Chapter One

Introduction

1.1 background:

As the population increase industrial and commercial development expected should be grow steeply the public transport road or rail based.
With the growing economy and inadequate public transport services, the passengers shall shift to private modes, which is already evident from the high vehicle ownership trends in the region.

This would not only aggravate the congestion on streets but also increase the pollution. Hence, it is essential to plan and provide for a Metro System is an efficient user of space and energy, with reduced level of air and noise pollution, fast, safe and economic and environment friendly mode for mass movement of passengers [1].

1.1.1 Type of metro and their capacity:

Rail based mass transport in cities can be brought mainly under three categories:-

Mode Carrying capacity (passengers/hour) Phpdt:

1. Light Capacity Metro System

i.e. Light Rail Capacity System (LRTS) Up to 30,000.

2. Medium Capacity Metro System 30,000-50,000.

3. Heavy Capacity Metro System 50,000-80,000.

Since, the number of commuters to be dealt is relatively less in Light Metro System, its trains consist of 3 Coaches (which can be increased to 6 Coaches in future) and other related infrastructure is also of a smaller size.

For medium capacity Metro systems, the train generally comprises 3 to 6 coaches with ultimate train headway of about 3 minutes.

The other related infrastructure, e.g. civil works, stations, passenger-handling equipment etc. are also planned accordingly.

Heavy capacity metro systems have to deal with large traffic densities ranging from 50,000 to 80,000 phpdt. Accordingly, the trains have 6 to 9 coaches and other related infrastructure is also of large size. Beyond the traffic level of 80,000 phpdt, additional parallel lines are normally planned [1].

1.1.2 Advantages of metro system:

Metro systems are superior to other modes because they provide higher carrying Capacity, faster, smoother and safer travel, occupy less space, are non-polluting and energy-efficient. To summarize a Metro system:

(i) Requires 1/5th energy per passenger km compared to road-based system.

(ii) Causes no air pollution in the city.

(iii) Causes lesser noise level.

(IV) Occupies no road space if underground and only about 2 meters width of The road if elevated.

(v) Carries same amount of traffic as 5 lanes of bus traffic or 12 lanes of Private motor cars (either way), if it is a light capacity system.

(VI) is more reliable, comfortable and safer than road based system

(vii) Reduces journey time by anything between 50% and 75% depending on Road conditions [1].

1.2 Problem Statement

The automation of metro train can be justified by:

*Schedules of train operations become more exact and timely.

*Traffic without the need for more operational staff.

*Enhanced safety where the element of human error is taken out completely.

1.3 Objectives:

The objectives of this project is the Design and simulation of traffic metro train using Microcontroller.

1.4 Methodology

The metro train is programmed for the specific path, Every station on the path is defined, stoppage timing of the train and time between the two stations is predefined, first the motor for metro train is controlled and name of each station is displayed over LCD, the time and the different delay for each station is provided displaying message in the train we are using Intelligent LCD Display.

1.5 Thesis outlines:

The report begins with the thesis background which includes an introduction to metro train system. The section states the objective of the project. The scope of the design, which consists of four aspects that related with the design of the controller, is also stated.

Chapter 2 is presents the literature reviews, highlighting related research on this project taken from books and the journals.

Chapter 3 is talk about the Hardware of metro train system, which included the Component metro train system.

Chapter 4 discusses about the software design for metro train automation system. It shows the flow chart that illustrates the whole research process. The method to design the metro train automation system is discussed in this chapter.

Chapter 5 presents the result and analysis that have been done by simulation using proteus. This chapter also discusses about the controller output and the performance of the controller.

The last chapter summarizes and concludes this thesis with recommendations for future works.

Chapter Two

Literature Review

2.1 Automation:

At one time or another, all of the train control functions have been performed by human operators, and many still are, even in the most technologically advanced transit systems.

Theoretically, any of these functions could also be performed by automatic devices, and more and more have, in fact, been assigned to machines over the years, before examining the technology by which train control automation has been achieved, it is first necessary to consider what is meant by automation and to clarify the terminology used in this report.

Figure 2.1 is a generalized diagram of the process by which any train control function is accomplished. It involves receiving information about some operational state of the system and some desired state. This information must then be interpreted for example, by comparing the two states and deriving a quantitative expression of the difference, next, an appropriate control response to null the difference must be selected, and some specific command message to the controlled element must be formulated and transmitted. A final, and all-important, step is monitoring the results of the control action to ascertain that the desired system state or condition has been achieved. This last step, called feedback, provides an input signal to start the process all over again, thereby creating a loop that permits the control process to be continuous and adaptive. If all of the steps in the general sequence shown in Figure 2.1 are performed by a human operator, the process is called manual, even though manual action in the strict sense may not be involved. Thus, manual denotes a process that may include visual, auditory, and other forms of sensory perception as well as purely cognitive activities such as interpretation, weighing alternatives, and decision making. The command output might be accomplished by some manual activity such as pressing a button or moving a control lever, or it might take the form of a voice command or simply a nod of the head. The essential feature of a manual process, as the term is used here, is that all the basic control steps to accomplish a function are human activities.

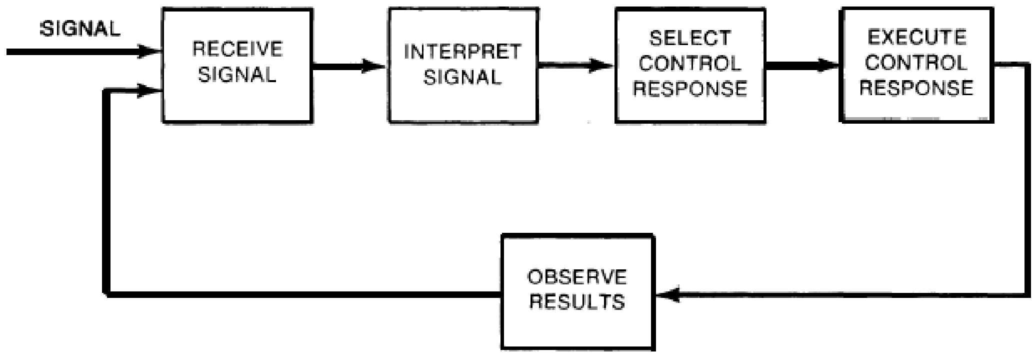


Figure 2.1 generalized control process.

It is also possible for all of the steps in the control loop to be accomplished by some mechanical or electrical device. If so, the process is called automated.

The device need not necessarily be complicated, nor is a computer required in order for the apparatus to process information and make a "decision."

A simple junction box with a two-state logic circuit (ON or OFF) would satisfy the definition of an automated control device, provided no human actions were required to receive and interpret input signals, select and order a response, and monitor the result.

Between the extremes of purely manual control and fully automatic control, there are numerous combinations of mixed man-machine control loops.

These are called semi-automated or partially automated the terms are used synonymously to denote a process (or a system) in which there are both manual and automatic elements. Thus, automation is not to be taken in an absolute, all-or-nothing sense. The machine can be introduced by degrees into a system to perform specific functions or parts of functions. When comparing parts of a train control system or when comparing one system with another, it is therefore possible to speak of automation in comparative terms and to say that one is more or less automated than another, depending on how many specific functions are performed by machines. For brevity, acronyms are used to describe certain areas where automation is applied in train control. ATC (automatic train control) refers generally to the use of machines to accomplish train control functions. It does not necessarily suggest a completely automated system. It can be applied to a system where certain functions or groups of functions are performed automatically while others are performed manually. ATP (automatic train protection), ATO (automatic train operation), and ATS (automatic train supervision) are used to designate major groups of functions that may be automated. For example, if a system is said to have ATP, it means that train protection is accomplished (either completely or mostly) by automatic devices without direct human involvement. If a system is described as having ATC consisting of ATP and some ATS, this indicates that train protection is assured by automatic devices and that train supervision is a mixture of manual and automatic elements. By implication, train operation in such a system would be manual. While automation involves the substitution of machine for human control, this does not mean that the human operator is removed from the system altogether. An automated system is not always an unmanned system, even though all functions are routinely performed by machines. For instance, train protection and train operation may be completely automatic in a given transit system, but there could still be an operator or attendant on board the train to oversee equipment operation and, most importantly, to intervene in the event of failure or malfunction. This emergency and backup role is, in fact, a major type of human involvement in even the most automated train control systems, In all rail rapid transit train control systems now in operation or under development, automation is utilized only for normal modes of operation, with manual backup as the alternative for unusual conditions, breakdowns, and emergencies. In passing, it should also be noted that automation is not synonymous with remote control, even though the two may at times go hand in hand. In train supervision, for example, many functions are accomplished manually by controllers who are physically far removed from the train and wayside. In central control facilities, the operators may never actually see the vehicles or track and yet perform all or most of the functions necessary to set up routes, dispatch trains, and monitor traffic. Conversely, automated functions are often performed locally, i.e., by devices on board the train or at a station or switch. In general, the location of the controlling element in relation to the controlled element is independent of how the functions are accomplished.

However, it is also true that automation does facilitate the process of remote control, and systems with a high level of ATC tend also to employ more centralized forms of train control, especially for supervisory functions [2].

2.2 Metro Systems:

As briefly stated before, a metro can be defined a mass transit system with high capacity and frequency, consisting of driven motor vehicles and/or towed vehicles circulating on rail, or with other binding guides or completely separated from any other type of traffic, with the operation regulated by signals [4].

The International Union of Public Transport (UITP) defines a metro as a tracked, electrically driven local means of transport, which has an integral, continuous track bed of its own (large underground or elevated sections) [5].

Metros are totally independent from other traffic, road or pedestrian. They are consequently designed in tunnels, viaducts, or on the surface level, but with physical separation.

Metropolitan railways are the optimal public transport mode for a high-capacity line or network service. Some systems run on rubber-tires but are based on the same control-command principles as steel-wheel systems. In different parts of the world, metro systems are also known as the Underground, Subway, Urban or Rapid Transit, or Tube; the term metro best generalizes the various names used for the same type of transit system. In other words, a metro system is a fully segregated system. UITP notes that this results in a high degree of freedom for the choice of vehicle width and length, and thus a large carrying capacity (above 30,000 passengers per hour per direction–pphpd). The intervals between stations would typically be more than 1 km, and because the alignment does not have to follow existing streets, curve radii and section gradient can be more generously dimensioned and permit an overall higher commercial speed [6].

This large carrying capacity indicates the main difference between the metro and LRT systems. Therefore, UITP states that metro systems require heavier investments than LRT, and can be implemented only in large cities where the demand justifies the capital cost.

the term metro is used wherever necessary, since the topic under examination for the research purposes could include systems consisting of elevated, at grade, and underground sections.
The volume of passengers that a metro train can carry is often quite high. Broadly classifying the public transportation systems for a large city as the bus transit system and rapid transit system (referring to the metro), it could be stated that the public transportation system stands on the metro system,

where any disruption in the metro system might lead to the fall of the overall structure.

Light rail transit (LRT) is a particular class of urban and suburban passenger railway that utilizes equipment and infrastructure that are typically less massive than that used for metro systems and heavy rail. As such, the main difference between LRT and metro systems is the mass of the utilized equipment and infrastructure. When a heavier mass of equipment and infrastructure is used, the cost of the system is higher, where one can broadly compare the costs of metro and LRT systems.

UITP defines LRT as a tracked, electrically driven local means of transport, which can be developed step by step from a modern tramway to a means of transport running in tunnels or above ground level [7].

2.3 Automation in metro:

In metro systems, automation refers to the process by which responsibility for operation management of the trains is transferred from the driver to the train control system. There are various degrees of automation (or Grades of Automation, GoA) these are defined according to which basic functions of train operation are responsibility of staff, and which the responsibility of the system itself are. For example, a Grade of Automation 0 would correspond to on-sight operation, like a tram running on street traffic. Grade of Automation 4 would refer to a system in which vehicles are run fully automatically without any operating staff.[3]

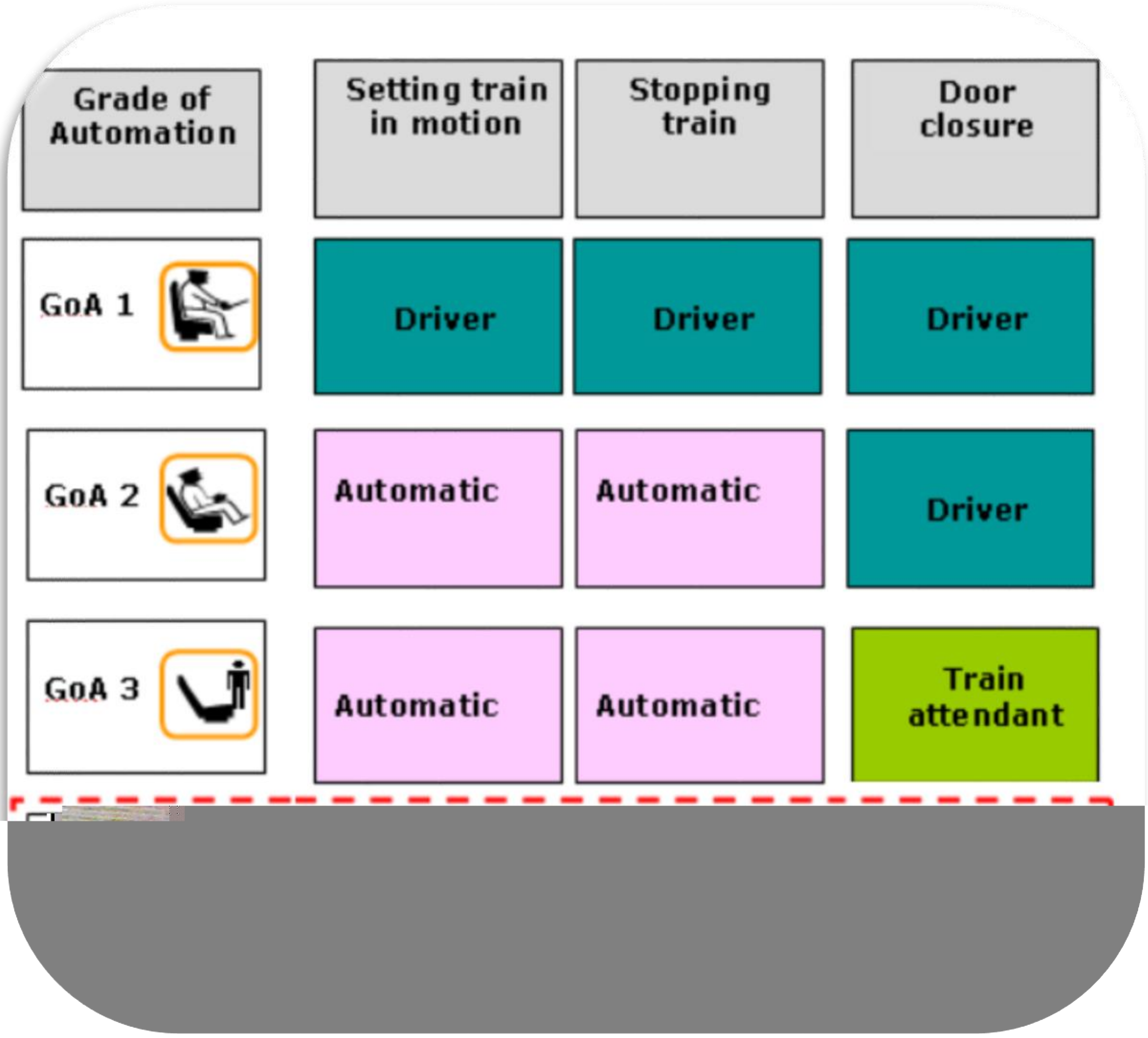


Figure 2.2 Grades of Automation in metro.

Technical progress has made metro train control systems capable of supervising, operating and controlling the entire operational process. The key elements for this are:

• Automatic Train Protection (ATP) is the system and all equipment responsible for basic safety, it avoids collisions, red signal overrunning and exceeding speed limits by applying brakes automatically. A line equipped with ATP corresponds (at least) to a GoA1.

• Automatic Train Operation (ATO) insures partial or complete automatic train piloting and driverless functionalities. The ATO system performs all the functions of the driver, except for door closing. The driver only needs to close the doors, and if the way is clear, the train will automatically proceed to the next station. This corresponds to a GoA2. Many newer systems are completely computer controlled; most systems still elect to maintain a driver, or a train attendant of some kind, to mitigate risks associated with failures or emergencies. This corresponds to a GoA3.

• Automatic Train Control (ATC) performs automatically normal signaler operations such as route setting and train regulation. The ATO and the ATC systems work together to maintain a train within a defined tolerance of its timetable. The combined system will marginally adjust operating parameters such as the ratio of power to coast when moving and station dwell time, in order to bring the train back to the timetable slot defined for it. There is no driver, and no staff assigned to accompany the train, corresponding to a GoA4. At Grade of Automation 4, ATC systems work within an overall signaling system with interlocking, automatic train supervision, track vacancy detection and communication functions [3].

