Sudan University of Seince and Technology

College of Engineering

School of Electronics Engineering

Medicine Dispensing Machine

(Design and implementation)

A Research Submitted In Partial fulfillment for the Requirements of the Degree of B.Sc. (Honors) in Electronics Engineering

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الآيـــــــة

قال تعالى:

﴿اللَّهُ نُورُ السَّمَوَتِ وَالْأَرْضِ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِن شَجَرَةٍ مُّبَارَكَةٍ زَيْتُونِةٍ لَّا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُّورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَن يَشَاءُ ويضرب الله الأمثال للناس والله بكل شيء عليم﴾

سورة النور – الآية 35

Dedication

This research paper is lovingly dedicated to our respective parents who have been our constant source of inspiration. They have given us the drive and discipline-e to tackle any task with enthusiasm and determination. Without their love and support this project would not have been made possible.

Acknowledgement

We offer our deepest thanks, gratitude, appreciation and love to those who carried the holiest message in life. To those who paved our path through science and knowledge. To all our school of electronics engineering distinguished teachers and special thanks and appreciation for our project supervisor **Dr. fadul Ahmed.** We also thanks all those who helped us and provided us with the necessary information to complete this search:

- **Dr. Alaa aldeen Awouda.**
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Abstract

It is necessary to provide medication to the aged in time. Automatic medication dispenser will be designed specifically for users who take medications without close professional supervision. It relieves the user of the error-prone tasks of administering wrong medicine at wrong time.

A required information about microcontroller interfaced with alphanumeric keypad, an LED display, a Motor Controller, an Alarm system, a multiple pill container and dispenser will be collected firstly. Then the design will be modeled and simulated using software programs such as Proteus to -simulate the circuit and Bascom AVR to program the microcontroller.

The major objective is to keep the device simple and cost efficient. The software used is reliable and stable. Elderly population can benefit from this device as it avoids expensive in-home medical care.

المستخلص

من الضروري توفير الدواء للمسنين في الوقت المناسب. تم تصميم موزع الدواء خصيصا للمستخدمين الذين يتناولون الأدوية دون إشراف طبي وثيق. وإنه يساعد في تجنب المستخدم لأخذ الدواء الخطأ في الوقت الخطأ.

سوف يتم تجميع المكونات الرئيسية لهذا الجهاز وهي متحكم دقيق مرتبط مع لوحة مفاتيح أبجدية رقمية، شاشة عرض، وحدة تحكم المحرك، ونظام إنذار، حاويات متعددة للحبوب. ومن ثم سيتم استخدام برنامجي (Bascom AVR،Proteus) لمحاكاة هذا التصميم.

الهدف من هذه العملية هي التسهيل على المستخدم ضبط الجرعة في التوقيت المطلوب. وتصميم جهاز بسيط وفعال وغير مكلف. البرنامج المستخدم هو موثوق لمستخدميه حيث يمكنهم الاستفادة من هذا الجهاز في تجنب تكلفه الرعاية الطبية المنزلية.

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List of abbreviation

ADC ……..……..…analog to digital converter

IR ……..……..…. Infrared sensor

CPU ……..…..central processing unit

RAM ……...…random access memory

**ROM……..……..... ** Read only memory

**MC ……..……... ** micro control

PLC…….....programmable logic control

DC ……..……... Direct current

PWM ……..……...pulse width modulation

RPM ……..……revolution per minute

A-DC ……...…..asynchronous DC motor

RISC ……..…..reduce instructions set computer

LED ……..……..…... Light emitting diode

Chapter One
Introduction

Chapter one
Introduction

1.1 Preface:

Medicine Dispensing Machine is small pharmacy to alarm and save the medication in suitable environment, designed to help people basis, especially who have one or more chronic conditions, Take multiple medications or have complex medication regimens, they may want to take medications properly, May have cognitive impairment, Have limited mobility and are at risk for falls.

The motivation for this project to avoid more problem such as forget dose, double dose and other problems for elderly. It features and alarm to alert the user that it is time to take their pills, making it perfect for the elderly as well as people who suffer from memory problems.

The goal has always been to keep people safe and independent as long as possible. The Medication Dispenser system is critical to getting individuals the right dose, at the right time.

Definition of this machine that you put the Patient medication into individual slots and load them into dispense, provide medication schedule to the machine and it will program it for you. Then the patient presses the button when they hear the reminder .The dispenser will dispense the medication that you have loaded for the senior at programmed times.

Anyone who has difficulty remembering to take his medication benefited from the project.

This Medicine Dispensing Machine regains their independence without having to rely on caretaker to administer their medication correctly.

1.2 Problem statement:

The biggest problem that faces the patient is remembering to take their medication especially the elderly and those with early dementia, Parkinson's disease or Vision Problems that cannot distinguish between the drugs especially that medicines were similar in shape, color and size. Moreover, the patient needs to supervise medical care. In addition, there is another problem faced the patient such as (missed dose, double dose and scattering medicines).

1.3 Proposed Solutions:

To design microcontroller-based system to realize the requirements of saving medicine within suitable environment long with ability to control over providing doses in certain preserved times.

1.4 Objective:

The aim of this project is to reduce medication errors for patients. In addition, to provide easy and comfortable mean to save medicines with ability to notify and prepare doses for patient.

The main objectives of this project are:

1. Design a close loop control system-using microcontroller.
2. Simulation of the system to enhance the overall system performance.
3. Performance evaluation for the proposed system.
4. Implement prototype hardware in a real time environment.

1.5 Methodology:

1. Literature review and visit for area of concern such as medication general storage conditions and the average of containers size, automatic control system theory.
2. Collect the requirements and evaluate it according to its importance.
3. Proposed outline design to be approved by end user representatives.
4. Study about automatic control algorithm, hardware component such as (motors, microcontroller, sensors and cooling system) that will be used to build the system.
5. Model and simulate the design using software programs such as Proteus to simulate the circuit and Bascom AVR to program the microcontroller).
6. Perform testing to ensure that design outcomes are achieves.
7. Recording and documenting findings observations complete registration.

