

Auto Metro Train

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Abstract—The proposed system is a fully automatic metro train which is pre-programmed to run between stations and it eliminates the need of manual driver. Thus human error is ruled out. In this project the train is equipped with a controller that enables stopping of train from station to station automatically at the stations using IR sensors, besides providing automatic opening of doors by sensors with a time limit. The paper presents the development process of a prototype for a driverless metro train using Arduino. Whenever the train arrives at the station, then the door opens automatically so that the passengers can get in. It is also equipped with passenger counting section, which counts the passenger entering and leaving the train by sensing the IR interruption of the sensor and displays that on the LCD display. The door closes after a preset time, the buzzer will start emitting sound while closing. The passengers in the train are made aware of next station by displaying it in train. The direction of running is indicated to the passengers outside using a display too. The source to destination and station display are displayed on LCD display. The train movement is controlled by motor driver IC which is interfaced to microcontroller.

Index Terms—Arduino Mega, IR sensor, Motor driver IC L293D, D.C. motor, Servo motor.

I. INTRODUCTION

The areas of research are automated vehicle and metro train which are prime fields with years of research. Methods have been developed for all cases, implementing latest technology and logical methods. The cost is a factor which differentiates between efficiency of each technological method. Railway system occupies significant place within the realm of transportation. While comparing with the other means of transportation, it has various advantages as it can carry a huge amount of passengers and heavy loads to longer distance. Railway system has changed in terms of speed, shape, mode of running that is beyond the imagination. From these changes the metro rail system emerged. Metro trains are a convenient, efficient, comfortable and affordable mode of urban transport. It is safe, eco-friendly and is electric, thus requires only 1/5th energy per passenger km compared to road based transport systems.

The project is to construct an auto metro train that runs automatically from one station to another, stops automatically at stations and also provides automatic opening and closing of doors, passenger count, provide next station display and source

to destination display. Arduino board, motor, motor driver IC, LCD display and IR module are the main hardware used here. Based on the program used the efficiency can be improved to an extent keeping the cost fixed. So when a cheap process is used in it and impart an efficient program then the cost factor can be brought down while uploading average efficiency. This embedded application mainly focuses on drawbacks in the existing system.

A. Existing System vs Proposed System

The existing system has the information about the train arrival and departure time, station display etc., that are announced manually. Few Disadvantages of Existing system

- Constant human intervention
- High cost
- More man power required
- Integration and installation is time consuming

The proposed system overcomes the above disadvantage and has the following advantages:

- Less manpower
- Automatic door closing and opening
- Display unit

II. LITERATURE SUREVEY

A. P. More et.al in "Smart Metro Train" presents driverless train which are programmed to run between two stations. For this, ARM 7 microcontroller is used. It exterminates the need of any driver. Thus, human blunder is ruled out. The prototype provides detection of passengers at the station. RFID module is used when a passenger is entering into the station, the passenger will swipe the card and if it is valid then the passenger can enter into the train. In the ThingSpeak webpage the passenger count is shown. The proposed system is an automated system which requires less manpower. The main reason behind this project is reducing mistake which can be done by humans. By using this smart metro train, it avoids a lot of discomfort for the passengers. The queue of passengers can be reduced to great extent. [1]

Rupal Jain in "Auto Metro train to shuttle between stations using capacitive switch cum sensor made of waste material for limiting the number of passengers" presents a modern driverless metro train equipped with eminent features. Metro trains are equipped with the 8051 microcontroller which controls the train and is programmed for the specified path. By using this the train timings will be exact and will avoid inconvenience caused to the passengers. It reduces human intervention in the control of trains and hence saves money.[2]

Parkash et.al in "Auto Metro Train to Shuttle Between Stations" is designed to demonstrate the technology used in metro train movement which are used in most of the developed countries. This train is provided with a controller that permits the automated running of the train from one station to a different. Train moves with the assistance of motors fixed to the controller with the assistance of H- bridge. It goes to the station and stops there for particular deadline which is pre-programmed and then moves to the opposite place.. The numbers of individuals coming inside are going to be counted with the assistance of IR sensor interfaced to the controller. In this ARM microcontroller is used.[3]

III. SYSTEM REQUIREMENT

The propose system consist of three sections i.e., the passenger count, automatic door and station display and source to destination display.

A. Microcontroller

The microcontroller used here is Arduino Mega 2560. It is based on ATmega2560. It consist of 54 digital input/output pins, 16 analog inputs, 4 UARTs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. The board can operate on an external supply of 7V to 12V. It has 256KB of flash memory for storing code, 8KB of SRAM and 4KB of EEPROM. Each of 54 digital pins can be used as an input or output pins.

B. IR Sensor

Infrared Obstacle Avoidance Sensor Module feature a pair of infrared transmitting and receiving tubes. These devices work by measuring the amount of light that is reflected into the receiver side. It has Vcc, GND and an OUTPUT pin. It works fine with 3v3 to 5V levels. Its effective distance range is 2cm to 80cm.