2.4 Automatic Train Operation

Basically cab signaling provides carborne automatic train protection in the form of collision prevention. With the addition of on-board equipmerit for sensing and comparing command (allowable) and actual speed, cab signaling makes it possible to expand the train protection function to permit speed regulation. This, in turn, forms the basis for extending automation into the area of train operation. Several forms of automatic train operation (ATO) are possible, but all have two basic features-automatic speed regulation and station stopping. Automatic speed regulation (ASR), as the name implies, is basically a comparator circuit for matching actual speed to command speed. Speed commands received from coded track circuits are picked up by a carborne receiver, decoded, and compared to actual train speed sensed by a tachometer in the drive mechanism. Up to this point, an automatic speed regulation system is like cab signaling. The difference arises in how this comparison is used. With cab signals, the comparison is used to actuate a penalty brake application to stop the train when actual speed exceeds command speed. With ASR, the comparison is used to control the motors and brakes in an effort to minimize the difference between actual and command speed. An advisory display of speed commands and train speed may be provided for the operator. In effect, ASR removes the human operator from the control loop for running the train and provides for an essentially instantaneous and invariant response by propulsion and braking systems, without the delay of human reaction time and without the variability and possibility for misinterpretation inherent in manual train operation. The other basic element of ATO is station stopping, which involves bringing the train to stop automatically at a predetermined location in each station. This is accomplished by special wayside control units working in cooperation with position receivers, logic circuits, and automatic speed regulation equipment on the train. One method uses wayside “triggers” spaced some distance from the station as reference points for programed stopping. The first trigger, farthest from the station, transmits a command signal that board the train, a velocity-distance generates, on profile which the train is to follow to a stop. Additional triggers, nearer the station platform, correct the generated velocity-distance profile for the effects of wheel slip and slide. The ASR system monitors the velocity-distance profile and controls the braking effort to bring the train to a stop at a predetermined point. Another method of programed stopping makes use of long wayside antenna to provide a series of position signals to a carborne control system as the train passes along its length. The carborne control system determines train position and combines this with speed and deceleration information (sensed on board the train), to produce an appropriate propulsion or braking command for the traction control system. To this basic ATO system, other automated features may be added. Doors can be opened automatically after the train is brought to a stop in a station, This requires a circuit to actuate door opening mechanisms and appropriate safety interlocks to assure that the train is in fact stopped and at a station. Door closure may also be automated by adding a timing circuit to measure how long the doors have been open and to initiate a door closure signal automatically after a predetermined dwell time has elapsed. Train departure can also be initiated automatically by introducing another control circuit to apply propulsion power after receipt of a signal confirming that doors are closed and locked.

For each of these levels of ATO, the train operator may be provided with an advisory display to show what commands are being received and what response is being made by automatic mechanisms. The operator may also be provided with manual override controls to inhibit automatic functions or to vary automatic system operation. For example, the operator may intervene manually to adjust the stopping point, to prevent some or all doors from opening, to vary station dwell time, or to initiate or prevent departure. Figure 8 shows a functional diagram of a typical ATO system and a picture of the train operator's console [2].

2.5 Microcontroller:

Basically a microcontroller is a computing device, and is a single integrated circuit ("Silicon chip" or IC) used to form part of a product that incorporates some software Program control. As a microcontroller is basically part of a computing system it can be used in applications requiring control, operator and user display generation, simple sequencing and many other mundane tasks.

A microcontroller device is not simple, but in general, a microcontroller unit may be considered as a computing device offering internal memory and a high level of input and output (I/O) device options. Ideally the use of a microcontroller device minimizes the number of external devices used in the system, and integrates as much of the external interfacing to switches, motors or other input / output devices as is practically possible. [4]

Figure 2.3 : micro controller

2.6 Types of Microcontrollers:

There are several different kinds of programmable microcontrollers at future electronics, we stock many of the most common types categorized by several parameters including Bits, Flash size, RAM size, number of input/output lines, packaging type, supply voltage and speed, and our parametric filters will allow you to refine your search results according to the required specifications. Programmable microcontrollers contain general purpose input/output pins, the number of these pins varies depending on the microcontroller, they can be configured to an input or an output state by software, When configured to an input state, these pins can be used to read external signals or sensors, When they are configured to the output state, they can drive external devices like LED displays and motors.

Microcontrollers offer a low cost computing solution. Alternative computing solutions come in many forms, and microprocessor devices can be considered a ‘cousin’ of the microcontroller device, but are optimized to manipulate high volumes of data and to provide the facilities for several tasks or windows to operate at any one time [12].

2.7 Difference between microcontroller and microprocessor

A microprocessor (abbreviated as μP or MPU) is a computer electronic component made from miniaturized transistors and other circuit elements on a single semiconductor integrated circuit (IC) (microchip or just chip). The central processing unit (CPU) is the most well-known microprocessor.

Microcontroller is basically a computer on a chip. (Abbreviated as μc or MCU).

Some of the primary differences between MCU and MPU, typically, MCU uses on-chip embedded Flash memory in which to store and execute its program as shown in figure 2.4.

Storing the program in this way means that the MCU has a very short start-up period and can be executing code very quickly. The only practical limitation to using embedded memory is that the total available memory space is finite. Most Flash MCU devices available on the market have a maximum of 2 Mbytes of Program memory and, depending on the application, this may prove to be a limiting factor. MPUs do not have memory constraints in the same way. They use external memory to provide program and data storage. The program is typically stored in non-volatile memory, such as NAND or serial Flash, and at start-up is loaded into an external DRAM and then commences execution. This means the MPU will not be up and running as quickly as an MCU but the amount of DRAM and

NVM you can connect to the processor is in the range of hundreds of Mbytes and even Gigabytes for NAND [9].

Another difference is power, by embedding its own power supply; an MCU needs just one single voltage power rail. By comparison, an MPU requires several difference voltage rails for core, DDR etc. The developer needs to cater for this with additional power ICs / converters on-board. From the application perspective, some aspects of the design specification might drive device selection in particular ways. For example, is the number of peripheral interface channels required more than can be catered for by an MCU Or, does the marketing specification stipulate a user interface capability that will not be possible with an MCU because it does not contain enough memory on-chip or has the required performance.

Microprocessor devices are relatively high cost items when compared to microcontrollers because of this high performance capability. In comparison, microcontrollers, as their name suggests, are in general optimized for control applications and not data manipulation. However, the principles and jargon often encountered in PCs are often replicated when considering microcontroller units [10].

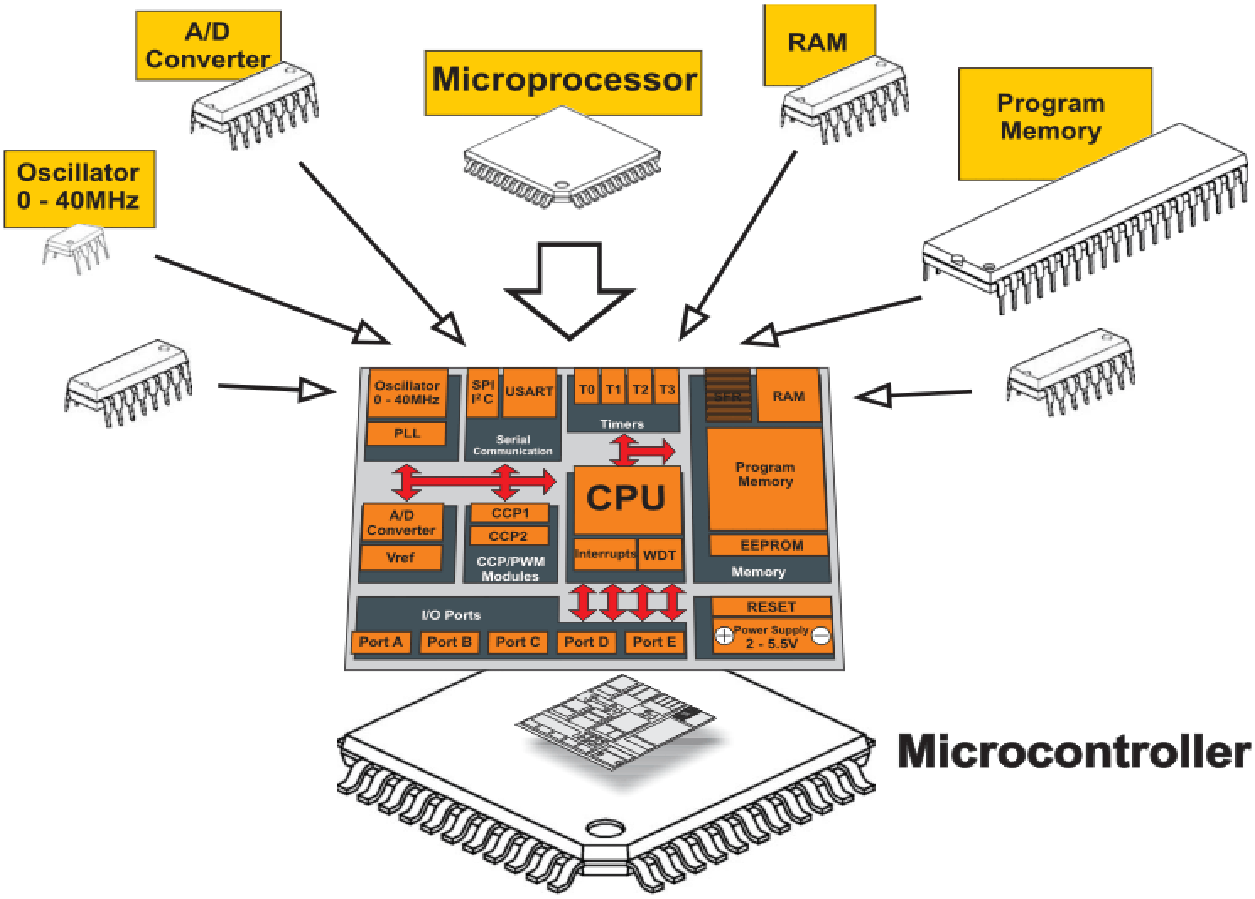


Figure 2.4 the different between microcontroller and microprocessor.

When embarking on the first design and knowing that, it is highly likely there will be many product variations. In that case, it is very possible a platform-based design approach will be preferred.

Another key aspect that will drive the selection between an MCU and an MPU is the need for a real-time/deterministic behavior of the application. Because of the processor core used in an MCU, as well as the embedded flash and considering the software used that is either an RTOS or bare metal The MCU will definitely take the lead on this aspect and will address perfectly the most time critical and deterministic applications.

Final point to consider is power consumption. While MPUs do have low power modes there are not as many or as low as the ones you would find on a typical MCU. With the external hardware supporting an MPU has an added factor, putting an MPU into a low power mode might also be slightly more complex. Also, the actual consumption of an MCU is magnitudes lower than an MPU, in low power mode for example with SRAM and register retention, you can consider a factor 10 to 100.

Many manufactures produce a various types of microcontrollers some of them are used widely because of fast execution, simplicity of programming and other considerations so AVR is used in this project to play the microcontroller role. [11]

Chapter Three

Hardware of metro train System

3.1 hardware requirement:-

a. Microcontroller (ATmega32).

b. LCD (16x4).

c. Dc motor.

d. L293D.

e. Buzzer.

f. Regulator.

g. IR sensor

3.2 MICRO CONTROLLER atmega32:

3.2.1 Features:

• Compatible with MCS-51® Products

• 4K Bytes of In-System Programmable (ISP) Flash Memory

– Endurance: 1000 Write/Erase Cycles

• 4.0V to 5.5V Operating Range

• Fully Static Operation: 0 Hz to 33 MHz

• Three-level Program Memory Lock

• 128 x 8-bit Internal RAM

• 32 Programmable I/O Lines

• Two 16-bit Timer/Counters

• Six Interrupt Sources

• Full Duplex UART Serial Channel

• Low-power Idle and Power-down Modes

3.2.2 Description:

The atmega32 is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of in-system programmable Flash memory. The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry- standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel atmega32 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications [12].

3.2.4 Block diagram:

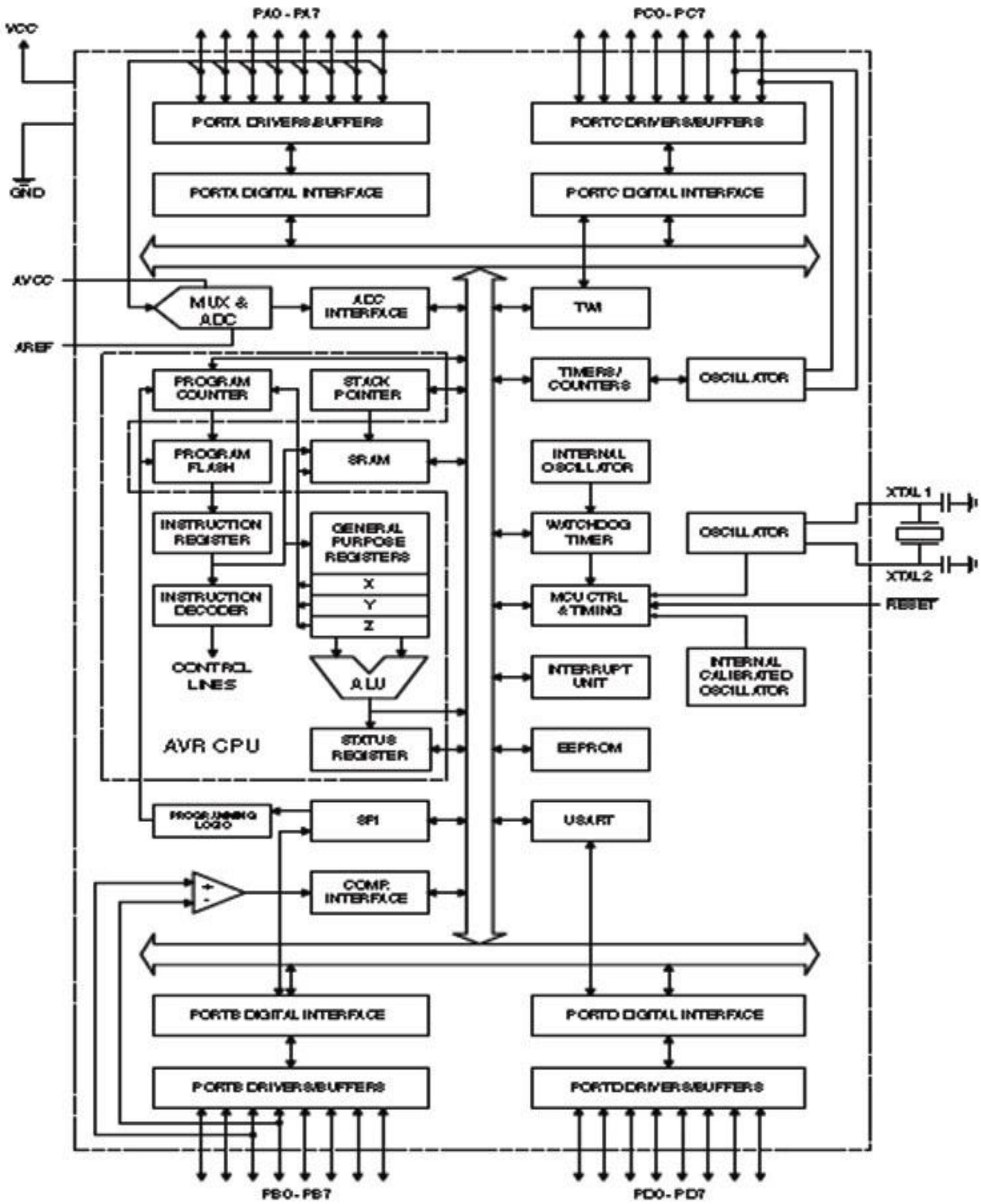


Figure 3.1: Block diagram

3.2.5 Pin Description:

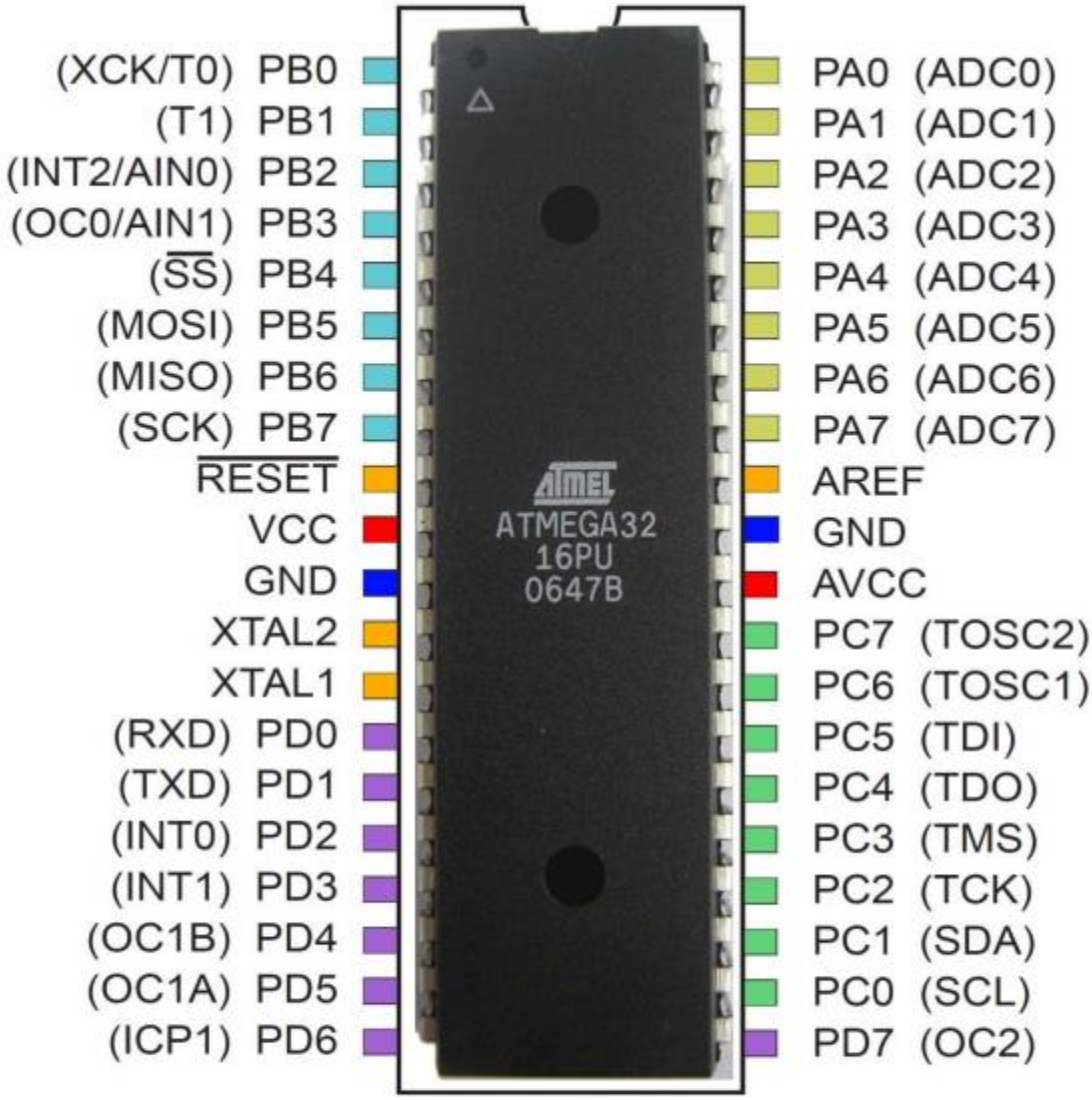


Figure 3.2: pin diagram of micro controller atmega32.

