



“Shuttling Metro Train between station”

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Abstract:- - In automating metro train the proposed autonomous train system is capable of detecting the station and automatically opens and the closes the door. The system also announces the station name over a predefined FM band frequency. The controlling device of the whole system is a Microcontroller. IR sensors, dc motors, voice circuit and FM transmitter are interfaced to Microcontroller. The IR sensors feeds the input to microcontroller and through this input it detects the station. The microcontroller stops the train once station is detected and automatically opens the door. The number of persons in and out is displayed on LCD this working happens for every station. To perform the task, Microcontroller is loaded with an intelligent program written using embedded 'C' language.

Key Words:- Microcontroller, IR Sensor, Regulator, etc

1. Introduction:- This project is designed so that students can understand the technology used in now-a-day driverless metro trains which are used in most of the developed countries like Germany, France and Japan etc. These trains are equipped with the CPU which controls the train. The train is programmed for a specific path. Every station on the path is defined and also the stoppage timing.

These trains are equipped with the CPU which controls the train. The train is programmed for a specific path. Every station on the path is defined and also the stoppage timing of the train and distance between the two stations predefined. This proposed system is an autonomous train eliminates the need of any driver. Thus, any human error is ruled out.

In this project PIC microcontroller has been used as CPU. Whenever the train arrives at the station it stops automatically, as sensed by an IR sensor. Then the door is opened automatically so that the passengers can go inside the train. The door then closes after a prescribed time set in the

controller by the program. Shuttling metro trains are an essential component of urban public transportation systems, designed to facilitate quick and efficient travel between designated stations.

Unlike traditional metro systems that may cover extensive routes with multiple stops, shuttles focus on connecting key points within a city or metropolitan area, often operating on short, direct routes. This specialization addresses the needs of commuters, tourists, and residents, providing a reliable mode of transport.

2. Operational Framework Scheduling:- Shuttling trains generally follow a consistent schedule providing passengers with reliable Transit options. Real-time updates are frequently available via mobile apps and station displays automated Systems. Many modern shuttle trains use advanced signaling and control systems that enhance safety and efficiency. Some are fully automated, reducing the need for human operators and minimizing operational costs.

2.1 Passenger Experience:-

2.1.1 Comfort and Accessibility: Shuttling trains are designed for passenger comfort, often featuring spacious seating and amenities such as air conditioning, Wi-Fi, and accessibility options for individuals with disabilities.

2.1.2. Safety Protocols: Enhanced safety measures, including surveillance cameras, emergency communication systems, and visible security personnel, are crucial for ensuring a secure travel environment. A shuttling metro train between stations is a train system that can travel between two stations without human intervention. The goal of these systems is to reduce the need for human interaction, which can lead to fewer faults. Whenever the train arrives at the station it stops automatically, as sensed by an IR sensor. Then the door is opens automatically so that the passengers can go inside the train. The door then closes after a prescribed time set in the controller by the program.

3. Literature Review: - There has been a lot of work done previously on this project using different approaches, different technologies, Microcontrollers, other equipment etc. In the paper titled “Automated System Design For Metro Train” by V. Sridhar, tell us how to use 8051 Microcontroller as the main controlling unit of the system.

The microcontroller inside the train is programmed In the kind of way that each station name saved inside the voice chip which having a unique code. So, each Time the bus or train reaches the

station, the reader within the bus or within the train gets the codes, they are Transmitted from the tag and the microcontroller gets this code and goes through inside the lookup desk, stored In the chip.

In this project, the train stops for about 10-15 seconds in the station and then before leaving the Station, it makes an announcement for the passengers to get into the train and the train starts to move to the Next station. But in this project, there has been no provision given for the automatic opening and closing of the Door. A toy train has been used for referencing the metro train. In the paper titled “A Driverless Metro Train using ARM7” by Parkash, Ratan Tambare and Chandra Jogi, the Driverless metro train is designed using ARM7 processor with the LPC2148 microcontroller, for the automated Metro train system.

This suggested framework is a driverless metro train that dispenses the need for installed staff and makes the total automatic train. There also is a passenger counting section, that counts the no. of Passengers present inside the train and it is then programmed to display that on the LCD screen. The paper titled “Auto Metro Train Shuttle Between Stations” by D. Pradeep Simha, N. Ajay Kumar, K. Pavan and O. Anuf, discusses the use of IR sensors to detect the passenger going in or out of the metro train. IR sensors use Infrared light to sense objects in front of them.

