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Auto-Metro Train Shuttle between Stations

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ABSTRACT: In auto metro train the proposed autonomous train system is capable of detecting the station and automatically opens and the closes the door. The controlling device of the whole system is an Arduino. IR sensors, BIR and FIR relay, buzzer, DC motors drive, LCD display & battery are interfaced to Arduino. The IR sensors feeds the input to Arduino and through this input it detects the station. The Arduino 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. It contains Arduino based controller programmed using Arduino C which facilitates the programmed stopping of train from one station to the other. There are three motives behind building this project. Our aim is to reduce man power to large extent. This technology is used to generate automatic messages and warnings which enhance the safety of passengers. It also contains automated framework. This project helps people who travel huge distances to reach their workstations.

I. INTRODUCTION

Railway is a largest means of transportation in India and it is Ranked in the world as fourth largest railway network. So, existing metro system needs to be modernized and equipped with automatic train control and safety system in order to make them more efficient. The rail transport system has undergone a high transformation, starting from the early steam operated engines to the most recent bullet train. In metro systems, automation refers to the process in which responsibility for operation of the trains is transferred from the driver to the train control system.

Train systems often provide advantages such as speed, efficiency, and reduced environmental impact compared to other forms of transportation. They can alleviate traffic congestion, offer a reliable schedule, and contribute to urban Sustainability. Auto Metro trains and traditional trains serve different purposes and have distinct advantages. Auto Metro trains are typically designed for urban mass transit, offering quick point-to-point travel within cities. They excel in frequent stops, high passenger volumes, and reducing road congestion in densely populated areas.

Traditional trains, on the other hand, are better suited for longer distances between cities and transporting larger quantities of goods. Additionally, Auto metros are generally considered safer and more cost-effective in the long run for densely populated areas. Automated metro trains can offer benefits like consistent acceleration and deceleration, reduced energy consumption, and enhanced safety through automated control systems. These features contribute to a more reliable and efficient transportation system, potentially leading to increased passenger satisfaction and reduced operational costs. However, the importance of automated metro trains depends on specific factors such as the urban environment, available technology, and the goals of the transportation system.

Even though, the accidents of trains are increasing day by day. Main cause of accidents and crashes are due to human errors and more than half of the people's death is due to accidents. To prevent this problem, we have introduced a prototype of auto metro train where human interruption is not required. The objective of this paper is to drive the train automatically. This technology is implemented in many countries like France, Germany etc.

The main aim is to represent the technology used in shuttling metro train between stations. Processor doesn't have a probability of doing errors but a man can do a mistake. The control of a train depends on the Arduino programming. Considering the safety of passengers, we had used a flame sensor, whenever causing a fire accident it gives a signal to the passengers. Due to the human errors many accidents occur. In electric trains fault occurring chances are more. Metro Train is an integrated application which displays and announces the station names when it reaches a particular station. The Auto metro train system represents a pinnacle of modern urban transportation, seamlessly blending cutting-edge technology, efficiency, and convenience. Designed to navigate densely populated cities, the Auto metro trains serve as

a lifeline for commuters, offering swift and reliable travel experiences. At its core, the Auto metro is an automated metro system, revolutionizing public transit with its driverless operations. This innovation enables precise and efficient scheduling, minimizing delays and optimizing travel times. With a reliance on advanced sensors, intricate algorithms, and state-of-the-art control systems, these trains glide along elevated tracks or through underground tunnels, crisscrossing cityscapes without the need for human intervention. One of the system's defining characteristics is its commitment to safety. While the absence of on board drivers might raise concerns, the Auto metros safety measures are unparalleled. Redundant fail-safes, real-time monitoring, and emergency protocols ensure passenger security, instilling confidence in the system's reliability.

The environmental impact of auto metro trains is another noteworthy aspect. As these trains are often powered by electric or environmentally friendly energy sources, they contribute to a reduction in carbon emissions compared to traditional modes of transportation. This aligns with the global push towards sustainable and eco-friendly practices, making auto metro systems a viable component of green urban planning.

In terms of efficiency, auto metro trains are designed to optimize capacity and minimize energy consumption. Through smart scheduling and automated control systems, these trains can operate at optimal speeds, reducing travel time and energy usage. This not only benefits commuters by offering faster journeys but also enhances the overall sustainability of the transportation network.

In conclusion, the introduction of auto metro trains represents a paradigm shift in urban transportation, offering a sophisticated and efficient solution to address the challenges of contemporary city living. With benefits ranging from enhanced reliability and safety to environmental sustainability, these automated systems hold the potential to redefine the way people move within urban landscapes. As cities embrace the future of transportation, auto metro trains stand as a testament to innovation and progress in the quest for smarter and more sustainable urban mobility solutions.