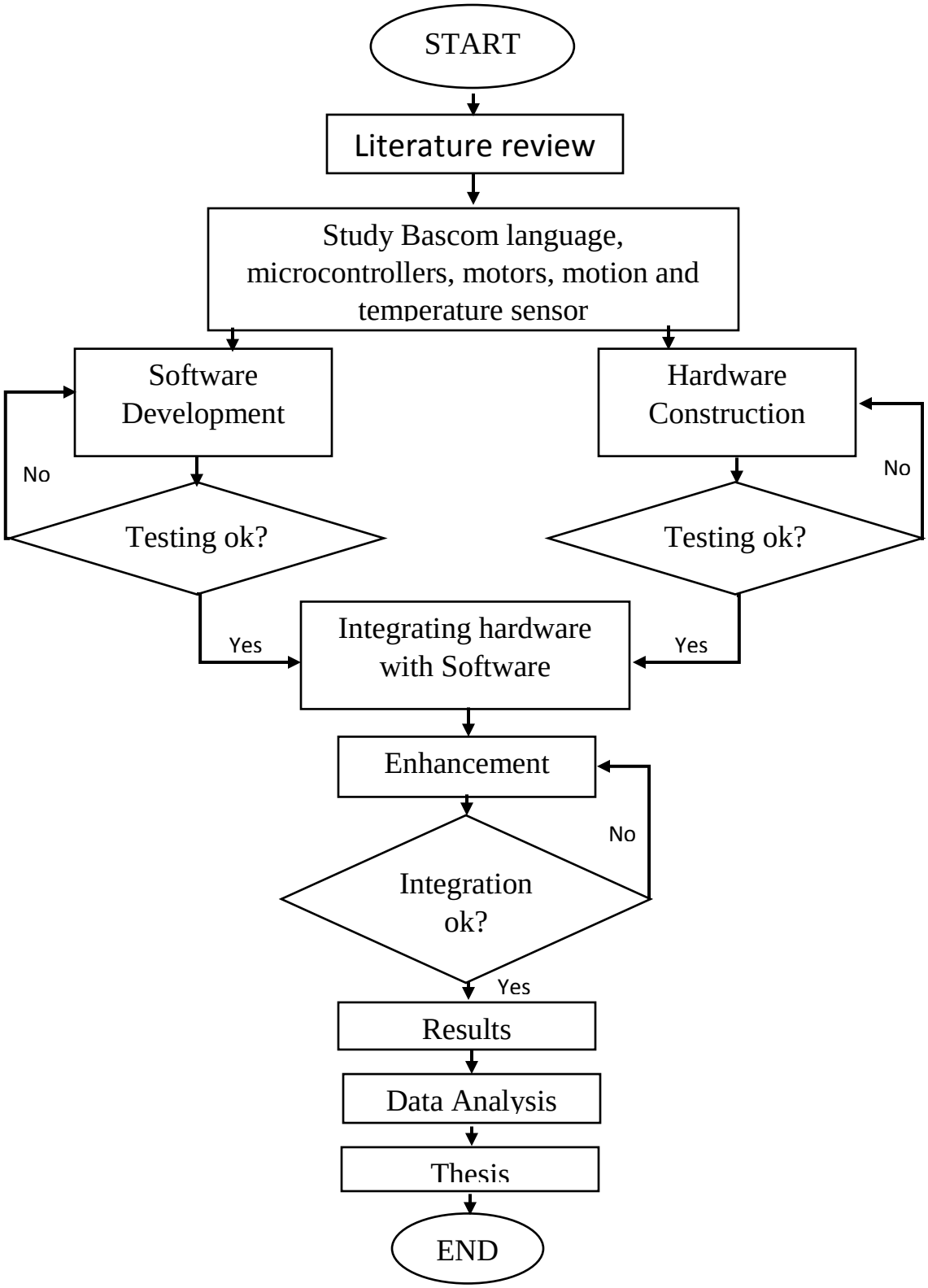

Figure1.1: Methodology for the project

1.6 Research Outlines:

This study is divided into five chapters. The first chapter is the introduction chapter, which will, provides a brief outlook of medicine dispensing machine and formulation of the problem statement while providing the proposal solution. The second chapter the literature reviews whereby ample ideas will be obtained to develop all research frameworks for this study. The third chapter is a circuit design. Then the fourth chapter is a simulation and discussion. Finally, the fifth chapter conclusion and recommendation, this chapter will come up with recommendations as well as conclusions of the overall thesis.

Chapter Two

Literature Review

Chapter Two
Literature Review

2.1 Background:

In the 1980s, automated dispensing devices appeared on the scene, a generation after the advent of unit-dose dispensing. The invention and production of these devices brought hopes of reduced rates of medication errors, increased efficiency for pharmacy and nursing staff, ready availability of medications where they are most often used (the nursing unit or inpatient ward), and improved pharmacy inventory. Although the capacity of such systems to contribute to patient safety appears great, surprisingly few studies have evaluated the clinical impact of these devices. [1]

2.2 Type of dispensing system:

There are many type of dispensing system depends on the domain of expertise considering to the user.

2.2.1 Drug dispensing systems in hospitals:

Drugs are one of the main tools of medical therapy and are a significant part of hospital budgets. Implementing safe, organized, and efficient drug-dispensing systems is essential for controlling costs and assuring that the medical prescription is safely followed as requested within the appropriate deadline. An appropriate dispensing system is an important ally for the prevention or reduction of medication errors by helping to minimize dispensing error opportunities in a pharmacy. At present, there are various types of dispensing systems for medical

prescriptions within a hospital. The first studies on the organization of such systems, specifically their relationship with medication errors, were published in the mid-sixties. These studies mostly performed in the United States of America were intensified during the 1970s and 1980s, aiming to provide safer dispensing systems. Investigation in this area in Brazil was started during the1990s and is still not numerically significant. [2]

2.2.2 Collective System:

In this system, drug-related actions are centered on nursing professionals, and the pharmacy is merely a drug delivery agent. This system has many facilitating conditions for errors. It is characterized by the distribution of drugs per hospital unit/service based on a request by a nurse. It implies the establishment of inventory in these units under the nurse's supervision. It is estimated that nurses spend about 25% of their time transcribing prescriptions, checking inventory, filling requests, and transporting and separating drugs in the various units. Institutional costs are high due to losses by theft, inadequate storage, and drug expiration. The advantages of this system are that drugs are readily available at the units. There are fewer requests to the pharmacy, with a corresponding reduction in pharmacy expenses related to human resources and materials. These advantages become obstacles for improved pharmaceutical service to patients. [3]

2.2.3 Individualized System:

In the individualized drug-dispensing system, the pharmacy and pharmacists participate more actively on drug-use issues; however, nursing participation and error rates are still high. In this system, drugs are dispensed per patient, usually for a 24-hour treatment period. The pharmacy dispenses drugs separately per patient,

according to the medical prescription, to the hospital units. In Brazil, 34.8% of hospitals use this drug-dispensing system for in-hospital patients.

The individualized drug-dispensing system has advantages, such as the possibility of reviewing medical prescriptions, increased control over drug use, less inventory in hospital units, reduced theft and losses, and individual patient invoicing. The disadvantages are the high rates of dispensing and delivery errors that still exist, the time spent by nurses calculating and preparing drug doses, increased expense regarding human resources and materials, and high losses due to theft and inadequate drug delivery. [4]

2.2.4 Mixed System:

The mixed dispensing system combines the collective and the individualized systems and is used in Brazilian hospitals. Hospital units are supported partially or completely by the individualized systems, and specific units (radiology, endoscopy, emergency, outpatient department, among others) are supported by the collective system. The mixed system is used by 13.2% of Brazilian hospitals for dispensing drugs.

The main disadvantage of the mixed system is a trend towards the collective rather than the individualized system, favoring drug dispensing by hospital unit rather than per patient dispensing. It is easier to dispense drugs by hospital unit instead of separating and packaging items for each patient. Pharmacy staff should be made aware of the importance of their work and that collective dispensing is easier but not as safe.

2.2.5 Unit dose system:

Drug administration in hospitals may involve 20 to 30 steps from prescription to delivery and monitoring. During the past 50 years, little has

changed in this process except for the development and implementation of the unit dose drug-dispensing system.

The high rate of medication errors in hospitals reported in many North-American studies towards the end of the 1950s, demonstrated the need to review traditional dispensing systems to improve safety in drug dispensing and delivery.

In 1960, North-American hospital pharmacists belonging to a multidisciplinary group developed the unit dose system, aiming to reduce medication error rates, drug costs, losses and theft, and to improve the productivity of health professionals and the quality of health care. This system consists of ordered drug dispensing with doses ready for delivery according to the patient's medical prescription. Every drug, in all pharmaceutical forms, is dispensed ready-to-use with no need for prior transference, calculation, and handling by nurses. Only drugs used in emergencies are stored in hospital units, together with the necessary doses for the next 24 hours of treatment of patients. [5]

2.3 Related work of dispensing devices:

The first automated pill dispensers in 1986. This device has served as a reference for almost every subsequent design. It consists of a detachable, rotating wheel with 12 storage compartments. A pharmacist can preload this wheel. Pills are mixed in the compartments and dispensed at regular programmed intervals (every two hours, four hours, etc.). An audio alarm alerts the user that pills have been dispensed. A major flaw is that dispensed, unconsumed pills build up in the base of the apparatus, making it easy for the patient to overdose. In addition, the patient must be competent enough to program the device. Agans submitted a more complex design in 1992. A microprocessor controls this machine, which dispenses pills at finer intervals than the Lewis and Roberts design. [6]

Agans does not use a rotating wheel for dispensing, a major innovation. As a result, the dispenser has more compartments while still maintaining a small footprint. The mechanical dispensing mechanism is far more complex, though, than the elegant rotating wheel. The dispenser provides push buttons for programming and an audio/visual alert system. Shaw solves many of the earlier designs' problems. His system adds a "Dispense" button that the user must press to dispense medicine. Consequently, dispensed pills do not accumulate. This advanced system receives, stores, and processes prescription data, which the user enters with a folding keyboard. The top lid locks to prevent medication access at unauthorized times. [7]

Finally, Shaw adds a logging feature to track patient compliance. Lim made the first attempt at "coaching" the user with his 1999 design. This dispenser allows a caregiver or pharmacist to record audio usage instructions for each medication. In addition, the device has a communication subsystem that connects to the phone network. If the patient does not comply with his regimen, the system can alert an off-site caregiver. This device, however, does not account for human error. The audio instructions can become disassociated with the corresponding medication. [8]

Two designs have been submitted in the past year. Lim improved his design by solving a previously unaddressed problem: securing loose pill bottles. All previous designs require the patient to transfer pills from bottles to the dispenser. Excess pills remain in the pill bottles. The system cannot track these pills and for a patient taking multiple medications, the bottles can become lost. Lim's new design locks the loose bottles in a compartment. Hubicki also takes a novel approach by providing compartments for medications in non-pill form. His design incorporates a mobile paging unit that prompts the user to take medications. Hubicki simplifies programming of the device to simply moving analog switches. He also notes that programmable systems in the prior art "do not appeal to many senior citizens who

have limited incomes and little experience in programming high-tech equipment" .One inventor approached the development of a medication organization system without using a storage cabinet. Sagar submitted a system with an electronic pill bottle cap. The cap has lights that indicate when a medication should be taken. The lights utilize color-coding to instruct the user. The cap also has a sensor that tracks compliance. [9]

Sagar's most important innovation involves the electronic transfer of product information. The system retrieves information from a database and automatically programs the bottle cap, eliminating the need for manual programming. The medications are not automatically dispensed, however, meaning that the user must still pick pills out of loose bottles at designated times.