- VCC - Supply voltage.
- GND - Ground.
- Port A (PA7:PA0):

Port A serves as the analog inputs to the A/D Converter.

Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive Characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tristated when a reset condition becomes active, even if the clock is not running.

- Port B (PB7:PB0):

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tristated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega32A as listed in Alternate Functions of Port B.

- Port C (PC7:PC0):

Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5 (TDI), PC3 (TMS) and PC2 (TCK) will be activated even if a reset occurs. The TD0 pin is tristated unless TAP states that shift out data are entered. Port C also serves the functions of the JTAG interface and other special features of the ATmega32A as listed in Alternate Functions of Port C.

- Port D (PD7:PD0):

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tristated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega32A as listed in Alternate Functions of Port D.

- PSEN:

  Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

- EA/VPP:

  External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

- XTAL1: Input to the inverting oscillator amplifier and input to the internal clock operating circuit.
- XTAL2: Output from the inverting oscillator amplifier [12].

3.3 Liquid crystal displays (LCDs):

3.3.1 Introduction:

Liquid crystal displays (LCDs) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarisers are pasted outside the two glass panels. These polarisers would rotate the light rays passing through them to a definite angle, in a particular direction.

When the LCD is in the off state, light rays are rotated by the two polarisers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarisers, which would result in activating/ highlighting the desired characters.

The LCD’s are lightweight with only a few millimeters thickness. Since the LCD’s consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCD’s don’t generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD’s have long life and a wide operating temperature range.

Changing the display size or the layout size is relatively simple which makes the LCD’s more customers friendly.

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications. This section describes the operation modes of LCD's then describe how to program and interface an LCD to atmega32.

3.3.2 LCD operation:

In recent years the LCD is finding widespread use replacing LEDs (seven-segment LEDs or other multisegment LEDs).This is due to the following reasons:

1. the declining prices of LCDs.

2. The ability to display numbers, characters and graphics. This is in contract to LEDs, which are limited to numbers and a few characters.

3. Incorporation of a refreshing controller into the LCD, there by relieving the CPU of the task of refreshing the LCD. In the contrast, the LED must be refreshed by the CPU to keep displaying the data.

4. Ease of programming for characters and graphics.

3.3.3 LCD pin description

The LCD discussed in this section has 14 pins. The function of each pins is given in table.

Pin description for LCD:

Pin	Symbol	I/O	Description

1	Vss	--	Ground
2	Vcc	--	+5V power supply
3	VEE	--	Power supply to control contrast
4	RS	I	RS=0 to select command register RS=1 to select data register
5	R/W	I	R/W=0 for write R/W=1 for read
6	E	I/O	Enable
7	DB0	I/O	The 8-bit data bus
8	DB1	I/O	The 8-bit data bus
9	DB2	I/O	The 8-bit data bus
10	DB3	I/O	The 8-bit data bus
11	DB4	I/O	The 8-bit data bus
12	DB5	I/O	The 8-bit data bus
13	DB6	I/O	The 8-bit data bus
14	DB7	I/O	The 8-bit data bus

3.3.4 LCDs Uses:

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

3.3.5 LCDs interfacing:

Sending commands and data to LCDs with a time delay:

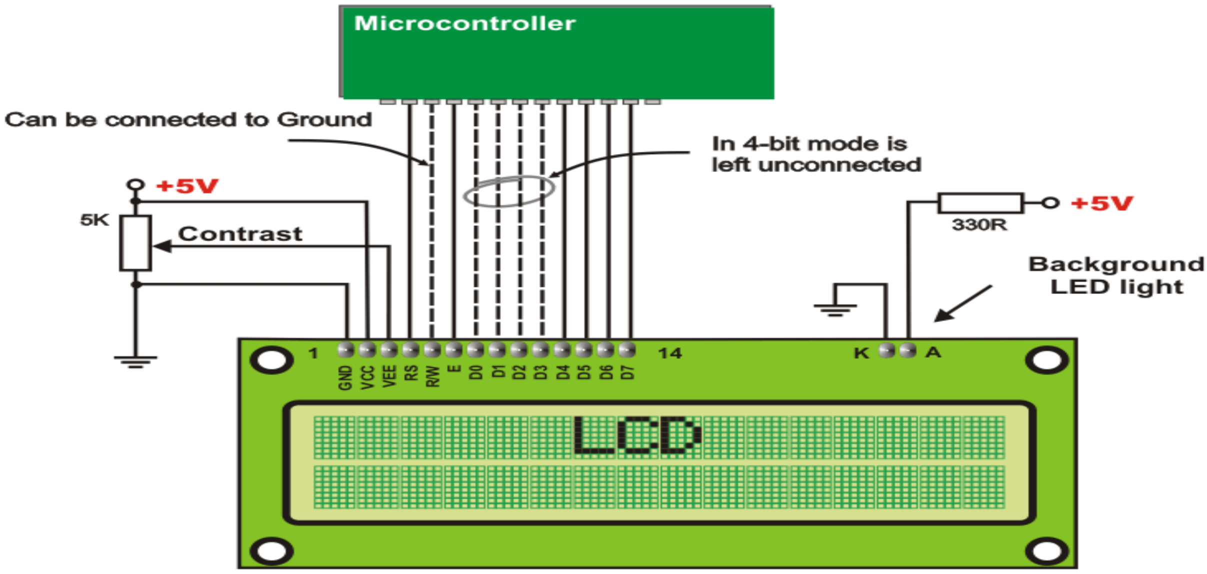


Figure 3.3 Interfacing of LCD to a micro controller.

To send any command from table 2 to the LCD, make pin RS=0.

For data, make RS=1.Then send a high –to-low pulse to the E pin to enable the internal latch of the LCD [13].

3.4 DC Motor:

A DC motor is an electric motor that runs on direct current (DC) electricity. DC motors were used to run machinery, often eliminating the need for a local steam engine or internal combustion engine. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Modern DC motors are nearly always operated in conjunction with power electronic devices.

Two important performance parameters of DC motors are the Motor constants, Kv and Km The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electrical magnets.

Figure 3.4 DC Motor

DC Motors have many advantages:

• High dynamic response
• High efficiency
• Long operating life
• Noiseless operation
•Higher speed ranges

DC motors main disadvantage is higher cost which arises from two issues. First, BLDC motors require complex electronic speed controllers to run. DC motors can be regulated by a comparatively trivial variable resistor (potentiometer or rheostat), which is inefficient but also satisfactory for cost-sensitive applications.

3.5 L293D:

3.5.1 Description

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

The l293d can drive small and quiet big motors as well.

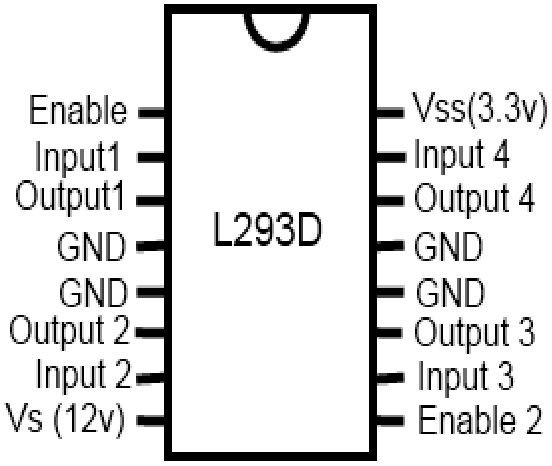


Figure 3.5 Pin Configuration of L293D

3.5.2 Concept:

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC are ideal for driving a DC motor.

In a single l293d chip there two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.

3.5.3 Working of L293D

there 4 input pins for this l293d, pin 2,7 on the left and pin 15 ,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

In simple to provide Logic 0 or 1 across the input pins for rotating the motor.

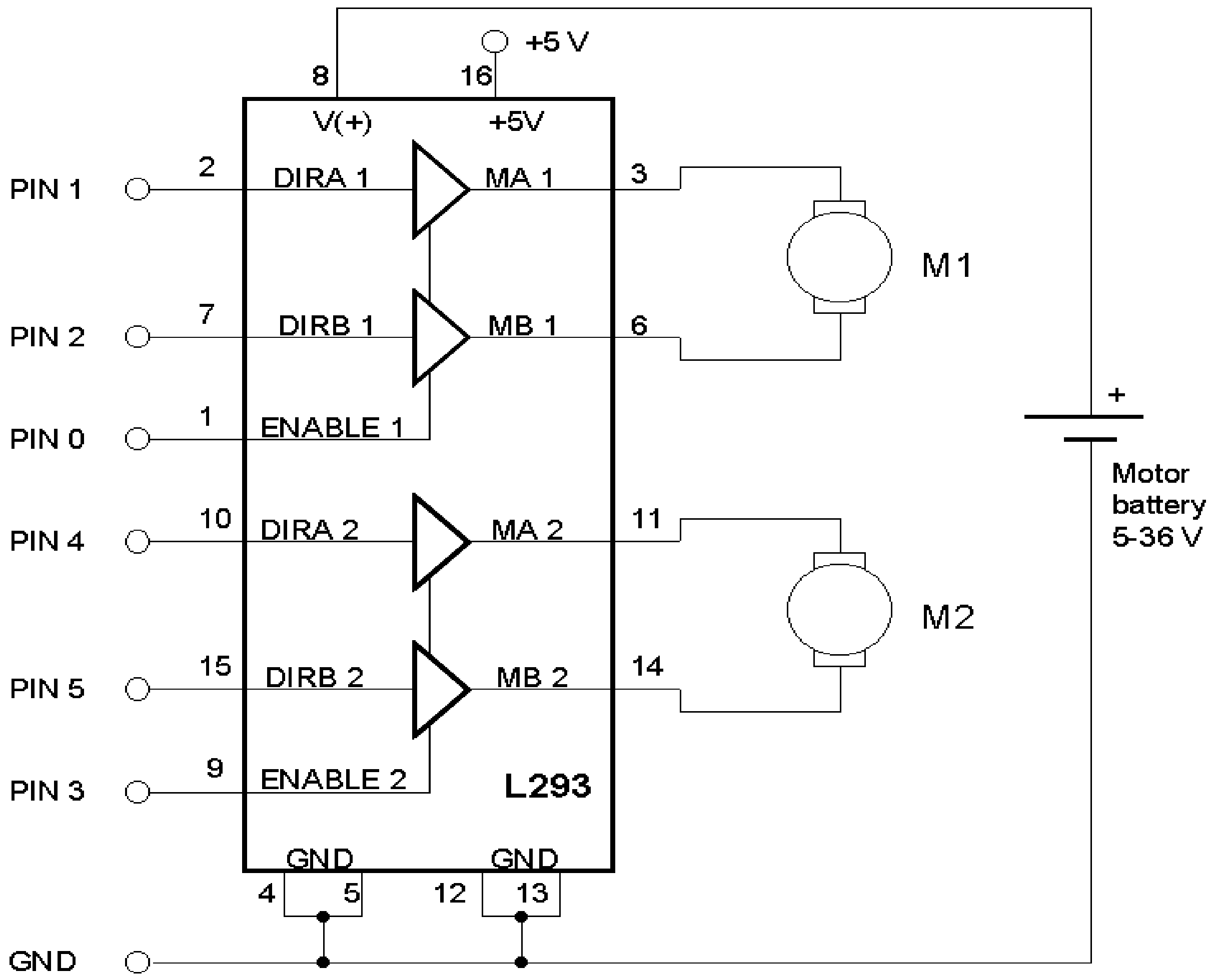


Figure 3.6 Internal Architecture of L293D.

3.5.4 L293D Logic

Let’s consider a Motor connected on left side output pins (pin 3&6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

- Pin 2 = Logic 1 and Pin 7 = Logic 0 motor work Clockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 1 motor work Anticlockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 0 motor No rotation
- Pin 2 = Logic 1 and Pin 7 = Logic 1 motor No rotation

In a very similar way the motor can also operate across input pin 15, 10 for motor on the right hand side.

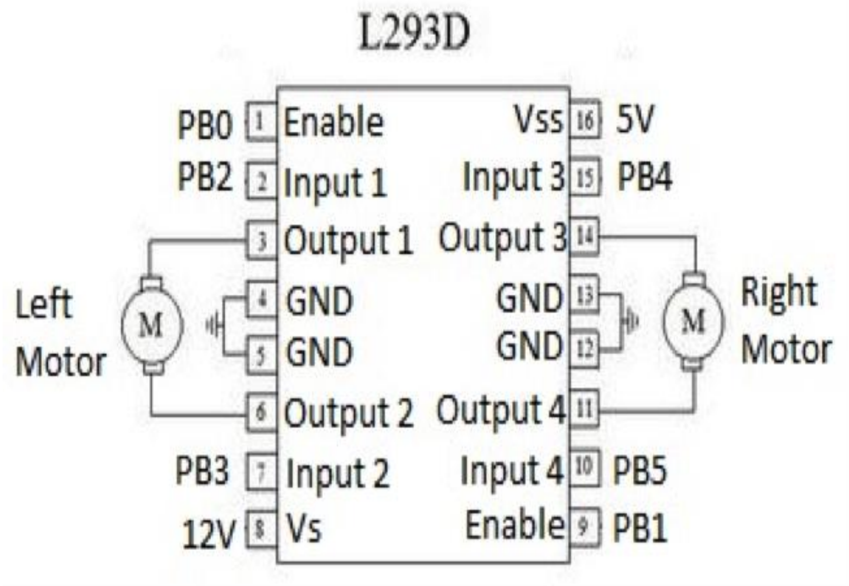


Figure 3.7 Pin Connection of L293D

3.5.5 Voltage Specification

VCC is the voltage that it needs for its own internal operation 5v; L293D will not use this voltage for driving the motor. For driving the motors it has a separate provision to provide motor supply VSS (V supply). L293d will use this to drive the motor. It means if you want to operate a motor at 9V then you need to provide a Supply of 9V across VSS Motor supply.

The maximum voltage for VSS motor supply is 36V. It can supply a max current of 600mA per channel. Since it can drive motors Up to 36v hence you can drive pretty big motors with this l293d.

VCC pin 16 is the voltage for its own internal Operation. The maximum voltage ranges from 5v and up to 36v.

TIP: Don’t Exceed the Vmax Voltage of 36 volts or it will cause damage [14].

3.6 Buzzer:

Buzzer is a device used for beep signal. This will help us to make understand information or message. A buzzer is usually electronic device used in automobiles, household applications etc. Fig(3.8) Buzzer It mostly consists of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electrical bell without the metal gong. Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to derive a loudspeaker and hook this circuit to a cheap 8-ohm speaker. These buzzers do not makes sound or turn on a light, they stop a nearby digital clock, briefly fire two smoke cannons on each side of the stage exit and open the exit. However, at the end of the Heartbreaker in Viking, the buzzer is replaced with a sword that, when removed, causes two contacts to touch, closing the circuit and causing the latter two actions above to occur.

Buzzer may be mechanical, electromechanical or electronic.

Mechanical: joy buzzer is an example of a purely mechanical buzzer.

Electromechanical: Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

Electronic: Piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Figure (3.8) Types of Buzzers.

3.8 IR sensor:

Basics of IR transmitter and receiver Transmitter and receiver are commonly used in engineering projects for remote control of objects. There are describe the basics if IR transmitter and receiver.

3.8.1 Basics of IR transmitter:

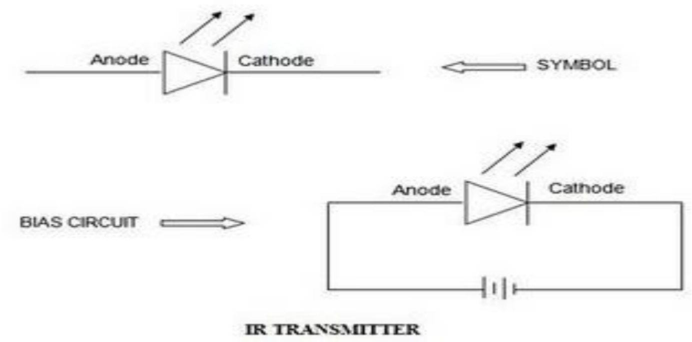


Figure 3.10 IR Transmitter.

An electroluminescent IR LED is a product which requires care in use. IR LEDs are fabricated from narrow band hetero structures with energy gap from 0.25 to 0.4 eV. Infra-red transmitter emits IR rays in planar wave front manner. Even though infra-red rays spread in all directions, it propagates along straight line in forward direction. IR rays have the characteristics of producing secondary wavelets when it collides with any obstacles in its path. This property of IR is used here. When IR rays gets emitted from LED, it moves in the direction it is angled. When any obstacle interferes in the path, the IR rays get cut and it produces secondary wavelets which propagates mostly in return direction or in a direction opposite to that of the primary waves, which produces the net result like reflection of IR rays.

3.8.2 Basics of IR receiver:

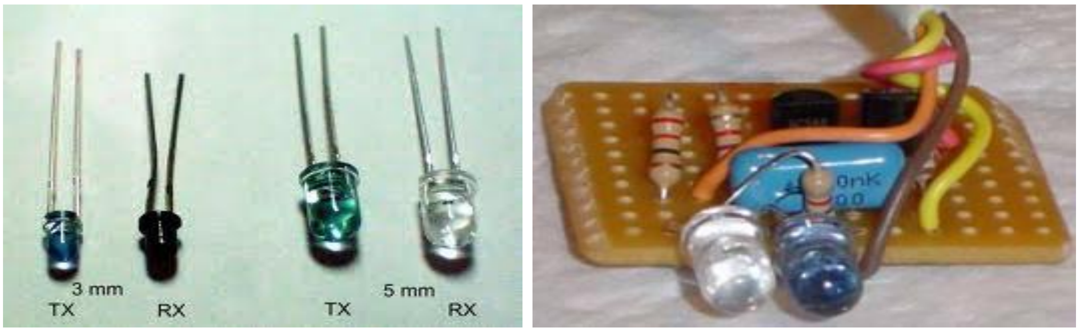


Figure 3.11 IR Photo Receiver.

