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A Driverless Metro Train using ARM7

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ABSTRACT: This paper presents a driverless metro train designed using ARM7 processor with the LPC2148 microcontroller which enables the train to run automatic from one station to another station. This proposed system is a driverless metro train and which eliminates the need onboard staff and makes the complete autonomous train. Thus, any human error is removed from the system. In this project ARM 7 has been used as CPU. When the train reaches the source or the destination station the train stops and start automatically as sensed by an IR sensor. Then the door of the train opens automatically and the passenger can enters into the train and leave from the train and after the prescribed time which set in the microcontroller program the door of the train closes automatically [2].

KEYWORDS: LPC2148,IR sensor, DC motor, LCD, Camera.

I. INTRODUCTION

The advancement in the field of rail transportation lot of advancement is made till the date. 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. Then the numbers of rail lines are automated to reduce the operation cost and improving the security and safety of services.

In this project is the Metro train equipped with the CPU, which is used to control the operation to and from the movement of the train which is written according to the written programmed path. The microcontroller from ARM7 is been used as CPU. When the train arrives at the station the sensor is according to the programming done onto the microcontroller. Then the door of the train is automatically opened so that the passengers can enter into the train and the door closes after the prescribed time set in the controller.

II. PROBLEM DEFINATION

By observing the all the different areas of the metro transport system the maximum of the accident are happened due to the different errors which is might be the electric or human [3] and the some of the service of the auto driverless train need to be improved The methods and technologies used for counting passengers and monitoring service

Disadvantages of the existing system.

- Manual service monitoring
- Manual passenger counting
- More Manpower is required.
- Installation and integration is time Consuming

The proposed below mentioned merits

- Automated system requiring less manpower.
- Automated Passenger counting helps to Identifying significant passenger load points where service is excessive or deficient, assisting service planning and schedule adjustment.
- Service monitoring technology helps to identify the system operations and tracking vehicle location and quality and adequacy of service, automatic train supervision (ATS), and automatic vehicle location (AVL) [4].

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III. MATERIAL

The **LPC2148** are based on a 16/32 bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory.

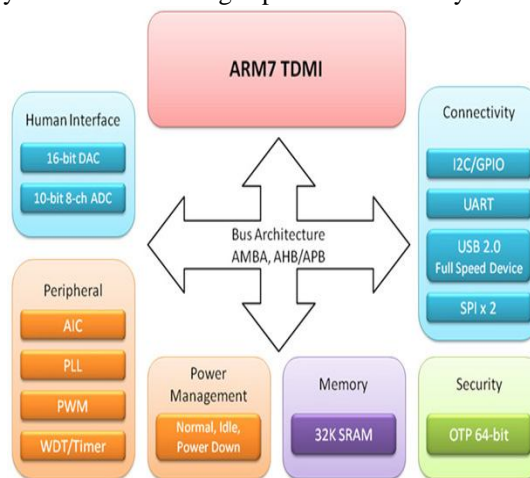


Fig: Bus Architecture AMBA

A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT, PWM channels and 46 GPIO lines with up to 9 external interrupt , three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

IV. ARM PROCESSOR

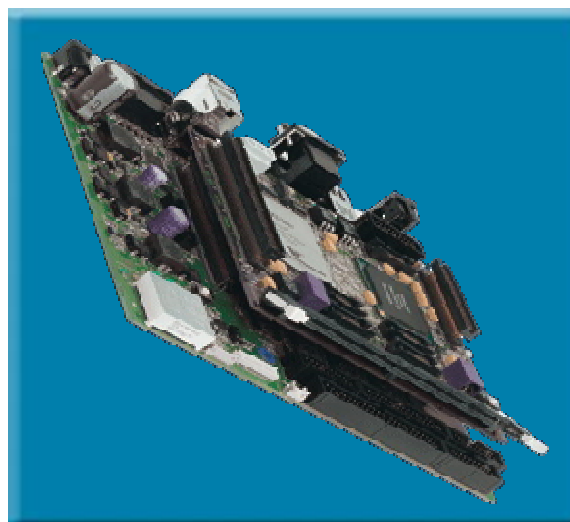


Fig: ARM7TDMI Processor Core

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The ARM7TDMI-S is a general purpose 32-bit microprocessor, the ARM7 processor offers the main features high performance and very low power consumption which increase the efficiency and reduce the power consumption. Current low-end ARM core for applications like digital mobile phones

- TDMI
 - T: Thumb, 16-bit compressed instruction set
 - D: on-chip Debug support, enabling the processor to halt in response to a debug request
 - M: enhanced Multiplier, yield a full 64-bit result, high performance
 - I: Embedded ICE hardware
- Von Neumann architecture