Several relevant products are currently available on the market. The Talking-Rx is a small device that attaches to the base of a pill bottle. A pharmacist or caregiver can then record audio instructions. The user has a small receiver that plays the instructions. E-pill of Wellesley, MA also sells several dispenser models including the MD.2. This product features 60 pill containers, audio/visual usage prompts, and a lockable cabinet. In addition, it can call a caregiver over the telephone to report compliance and refills. No product in the prior art both eliminates user programming and secures loose pill bottles. [10]

Furthermore, the only system that does not require manual programming, Sagar's design, needs network access. Patients in rural areas may not have such connectivity.

Finally, no extant system detects harmful medication combinations. In summary, by solving previous design flaws, SmartPill minimizes patient risk like no other product.

The McLaughlin dispensing system, the Baxter ATC-212 dispensing system, and the Pyxis Medstation Rx. Their attributes are described below. The

McLaughlin dispensing system5 includes a bedside dispenser, a programmable magnetic card, and a pharmacy computer. It a locked system that is loaded with the medications prescribed for a patient. At the appropriate dosing time, the bedside dispenser drawer unlocks automatically to allow a dose to be removed and administered. A light above the patient's door illuminates at the appropriate dosing time. Only certain medications fit in the compartmentalized cabinet (such as tablets, capsules, small pre-filled syringes, and ophthalmic drops). The Baxter ATC-212 dispensing system 6 uses a microcomputer to pack unit- dose tablets and capsules for oral administration. It is usually installed at the pharmacy. Medications are stored in calibrated canisters that are designed specifically for each medication. Canisters are assigned a numbered location, which is thought to reduce mix-up errors upon dispensing. When an order is sent to the microcomputer, a tablet is dispensed from a particular canister. [11]

The 112 drug is ejected into a strip-packing device where it is labeled and hermetically sealed. The Pyxis Medstation, Medstation Rx, and Medstation Rx 1000 are automated dispensing devices kept on the nursing unit. These machines are often compared to automatic teller machines (ATMs). The Medstation interfaces with the pharmacy computer. Physicians' orders are entered into the pharmacy computer and then transferred to the Medstation where patient profiles are displayed to the nurse who accesses the medications for verified orders. Each nurse is provided with a password that must be used to access the Medstation. Pharmacists or technicians keep these units loaded with medication. Charges are made automatically for drugs dispensed by the unit. Earlier models had sufficient memory to contain data for about one week, and newer models can store data for longer periods. Studies reviewed did not include the automated dispensing systems manufactured by Omnicell, which produces point-of-use systems that can be integrated into a hospital's information system.10 Omnicell systems are also

capable of being integrated into external support systems that support machine-readable code, drug information services, and medication error reporting systems. [12]

2.4 Outline design:

There are many technical features necessary to achieve the goal considered below:

1. Enable user to inter configurations and setting.
2. Reserving the configuration.
3. Number of Slots to preserve or to host the tablets of medicines.
4. Control the position of slots based on preserved configurations.
5. Notify user to system status.
6. Alert user when critical events occurs.
7. Display entered values and current slots position.

2.4.1 Central processing unit (CPU):

To design the dispensing machine it is need a control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices and responsible for performing all the functions and commands of the medicine box. The basic requirements are a few Input output ports to interface the keyboard, display unit, motor, and speaker.

Interrupts are used to enable the user to interact with the system for programming.

There are a number of technical features of controlling such as: microcontroller, microprocessor and PLC.

2.4.1.1 Microcontroller and microprocessor:

Microprocessor is an IC, which has only the CPU inside it and does not have RAM, ROM, and other peripheral on the chip. Microcontroller has a CPU, RAM, ROM and other peripherals all embedded on a single chip.

Microcontrollers are designed to perform specific tasks, applications where the relationship of input and output is defined, examples washing machine, telephone, mobiles. Microprocessor find applications where tasks are unspecific, applications where the relationship between input and output is not defined examples games, websites, photo editing.

The clock speed of the Microprocessor is quite high as compared to the microcontroller. 1GHz for Microprocessor to a few MHz to 30-50 MHz for microcontroller.

A microcontroller is far cheaper than a microprocessor. Microprocessor cannot be used alone. They need other peripherals like RAM, ROM, buffer, I/O ports etc. Hence, a system designed around a microprocessor is quite costly.

2.4.1.2 Microcontroller and PLC:

PLC is a special microcontroller designed for industrial use, for controlling machinery or processes. It is programmed using Ladder diagrams.

The advantages of PLC control are:

1- It has industrial properties such as isolated IO.

2- Noise of environment cannot effect on PLC.

The disadvantages of PLC control are:

1- Too much work required in connecting wires.

2- Difficulty with changes or replacements and in finding errors.

3- When a problem occurs, hold-up time is indefinite. [13]

According to this features microcontroller will be chosen to control the dispenser.

2.4.1.3 Microcontroller:

A microcontroller is a computer present in a single integrated circuit, which is dedicated to perform one task and execute one specific application.

Classification of microcontroller According to Number of Bits are 8-bits, 16-bits and 32-bits microcontroller.

In 8-bit microcontroller, the point when the internal bus is 8-bit then the ALU is performs the arithmetic and logic operations. The examples of 8-bit microcontrollers are Intel 8031/8051, PIC1x and Motorola MC68HC11 families.

The 16-bit microcontroller performs greater precision and performance as compared to 8-bit. A longer timer extreme worth can likely prove to be useful in certain applications and circuits. It can automatically operate on two 16-bit numbers. Some examples of 16-bit microcontroller are 16-bit MCUs are extended 8051XA, PIC2x, Intel 8096 and Motorola MC68HC12 families.

The 32-bit microcontroller uses the 32-bit instructions to perform the arithmetic and logic operations. These are used in automatically controlled devices including implantable medical devices, engine control systems, office machines, appliances and other types of embedded systems. Some examples are Intel/Atmel 251 family, PIC3x. [14]

2.5 Motor:

In order to get the complete design of the dispenser machine a motor must be used to rotate the container to achieve the goal of the machine. Electric motor is an electromechanical device that converts electrical energy to mechanical energy. The general working mechanism is the same for all motors. There are many types of motors such as DC motor, AC motor and servomotor.

2.5.1 DC Motors:

DC (Direct Current) Motors are two wire (power & ground), continuous rotation motors. When you supply power, a DC motor will start spinning until that power is removed. Most DC motors run at a high RPM (revolutions per minute), examples being computer cooling fans, or radio controlled car wheels.

The speed of DC motors is controlled using pulse width modulation (PWM), a technique of rapidly pulsing the power on and off. The percentage of time spent cycling the on/off ratio determines the speed of the motor. The most important features Fast, continuous rotation motors – Used for anything that needs to spin at a high RPM e.g. car wheels, fans etc.

2.5.2 Stepper motor:

A stepper motor is an electromechanical device, which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The motors rotation has several direct relationships to these applied input pulses. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied.

More important is the fact that a stepper motor can actually be used without any type of feedback loop. Since the motor moves in distinct steps as defined by a step angle.

The most important features Slow, precise rotation, easy set up and positional control. Where servos require a feedback mechanism and support circuitry to drive positioning, a stepper motor has positional control via its nature

of rotation by fractional increments. Suited for 3D printers and similar devices where position is fundamental.

2.5.3 SERVO-Motor:

Servomotors are generally an assembly of four things a DC motor, a gearing set, a control circuit and a position-sensor (usually a potentiometer).

The position of servomotors can be controlled more precisely than those of standard DC motors, and they usually have three wires (power, ground & control). Power to servomotors is constantly applied, with the servo control circuit regulating the draw to drive the motor. Servomotors are designed for more specific tasks where position needs to be defined accurately such as controlling the rudder on a boat or moving a robotic arm or robot leg within a certain range.

There are two types of servo-motors: AC and DC. AC servos can handle higher current surges and tend to be used in industrial machinery. DC servos are not designed for high current surges and are usually better suited for smaller applications. Generally, DC motors are less expensive than their AC counterparts. These are also servomotors that have been built specifically for continuous rotation, making it an easy way to get your robot moving. They feature two ball bearings on the output shaft for reduced friction and easy access to the rest-point adjustment potentiometer.