Infrared photo receiver is a two terminal PN junction device, which operates in a reverse bias. It has a small transparent window, which allows light to strike the PN junction. A photodiode is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. Most photodiodes will look similar to a light emitting diode. They will have two leads, or wires, coming from the bottom. The shorter end of the two is the cathode, while the longer end is the anode. A photodiode consists of PN junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced [15].

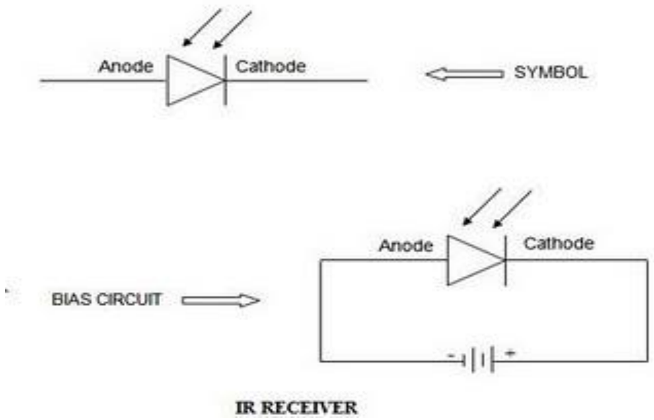


Figure 3.13 IR Receiver.

Chapter Four

Software Design of metro train System

4.1 Working:

- When metro Train stopped LCD will display inter password if you need running.
- The train is designed for five stations, named as stat1, stat2, stat3, stat4 and stat5. The stoppage time is 5 minute between two any stations.
- If inter wrong password you have three chance, if input three chance wrong display wrong password and closed program.
- If inter correct password the buzzer on for one minute and door open and LCD will display door is open and wait 4 minute to passenger come to in metro train, after 4 minute finished closed door, the buzzer on for one minute and LCD will display door is closed.
- Metro Train start running after the door is closed and running in low speed for five minute LCD will display metro Train running in low speed.
- After that metro Train running in high speed if not arrive to next station and LCD will display metro Train running in high speed, display current station and next station.
- After metro Train arrive to next station running in low speed, the buzzer on for one minute and LCD will display metro Train running in low speed.
- After metro Train arrive to center of next station stopped, the buzzer on for one minute and LCD will display metro Train stopped.
- After metro Train stopped door open and LCD will display door is open and wait 4 minute to passenger come to in metro train, after 4 minute finished closed door, the buzzer on for one minute and LCD will display door is closed.

- After that repeat all above step to arrive last station after that reverse automatically.

4.2 block diagram of metro train prototype.

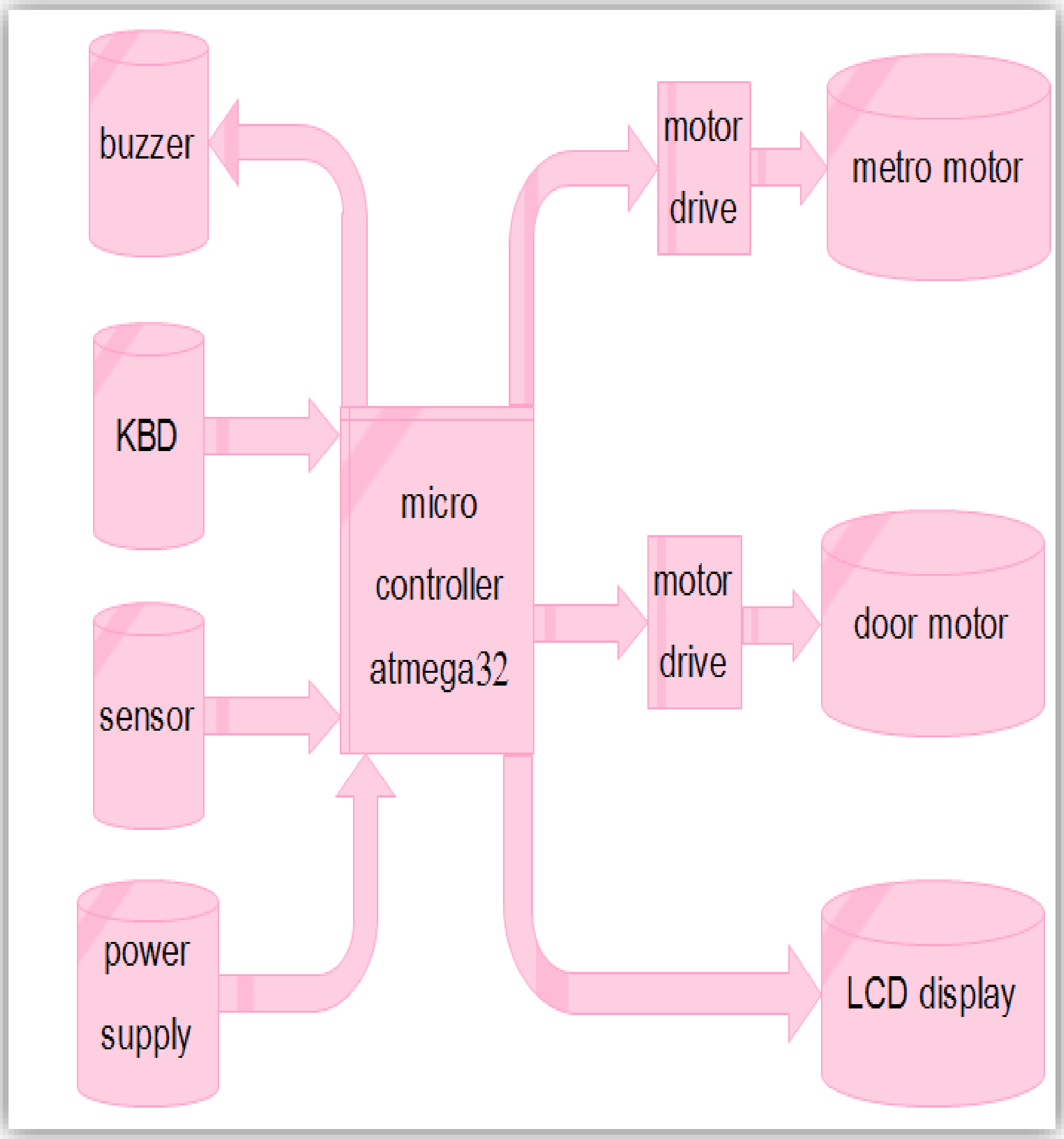


Figure 4.1 block diagram of metro train.

4.3 circuit diagram of metro train:

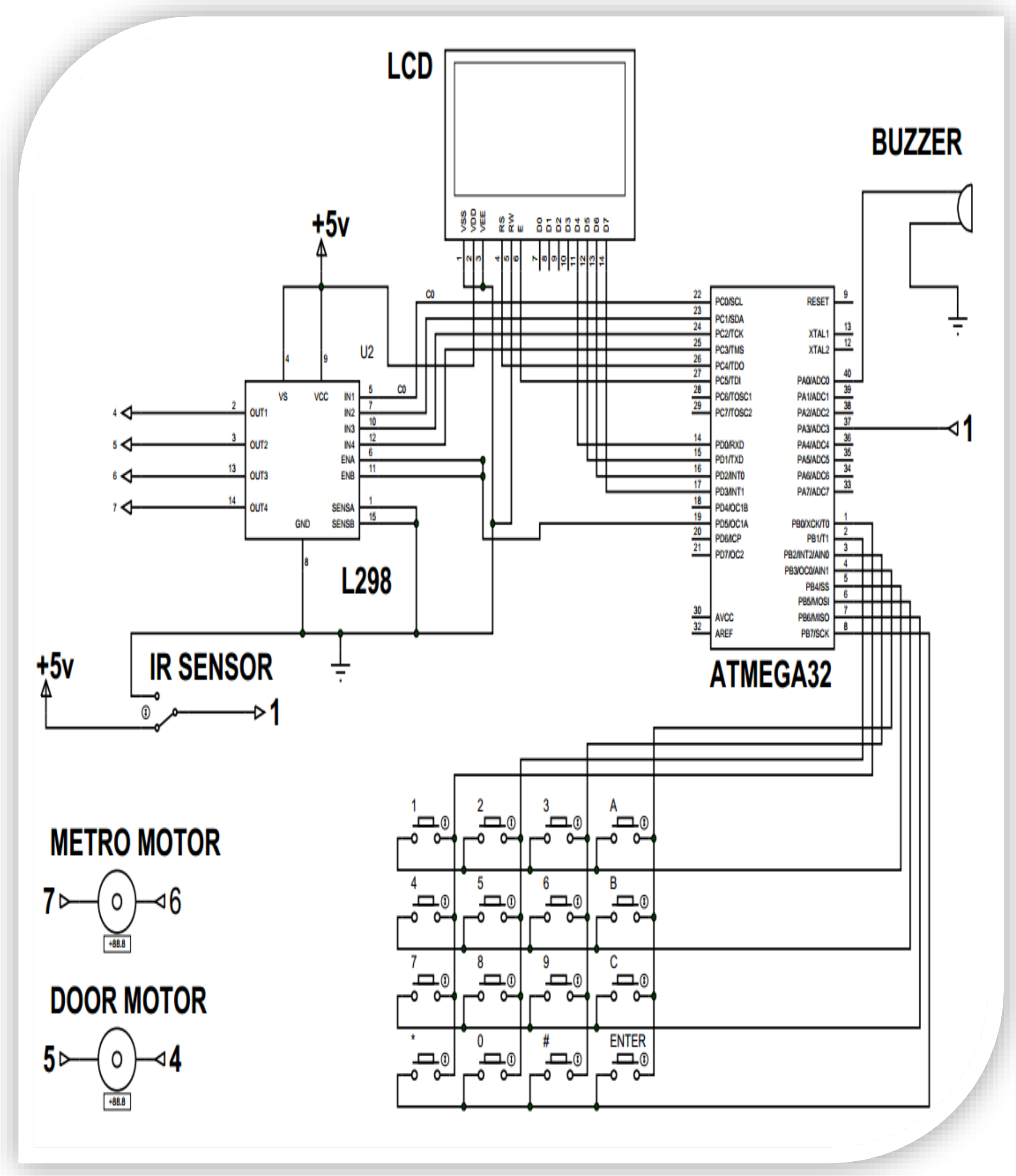
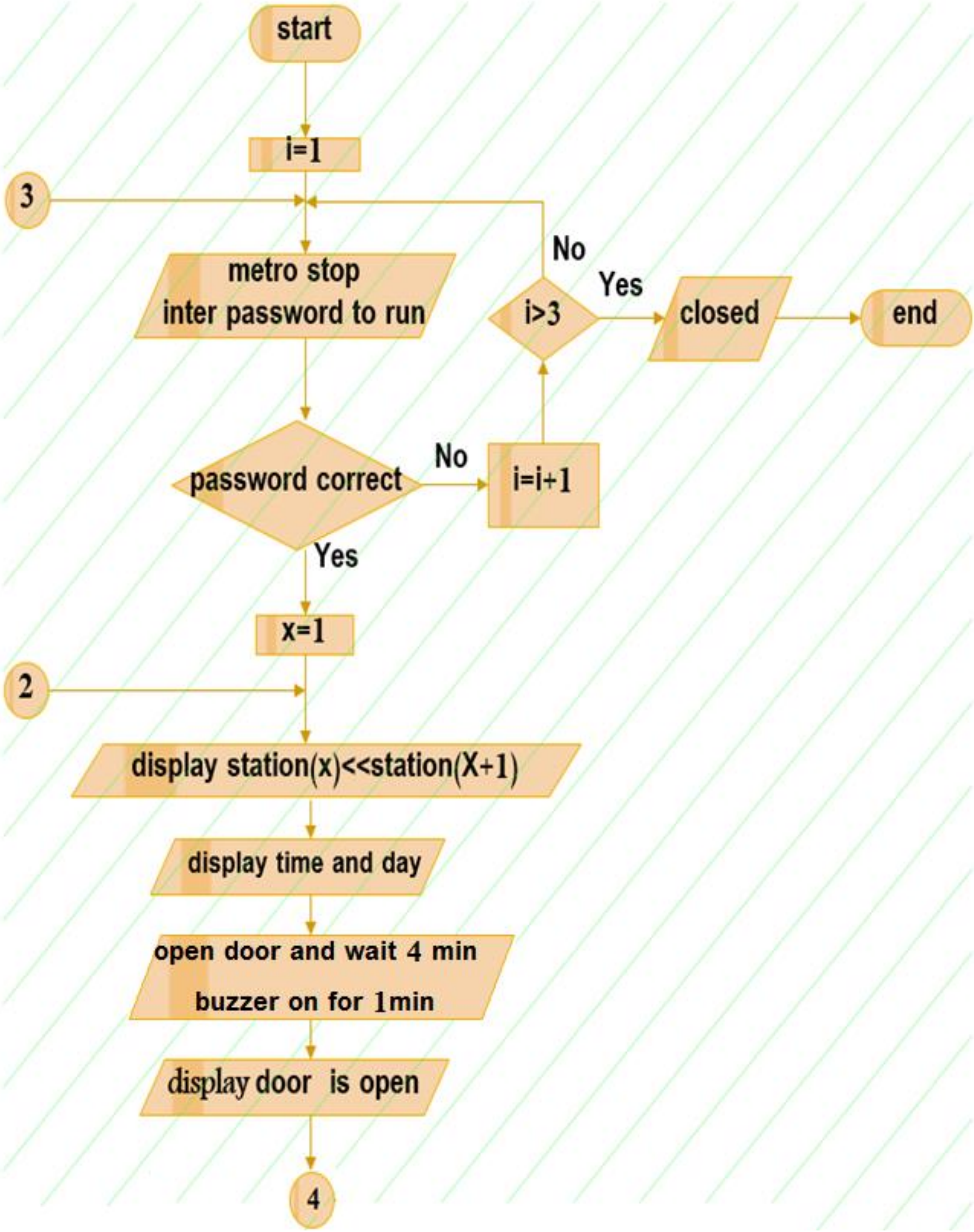
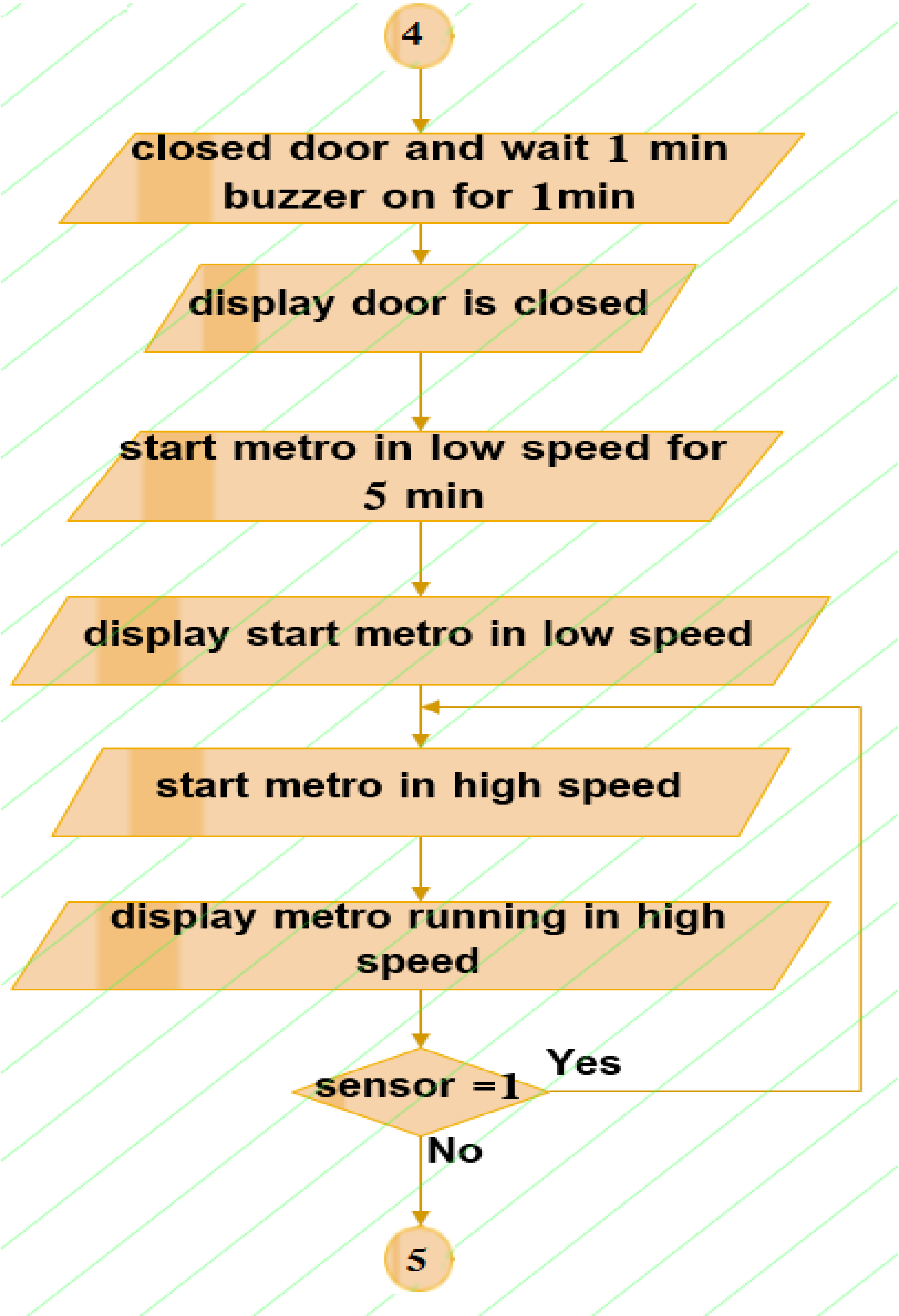
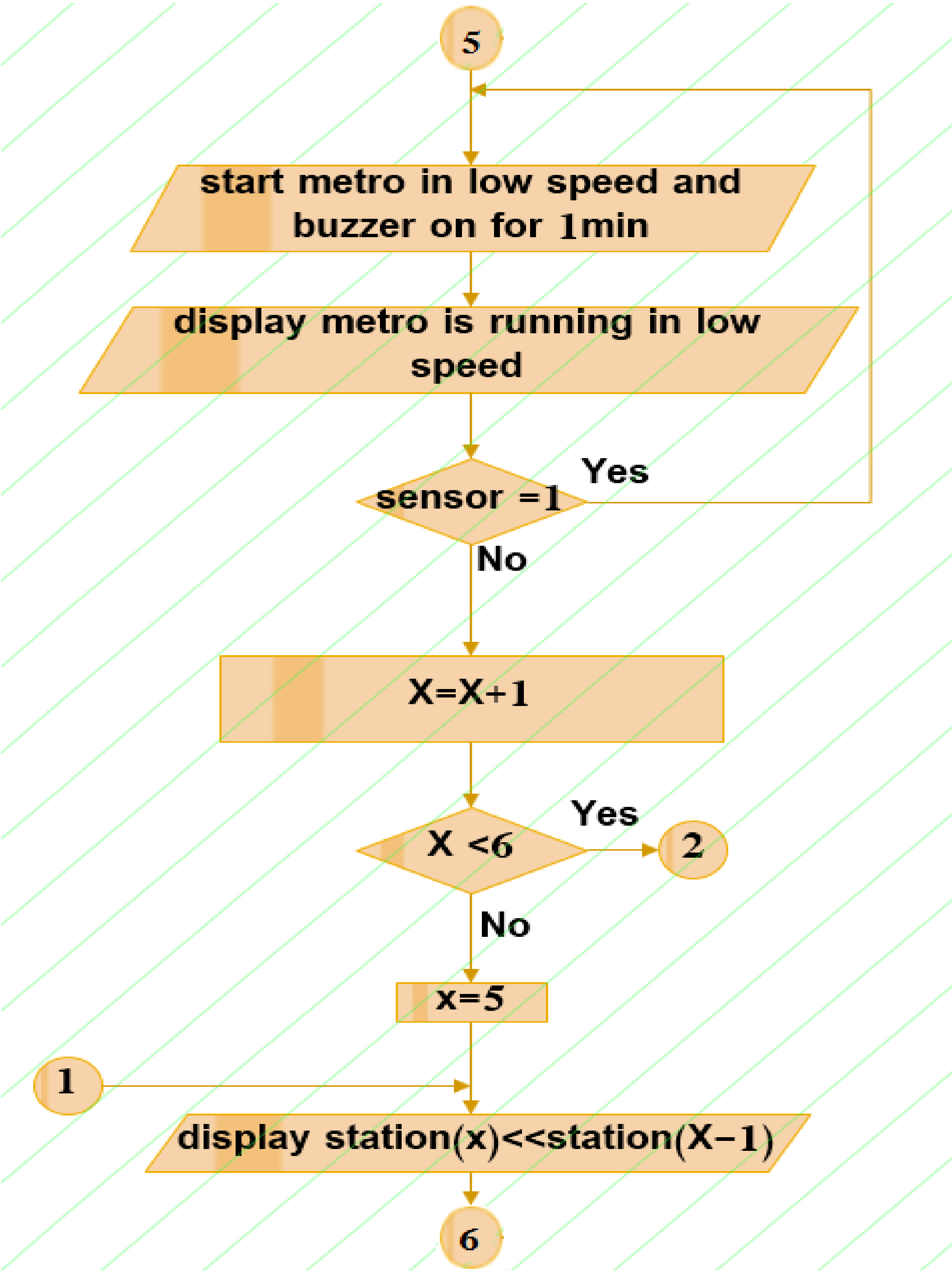