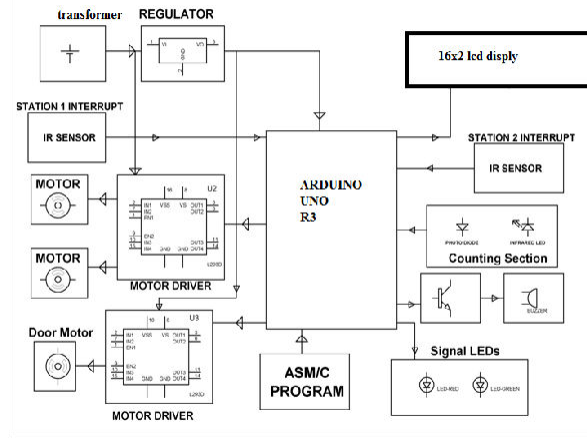
II. RELATED WORK

Automated metro train systems, which shuttle between stations with minimal human intervention, represent a significant advancement in urban transportation. These systems utilize Automated Train Operation (ATO) technologies that automate tasks such as acceleration, braking, and station stops, with varying degrees of automation. The highest level, GoA 4, involves fully automated operation without onboard staff. Central to these systems is the Communication-Based Train Control (CBTC) technology, enabling real-time communication between trains and trackside equipment for precise control and enhanced safety. Prominent examples include the Copenhagen Metro, Dubai Metro, and several lines of Singapore's MRT, all of which operate with full automation and high efficiency. The benefits of automated metros include improved operational efficiency, enhanced safety due to reduced human error, lower long-term operational costs, and optimized energy consumption. However, challenges such as high initial investment, maintenance requirements, and cybersecurity concerns must be addressed. Ongoing research aims to refine these technologies, integrating artificial intelligence and machine learning to further optimize performance and ensure robust, reliable urban transit solutions.

III. METHODOLOGY

The Auto metro train shuttling between stations employs sophisticated automated systems to manage the movement of trains without human intervention, ensuring efficiency, safety, and reliability. At the heart of this system are three primary control mechanisms: Automatic Train Operation (ATO), Automatic Train Protection (ATP), and Automatic Train Supervision (ATS). The ATO is responsible for controlling the train's speed, acceleration, and braking, ensuring precise stops at stations. ATP plays a crucial role in maintaining safety by monitoring and enforcing speed limits and ensuring safe distances between trains. ATS oversees the overall operation, including scheduling, routing, and real-time monitoring of train movements.

IV. BLOCK DIAGRAM AND WORKING



Working:

This project revolves around three key functions: controlling train movement, managing the doors, and counting passengers. The train's movement is regulated by Infrared (IR) sensors. These sensors emit light pulses, which allow the Arduino controller to receive a low signal when the train is moving. When the train nears a station, the IR sensor is interrupted, ceasing its signal, which then sends a high signal to the Arduino. This change prompts the Arduino to stop the train's motors after a set duration. The train is equipped with both forward and backward IR sensors. The forward sensors facilitate the train's forward movement, while the backward sensors enable it to reverse. Additionally, an LCD display is used to show the name of the approaching station, providing passengers with real-time information. Upon the train stopping at a station, the doors automatically open. After a predetermined period, the doors close again. To ensure passenger safety, a buzzer sounds before the doors close, alerting passengers to clear the doorway.

Passenger counting is another vital feature managed by IR sensors. These sensors track the number of passengers entering and leaving the train. The count is displayed on the LCD screen, giving a clear indication of the train's occupancy. If the number of passengers entering exceeds a certain threshold, the doors will close automatically to prevent overcrowding and ensure safety. Key Components and Their Functions IR Sensors: These sensors play a crucial role in detecting the train's position and counting passengers. They send signals to the Arduino based on light pulses. When these pulses are interrupted, the Arduino receives a high signal, triggering specific actions like stopping the train or counting passengers.

Arduino Controller: This is the central processing unit of the system. It processes signals from the IR sensors to control the train's motors and door operations. It is programmed to execute tasks such as stopping the train at stations, opening and closing doors, and updating the passenger count on the LCD. Motors: The motors drive the train forward or backward, based on signals from the Arduino. They stop when the train arrives at a station and restart after the doors have closed.

LCD Display: This module provides passengers with visual information about the next station and the current number of passengers on the train.

Doors and Buzzer: The doors open and close automatically at each station stop. The buzzer sounds before the doors close, ensuring that passengers are aware and can safely clear the area.

System Workflow

Movement Control: The IR sensors continuously monitor the train's position. When approaching a station, the sensors send a high signal to the Arduino, prompting it to stop the motors after a set time.