C. Motor driver IC L293D

It allows DC motor to drive forward and backward direction. It is a 16 pin IC which can control a set of two DC motor with a single IC. It is a dual H-bridge motor driver IC. Motor driver take a low current control signal and provide a high current signal thus they act as a current amplifier. This drives the motors. The two DC motors can be driven simultaneously, both forward and backward directions.

D. LCD Display 16x2

LCD stands for Liquid Crystal Display. LCD 16x2 has 16 columns and 2 rows. So it will have 32 characters in total and each character will be made of 5x8 pixel dots. Its operating voltage is 4.7V to 5.3V and the current consumption is 1mA without backlight.

E. D.C. Motor

DC motor converts a DC electrical energy into mechanical energy. The voltage range of each of these is 12V. Hence 12V battery is used along with a motor driver.

F. Servo motor SG90

It is tiny and light-weight with high output power. Servo can rotate approximately 180 degrees. Its operating voltage is +5V typically. Servo motors are a DC motors that permits for precise control of angular position.

IV. PROPOSED SYSTEM

A. BLOCK DIAGRAM

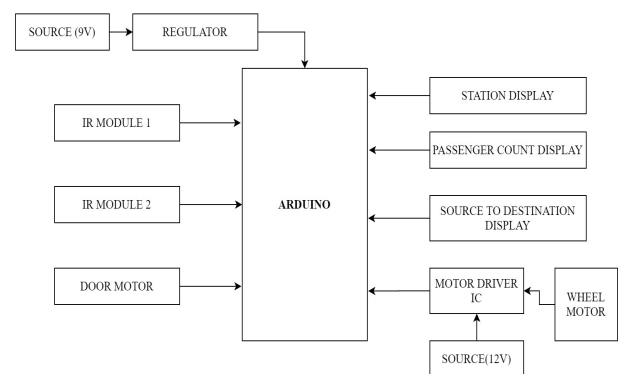


Fig. 1. Block diagram

B. SYSTEM DESIGN

The main objective of the project is to design and demonstrate an auto metro train that can be started and then be stopped automatically at the stations using IR sensor, besides providing automatic opening and closing of doors with a time limit.

Controlling the movement of the train: The method adopted to executed this is to stop the train at certain time intervals. In order to calculate the travelling time the distance between the stations and the speed of the train should be known.

Controlling the opening and shutting of door: As the train stops, i.e., the arduino sends a sign to the motor driver to stop the motors; the arduino also sends a high signal to the door motor driver such that it drives the motor to open the door, for the passenger to get in. The arduino is programmed such that the door is opened till the number of passenger entering reach a limit and then the arduino is programmed to signal the

motor driver to rotate the motor so as to close the door or the doors remain open for a specified time, after which it closes. A buzzer is provided to alert the passenger about closing doors.

Controlling the count of number of passenger entering and leaving the train: This is done using a passenger counter system. This again consists of an IR LED-Photodiode arrangement, one at the door and another a distance away. When a person enters the door, there is an interrupt between the IR LED and the photodiode and accordingly the corresponding transistor sends a logic high speed to the arduino. As the person leaves the area and goes further inside interrupting the second IR LED-Photodiode arrangements, the first IR LED-Photodiode arrangement comes back to its normal operation and a low signal is send from the corresponding transistor to the arduino. This transistor from high to low of the arduino pins causes an increase in the number display of the LCD display programmatically. When the count reaches a maximum, the arduino is programmed so as to trigger a buzzer alarm. Similarly when an interrupt is sensed between the second IR LED-Photodiode arrangement, the transistor from high to low signal of the arduino causes a decrease in the number count of the LCD display. These IR sensors can be placed either horizontally or vertically. When placed horizontally error occurs when people enter parallel to one another. When placed vertically a series of sensors should be installed. Though people entering in a parallel manner are counted, there are chances that a person may be counted more than once.

Two LCD display are provided to display source to destination and next station respectively. The next station displayed in the LCD will be updated once the train leaves a station. The source to destination displayed in the LCD will be changed once it reaches the destination.

C. CIRCUIT DIAGRAM

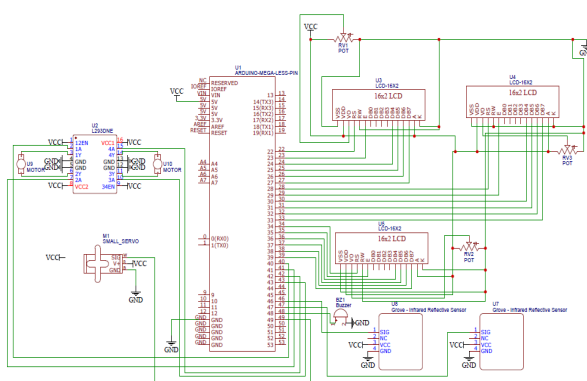


Fig. 2. Circuit diagram

D. CIRCUIT DESIGN

Arduino is the central component used in this project to which all the programs are coded. It is a 54 digital pin board. The circuit consist of three LCDs, for the station display, seat availability display and for source to destination display.