The advantage of servomotor is High-speed operation is possible, high torque, capable of holding a static (i.e. no motion) position, do not overheat at standstill or lower speeds, able to reverse directions quickly, able to return to a given position time after time without any drift. [15]

2.5.4 Motor controller:

Servomotor its needs a drive circuit to control its direction. H-bridge is commonly used. The H-bridge is an electronic_circuit that enables a voltage to be applied across a load in either direction. In addition, generally used to reverse the direction of the motor, but can also be used to 'brake' the motor. H-bridge named because it has four switching elements at the corners of the H and the motor forms the cross bar. It consists of four switches, typically implemented with bipolar junction transistors or MOSFETs, and four fly-back diodes. [16]

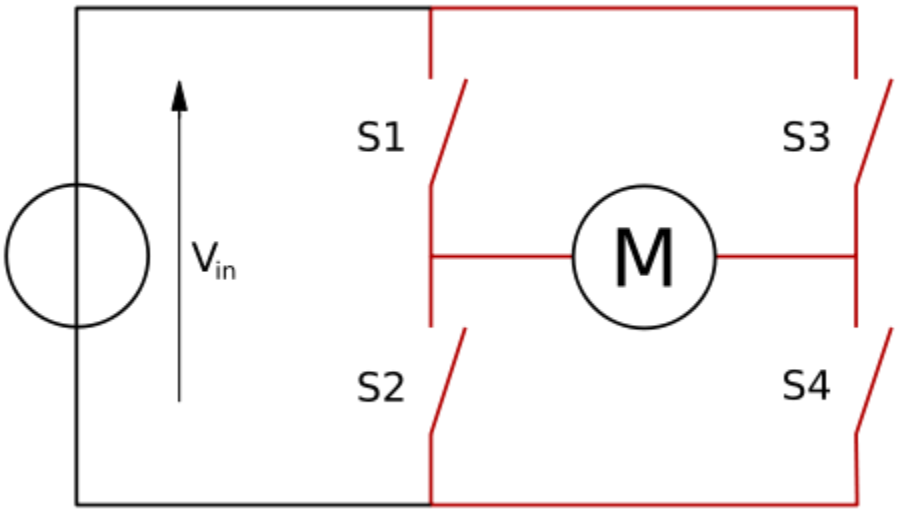

Figure 2.1: H-bridge

2.6 Sensor:

Transducer is a device which transforms energy from one type to another, even if both energy types are in the same domain. Typical energy domains are mechanical, electrical, chemical, magnetic, optical and thermal. Transducer can be further divided into sensors, which monitors a system and actuators, which impose an action on the system.

Sensor is a device for sensing a physical variable of a physical system or an environment. It senses the environmental phenomena and output an electrical signal.

An actuator may be described as opposite to a sensor it converts electrical signal into generally nonelectrical energy. For example, an electric motor is an actuator it converts electric energy into mechanical.

Sensors can be classified in many ways depending on the criteria chosen:

1. Field of applications.
2. Conversion Phenomena.
3. Specification.
4. Measuring mechanism.

Characteristics of sensors Accuracy, Resolution, Sensitivity, Repeatability, Dynamic Range, Linearity, Transfer Function (Frequency Response), Bandwidth. To control the movement of the servomotor, a Motion sensor must be used.

2.6.1 Motion sensor:

These sensors are based on many types such as infrared light and ultrasound.

1- Ultrasonic sensor:

These sensors are designed to generate high frequency sound waves and receive the echo reflected by the target. These sensors are used in a wide range of applications and are very useful when it is not important the detection of colors, surface texture, or transparency.

The most Advantages of Ultrasonic sensors are the output value is linear with the distance between the sensor and the target. These sensors are designed for contact-free detection. But the Ultrasonic sensors must view a high density surface for good results and have a response time with a fraction less than other types of sensors.

2- Infrared sensor:

An infrared sensor measure the IR light that is transmitted in the environment to find objects by an IR LED. This type of sensor is very popular in navigation for object avoidance, distance measured or line following applications. This sensor is very sensitive to IR lights and sunlight, and this is the main reason that an IR sensor is used with great precision in spaces with low light.

Advantages of infrared sensor is can detect infrared light over a large area, they can operate in real-time, the IR sensor uses non-visible light for detection and they are cheap sensors.

Disadvantages of infrared sensors is very sensitive to IR lights and sunlight, and it has a weakness to darker colors such as black. According to this feature of infrared sensor, IR sensor must be used.

2.6.2 Temperature sensor:

In order to make the device more suitable environment for the drug, there must be added a cooling system inside the dispenser.

This is an analog temperature sensor is easy to explain, it is a chip that gives the ambient temperature.

Because these sensors have no moving parts, they are precise, never wear out, do not need calibration, work under many environmental conditions, and are consistent between sensors and readings. Moreover, they are very inexpensive and quite easy to use.

There are two basic physical kinds of temperature sensors: Contact sensor and Non-contact sensors.

2.6.2.1 The general Type of Temperature sensor:

1. Resistive Temperature Devices(RTD)
2. Thermistors
3. LM35 series temperature sensors
4. THERMO-COUPLE.

1-Thermo-couple:

A Thermo-couple is a type of temperature sensor produced by connecting two different materials (metals) or consists of two dissimilar conductors in contact, which produces a voltage when heated. The size of the voltage is dependent on the difference of temperature of the junction to other parts of the circuit.

2- LM35:

The LM35 can be described as precise integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature or expressed in Celsius temperature. It is designed in a way to be included in an incorporated circuit on a circuit board. It does not require any adjustments to give accurate readings. According on this features the LM35 will picked to measured temperature. [17]

2.7 Cooling system:

There are many types of cooling systems:

1. Liquid-to-liquid.
2. Closed-loop dry system.
3. Open-loop evaporative system.
4. Fan.

2.7.1 A liquid-to-liquid:

A liquid-to-liquid cooling system is an ideal fit for this situation. It uses the well water on one side of an intermediate heat exchanger and a coolant such as glycol and water on the other side of the intermediate heat exchanger in a closed loop to cool the compressor.

2.7.2 Closed-Loop Dry Cooling Systems:

A closed-loop dry cooling system is very much like the radiator in your car. The system uses an air-cooled fluid cooler to transfer the heat from the closed-loop coolant fluid pumped through rows of finned tubes that have ambient air blown/drawn across them.

2.7.3 Open-loop Evaporative Cooling Systems:

The next system, an open-loop evaporative cooling system is completely different than the first three listed above. This system has the ability to use the design wet bulb as the basis for the outlet temperature of the cooling water. For example if the design dry bulb for the location is 95 F and the design wet bulb is 75 F, the system can provide approximately 82 F water to the load.

2.7.4 Fan:

The specific type of DC motor used in ceiling fans is a brushless DC motor, (asynchronous DC motor).A DC motor uses an internal array of magnets of opposing polarity.

This creates a magnetic field that creates the torque required to rotate the motor's rotor. This process requires less electrical energy, translating into a 70% or greater reduction in power consumption over standard AC motors.

The simplest method of fan control is just run a fan of appropriate capacity at full speed 100% of the time. The main advantages of this are guaranteed fail-safe cooling and a very simple external circuit. The most of medication storage at room temperature so will chose FAN as cooling system in this project. [18]

2.8 Fan Controlling:

PWM is prevalent method currently used for controlling fan speed in low-frequency PWM control. The voltage applied to the fan is always either zero or full-scale-avoiding the problems experienced in linear control at lower voltages.
The principal advantage of this drive method is that it is simple, inexpensive, and very efficient, since the fan is either fully on or fully off. A disadvantage is that the tach information is chopped by the PWM drive signal, since power is not always applied to the fan. [19]

2.9 Additional component:

In order to get the complete design of the dispenser machine there must be added additional component such as:

2.9.1 Keypad:

A keypad is a set of buttons or keys bearing digits, symbols and/or alphabetical letters placed in order on a pad, which can be used as an efficient input device. A keypad may be purely numeric, as that found on a calculator or a digital door lock, or alphanumeric as those used on cellular phones. There are many type of keypad such as Keypad 4x4**,** Keypad 4x3, etc.
For this purpose, a Keypad 4x4 will used for simplicity, availability and cost efficient.

The Keypad 4x4 Used for loading numeric into the microcontroller. It consists of 16 buttons arranged in a form of an array containing four lines and four columns.

2.9.2 Display Unit:

The collected and processed data may need to be displayed. A LCD is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery powered electronic devices because it uses very small amounts of electric power. For this purpose, an LCD 2×16 will used for simplicity and cost efficient.

2.9.3 Alarm Module:

The alarm module will provide an audible alarm tone. Additionally, the alarm module will provide a visual cue, through the use of LEDs. The design of the alarm module will be to provide a limited alarm function in case of loss of main AC power.

2.9.3.1 Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

2.9.3.2 LED:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the

device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. [20]

Chapter Three
Circuit design

Chapter Three

Circuit design

This chapter shows system block diagram, operation description and system components.