V. IR SENSOR

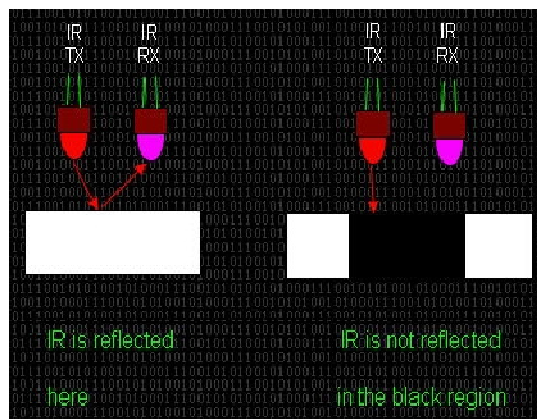


Fig: IR Reflectance

IR reflectance sensors contain a matched infrared transmitter and infrared receiver pair. These devices work by measuring the amount of light that is reflected into thereceiver. Because the receiver also responds to ambient light, the device works best when well shielded from abient light, and when the distance between the sensor and the reflective surface is small(less than 5mm). IR reflectance sensors are often used to detect white and black surfaces. White surfaces generally reflect well, while black surfaces reflect poorly.

VI. LCD

LCD Display. LCD stands for Liquid Crystal Display which is used to display the information on LCD like status of input, processing and output. These components are specialized for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD



Fig: LCD.

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screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines

VII. H-BRIDGE

An H-bridge is an electronic circuit which enables DC electric motors to be run forwards or backwards. The two basic states of H-bridge. The term "H-bridge" is derived from the typical graphical representation of such a circuit. An H-bridge is built with four switches (solid-state or mechanical). When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the motor

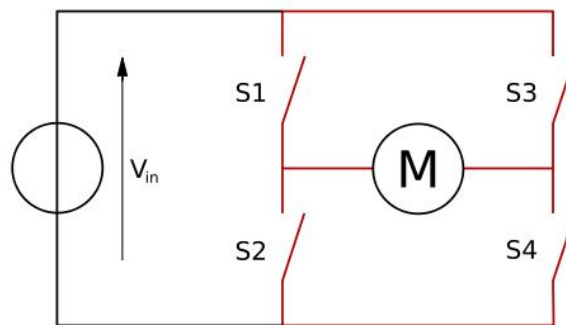


Fig H Bridge Circuit

Using the nomenclature above, the switches S1 and S2 should never be closed at the same time, as this would cause a short circuit on the input voltage source. The same applies to the switches S3 and S4. This condition is known as shoot-through work by measuring the amount of light that is reflected into the receiver. Because the receiver also responds to ambient light, the device works best when well shielded from ambient light, and when the distance between the sensor and the reflective surface is small (less than 5mm). The below table shows the Working of an H-Bridge Circuit

S1	S2	S3	S4	Result
1	0	0	1	Motor moves right.
0	1	1	0	Motor moves left.
0	0	0	0	Motor free runs.
0	1	0	1	Motor brakes.

VIII. DC MOTOR

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

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Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization). An electric motor is a machine which converts electrical energy into mechanical energy. motor has six basic parts axle, rotor (a.k.a., armature), stator, commutator, fieldmagnet, and brushes. In most common DC motors the external magnetic field is produced by high-strength permanent magnets.

The stator is the stationary part of the motor this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout

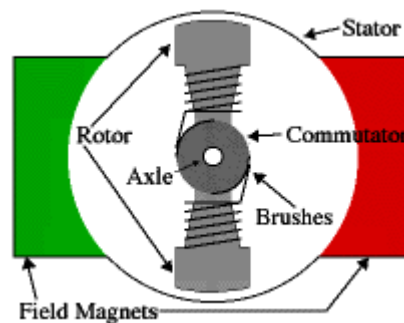


Fig DC Motor

IX. WORKING PRINCIPLE

In order to execute the program onto the microcontroller, microcontroller requires basic configuration like 5V regulated power supply, clock, and reset circuit Train moves with the help of motors fixed to the controller with the help of H-bridge. Working Principle of Driverless metro train using ARM7.

The IR Sensor is used to detect the station and which collect the relevant station information and other sensors used to count the passenger which is entering into to the train here one sensor is used for counting the passenger entering into the train and other is used for passengers are leaving from train. Here the sensor acts as an input device which receives the input and then the input is given to the microcontroller to process the input and perform the required operation according the program written on the microcontroller chip. The all the information of the passengers are displayed on the LCD.

The wireless A/V camera is interfaced to the system to monitor the status of the train and all the ongoing activities into the train to make the passenger journey safe and secure and which is used to track the location of the train , update the details to the passenger in the real time .

