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Innovation on Rails: Auto Metro Train Systems for Modern Cities

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Abstract: The " Innovation on Rails: Auto Metro Train Systems for Modern Cities " research paper explores the transformative potential of integrating autonomous technologies into metro train systems, revolutionizing urban transportation. This study focuses on the comprehensive design and development of an auto metro train that operates seamlessly between stations, leveraging advanced technologies to enhance safety, efficiency, and sustainability.The project employs a multidisciplinary approach, combining autonomous navigation systems, cutting-edge sensors, and robust communication networks to create an intelligent and responsive metro train system. By eliminating the need for human operators, the auto metro train aims to optimize travel times, reduce operational costs, and contribute to the overall efficiency of urban transportation.Key components of the research include an in-depth analysis of autonomous navigation algorithms, the integration of advanced sensors for real-time environmental monitoring, and the establishment of a reliable communication infrastructure.

***Index Terms*– Auto Metro Train,Sensors,Safety,Urban Mobility**

I. INTRODUCTION

With the accelerating pace of urbanization and the ever-increasing demand for efficient and sustainable urban transportation, the design and development of an Auto Metro Train to Shuttle Between Stations represents a pivotal initiative at the intersection of technology and transit. As cities grapple with congestion, environmental concerns, and the need for seamless mobility, the integration of autonomous technologies into metro train systems emerges as a transformative solution.Traditional metro systems, while stalwarts in providing reliable mass transit, are now faced with the challenge of evolving to meet the demands of modern urban living. This research embarks on a comprehensive exploration of the potential offered by autonomous metro train systems, with a specific focus on designing a sophisticated and responsive system capable of shuttling between stations without human intervention.The objective of this study is to transcend the limitations of conventional metro systems by leveraging cutting-edge technologies such as autonomous navigation, advanced sensors, and robust communication networks. By introducing automation, the research aims to optimize travel times, enhance operational efficiency, and contribute to the overall intelligence of urban transportation.

II. LITERATURE REVIEWS

Parkash Ratan, Chandra Jogi

This project aims to display off the metro train's capabilities transportation, which is normal in a large number of advanced countries. A controller has been set up on this train so that it to operate automatically from one station to the next. To move the train one station to the following, they used an ARM 7 CPU. They also employed an infrared sensor, which is used to open the door.

D. Pradeep simha1, N.Ajay kumar2,K.Pavan3,O.Anuf

The PIC microcontroller was used as the CPU in this project. An infrared sensor senses when the train arrives at the terminus, so it stops instantly. Part of this automation task is explored in this study, and a microcontroller-based prototype is constructed. The prototype includes actions like as travelling along a predetermined course with predefined stations, sensing station arrival, and thus properly halting. Messages are announced to passengers via a display that is synchronized with the train's passage through its path. Alarms signals are generated as well as necessary. Controlling the opening and shutting of the doors, as well as the time of such activities, is taken into account.

S V S Prasd, K Nishanth Rao, V Arun, D Laxma Reddy

This paper describes the technologies employed in control system-equipped driverless trains. TO avoid errors resulting from human error while driving, many cases have been created that provide station information such as the direction, arrival and departure timings of a train. All

stations' distance between each other is predefined in a way that is meaningful to the passengers, and the screen shows a message that includes the quantity of travelers on board the train. This metro train is operated by a controller who drives the train one station to the following. The procedure will be repeated for the remaining stations after the train reaches its destination

Bharathi K V1, Divya2, Raseeda S3, Tejaswini N S4, Dr.Shankaralingappa C B

This study is intended to display the technology utilized for the movement of metro trains in the vast majority of developed countries. As a CPU, they used ARM 7. An infrared sensor senses when the train arrives at the terminus, so it stops instantly. The door then closes, and the train departs at the moment specified by the programmed in the controller. An LCD connected to the ARM 7 displays the passenger counts and stations. A motor driver IC interfaced to the ARM 7 controls the train's movement. The train has a buzzer that warns passengers before closing the door and also before beginning. This study is intended to demonstrate the technology utilized in metro train movements in most developed countries. As a CPU, they used ARM 7. An infrared sensor senses when the train arrives at the terminus, so it stops instantly. The door then closes, and the train departs at the moment specified by the programmed in the controller. An LCD connected to the ARM 7 displays the passenger counts and stations. A motor driver IC interfaced to the ARM 7 controls the train's movement. The train has a buzzer that warns passengers before closing the door and also before beginning ARM 7. The train incorporates a buzzer to alert the passengers before closing the door and also warn them before starting.

Naga Swetha R1, Yashwanth Badri2, Mahesh3, Rabbani Basha

They employed a controller that allows the train to operate automatically from one station to the next. The suggested technology is a selfdriving trainthat does not require a driver. As soon as the train comes into the station, it automatically stops, as detected by an RFID Module. The door then automatically opens, allowing passengers to board the train. It additionally contains a passenger counting area wherein the number of individuals stepping on and off the train is recorded. They've also deployed a buzzer to warn people before closing the door and before looking.