An infrared sensor is an electronic gadget, that is used to detect Some aspects of the vicinity. With the help of IR sensors, the number of passengers traveling is counted which is Then displayed on the LCD display. Another paper titled “IoT Based Auto Metro Train Shuttle Between Stations” by A.Suman Kumar Reddy, A.Maheswar Rao have incorporated DHT11 Sensor in their project. The DHT11 is usually utilized as a Temperature and humidity sensor that accompanies a devoted NTC to gauge temperature and an 8-bit Microcontroller to yield the measurements of temperature and humidity as serial data.

They have accompanied This technology to further enhance the project so that the prototype also detects the temperature and humidity Inside the train, along with the rest of its working. The paper titled “A Survey Paper on Driverless Metro Train” by Chavan Rohit Dnyaneshwar, Dabhade Swapnil Dilip, Kesbhat Amol Surendra, Nage Mohan Ramadas, and Mrs.Gauri. K Jagtap discusses the use of the LPC2148 Microcontroller as the main controlling unit of the proposed system. LPC2148 microcontroller. With 512 KB On-chip flash ROM, In-System Programming (ISP) and Inapplication programming, #2 KB of RAM, two 10- bit ADC channels ,USB 2.0 full-speed device Controller and two UART links, LPC2148 is a 16/32-bit RISC Microcontroller with 512 KB of flash ROM, two 10-bit ADC channels, and two UART links, one of which can Interface with a DSP. LPC2148 is costlier than other microcontrollers e.g. Arduino.

4,Block Diagram :-

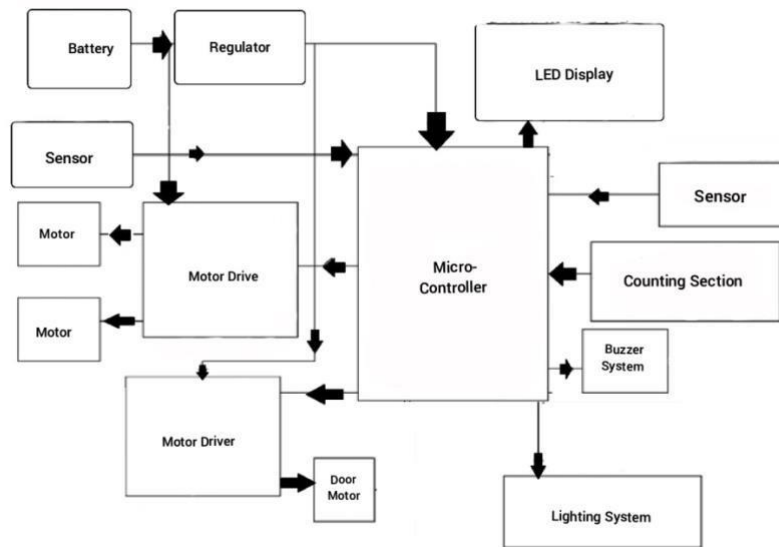


Fig. a: Shuttling metro train between station

4. Working principle:-

4.1. Microcontroller :- A Microcontroller is a single integrated circuit, commonly with the following features: central processing unit ranging from small and simple 4-bit processors to complex 32-bit or 64-bit processors. Volatile memory (RAM) for data storage. ROM, EPROM, EEPROM or Flash memory for program and operating parameter storage. This controls the train's development and passenger checking. It also creates a notice flag and automatically opens and closes the doors.

4.2 Motor Drive :- A Motor driver, also known as a control motor, is an electronic device or module that controls and manages the operation of an electric motor. It serves as an interface between a microcontroller or other control system and the motor itself, enabling precise control of the motor's speed, direction, and other parameters. Interfaced with the microcontroller to control the movement of the train.

4.3. Door Motor:- A Door motor is a device that opens and closes a door using a motor-driven mechanism. Automatic doors use a variety of sensors to detect the presence of a person or object and activate the motor. The door then remains open for a set amount of time before closing automatically. Opens automatically when the train arrives at a station and closes when the train is full or the allotted time has expired .

4.4. Motor:-A Motor is an electrical device that converts electrical energy into mechanical energy, generating rotational motion or torque. It uses electromagnetic induction to produce movement, powered by DC or AC electrical signals. A motor driver controls the rotation of motors that open and close the doors .

4.5. Senso :- Detects and responds to some type of input from the physical environment. The input can be light, heat, motion, moisture, pressure or any number of environmental phenomena. IR sensors detect when the train is at a station and count the number of passengers entering and exiting the train.