The passenger count is established using IR modules connected to the Arduino, the LCD corresponding to it is display the count. When the passenger passes the IR module, the light from IR LED is reflected back to the photodiode. This produces high output, which is detected by Arduino. This is taken as input signal by the Arduino and based on the direction of motion of the passenger, the count will be updated. Door control is obtained using a 5V micro servo SG90. The Arduino is connected to motor using L293D motor driver. Motor driver provides the motor with sufficient current for its working. L293D is a 16 pin IC which can be used for controlling up to 2 motors. The two LCDs for the station display and source to destination display is connected to Arduino.

E. WORKING

When supply is given to the Arduino, the wheel motor connected to the Arduino through the motor driver is turned along and thus the train starts moving. Then the source to destination and the next station is displayed in two LCDs provided. The third display will also show the seats available. The train identifies and stops at the station based on the predefined time that is required to reach the next station. Once the train reaches the desired station, the train stops and door is opened for a specified time limit. The control of door is using a micro servo connected to the Arduino. Once the door is open, the people may board or leave the train and based on that the number of seats available, the count will be updated in the display. The passengers are alerted with the buzzer before the closing of doors to ensure passenger safety. Once the train leaves the station the next station in the display will be updated. Finally when train arrives at the destination and all the passengers will leave the train. Then the train reverses the direction of movement and the source to destination display will be updated.

V. RESULT

Fully automatic metro train is achieved. It moves automatically from one station to another and automatic opening and closing of door. While the passengers enter the train, the passenger count is taken and displayed on the LCD displayed. The next station and source to destination display is also displayed on the LCD screen.

A. Passenger Count



Fig. 3. Passenger Count

The passenger count which is obtained by using IR sensor is displayed on 16x2 LCD display as shown in Fig 3.

B. Source to destination Display

Throughout the whole journey the source to destination display is displayed on a 16x2 LCD display as shown Fig 4.

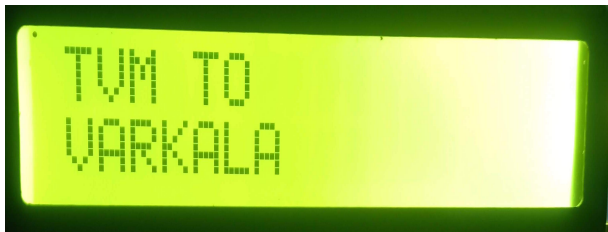


Fig. 4. Source to destination Display

C. Next Station Display

When the train leaves a station the next station display is displayed on a 16x2 LCD display as showed in Fig 5.



Fig. 5. Next Station Display

D. Implemented Model

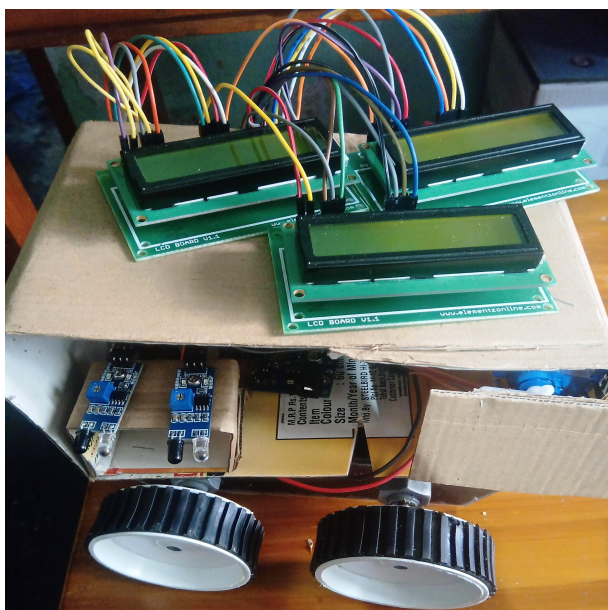


Fig. 6. Implemented model

VI. CONCLUSION

In this work, Auto metro train can be developed and implemented at low power and high efficiency. This system provides automatic running, gives information about the number of seats available, automatic opening and closing of doors, station display and source to destination display. The Metro Rail System has proven to be most efficient in terms of energy consumption, space occupancy and number transported.

- High capacity carries very high volumes of peak hour direction trips.
- Eco-friendly causes no pollution, much less noise pollution.
- Low energy consumption 20 percent per passenger km in comparison to road based systems.
- Greater traffic capacity carries the maximum amount traffic as 7 lanes of vehicular traffic or 24 lanes of automobile traffic.
- Very low ground space occupation 2 meter width just for elevated rail.
- Faster reduces journey time by 50% to 75%.

VII. FUTURE SCOPE

Apart from the features implemented so far, there are many other modifications possible to make it more efficient and reliable. The features include:

- Audio Announcement of next station: As of now, the passengers are made aware of the next station through display only. Audio announcement will make this more efficient.
- Frequency of train controlled based on crowd: This is done in order to control crowd in train and also helps in control wastage of energy. During peak hours, the delay between subsequent trains are reduced and at off peak period, the delay is increased.
- Fire Alert: Being a fully automated system, in case of fire, passenger safety should be ensured too. Doors should get opened once fire breaks out.
- Time controlled manually from stations at emergency situations. When an emergency situation occurs, it should have a mechanism such that the train can be controlled manually, so as to prevent mishappenings.

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