Development of Prototype of Smart Metro Train

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ABSTRACT

The transportation sector has a major influence on the growth of economy of India most of which is driven by the railway sector. In the existing system, the railway transportation depends on a driver who is responsible for the motion and braking of the train which might result in human errors due to negligence. The development of smart metro prototype project provides a solution to this by making the train unmanned and by removing any kind of human made errors. The prototype makes use of arduino to control the train movements along with a LCD display which provides information about the stations whenever the train stops. A buzzer will be present to provide audio warnings regarding the doors being opened and closed in a station. It also controls the passenger counting with the help of an IR sensor and generates a warning signal whenever a threshold value of passengers is reached.

Keywords: *Arduino , Metro Train, Driverless, Passenger counting.*

I. INTRODUCTION

This project is designed to demonstrate the technology used in metro train movement in most of the developed countries. This proposed system is an automatic (unmanned) train and it eliminates the need of any driver.

The movement of the train is controlled by a motor driver IC L293D interfaced to the arduino. It makes use of a 12V battery to run the prototype of the train. Whenever the train arrives at the station it stops automatically, the door opens and closes automatically after a prescribed time delay set in the arduino by the program. The station names as well as the opening and closing of the doors are displayed on the 16 segment LCD display. The train incorporates a buzzer to provide warnings to the passengers before opening and closing the door.

It is also equipped with a passenger counting system, which makes use of an IR sensor and counts the number of passengers entering and leaving the train. The passenger counts are displayed on a LCD which is interfaced to the arduino. The door closes when it reaches the threshold of maximum occupancy level irrespective of the time allotted for the door to be open. This reduces one of the major problem of overcrowding in the metro trains.

II. BLOCK DIAGRAM

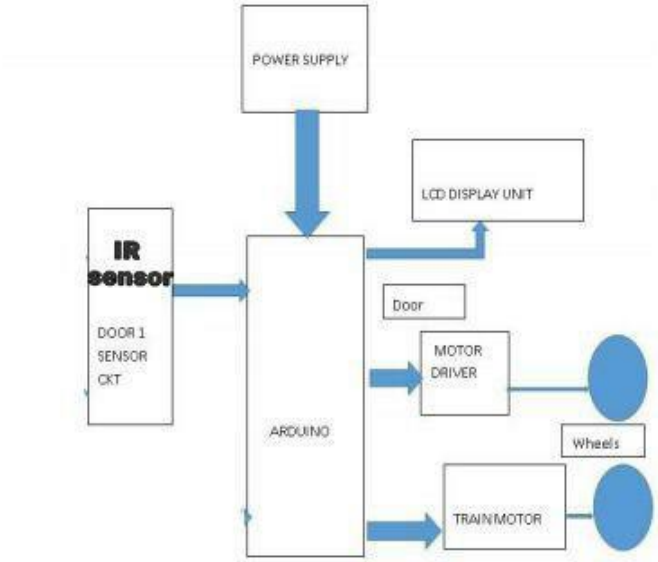

Fig 1. Block Diagram Of Smart Metro Train Prototype

2.1 Arduino

The Arduino UNO is an open-source arduino board. The board consists of both digital and analog input/output pins that can be used in various circuits and boards. The board consists of 14 Digital pins and 6 Analog pins where every pin will operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50K ohms. It can be programmed with the Arduino IDE(Integrated Development Environment). The board can be powered by a USB cable or by an external 9V battery.

Fig 2. Arduino

2.2 L293D Module

The Motor Driver IC is used for the motors that enables us to control the speed and direction of the motors simultaneously.It is a 16 Pin IC. This is designed to operate at voltages from 5 V - 36 V.

