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Revolutionizing Urban Transit: Design Strategies for Auto Metro Trains

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Abstract: The world is advancing ahead in terms of innovation step by step, which is contributing towards making our lives more comfortable and peace living .We are today encircled by many mechanical items which assist us with improving our work and working more efficiently .The world has been advancing with the up-gradation of innovation exponentially. Every innovation has been steadily becoming computerized, and so is the innovation utilized in transportation. Transportation is a most extreme need for individuals. In this way, there has been a steady improvement in the field of transportation as well. Prior, the trains were operated physically with the assistance of a driver. The issues confronted with the utilization of physically worked metro trains were that it was wasteful in their exhibition, similar to speed, delay, and so forth. Likewise, a solitary slip-up made by the driver can cause genuine outcomes which affect the passenger life . Serious issue is, that the manual metro train has no control over the long run, antagonistically influencing the railroad network the executives framework. To handle this issue, the need for drivers is dispensed with by the idea of driverless metro trains. The benefits of an mechanized metro framework are-that travelers' security is within proper limits, power utilization is brought down, accordingly, improving its working.

***Index Terms*– Driverless Metro, Arduino UNO, L293D Motor IC, L298N Motor IC, IR Sensor, DC Motor**

I. INTRODUCTION

A computer system called an embedded system is made to carry out one or a small number of specific tasks, frequently under real-time computing limitations. It serves as a part of a larger equipment, usually consisting of other mechanical and physical parts. A general-purpose computer, like a personal (PC), on the contrary, is intended to be adaptable and to suit a variety of end-users needs. Embedded systems handle many common devices nowadays. One or more digital signal processors (DSPs) or microcontrollers serve as the main processing cores for embedded systems. Technology has advanced significantly in all parts of our lives, including transportation, which has experienced a significant revolution. Despite this, train accidents are becoming more common. The most common causes are caused by humans, whereas some are caused by incidents or accidents. In India today, if a train catches fire in any cabin, the alarms would sound, but no fire controllers will be activated. Trains have standard fire extinguishers that are activated manually. It will take more time. To address this issue, we are creating a smart fire system comprised of a nozzle spray mechanism and a sensor. This is controlled via Arduino programming. When a train catches fire, the door automatically opens, and the nozzle automatically sprays water to suppress the flames.

II. LITERATURE REVIEWS

In the paper titled "Automated System Design For Metro Train" by V.Sridhar, tell us how to use 8051microcontroller 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 is 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. Jagtapdiscusses 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 In-application 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.

III.**Objective**

This model will be implemented to provide security, consistent, efficiency and high quality service to the passengers.

This type of automated trains can be inserted in traffic without the help of human operations can be performed so that traffic levels will be reduced.

This should be high equipped to identify the safety systems like fire accidents, noticing if any possible damage in the compartment.

To identify the fire catches in compartment via temperature sensor and smoke sensor.

Automatic closing and opening of doors when platform arrive. To reduce Human interaction so that the wages also pretended.

IV. **Methodology**

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about ideology.
Step2: - After that the components which are required for Metro Train Shuttle are decided.
Step 3: - Design and analytical calculation will be prepared with Pin Configurations of each embedded are made.
Step 4: - Programming will be done
Step 5: - The components will be assigned with each pin specifications.
Step 6: - The testing will be carried out and then the result and conclusion will be drawn

V. **Scope of the project**

This project contributes huge alignment in various forms by minimizing the risk of humans when accidents take place because of fire catching condition.

This project can be even modulated manually but it is thoroughly difficult to observe each & every time after passengers enters or exist the compartment, so our project is automated with embedded coding to minimize the complexity to Monitor, operate and deliver safety for passengers. It has a scope to control wirelessly via Smart Embedded system.

This type of system can be manipulated for multi-Tasking in future

IV. **Working of System**

Initially when the Metro type Proposed train starts, it moves automatically with the help of motors which consists of Dc motor via L29 3d Drivers By using the IR Senor we can identify whether the plat-form is there or not and correspondingly door is opened or closed. Safety management will be provided using MQ-135 Gas or temperature sensors which identifies danger situation in the compartment with an buzzer notification. And if Compartment catches fire, auto-power cut-off will be provided to the motors with emergency door opening Safety management to the proposed system. The opening and closing of doors are operated through a Rack & Pinion Mechanism. Arduino Mega Board will used to control all the operations and using ESP 8266 with inbuilt Wi-fi module Metro Data Monitoring in the Cloud will be done. If flame sensor is ON, then door opens and it gives a buzzer sound to alert the passengers. Train starts automatically and when it arrives the station, it stops informingly, then the door opens and closes so that, the passengers can go inside the train until a prescribed time set in the controller, when it reaches a particular station it stops for a certain time limit which is pre-programmed and then shuttles to the other station. Options' for extra Modification May or may not be used. which costs 3500/- more below development or Passenger counting system using IR sensor. It is also equipped with a passenger counting section, which counts the number of passengers entering and leaving the train. By using IR Sensor, the number of persons who are coming inside will be counted at the same time it will reduce the count when the passenger leaves the train. It displays increment and decrement of passengers count in LCD.