3.1 System Block diagram:

The figure (3.1) shows the proposed system block diagram.

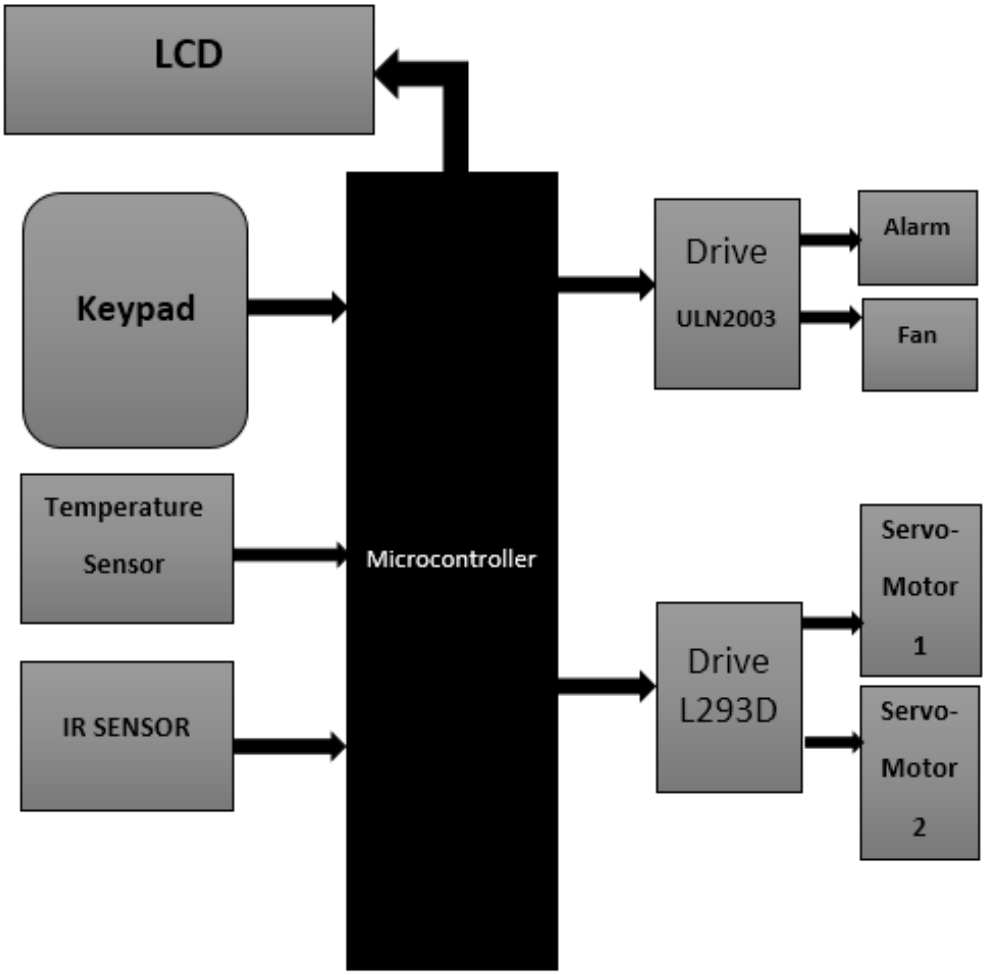

Figure 3.1: Block diagram.

3.1.1 Microcontroller (ATMEGA 16):

The microcontroller is the main part of the dispenser. It is responsible for performing all the functions and commands of the medicine box. The microcontroller is selected to meet the required functionality of the dispenser without wasting money on unneeded features. The basic requirements of the microcontroller are a few Input output ports to interface the keyboard, display unit, motor, and speaker.

Microcontroller is a small computer on a single integrated circuit small, low cost computer on chip. It is use to control embedded application, also used to control one or more task in the operation of device or a system.

Microcontroller reduces the size of application compared to the application that used separated microprocessor, memory and I/O devices.

In this project the microcontroller is used Atmega16 which have the requiring size of memory that needed, it's the main controller of the system that receive signals from sensors and process the received signals to control the motor based on the result.

The ATMEGA 16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle. It has the following features:

- 16 Kbytes of In-System Self-programmable Flash program memory.
- 512 Bytes EEPROM.
- 32*8 General Purpose Working Registers.
- 32 general-purpose I/O lines.
- Two 8-bit timer/counter with separate prescalers and compare modes.
- Four PWM Channels. [21]

3.1.1.1 Pin descriptions:

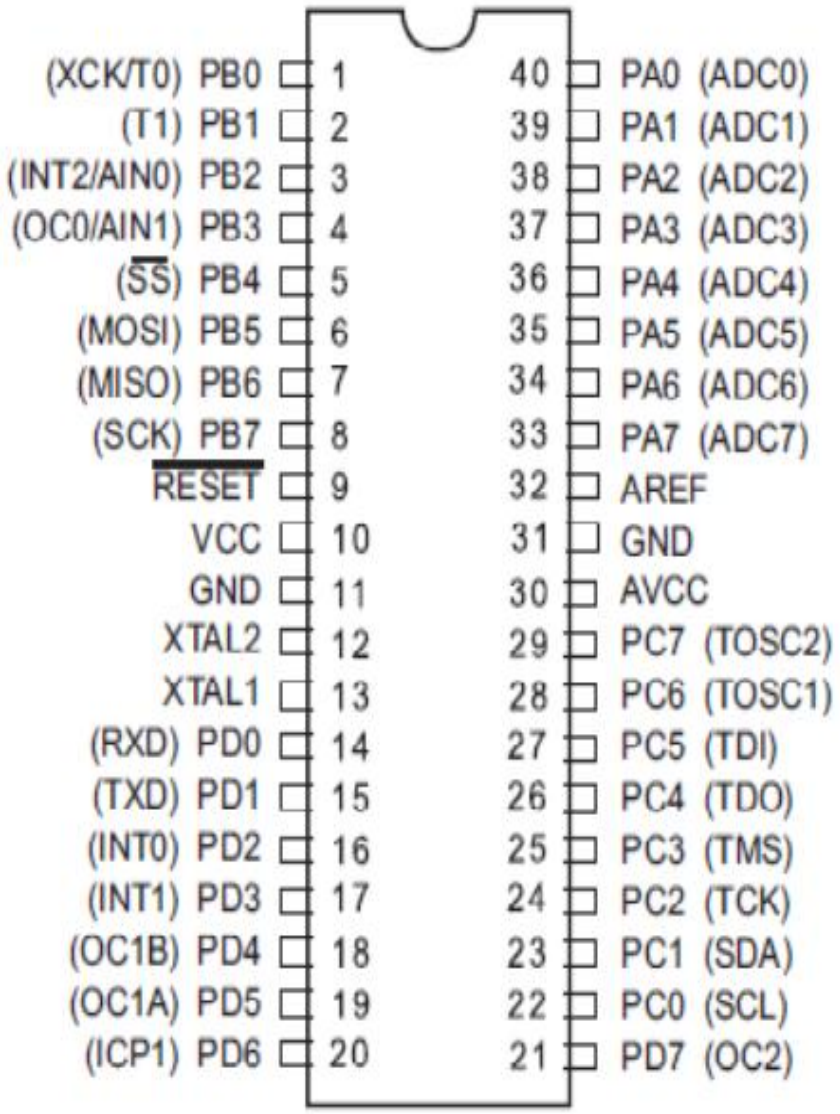

Figure 3.2: pin description of ATMEGA 16

Table 3.1: pin description of microcontroller

Pin Number	Pin name	Function	Connected to
1	PB0/T0/XCK	Output	LCD(RS)
2	PB1/T1	Input	Switch1
3	PB2/AINO/INT2	Output	LCD(E)
4	PB3/AIN1/OC0	Input	Switch2
5	PB4/SS	Output	LCD(D4)
6	PB5/MOSI	Output	LCD(D5)
7	PB6/MISO	Output	LCD(D6)
8	PB7/SCK	Output	LCD(D7)
9	RESET		
10			
11			
12	XTAL1		
13	XTAL2		
14	PD0/RXD	Input	Keypad
15	PD1/TXD	Input	Keypad
16	PD2/INT0	Input	Keypad
17	PD3/INT1	Input	Keypad
18	PD4/OC1B	Input	Keypad
19	PD5/OC1A	Input	Keypad
20	PD6/CP1	Input	Keypad
21	PD7/OC2	Input	Keypad
22	PC0/SCL		
23	PC1/SDA	Output	ULN2003
24	PC2/TCK		
25	PC3/TMS		
26	PC4/TDO		
27	PC5/TDI	Output	ULN2003
28	PC6/TOSC1	Output	ULN2003
29	PC7/TOSC2	Output	ULN2003
30	AVCC		
31			
32	AREF		
33	PA7/ ADC7	Output	L293D
34	PA6/ ADC6	Output	L293D
35	PA5/ ADC5	Input	IR Sensor C

36	PA4/ ADC4	Input	IR Sensor B
37	PA3/ ADC3	Input	IR Sensor A
38	PA2/ ADC2	Output	L293D
39	PA1/ ADC1	Output	L293D
40	PA0/ADC0	Input	Temp Sensor

3.1.2 DC Servomotors:

These motors are either separately excited dc motors or permanent-magnet dc motors. The speed of DC servomotors is normally controlled by varying the armature voltage. Their armature is deliberately designed to have large resistance so that torque-speed characteristics are linear and have a large negative slope the negative slope serves the purpose of providing the viscous damping for the servo drive system.