Figure 4.2 circuit diagram of metro train.

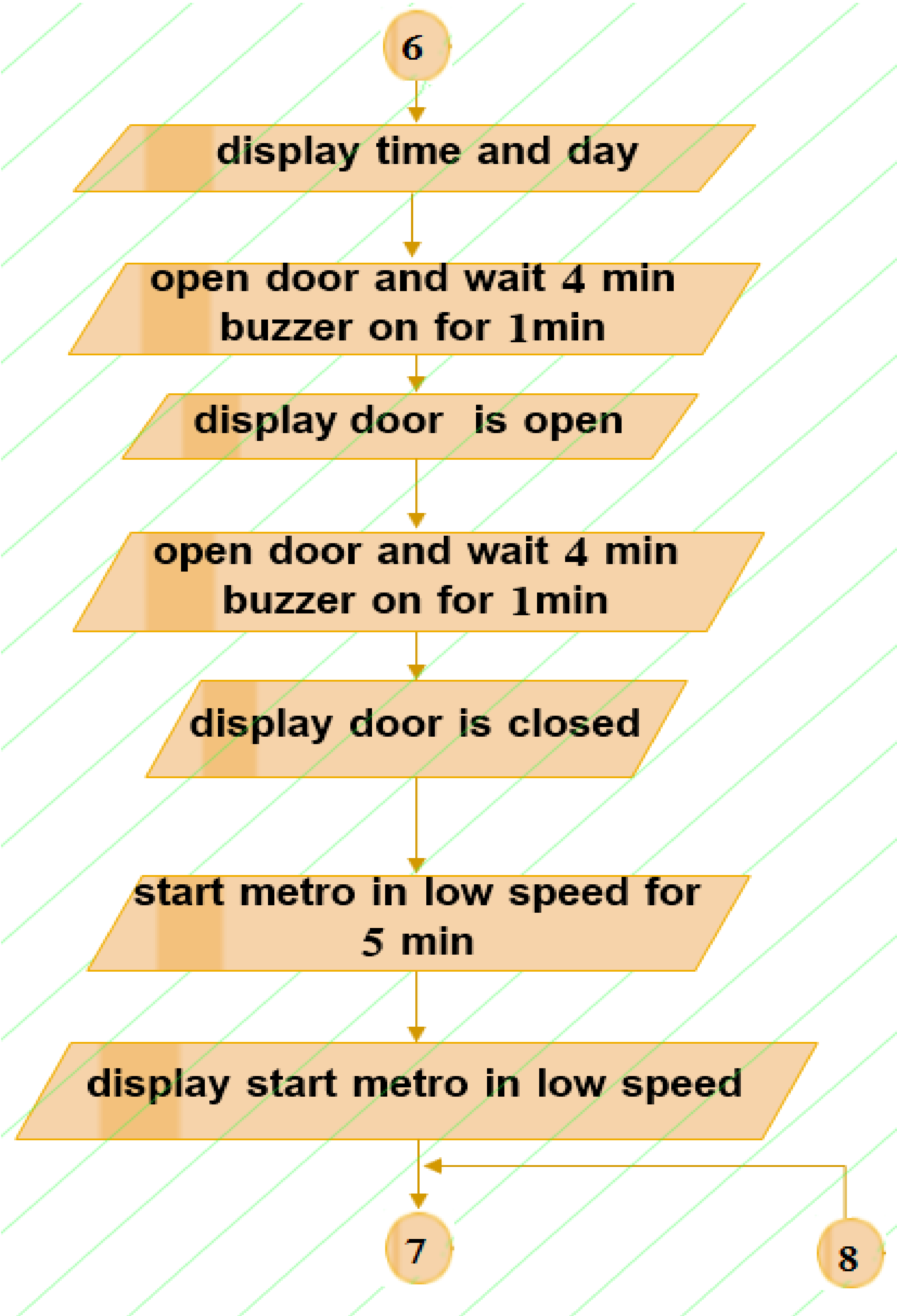
4.4 flow chart:




4
closed door and wait 1 min
buzzer on for 1min
display door is closed
start metro in low speed for
5 min
display start metro in low speed
start metro in high speed
display metro running in high
speed
sensor =1
Yes
No
5



5
start metro in low speed and buzzer on for 1min
display metro is running in low speed
sensor =1
Yes
No
X=X+1
X <6
Yes
2
No
x=5
1
display station(x)<<station(X-1)
6


6
display time and day
open door and wait 4 min
buzzer on for 1min
display door is open
open door and wait 4 min
buzzer on for 1min
display door is closed
start metro in low speed for
5 min
display start metro in low speed
7
8

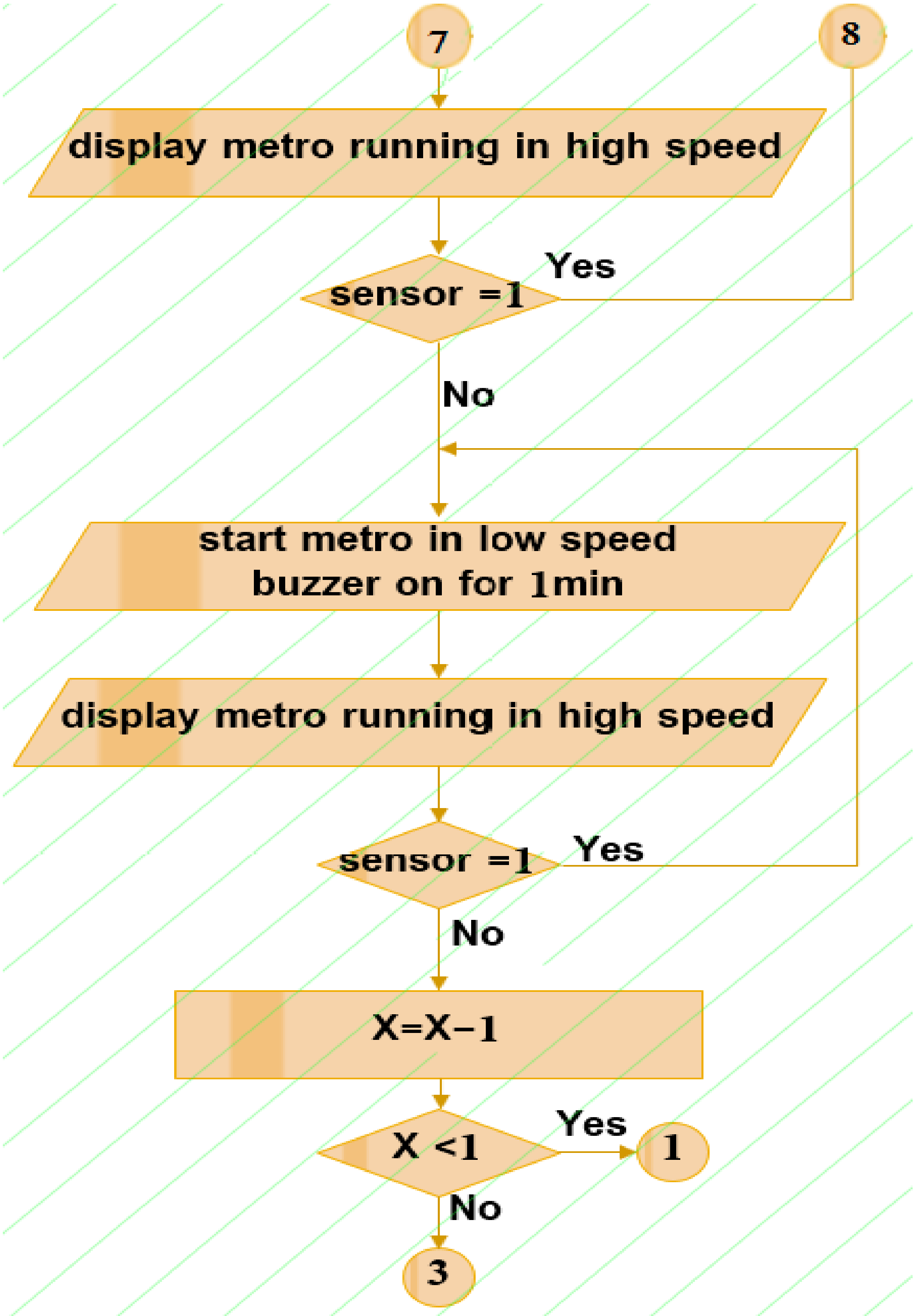


Figure 4.3 flow chart.

4.5 software requirement:-

We using in the thesis some program:

- Bascom avr
- protus

4.5.1 Bascom & AVR BASCOM-AVR:

Bascom & AVR BASCOM-AVR is four programs in one package, it is known as an IDE (integrated development environment) it includes the Program Editor, the Compiler, the Programmer and the Simulator all together.

4.5.1.1 Program Editor:

In it write the code of the program the Figure 4.4 show Program Editor.

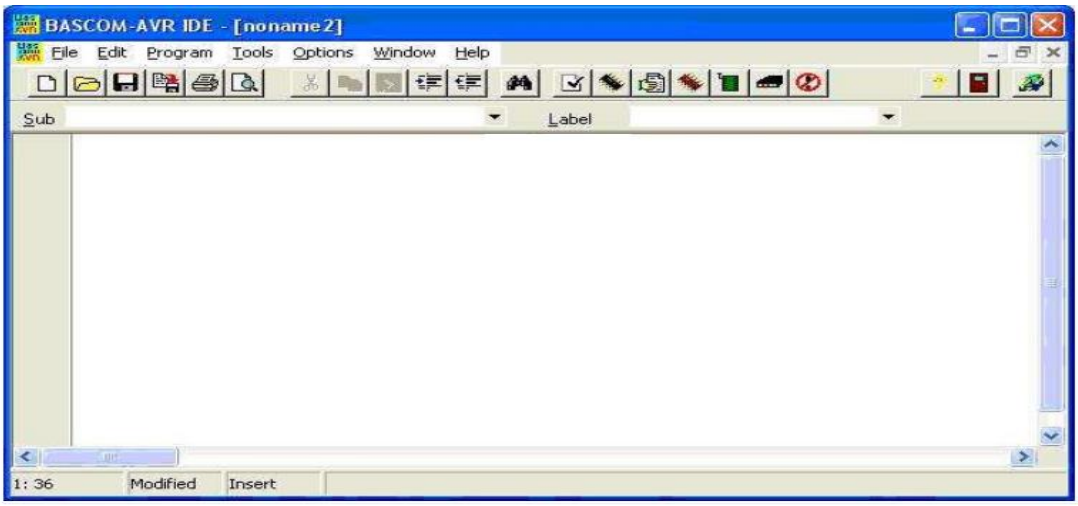


Figure 4.4 Editor Program of BASCOM-AVR.

4.5.1.2 The compiler:

The command to start the compiler is F7 or the black IC picture in the toolbar. This will change your high-level BASIC program into low-level machine code. If your program is in error then a compilation will not complete and an error box will appear. Double click on the error to get to the line which has the problem.

4.5.1.3 The programmer:

When you have successfully compiled a program pressing F4 or the green IC picture in the toolbar starts the programmer. If no microcontroller is connected an error will pop up. If the IC s connected then the BASCOM completes the programming process and automatically resets your microcontroller to start execution of your program.

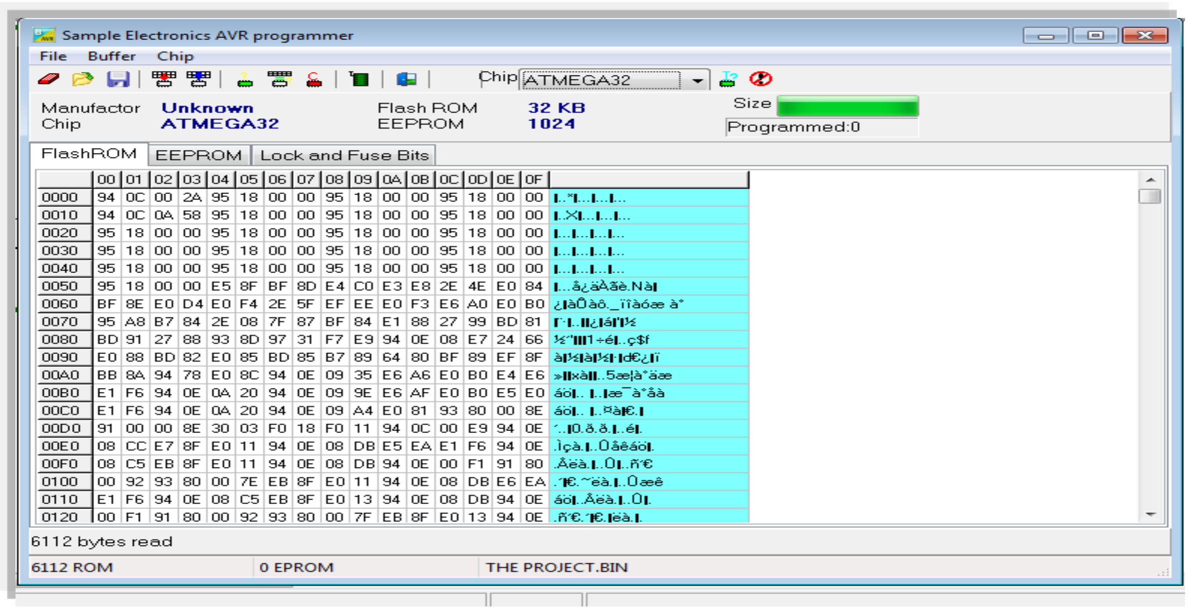


Figure 4.5 Editor Program of BASCOM-AVR.

4.5.1.4 The Bascom-AVR simulator:

Press F2 to pen the simulator Double click in the yellow area under the word VARIABLE to select the variables you want to watch. Press F8 to step through the program and see what happens to the value of the variable at each step.