4.6. Battery:-A Battery is a device that stores chemical energy and converts it to electrical energy. Batteries are a key component of many electronic devices. A 12V battery is required to power the motor driver IC and door motor in a shuttling metro train between stations. The train's power supply comes from a 12V battery, and the Arduino Mega is the main controller. The Arduino is supplied with 5V from a source like a power bank.

4.7. Regulators:-A regulator is an electronic component or circuit that maintains a constant output voltage or current despite changes in the input voltage or current. Regulates voltage supply to train's electrical systems. Maintains stable 12V/24V/48V DC output despite input voltage fluctuations. Ensures efficient power distribution to traction motors, lighting, and communication systems. Protects against overvoltage, under voltage, and short circuits. Provides reliable power supply for safe and smooth train operation.

4.8. LED Display:-7-Segment display is rather simple and involves activation of the appropriate segments as to from the desired characters .A controller, such as a microcontroller or integrated circuit, controls the current flowing through individual LEDs, depending on the digit or character to be displayed to display information about the stations and the train, such as the train, such as the time limit and number of passengers on board.

4.9. Counting section:-The IR sensors count the number of passengers entering and exiting the train. Uses a capacitive switch-like sensor to count the number of passengers entering and exiting the train.

4.10. Buzzer:-A buzzer is used in a shuttling metro train between stations to alert passengers before the doors close and when the train is about to start. 4.9.1Before doors close:- A buzzer sounds to alert passengers when the doors are about to close

4.10.2 Before train starts:- A buzzer sounds to warn passengers before the train starts.

4.10.3 Obstacle detection:- A buzzer sounds and the train stops if an IR sensor detects an object in front of the train.

4.11. Lighting system:-Train, signal LEDs are used to indicate red and green signals to the train, and to blow a buzzer before and after the train stops at a station. Here are some other ways that signals are used in a shuttle metro train.

5. Advantage:-

5.1. Passenger Benefits:-

- 1.Reduced travel time
- 2.Increased frequency
- 3.Convenient for short-distance travel
- 4.Easy transfers
- 5.Reduced waiting time

5.2. Operational Benefits:

- 1.Improved capacity utilization
- 2.Efficient use of infrastructure
- 3.Reduced congestion on main lines
4. Simplified operations
- 5.Cost-effective

6.Application :-

6.1. Reduced human intervention :-Automatic operation reduces the risk of safety and availability issues.

6.2. Improved schedules :-Automatic commuter counting can help adjust schedules to prevent overoccupancy and train delays.

6.3. Station detection :-An autonomous train system can detect a station and automatically open and close the doors.

7. Methodology :- Our project can be roughly divided into three parts; the first segment deals with the detection of each station, The second includes the mechanism for the movement of the train prototype, and the last segment deals with The monitoring of the metro train. We shall discuss each segment elaborately-There are three stations in our prototype.

The model train has to stop at each station and then move to the next One and then again, perform the same function. In order to achieve this, we have used Light Dependent Resistor (LDR).

The output of each LDR will be connected to Nord MCU. The Nord MCU will be placed to the track.

Light signal will be provided during the incoming of train on the station, which is detected by the LDR and that helps Nord MCU that the train has reached the particular station. The wheels of the train are moved using motors (Battery operated motor), which is connected to L298N motor Driver IC. The forward and reverse movement of the train is achieved using Nord MCU. Four pins of the L298N Motor driver IC will be interfaced with Nord MCU.

Nord MCU will be connected to the server. This is done in Order to communicate our instruction to the train, via mobile. The forward and backward motion can be Controlled using our mobile, with the help of the By link app. The monitoring of the prototype is done using Arduino. It includes the passenger counting section, using IR Sensor and LCD display. The number of passengers entering or leaving the train will be displayed on the LCD Screen. The location of the train will also be displayed on our mobile.

L293D motor driver IC is used for the Functioning of CD (sliding door). The CD trolley will be connected to the motor. The more connected To L293D motor driver IC. For obstacle avoidance, Arduino is interfaced with Infrared (IR) sensor, that detect Any obstacle on the track within its proximity. These are the three steps in which our whole project system working is define i.e., getting notification at the time of metro train reaching station, forward and reverse movement and monitoring.

8. Future scope:-1.This system can be further improved in future by making use of high-speed sensors which Enables fast and more effect operation.

9. Conclusion:-The conclusion of a project to shuttle metro trains between stations is that it can improve the quality of life in cities, reduce human intervention, and make public transportation more attractive.

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