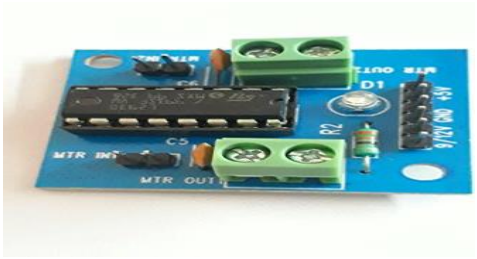

Fig 3. L293D module

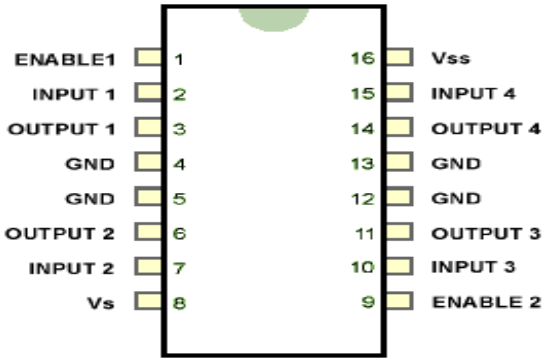

Fig 4. Motor driving IC L293D and its pin configuration

TABLE 1.

The functionality of the motor driver L293D

PINS	PINS	DIRECTION
Pin 2 = Logic 1	Pin 7 = Logic 0	Clockwise Direction
Pin 2 = Logic 0	Pin 7 = Logic 1	Anticlockwise Direction
Pin 2 = Logic 0	Pin 7 = Logic 0	Hi-Impedance
Pin 2 = Logic 1	Pin 7 = Logic 1	No rotation

2.3 150 rpm DC Motor

The motor used here is a 150 RPM DC geared and a single shaft motor which is suitable for applications requiring small power.It operates from 2V to 12V providing a wide range of torque.

Fig 5. DC Motor

2.4 IR Sensor

An Infrared Sensor is a device, that senses some aspects of the surroundings.It can measure the heat of an object and also detects the motion of the objects. The transmitter is simply an IR LED (Light Emitting Diode) and the reciever is an IR photo diode which transmits and waits for the reflected IR energy in order to detect the presence of any obstacle that is present in front of the sensor. The module also has a potentiometer (preset) which is used to adjust the range of detection

Fig 6. IR Sensor

2.5 LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) screen is an electronic display module which is 16x2 display (It can display 16 characters per line and can display 2 such lines) and are used in a variety of devices and circuits. They can be easily programmed and are also economical.

It consists of 2 registers namely -

- The Command Register - It stores all the instructions(command) given to the LCD in order to carry put a predefined task like setting the cursor position or controlling the display and so on.
- The Data Register -
  It stores all the data which is to be displayed on the screen of the LCD.

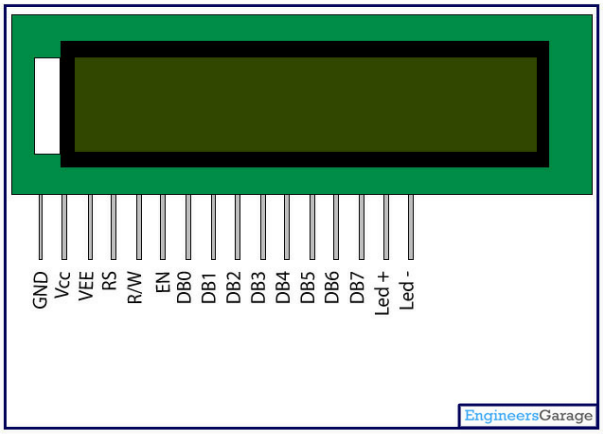

Fig 7. A two Line (16x2) LCD display

2.6 10k Potentiometer

It is a potentiometer which can be adjusted by rotating it and simultaneously the resistance also changes. The VCC or Power is always supplied to the outer pin, GND to the other pin, and the center pin is connected to a voltage that varies from 0 to VCC which depends on how much the pot is rotated.

Fig 8. Potentiometer

2.7 Buzzer

Buzzer is an electronic device used for an indication of our information or a message with the help of a beep signal. It is used in a wide range of applications.