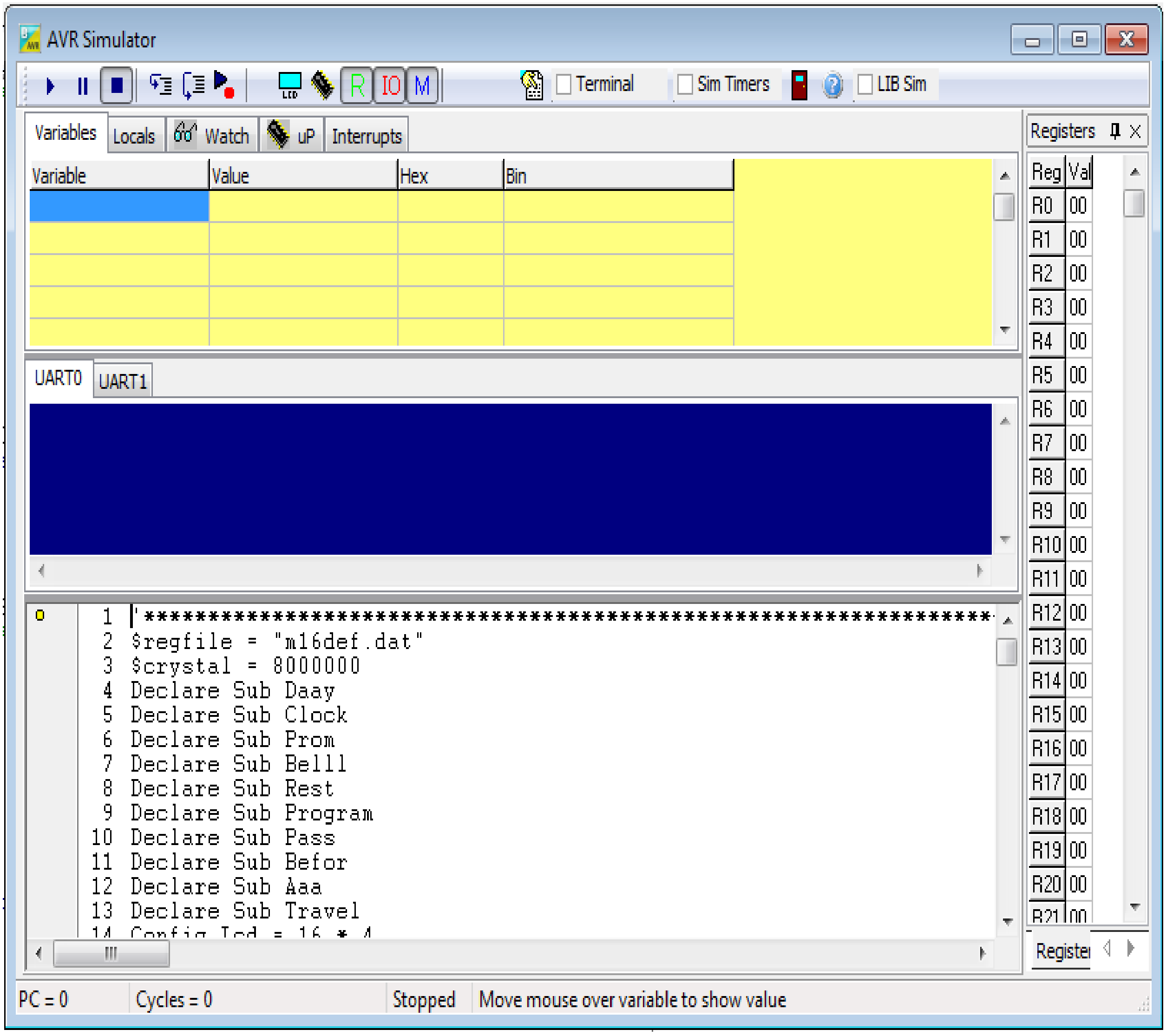


Figure 4.6 Editor Program of BASCOM-AVR.

4.6.2 Protius ISIS:

Proteus Virtual System Modelling (VSM) software offers the ability to co-simulate both high and low-level micro-controller code in the context mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs. For the first time ever, it is possible to develop and test such designs before a physical prototype is constructed.

With this Virtual System Modelling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development.

The designer can interact with the design using on screen indicators such as LED and LCD displays and actuators such, as switches and buttons. The simulation takes place in real time.

The most important feature of Proteus VSM is its ability to simulate the interaction between software running on a micro-controller and any analog or digital electronics connected to it.

The micro-controller model sits on the schematic along with the other elements of pro-duct design. It simulates the execution of designer object code (machine code), just like a real chip. If the program code writes to a port, the logic levels in circuit change accordingly, and if the circuit changes the state of the processor's pins, this will be seen by the program code, just

as in real systems [8].

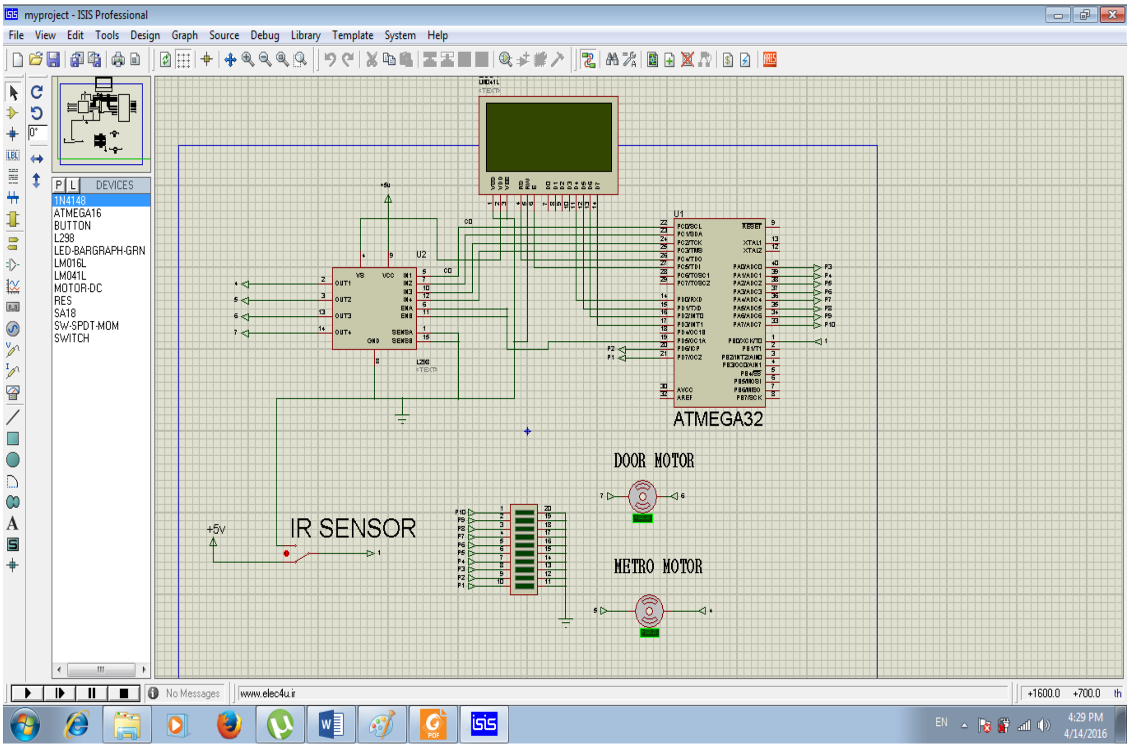


Figure 4.7 Simulation using Protus ISIS

Chapter Five

Simulation Result

5.1 Simulation Results:

When start metro Train simulation LCD will display inter password if you need running figure 5.1 show that.

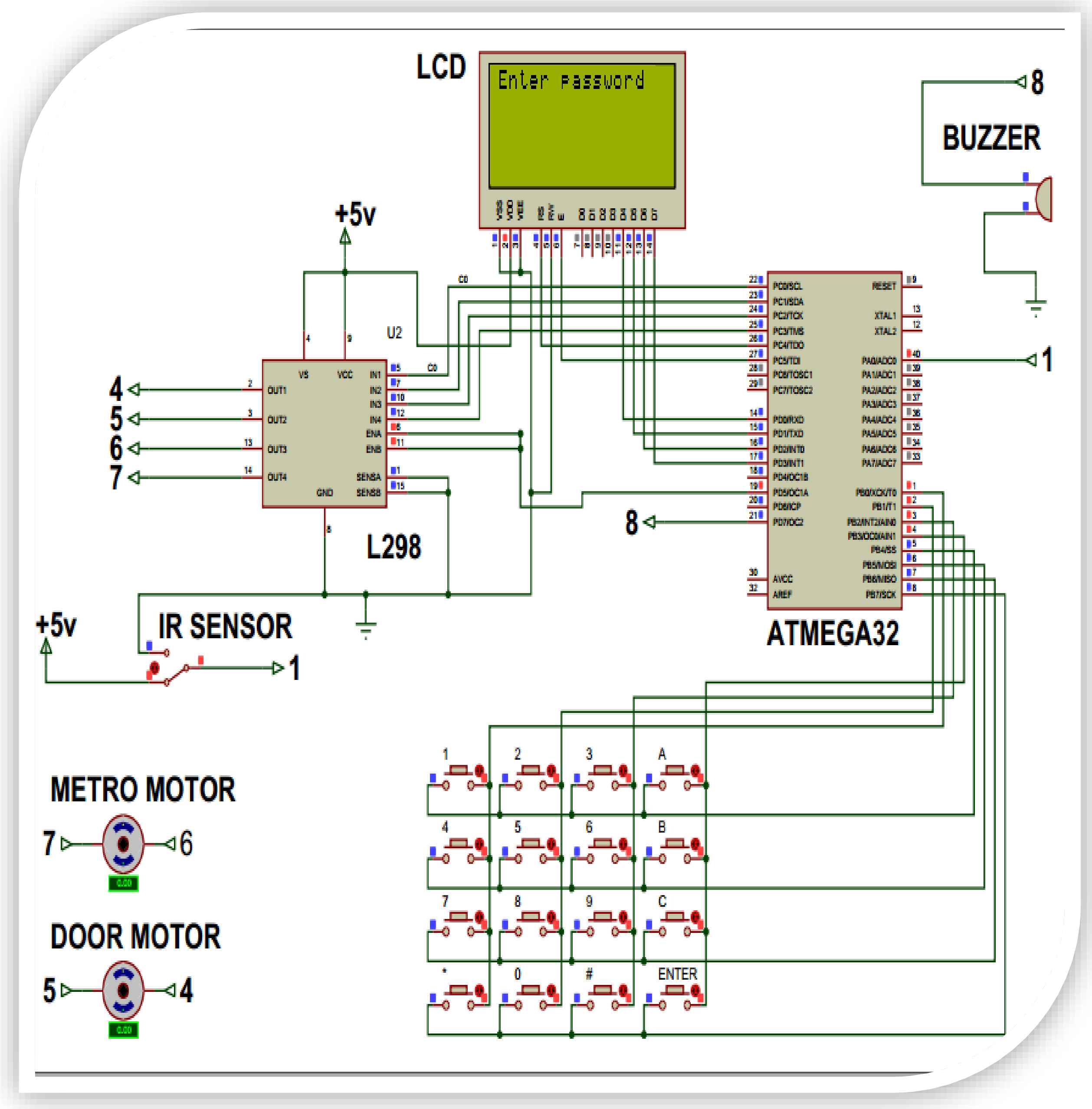


Figure 5.1 metro Train stopped.

If inter wrong password three chance display wrong password and closed program figure 5.2 show that.

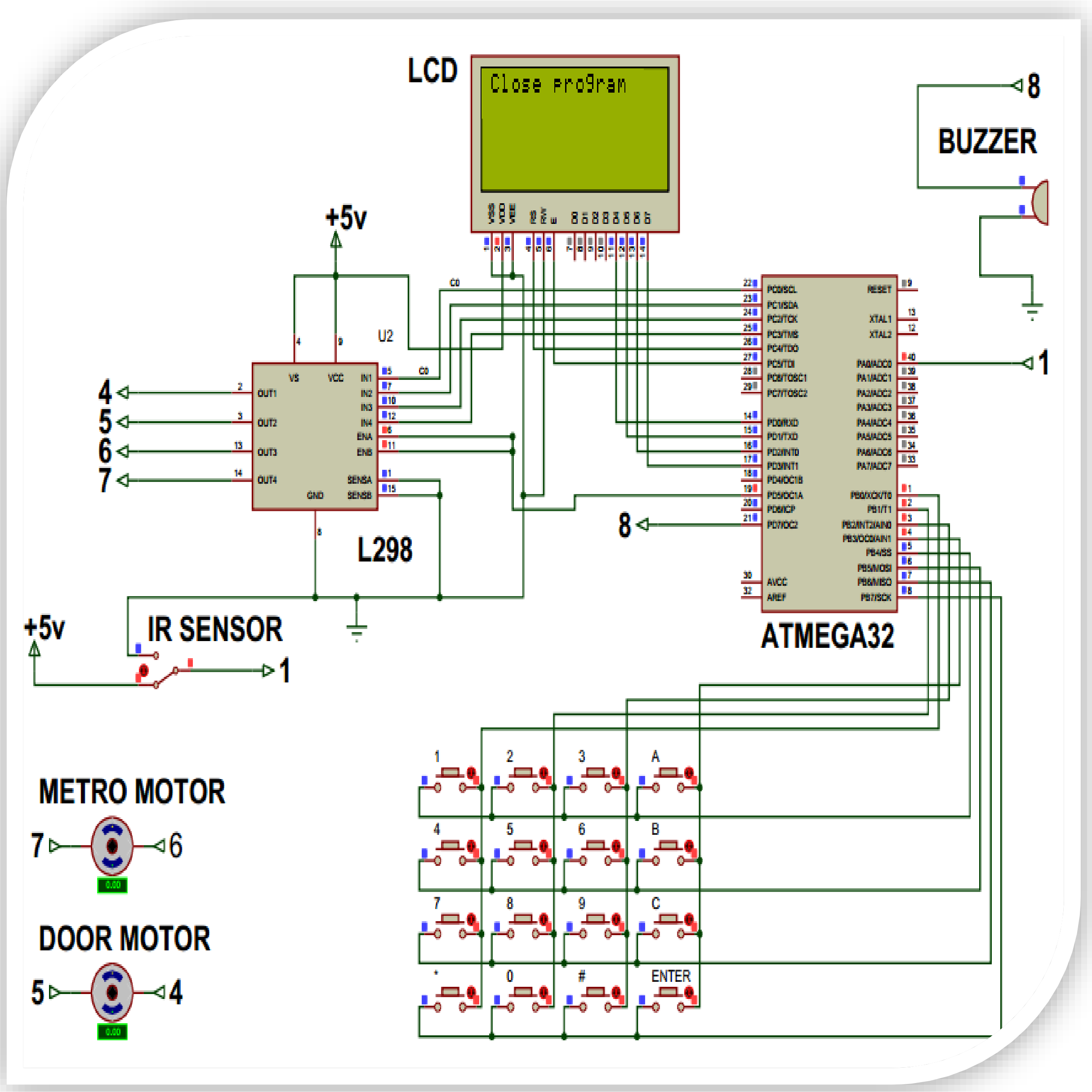


Figure 5.2 metro Train when inter wrong password.

If password correct buzzer on for one minute and door open and LCD will display door is open figure 5.3 show that.

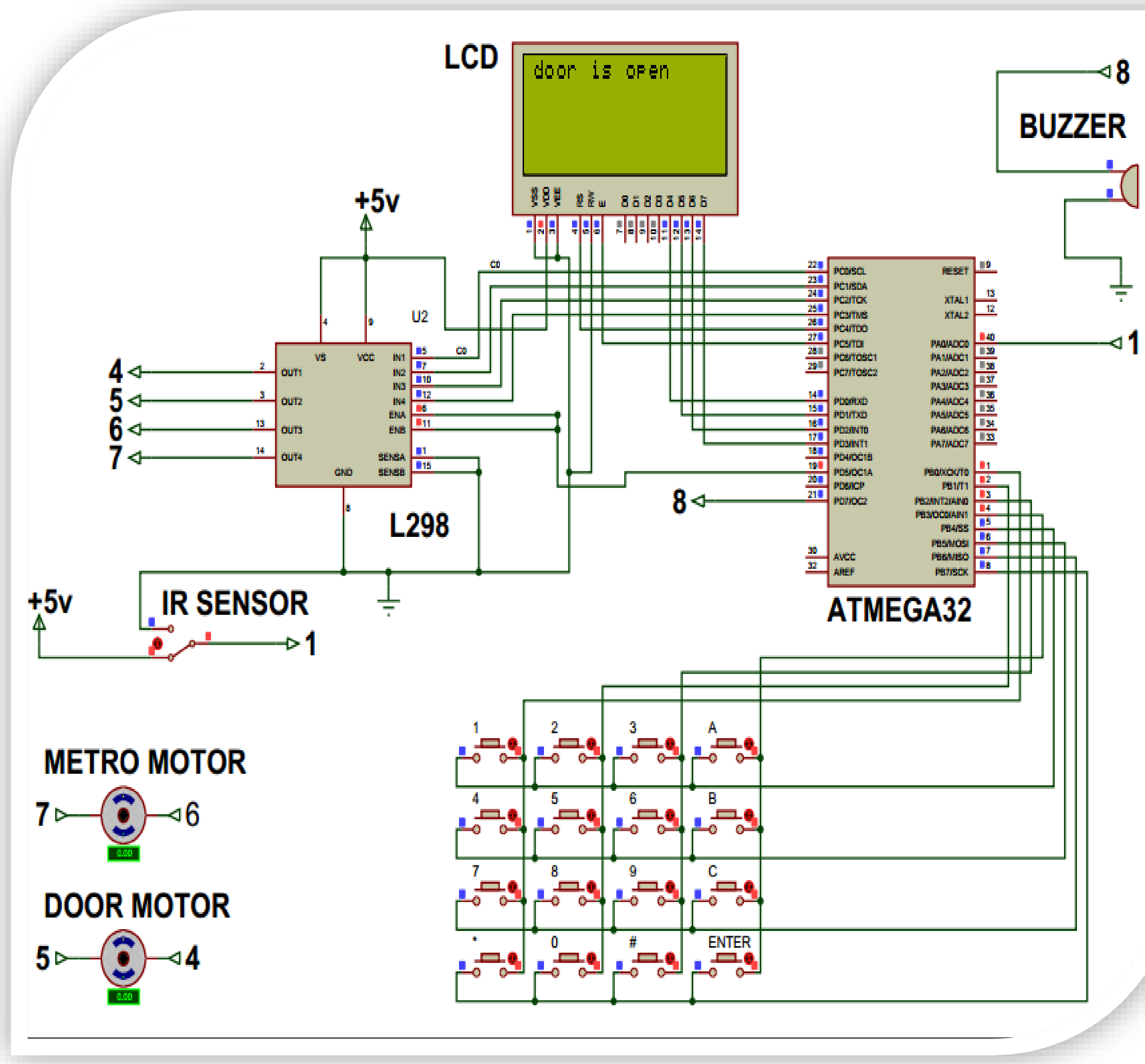


Figure 5.3 metro Train when inter correct password.