Actual Working Model V. Calculations

✓ Design of Support Area of rectangular

We had taken a teak wood frame which is available in the market of thickness 4 mm and length, width according to requirement.

Thickness = 5 mm
W = 300mm
L = 400mm

The total surface area of the rectangular prism is given by:

A = 2(lb + bh + lh)
= 2((400 x 300) + (300 x 5) + (400 x 5))
= 247000 mm^2

Mass = 0.385 Kg = 0.385 x 9.81 = 3.776 N From CATIA v5 software

@ Area = 247000 mm^2 = 0.247m^2 Moment of Inertia I_{CM}

= 1/12 x M (w^2 + l^2)

= 1/12 x 3.776(400^2 + 300^2) = 78666.6 Nmm^2

✓ Assume load on the frame including all components = 5Kg = 49.05 = 50 N

FOS = 1.5 = 50X 1.5 = 75N

Perpendicular distance = 400 / 2 = 200 mm

M = 75 X 200 = 15000 Nmm^2

M = 15000 Nmm^2 I = 78666.6 Nmm2

Y = Distance of the layer at which the bending stress is consider = 5/2 = 2.5 mm Sigma b

= M X Y / (I)

= 15000 X 2.5 / (78666.6)

= 0.4766 Mpa

Wood Plywood 13.8 Ultimate Yield strength Hence Design is safe.

▪ Motor selection on total pay load of component

✓ Total weight on the frame

= 50N + 2 Kg extra load = 70 N + 19.62 N = 90 N

= 100N

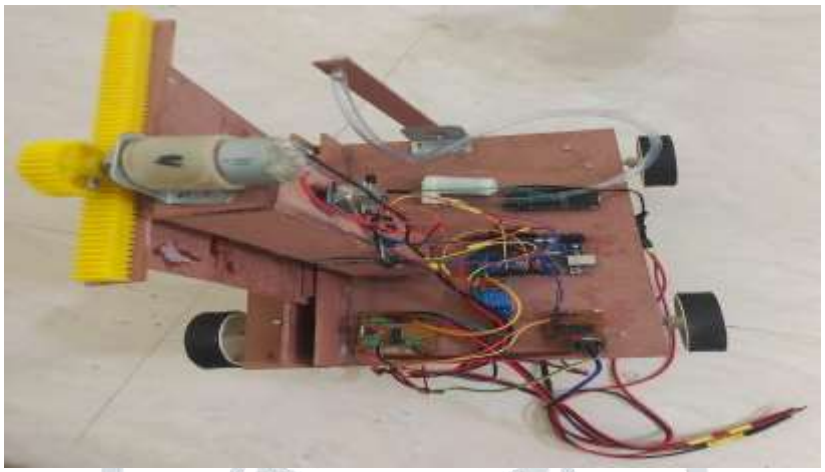
✓ No wheels 4

Load is distributed into 4 wheels Actual load = total load / no. of wheels

= 100/4 = 25 N

✓ Diameter of inside hole of a wheel 10mm Torque = ½ Force X Diameter = ½ X 25 X 10mm

= 125 N.mm = 0.125 Nm.



Actual Working Model

Sl No	Components	Specs	Price
1.	Arduino At Mega	1x	950-1450/-
2.	ESP 8266 with Wi-fi Module In Built	1X	368/-
3.	DC Motors	3-4X	1750/-
4.	Rack And Pinion plastic DIY	1X	350-400/-
5.	L29 3D motor Driver	2X	675/-
6.	Temperature sensor Module	1X	645/-
7.	MQ-135 smoke sensor	1X	350/-
8.	Clamps, frame and wheels	-	1750
9.	Ir sensor	1X	650/-
10.	Battery	1X	975/-
11.	Other Components like door teak wood resistor & buzzer etc.	-	500/-
12.	Fabrication	-	**2000/-**
	Total	-	**9,863/-**

Cost & estimation of the proposed system

V. CONCLUSION

The design and development of the auto metro train system stand as a remarkable achievement in urban transportation. As cities continue to grow and face increasing mobility challenges, this innovative solution provides a blueprint for sustainable, efficient, and passengercentric public transportation systems. The success of this endeavor lays the groundwork for the evolution of urban mobility, setting the stage for future advancements in the field.

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