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse and a repetition rate. A servomotor can usually only turn 90° in either direction for a total of 180° movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. The PWM sent to the motor determines position of the shaft, and based on the duration of the pulse sent via the control wire the rotor will turn to the desired position. The servomotor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. [22]

3.1.3 Drive L293D:

L293D is a typical Motor drive or IC, which allows DC motor to drive on either direction. L293D is a 16-pin IC that 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.

It works on the concept of 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 motors independently. Due its size is very much used in robotic application for controlling DC motors.

There are 16 pins sticking out of this IC, this is the functionality and the connection of each pins:

Table 3.2: pin description of drive L293D

Pin Name	Function	Name	Connected to
1	Enable pin for motor 1; active high	Enable 1,2	
2	Input 1 for Motor 1	Input 1	Pin A.1
3	output 1 for Motor 1	Output 1	Servo 2
4	Ground (0V)	Ground	
5	Ground (0V)	Ground	
6	Output 2 for motor 1	Output 2	Servo 2
7	Input 2 for motor 1	Input 2	Pin A.2
8	Supply voltage for motor: 9-12V (up to 36V)	VCC 2	VCC
9	Enable pin for motor 2: active high	Enable 3,4	
10	Input 1 for Motor 1	Input 3	Pin A.6
11	Output 1 for Motor 1	Output 3	Servo 1
12	Ground (0V)	Ground	
13	Ground (0V)	Ground	
14	Output 2 for Motor 1	Output 4	Servo1

15	Input 2 for Motor 1	Input 4	Pin A.7
16	Supply voltage : 5V (up to 36V)	VCC 1	VCC

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

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

Table 3.3: motor controller

Input 1	Input 2	Enable 1,2	Result
0	0	1	Stop
0	1	1	Anti-clockwise rotation
1	0	1	Clockwise rotation
1	1	1	Stop
0	1		50% duty cycle Anti-clockwise rotation with half speed
1	0		50% duty cycle clockwise rotation with half speed

3.1.4 Infrared sensor:

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor.

An IR sensor consists of an emitter, detector and associated circuitry. The circuit required to make an IR sensor consists of two parts: the emitter circuit and the receiver circuit.

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, its resistance and correspondingly, its output voltage, change in proportion to the magnitude of the IR light received. This is the underlying principle of working of the IR sensor. [23]

The Advantage of IR sensor is easy for interfacing and readily available in market. In addition, IR sensor have many applications such as thermography, heating, Spectroscopy, Meteorology, Photo bio modulation and Climatology.

Table 3.4: IR controlling

Boxes	IR1	IR2	IR3	Drive L293D		State (motor)
Box A	1	0	0	1	0	0 (Stop)
Box B	0	1	0	1	0	0 (Stop)
Box C	0	0	1	1	0	0 (Stop)
No Box	0	0	0	1	0	1 (open)

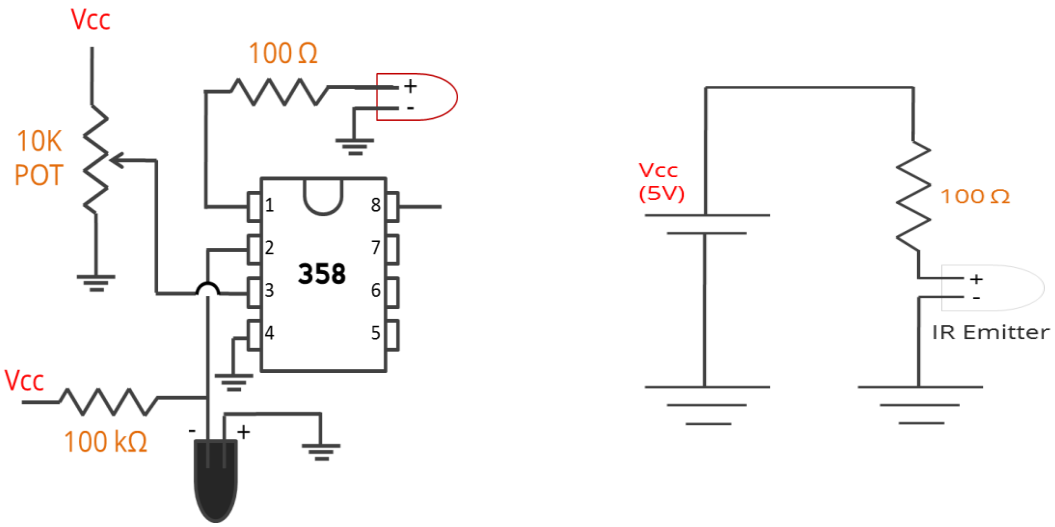

Figure 3.3: IR sensor

3.1.5 Controlling of cooling system and alarm module (ULN2003):

The ULN2003 is a high voltage, high current Darlington array each containing seven open collector Darlington pairs with common emitters. Each open collector Darlingtonis rated at 500 mA. It can accept output voltages of up to 50V. Suppression diodes are included for inductive load driving so it used for fan, buzzer and led.

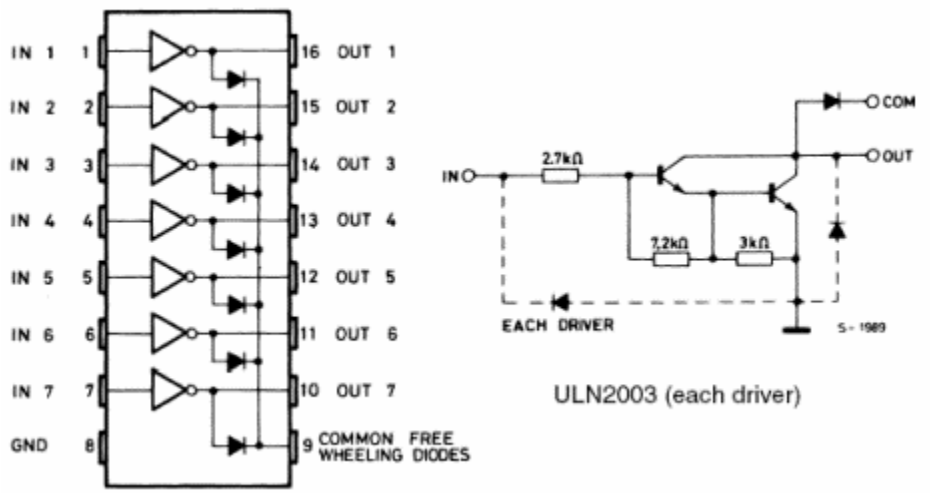

Figure 3.4: ULN2003

Table 3.5: pin description of ULN2003

Pin Number	Pin name	Function	Connected to
1	1B	Input	Pin C.7
2	2B	Input	Pin C.6
3	3B	Input	Pin C.5
4	4B	Input	Pin C.1
5	5B		
6	6B		
7	7B		
8			
9	COM		
10	7C		
11	6C		
12	5C		
13	4C	Output	Buzzer1/ LED
14	3C	Output	Buzzer2
15	2C	Output	
16	1C	Output	FAN

3.1.6 Controlling temperature:

IC LM35 is a sensor use for detecting accurate centigrade temperature. LM35 is a thermometer on a chip, designed by Semiconductor Instead of using mercury or another fluid; it relies on a property of diodes that causes the breakdown voltage of the diode to increase with temperature. This relationship is linear and predictable, making the LM35 a very accurate temperature sensor, with a voltage output that is linearly proportional to temperature.

This sensor use the fact that, as temperature increases, the voltage across a diode increases at a known rate. When the temperature reach to 30 Centigrade the DC motor (fan) will run.