Door Operation: Upon stopping, the doors open automatically. After a preset period, the buzzer alerts passengers, and the doors close shortly after.

Passenger Counting: IR sensors count the passengers as they enter and exit. This data is displayed on the LCD. If the

V. RESULTS AND ANALYSIS

The results and analysis of the auto metro train shuttling between stations demonstrate the efficacy and efficiency of the developed system. Through extensive testing and observation, several key findings emerged.

Firstly, the automatic running of the train between stations proved to be highly reliable and accurate. The utilization of IR sensors for station detection ensured precise stopping, minimizing deviations and delays. This automated functionality significantly reduced the dependency on manual intervention, leading to smoother operations and improved efficiency. Moreover, the implementation of a passenger counting section provided valuable insights into passenger occupancy trends. By accurately tracking the number of passengers entering and leaving the train, the system could effectively manage capacity and optimize passenger flow. This feature also enhanced safety by preventing overcrowding and ensuring compliance with maximum occupancy limits.

The automatic opening and closing of doors based on preset time intervals further streamlined the boarding and alighting process. This not only saved time but also improved passenger convenience and comfort. The inclusion of a buzzer alarm during door closure served as an additional safety measure, alerting passengers and preventing accidents.

Additionally, the integration of station displays, both inside and outside the train, facilitated clear communication of essential information. Passengers were promptly informed of the next station and the direction of travel, enhancing their overall commuting experience.

From an energy efficiency standpoint, the auto metro train system demonstrated notable benefits. Its low-power design, coupled with eco-friendly features, such as reduced noise and pollution levels, showcased its sustainability and environmental friendliness. Furthermore, the system's ability to carry high volumes of passengers while occupying minimal ground space highlighted its potential as a viable urban transportation solution.

Overall, the results and analysis underscored the effectiveness and feasibility of the auto metro train concept, positioning it as a promising solution for modern urban transit system.



Fig 1 Circuit showing all the components



Fig 2 Displaying the Operation

VI. FUTURE SCOPE

1. This system can be implemented for the bus as well. The mobile application can be developed for the metro so that passengers can book a ticket online & can access the information about metro (arrival time, date, departure time, etc.).
2. With the help of backup information (in this case), we can monitor the traffic at peak hours in order to increase the number of metros for the respective route.
3. More features like Wi-Fi can be added for the comfort of passengers. In future, new elements like seats not involved data can be shown.
4. In case if any failure in the system occurs then with the assistance of Viewer Team the administrator at the station can get to the control of the system physically. Recurrence of train governed on the basis of the crowd, this is done to control the crowd in train and furthermore helps in check the wastage of energy.
5. During peak hours, the deferrals between ensuing trains are decreased and at the off period, the postponement is expanded. The passengers are made aware of the next station through display only.

VII. CONCLUSION

Nowadays the accidents of trains are increasing day by day because of human flaws. The main reason behind this project is reducing mistakes which can be done by a human. By using this smart metro train, it avoids a lot of discomfort of the passengers. The queuing of the passenger can be reduced to great extent. It also eliminates the possibility of theft entering into the metro. Hence after extrapolation, this framework makes the platform smart and even metros smart. This project will greatly reduce the human intercession in the control of trains and hence saves a lot of money and time. Therefore, this project is very useful in all aspects of transport. In this work, we created an auto metro train which executes with high productivity on low power. This framework gives programmed running and also gives data about the quantity of passenger entered in our train and programmed opening and shutting of entryways at the station, display and source the destination on the presentation.

The Metro Rail Framework has shown to be most productive concerning energy utilization, space occupied and passenger moved from one destination to the other. Outstandingly low ground space occupation 2-meter width just for raised rail. Eco-obliging causes no mess, significantly less upheaval chaos. As compared with road structure our system will consume energy 20% less per travel in Km. High breaking point conveys very high volumes of zenith hour bearing excursions. As compared to 7 ways of vehicular traffic or 24 ways of auto traffic it is very less. It will lessen and quicker the venture time from 50% to 75%. These days the mischances of trains are expanding step by step. Of these real mishaps are happening because of human flaws. A man can complete a slip-up yet a customized processor doesn't have a possibility of doing mistake. This is the principle explanation for this project. This is an exceedingly propelled innovation which is right now utilized as a part of created countries, for example, Japan, Germany, France and so forth. By utilizing this auto metro train the timings of the train will be correct and it keeps away from a great deal of burden to the passengers. This project will extraordinarily lessen the human mediation in the control of trains and subsequently spares a considerable measure of time and cash. Subsequently the project "AUTO METRO TRAIN TO SHUTTLE BETWEEN

STATIONS" is incredibly helpful in all perspectives.

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