Premchand bharti, ratnesh pandey, ashwini mathurkar

This study servers as an example of the train in movement technique that is used in the majority of industrialized nations. In this driverless metro train, the controlled halting of the train between stations is made possible by our Arduino- Based controller. The improvement of a framework for a driverless train initiated using an Arduino-based controller is shown in this study. Various sensors are included in the hardware circuit design, which is constructed on circuit boards, for automation purposes. The components are put together in a train-like framework. Trains without drivers are equipped with a control system that is programmed to direct them along a specific path

Rupal jain

They employed an 8051-family microcontroller, which serves as the project's CPU. An IR sensor detects when the train enters the station and causes it to stop instantly. The train door then automatically opens, allowing the passengers to board. The door then shuts after the predetermined amount of time. Additionally, it has a section for counting passengers that keeps track of those getting on and off the train. Regardless of the time given for the door to remain open, the door closes when it hits the maximum occupancy level.

III.Material

- **Arduino Uno:**

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328p microcontroller (MCU) and developed by

Arduino.cc and initially released in 2010.The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuit.The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.

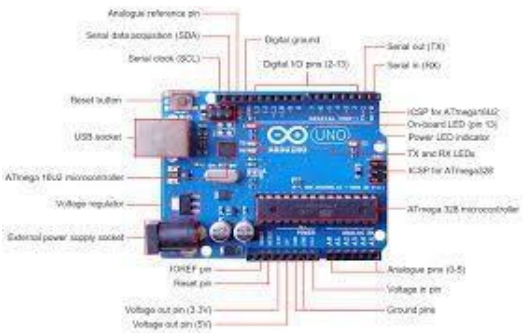

Fig.1: Arduino Board

➢ **IR Sensor:**

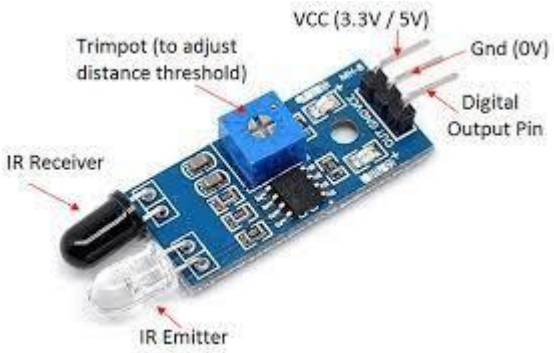

Fig.2: IR Sensor

The IR sensor or infrared sensor is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion. In many electronic devices, the IR sensor circuit is a very essential module. This kind of sensor is similar to human's visionary senses to detect obstacles.

➢ **NTC Thermistor Temperature Sensor: -**

NTC thermistors are a semiconductor ceramic made with various metal oxides. Their electrical resistance decreases with increasing temperature. This resistance is processed by an electronic circuit to provide temperature measurement.

Fig.4: NTC Thermistor Temperature Sensor

➢ **Mq-135 gas or smoke sensor: -**

Fig.5: Mq-135 Gas Sensor

MQ135 is an air quality sensor that can detect a wide range of gases, comprising NH3, alcohol, smoke, carbon dioxide, and benzene. And, hence ideal for offices, industries or factories, or workplaces. MQ135 gas sensor has an acute sensitivity to Ammonia, Sulfide, smoke, and other toxic gases.

➢ **ESP32 / ESP8266: - ESP32 / ESP8266 is used for IOT to create, Deploy & monitoring of Battery**

ESP32 is dual-core 80Mhz to 240MHz CPU and ESP8266 is an 80MHz singlecore processor.ESP32 has extra features such as CPU core, Faster Wi-Fi, Bluetooth 4.0 (BLE), touch sensitivity pins, and built-in Hall Effect sensors and temperature sensors. The ESP32 has more GPIO pins as compared to the ESP82662.

Fig.6.ESP32 / ESP8266

➢ **NTC Thermistor Temperature Sensor: -**

It is extremely temperature sensitive. It is commonly used to detect the temperature of the surroundings. An NTC thermistor is a temperature sensor that measure temperature using the resistance qualities of ceramic/metal compposites. Our full spectrum a number of advantages of NTC sensors include their small dimensions, outstanding long-term stability, high accuracy, and precision when it comes to thermal sensing.

Fig.7: NTC Thermistor Temperature Sensor

➢ **Mq-135 gas or smoke sensor: -**

Fig.8: Mq-135 Gas Sensor

The MQ-135 Gas sensor is capable of identifying smoke, ammonia (NH3), Sulphur (S), benzene (C6H6), and other hazardous gases. Both a digital and analogue output pin are present on this sensor, much like on other gas sensors from the MQ series. The digital pin swings high if the level of these gases in the air rises beyond a threshold that has been set. To set this threshold value, utilise the built-in potentiometer. It is possible to determine the concentration of different gases in the atmosphere using the analogue signal produced by the analogue output pin.

➢ **IR Sensor:**

Fig.9: IR Sensor

An infrared sensor is a piece of technology that uses light to detect items close by. An IR sensor can identify movement and heat from an item. Typically, thermal radiation of some kind is emitted by all infrared emitting items. Despite being undetectable to the human eye, these radiations can be detected by an infrared sensor. Simple infrared photodiodes are used as the emitter and detector, respectively, whereas simple infrared LEDs are used as the emitter. The photodiode is sensitive to infrared light with the same wavelength as the IR LED. The intensity of infrared light that strikes a photodiode has an impact on its resistances and output voltage

VI. CONCLUSION

The design and development of auto metro trains represent a progressive step towards reshaping urban transportation. The findings highlight the multifaceted benefits, from efficiency gains and sustainability to innovative engineering solutions. As these systems continue to evolve, the journey towards a smarter, greener, and more connected urban future becomes increasingly tangible.

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