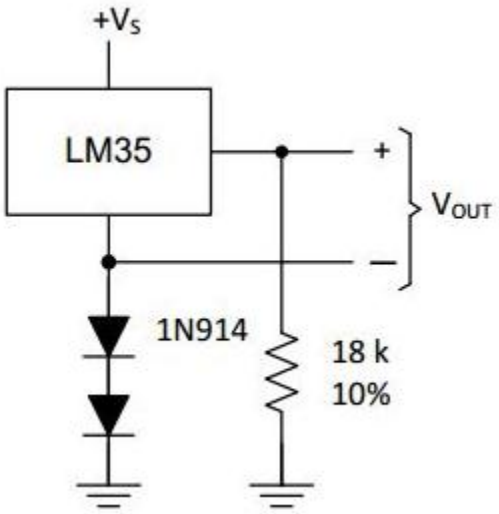

Figure 3.5: LM35

Table 3.6: connection of LM35

Pin Number	Connected to
1	VCC
2	Pin A.0
3	Ground

3.1.7 Display unit:

The monitoring element is the common LCD LM016L chip; it will display a number of messages to the user. These messages include things such as, setting the clock, questions about entering new medication data, which has 16 pins.

This pin can be interfaced with microcontroller in 4 Bit or 8 Bit mode. These differ in how data is send to LCD. In 8 bit mode to write a character, 8 bit ASCII data is send through the data lines D0 – D7 and data strobe is given through

E of the LCD. LCD commands, which are also 8 bit, are written to LCD in similar way.

However, 4 Bit Mode uses only four data lines D4 – D7. In this mode 8-bit character ASCII data and command data are divided into two parts and send sequentially through data lines. The idea of 4-bit communication is used save pins of microcontroller. 4-bit communication is a bit slower than 8-bit communication but this speed difference can be neglected since LCDs are slow speed devices. In this project will use 4-bit mode connected as below:

Table 3.7: pin description of LCD

Pin Number	Function	Connected to
1	VSS	
2	VDD	
3	VEE	
4	RS	Pin B.0
5	RW	GROUND
6	E	Pin B.2
7	D0	
8	D1	
9	D2	
10	D3	
11	D4	Pin B.5
12	D5	Pin B.6
13	D6	Pin B.7
14	D7	Pin B.8

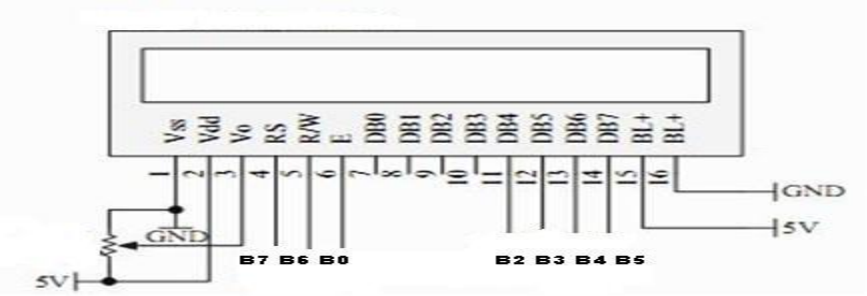

Figure 3.6: pin description of LCD

3.1.8 Keypad 4x4:

A keypad is a set of buttons or keys bearing digits, symbols and/or alphabetical letters placed in order on a pad, which can be used as an efficient input device. A keypad may be purely numeric, as that found on a calculator or a digital door lock, or alphanumeric as those used on cellular phones.

Used for loading numeric into the microcontroller. It consists of 16 buttons arranged in a form of an array containing four lines and four columns. [24]

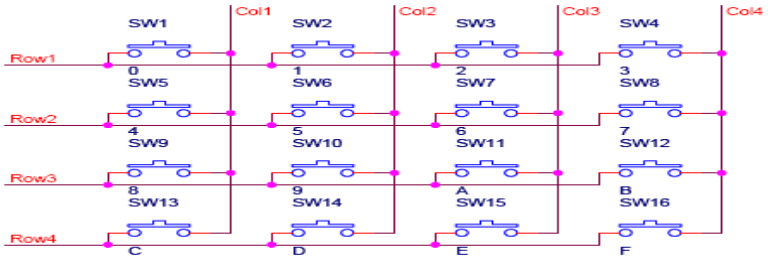

Figure 3.7: Keypad 4x4

3.2 System flow chart:

System operation is described in the following flow chart in several stages:

3.2.1 Initialization and input phase:

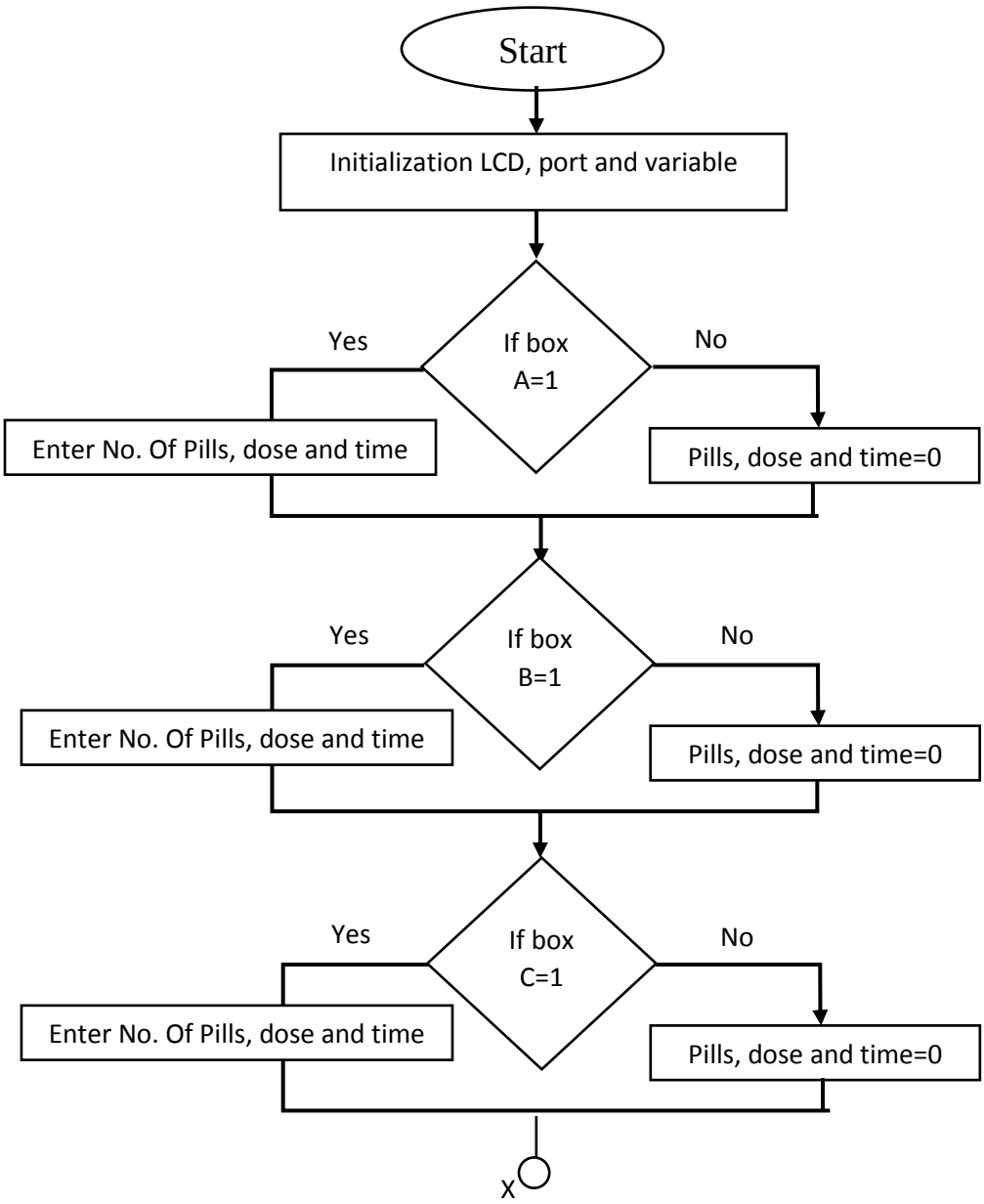

Figure 3.8: software algorithm (a)

