passengers and their safety. Even though our project comes with many advantages, there are some disadvantages which cannot be ignore. Some of them are –more time requires to install the project and complexities may come once the system is manufactured completely.

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