After that closed door, the buzzer on and LCD will display door is closed figure 5.4 show that.

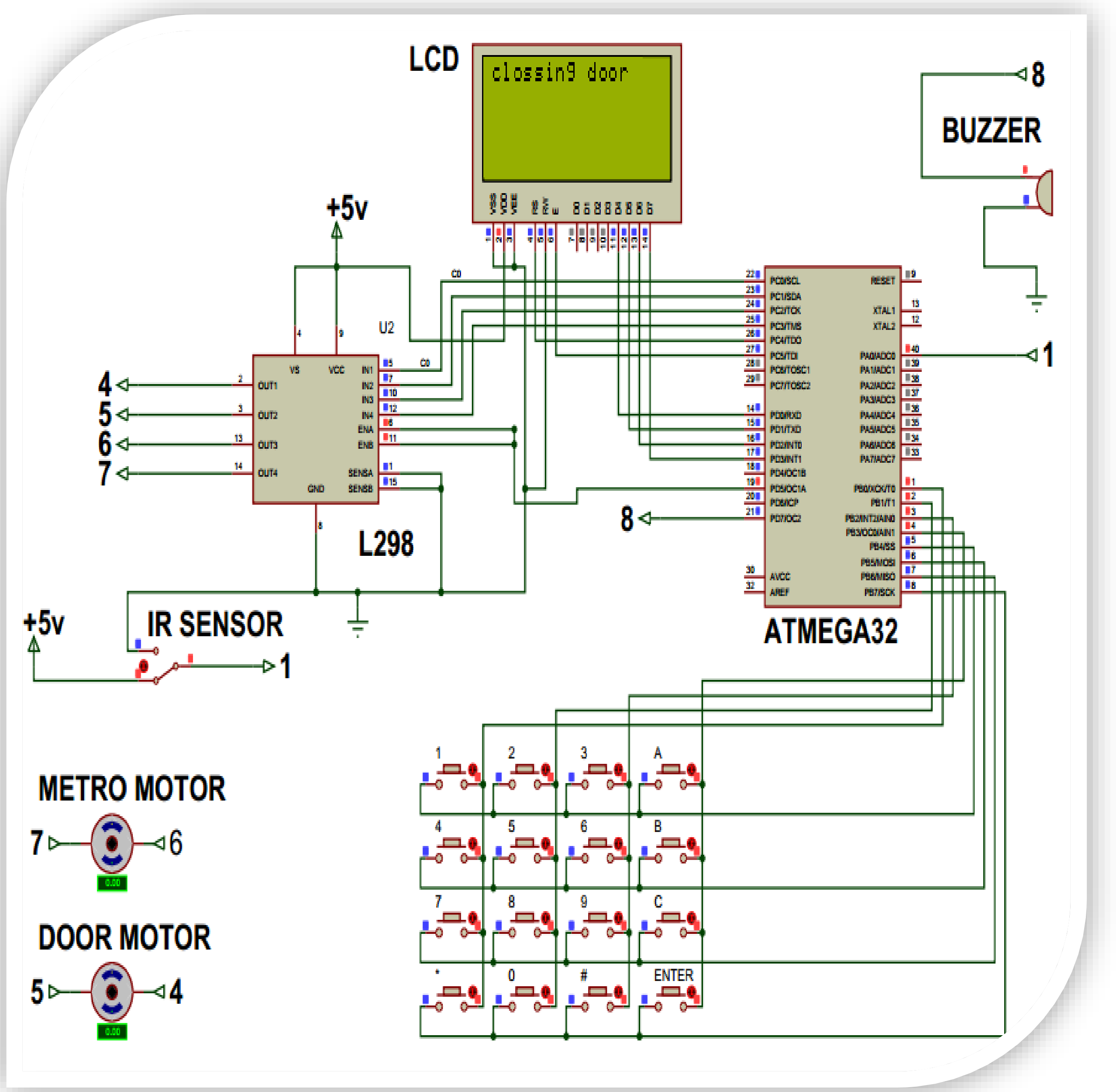


Figure 5.4 metro Train door system.

Metro Train start running in low speed after the door is closed LCD will display metro Train running in low speed figure 5.5 show that.

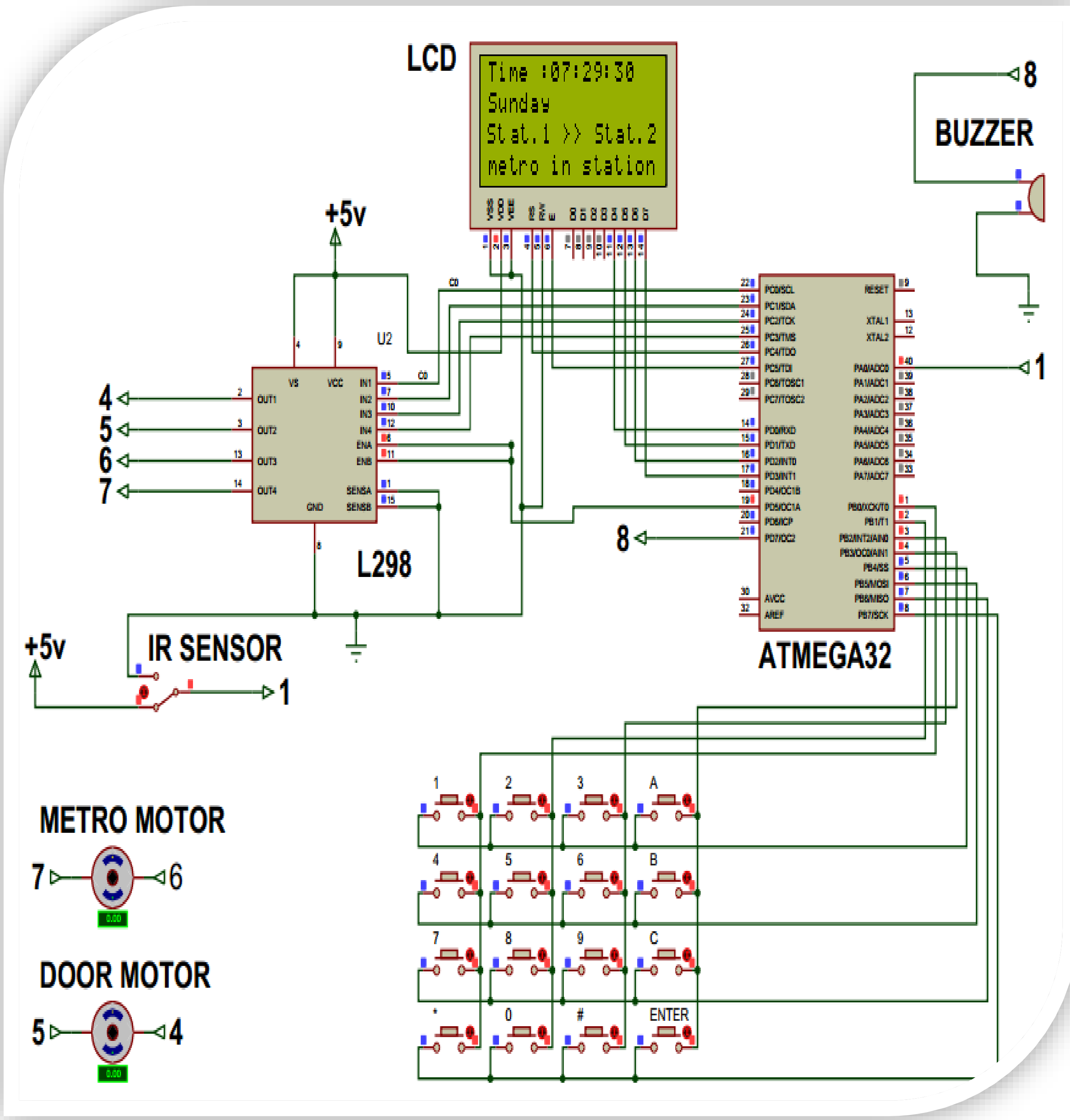


Figure 5.5 metro Train in station.

After metro Train go out current statin running in high speed and LCD will display

Metro Train running in high speed, display current station and next station figure 5.6 show that.

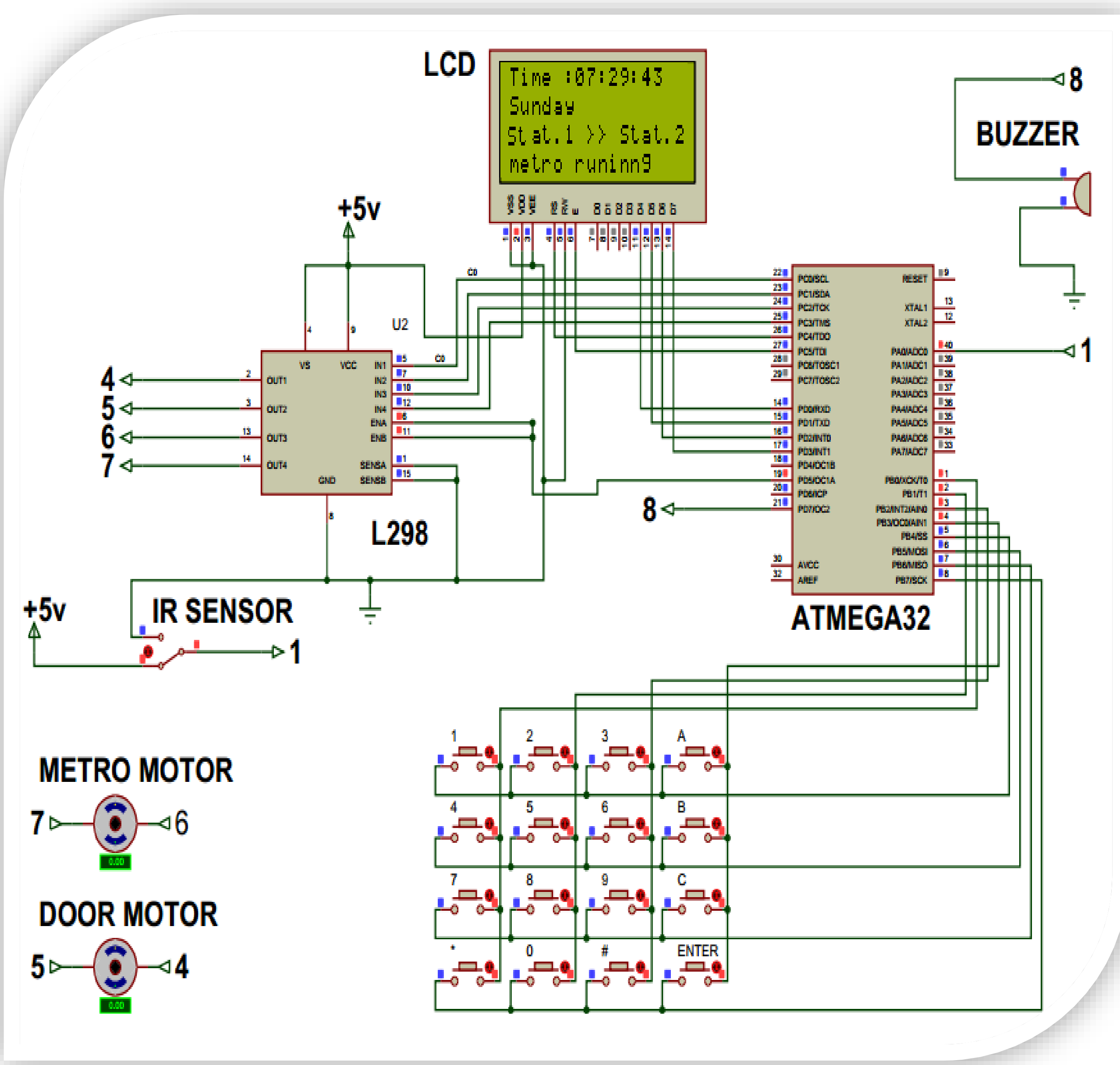


Figure 5.6 metro Train between two stations.

After metro Train arrive to next station running in low speed, the buzzer on and LCD will display metro Train running in low speed figure 5.7 show that.

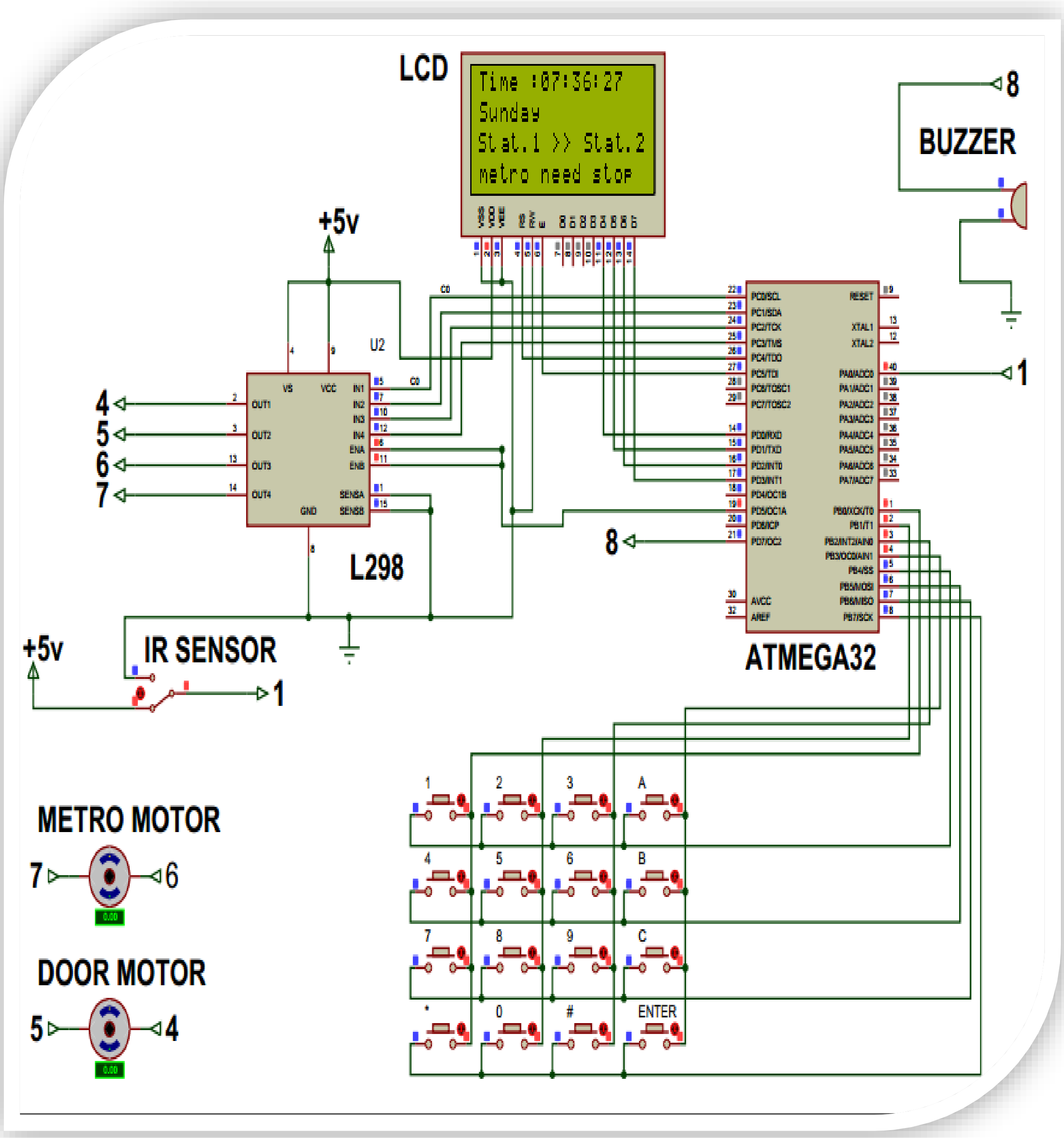


Figure 5.7 metro Train between two stations.

After metro Train arrive center of the next station stopped LCD will display metro Train stopped figure 5.8 show that.

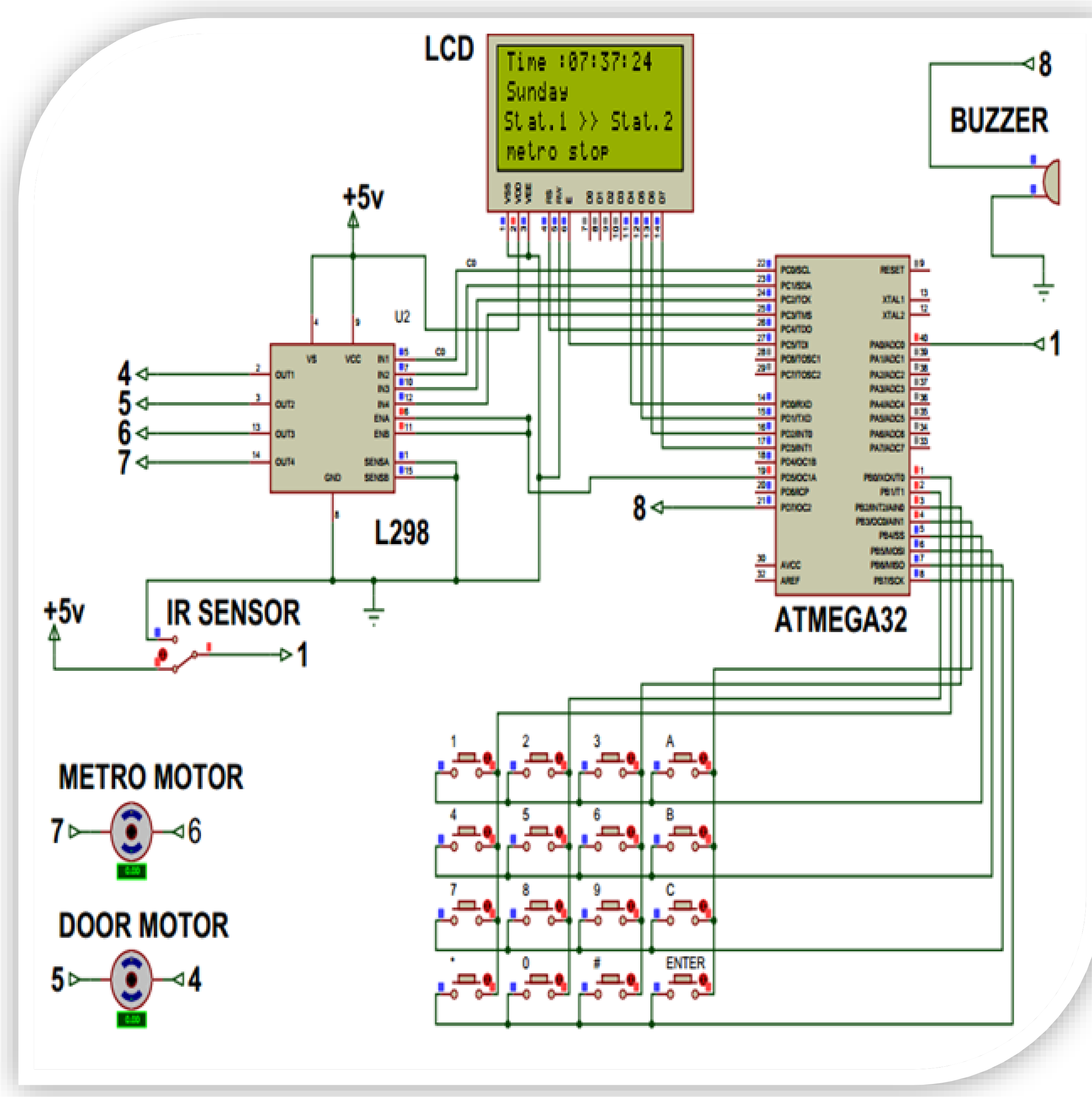


Figure 5.8 metro Train when arrive center of the next station.