Fig 9. Buzzer

2.8 Battery

A battery is a device which is made up of one or more electrochemical cells which are used to power electrical devices. A battery may be present in varying sizes, shapes and voltage specifications. It has two terminals, the positive terminal being cathode and the negative terminal being anode. Whenever a battery is connected to an

external circuit, the electrolytes in a battery move as ions and as the reactions get completed, it delivers energy to the external circuit.

Fig 10. Battery

III. WORKING PRINCIPLE

Controlling the movement of the train: The movement of the train in all the directions is controlled by the motor driving IC LM293D. The arduino is programmed to run the train in a particular track which is designed by the programmer between two predefined stations. The program drives the motor driving IC to run the train in the specified directions.

Controlling the opening and closing of doors: As the train stops, i.e. the arduino sends an interrupt signal 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 passengers to get in. The arduino is programmed such that the door is opened till the number of passengers 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.

Controlling the count of number of passengers entering and leaving the train: This is done using a passenger counter system. This again consists of an IR sensor. When a person enters the door, it senses the presence of a person and starts counting the people entering the train. When the count reaches a maximum, to which the arduino is programmed, it automatically closes the doors.

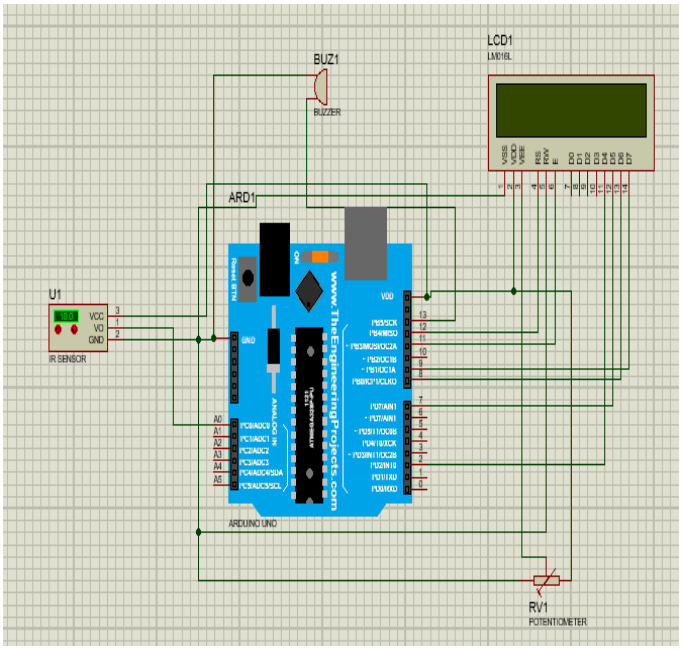

Fig 12. Circuit diagram Of Smart Metro Train Prototype

IV. ALGORITHM

Step1: Start

Step2: Declare variables m1a,m1b,m2a,m2b,I,j,k,l,n and m.

Step3: Input and output declare has to be done for Ardunio pins.

Step4: Initialize variables m1a,m1b,m2a and m2b with '0'.

Step5: Initialize cursor position in 16*2 LCD.

Step6: Provide variables m1a,m1b,m2b and m2a with '1'.

Step7: Provide delay of one second.

Step8: Provide variables m1a,m1b,m2b and m2a with '0'.

Step9: Read IR sensor value.

Step10: Increment declared variable upto 4.

Step11: Repeat Step6.

Step12: Repeat Step8 after a delay of one second.

Step13: Stop.

V. CONCLUSION

The proposed system is an advanced technology which is currently used in many of the developed nations like Japan, Germany etc. By using this prototype the timings of the train will be exact and it avoids the inconvenience to the passengers. It makes the journey hustle free and safe. The unmanned metro train provides errorless services for human intervention.The metro train in this project is designed to run only between two stations but can be programmed to work for as many stations according to our requirements.

We can incorporate automatic announcement system to inform the passengers about the next station by using text to speech converter.

We can introduce RFID based ticketing system at each station which helps the country go paperless.

We can also implement GPS tracking to show the location of train by which many of the accidents can be avoided.

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