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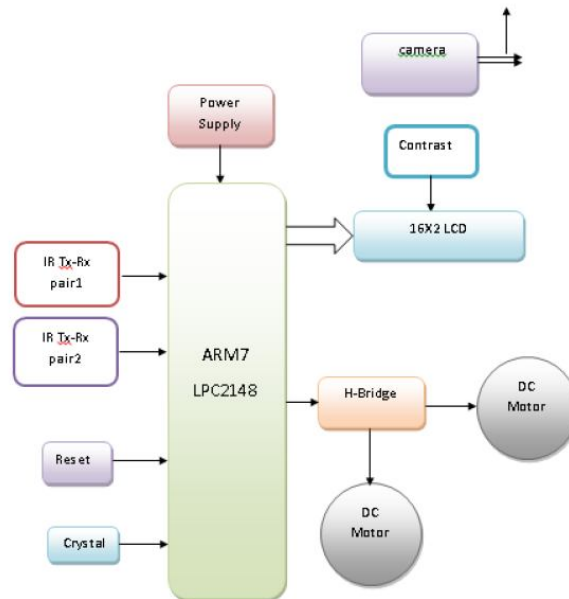


Fig: Block diagram of Driverless metro

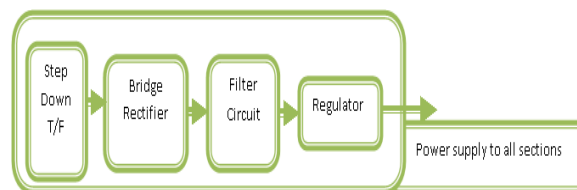


Fig Power Supply unit

Fig shows power supply unit in which Step down transformers are used to re-duce electrical voltage. The primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it. The main function of the step down transformers is to convert electrical voltage from one level or phase down to a lower level.

Here the bridge rectifier is used to convert an AC waveform into a DC waveform (OR) Rectifier converts AC current or voltages into DC current or voltage , the Filter circuits are used to remove unwanted or undesired frequencies from a signal, and the is an electrical regulator used to automatically maintain a constant voltage level. Then the power supply is given to the system to carry out all the operations.

Fig shows State diagram showing the train activities during departure. Before departure of the train a welcoming message is displayed on the LCD and alert the passenger before closing the door and departure and the door closing and opening time then the motor state switch to the on condition and train starts moving all the operation are done using the programming.[1]

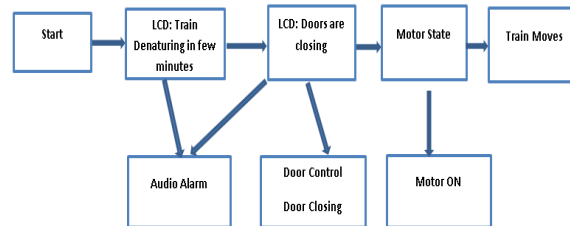


Fig Diagram of the train during the departure.

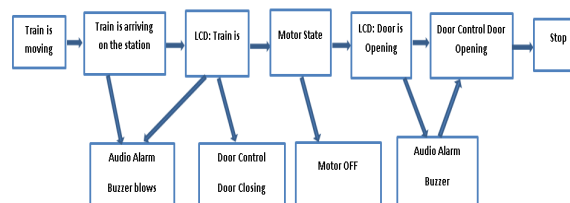


Fig State Diagram of the train during arrival

Fig Shows a state diagram showing the train activities during arrival. When the train is moving the status of the train is displayed on the LCD Screen the train is running. Before arriving on the station the buzzer sound and alert the passenger train is arrived at station and the motor state changes to the off state and the train stop. Then the door of the train is opens automatically so that the passenger can enter into the train after the predefined time the door of the train closes and the buzzer sound to alert the passengers the door is going to close and the process repeats at each station [1].

X. RESULTS AND DISCUSSION

- Whenever the train arrives at a station, the IR line is interrupted and the train stops automatically.
- After the train is stopped the doors of the train will be opened and a buzzer will be blown indicating the passengers that the station is arrived.
- Meanwhile the passenger counting section will count the no. of passengers present inside the train and displays it on a LCD screen.
- After a prescribed time set in the controller, a buzzer will be blown and the doors will be closed automatically.
- Then the train will move to the next station and process will continue at every station.
- The principal service issues that passenger counting technology has identified are the need to provide more service, to track changes in passenger demand, and to track on time performance issues.
- AVL in Auto Metro increases traffic control efficiency and improves customer service information.
- In Metro monitoring equipment for preventive maintenance, together with service monitoring, improves service reliability.
- The accuracy and abundance of data provided by service monitoring technology—especially ATS and AVL—help to determine what issues need to be addressed. Reinforced by manual staff monitoring, monitoring technologies are enabling transit providers to provide more efficient and effective service

XI. CONCLUSION

By using this auto metro train the timings of the train will be exact and it avoids a lot of inconvenience to the passengers. The passenger counting technology provides more service, to track changes in passenger demand, and to track on time performance issues. This project will greatly reduce the human intervention in the control of trains and hence saves a lot of time and money. Closer, more accurate relation of passenger boarding's and alighting's with



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respective locations Trains must operate without any staff onboard. Lower staffing costs. On-time performance (OTP) information, including arrival and departure times.High levels of safety and security Elimination of boring but stressful jobs Greater service flexibility Lower energy consumption

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