After that repeat all above step to arrive last station after that reverse automatically figure 5.9 show that.

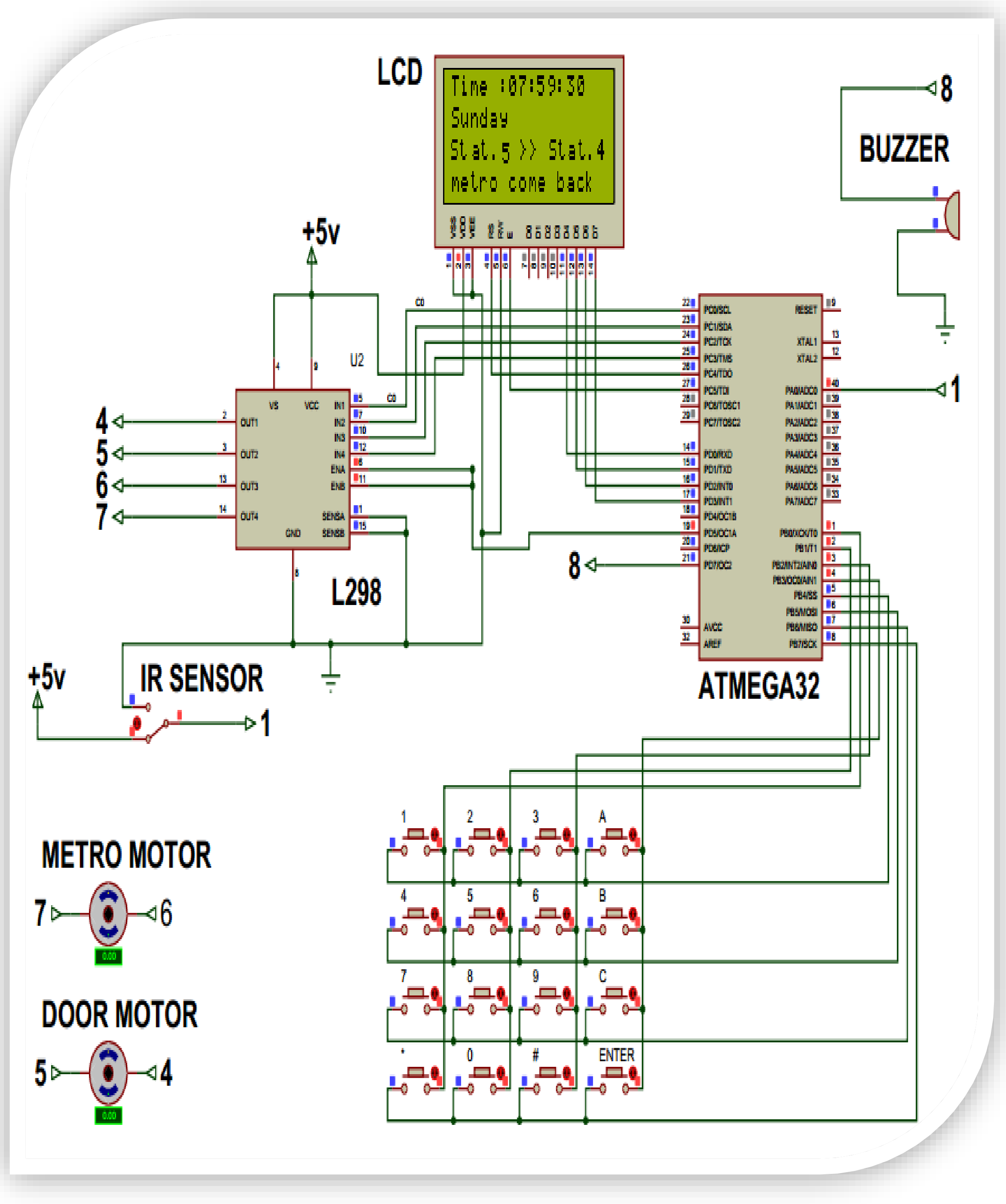


Figure 5.9 metro Train reverse automatically from last station.

Chapter Six

Conclusion & Recommendations

5.1 conclusion:

Fully Automatic metro train system less time delays without the need for operational staff, and safety where the element of human error is taken out completely.

5.2 recommendation:

Each and every thesis is never complete as new things are learned further modifications can be done. There are always remains an infinite scope of improvement to a system design. It’s only the time and financial constraints that impose a limit on the development. Following are the few enhancements that may add further value to the system.

- Using other sensor because have small range detect and using more than one sensor.
- Using GSM module to show immediately point that metro in it and send this
  point to the all station to help passenger know where the metro train know.
- Using break to stop in point that in design.

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[13] http://www.futurlec.com/LED/LCD16X4BL.shtml

[14] www.alldatasheet.com/view.jsp?Searchword=L293&sField=1

[15]http://category.alldatasheet.com/index.jsp?sSearchword=IR%20SENSOR

Appendix (A)

Bascom Program Code

```
‘TITLE       : AUTOMATION OF METRO TRAIN TRAFFIC.
'   NAME    : ALMAHI OSMAN MOHAMMED ALMAHI.
'BATCH     : 07.
'PROGRAM           : M.SC IN MECHATRONIC.
'CONTROLLER     : ATMEGA32.
'*********************************************************************
$regfile = "m32def.dat"
$crystal = 1000000
Config Lcd = 16 * 4
Config Lcdpin = Pin , Db4 = Portd.0 , Db5 = Portd.1 , Db6 = Portd.2 , Db7 = Portd.3 ,
Rs = Portc.4 , E = Portc.5
Config Kbd = Portb , Debounce = 10000
Config Timer1 = Pwm , Pwm = 8 , Compare A Pwm = Clear Down , Prescale = 1024
Declare Sub Metrotrain
Declare Sub Prog
Declare Sub Pass
Declare Sub Aaa
Declare Sub Doordec
Declare Sub Doorinc
Declare Sub Startmetro
Declare Sub Stopmetro
Declare Sub Inversemetro
Declare Sub Door
Declare Sub Station
Config Clock = Soft
```

```
Config Date = Dmy , Separator = /
Config Porta = Input
Config Portb = Input
Config Pinc.0 = Output
Config Pinc.1 = Output
Config Pinc.2 = Output
Config Pinc.3 = Output
Config Pind.6 = Output
'*********************************************************************
Dim Div As Byte
Dim A As Word
Dim Var1 As Byte
Dim Alma As Byte
Dim B As Bit
Dim C As Byte
Dim D As Byte
Dim M As Byte
Dim X As Word
Dim Y As Byte
Dim Z As Byte
Dim Dayinweek As Byte
Dim Strweekday As String * 8
Dim Q As Byte
Dim W As Byte
Dim G As Byte
Dim O As Byte
Dim Al As Byte
```

```
Dim Hi As Byte

Dim I As Byte

Dim H As Byte

Dim Ss As Byte

Dim Mm As Byte

Dim Dd As Byte

Dim Hh As Byte

Enable Interrupts

Cursor Off

'***********************************************************************

Time$ = "07:59:50"

Ss = _sec

Mm = _min

Hh = _hour

Lcd "     Welcome"

Wait 5

'***********************************************************************

Alma = 10

Call Prog

For O = 1 To 3

Cls

Locate 1 , 1

Lcd "Enter password"

Locate 2 , 1

Call Pass

X = H

Locate 2 , 1
```

```
Lcd "*"
Locate 2 , 3
Call Pass
Y = H
Locate 2 , 3
Lcd "*"
Locate 2 , 5
Call Pass
Z = H
Locate 2 , 5
Lcd "*"
Cls
If X = 1 And Y = 2 And Z = 3 Then
Lcd "     Welcome"
Waitms 1000
'*****************************************************************
Call Prog

Else
Lcd "Error"
Waitms 1000
Next
Cls
Lcd "Close program"
Waitms 1000
End If
End
```

```
'**********************************************************************
Sub Prog
B = 0
Portc.0 = 0
Portc.1 = 0
Portc.2 = 0
Portc.3 = 0
Call Aaa
Call Door
Portc.2 = 0
Portc.3 = 1
Locate 3 , 1 : Lcd " Stat.1 - Stat.2"
Call Station
Portc.2 = 0
Portc.3 = 1
Locate 3 , 1 : Lcd " Stat.2 - Stat.3"
Call Station
Portc.2 = 0
Portc.3 = 1
Locate 3 , 1 : Lcd " Stat.3 - Stat.4"
Call Station
Portc.2 = 0
Portc.3 = 1
Locate 3 , 1 : Lcd " Stat.4 - Stat.5"
Call Inversemetro
Call Station
Portc.2 = 1
```

```
Portc.3 = 0
Locate 3 , 1 : Lcd " Stat.5 - Stat.4"
Call Station
Portc.2 = 1
Portc.3 = 0
Locate 3 , 1 : Lcd " Stat.4 - Stat.3"
Call Station
Portc.2 = 1
Portc.3 = 0
Locate 3 , 1 : Lcd " Stat.3 - Stat.2"
Call Station
Portc.2 = 1
Portc.3 = 0
Locate 3 , 1 : Lcd " Stat.2 - Stat.1"
Call Station
End Sub
'********************************************************************
Sub Pass
H = 0
Do
Waitms 300
Q = Getkbd()
W = Lookup(q , Data)
If W = 1 Then
Lcd "1"
H = 1
Elseif W = 2 Then
```

```
Lcd "4"
Elseif W = 3 Then
Lcd "7"
Elseif W = 4 Then
 Lcd "*"
Elseif W = 5 Then
Lcd "2"
H = 2
Elseif W = 6 Then
Lcd "5"
Elseif W = 7 Then
Lcd "8"
Elseif W = 8 Then
Lcd "0"
Elseif W = 9 Then
Lcd "3"
H = 3
Elseif W = 10 Then
Lcd "6"
Elseif W = 11 Then
Lcd "9"
Elseif W = 12 Then
Lcd "#"
Elseif W = 13 Then
Lcd "A"
Elseif W = 14 Then
Lcd "B"
```

```
Elseif W = 15 Then
Lcd "C"
 Elseif W = 16 Then
Lcd " "
End If
Loop Until W = 16
End Sub
'**********************************************************************
Weekdays:
Data "Monday          " , "Tuesday         " , "Wednesday       " , "Thursday        " , "Friday          " , "Saturday        " , "Sunday          "
Data:
Data 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 11 , 12 , 13 , 14 , 15 , 16
'***********************************************************************
Sub Startmetro
  If A >= 250 Then
  A = 250
  Pwm1a = A
  Else
  A = A + 20
  Pwm1a = A
  Waitms 100
  End If
End Sub
'***********************************************************************
Sub Stopmetro
  If A <= 20 Then
```

```
  A = 20
  Pwm1a = A
  Waitms 100
  Else
  A = A - 20
  Pwm1a = A
  Waitms 100
  End If
End Sub
'**********************************************************************
Sub Door
Portc.0 = 0
Portc.1 = 0
Portd.6 = 1
Cls
     Locate 1 , 1 : Lcd " door will open"
     Locate 2 , 1 : Lcd "   after few   "
     Locate 3 , 1 : Lcd " sec  pasenger "
     Locate 4 , 1 : Lcd "   becarefull  "
Wait 5
Portd.6 = 0
    A = 250
    Pwm1a = A
    Portc.0 = 0
    Portc.1 = 1
  Do
  If A >= 250 Then
```

```
  A = 250
  Pwm1a = A
  Else
   A = A + 10
  Pwm1a = A
  Waitms 1
  End If
  Loop Until A = 250
Waitms 2500
    Portc.0 = 0
    Portc.1 = 0
    Cls
    Locate 1 , 1 : Lcd "door open please"
    Locate 2 , 1 : Lcd "pasenger arrive"
    Locate 3 , 1 : Lcd "  Go Out  "
Var1 = 0
Do
If Alma > 0 Then
Call Doordec
Else
Var1 = 20
End If
Locate 4 , 1 : Lcd "no pasenger:"
Locate 4 , 13 : Lcd Alma
Loop Until Var1 = 20
    Cls
    Locate 1 , 1 : Lcd "door open please"
```

```
     Locate 2 , 1 : Lcd "pasenger travell"
     Locate 3 , 1 : Lcd "    welcome  "
Var1 = 0
Do
If Alma < 250 Then
Call Doorinc
Else
Var1 = 20
End If
Locate 4 , 1 : Lcd "no pasenger:"
Locate 4 , 13 : Lcd Alma
Loop Until Var1 = 20
Portd.6 = 1
      Cls
      Locate 1 , 1 : Lcd "door will closs"
      Locate 2 , 1 : Lcd "   after few  "
      Locate 3 , 1 : Lcd " sec  pasenger "
      Locate 4 , 1 : Lcd "   becarefull  "
Wait 5
Portd.6 = 0
     A = 250
     Pwm1a = A
     Portc.0 = 1
     Portc.1 = 0
Do
   If A >= 250 Then
   A = 250
```

```
   Pwm1a = A
   Else
   A = A + 10
   Pwm1a = A
   Waitms 1
   End If
   Loop Until A = 250
Waitms 2500
      Portc.0 = 0
      Portc.1 = 0
      Cls
      Locate 1 , 1 : Lcd "door is clossed"
      Locate 2 , 1 : Lcd "metro will start"
      Locate 3 , 1 : Lcd "   pasenger "
      Locate 4 , 1 : Lcd "   becarefull  "
       Wait 5
Portd.6 = 1
Wait 5
Portd.6 = 0
Cls
Call Aaa
End Sub
'*************************************************************************
Sub Inversemetro
   Lcd "metro come back"
   If B = 0 Then
      B = 1
```

```
    Portc.2 = 0
    Portc.3 = 1
  Elseif B = 1 Then
    B = 0
    Portc.2 = 1
    Portc.3 = 0
  End If
  Waitms 500
End Sub
'*********************************************************************
Sub Station
'*********************************************************************
Do
Call Aaa
Lcd "metro in station"
A = 20
  If A >= 250 Then
  A = 250
  Pwm1a = A
  Else
  A = A + 10
  Pwm1a = A
  Waitms 100
  End If
Waitms 100
Loop Until Pina.0 = 0
Waitms 2000
```

```
'*********************************************************************
Do
Locate 4 , 1 : Lcd "metro out station   "
Call Aaa
Call Startmetro
Loop Until Pina.1 = 0
Waitms 1000
Do
Locate 4 , 1 : Lcd "metro need stop    "
Call Aaa
Call Stopmetro
Loop Until Pina.2 = 0
Portc.2 = 0
Portc.3 = 0
Waitms 1000
Call Aaa
Locate 4 , 1 : Lcd "                    "
Locate 4 , 1 : Lcd "metro stop     "
Wait 4
Call Door
End Sub
'*********************************************************************
Sub Aaa
Locate 1 , 1
Lcd "Time :"
Locate 1 , 7
Lcd Hh
```

```
Locate 1 , 9
Lcd ":"
Locate 1 , 10
Lcd Mm
Locate 1 , 12
Lcd ":"
Locate 1 , 13
Lcd Ss
Locate 1 , 15
Lcd "   "
If Hh < 10 Then
Locate 1 , 7
Lcd "0"
Locate 1 , 8
Lcd Hh
End If
If Ss < 10 Then
Locate 1 , 13
Lcd "0"
Locate 1 , 14
Lcd Ss
End If
If Mm < 10 Then
Locate 1 , 10
Lcd "0"
Locate 1 , 11
Lcd Mm
```

```
End If
Incr Ss
If Ss > 59 Then
Ss = 00
Incr Mm
End If
If Mm > 59 Then
Mm = 00
Incr Hh
End If
If Hh > 23 Then
Hh = 00
End If
Dayinweek = Dayofweek()
Strweekday = Lookupstr(dayinweek , Weekdays)
Locate 2 , 1 : Lcd Strweekday
Waitms 500
End Sub
'**********************************************************************
Sub Doorinc
If Pina.4 = 0 And Alma < 250 Then
Alma = Alma + 1
Waitms 500
Var1 = Var1 + 1
Else
Alma = Alma
Var1 = Var1 + 1
```

```
Waitms 500

End If

End Sub

'****************************************************************************

Sub Doordec

If Pina.3 = 0 And Alma > 0 Then

Alma = Alma - 1

Waitms 500

Var1 = Var1 + 1

Else

Alma = Alma

Var1 = Var1 + 1

Waitms 500

End If

End Sub

'****************************************************************************
```