3.2.2 Checking the counters:

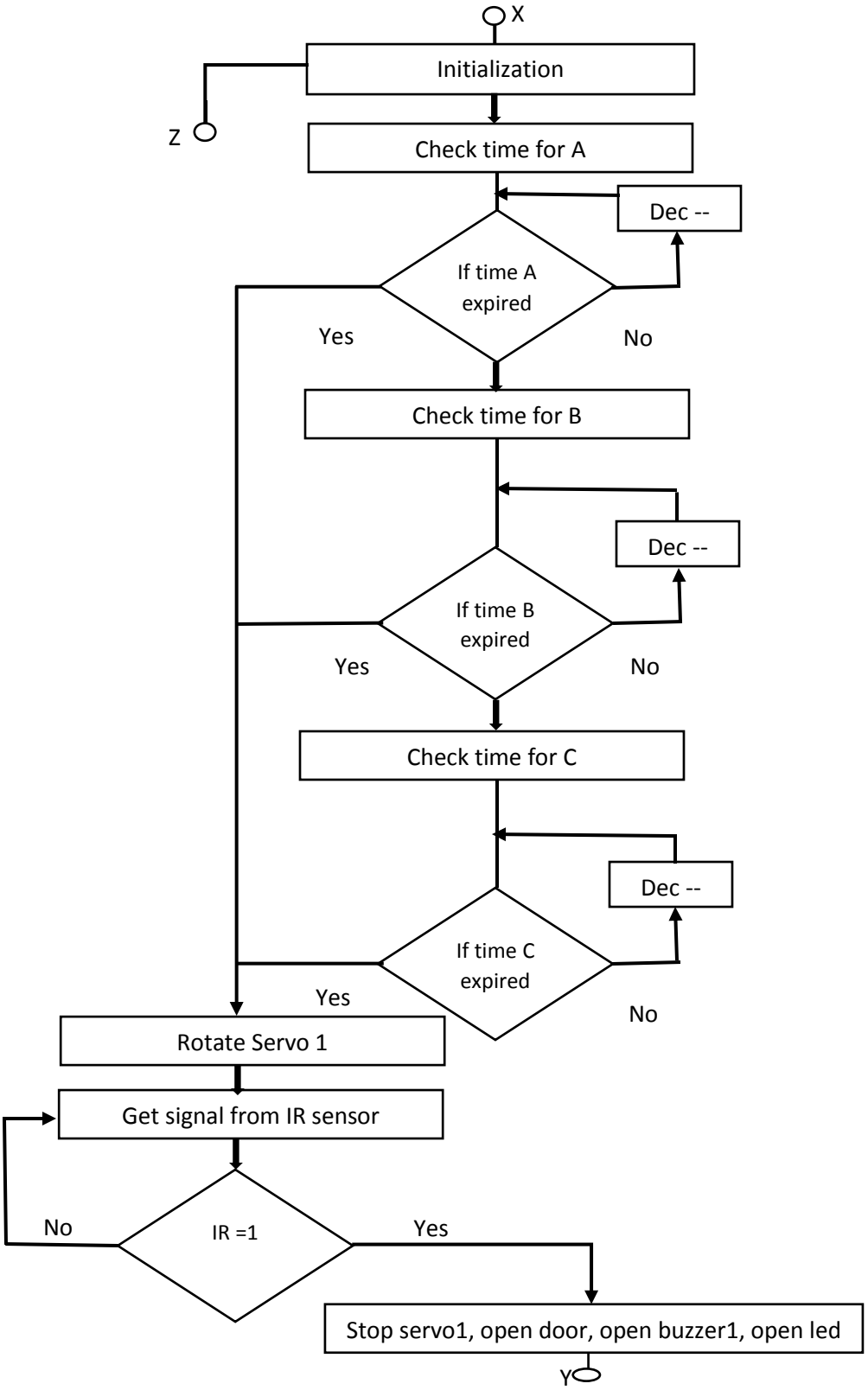

Figure 3.8: software algorithm (b)

3.2.3 Dispensing process:

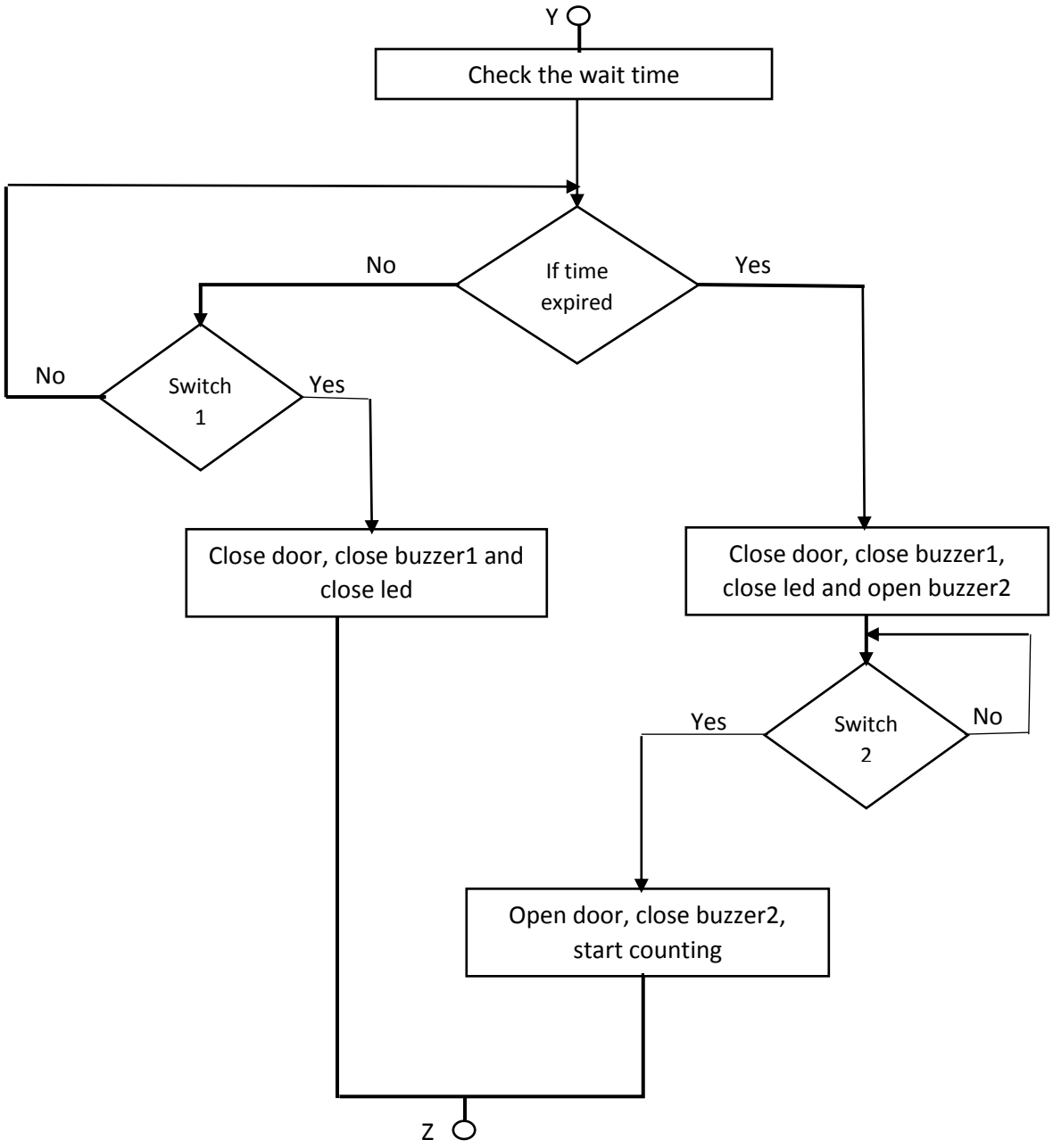

Figure 3.8: software algorithm (c)

3.3 System work principle:

This section will be talking about how the system works.

3.3.1 Initialization and input phase:

First, the system initializes the LCD, ports and the internal variables, then the input process starts; this input is the time between doses, the number of pills and Dosage.

3.3.2 Checking the counters:

The counter reached the required time, the dispensing process starts, if not the counter will decrease and check it again.

3.3.3 Dispensing process:

When the counter reach the required time the microcontroller Send a signal to the servomotor, the servomotor rotate until the required slot faces the door, then the door will open and the alarm, LED will turns ON.

If the patient take the dose and hit the first switch then the led , door and the alarm will turned off ,but if the patient doesn't come in a determined time then the miss dose process status will be activated.

3.3.4 Miss dose process:

In this status, if the determined time is over, the first switch did not hit by the patient, the door and the first alarm will automatically turned off. After that, the second alarm will turned on, until the patient hit the second switch then the second alarm will turned off, the door will open and the counter will start counting again.

3.3.5 Controlling temperature:

The temperature degree measured by using the sensor each at time, if the temperature is greater than 30 degree then the fan will turned on until getting the required degree.

Chapter Four

Simulation and discussion

Chapter Four
Simulation and discussion

4.1 Simulation:

This chapter show the simulation result for notifying and dispensing a medication in specific time.

The first figure below shows message in the LCD ask for choosing (0 or 1) to program slot A, B and C (figure 4.1). The second figure shows the asking for entering the number of pills in slot A, B and C (figure 4.2) the third figure shows the asking for entering the dose in slot A,B and C (figure 4.3). The forth figure shows the asking for entering the time between the doses in slot A, B and C (figure 4.4).

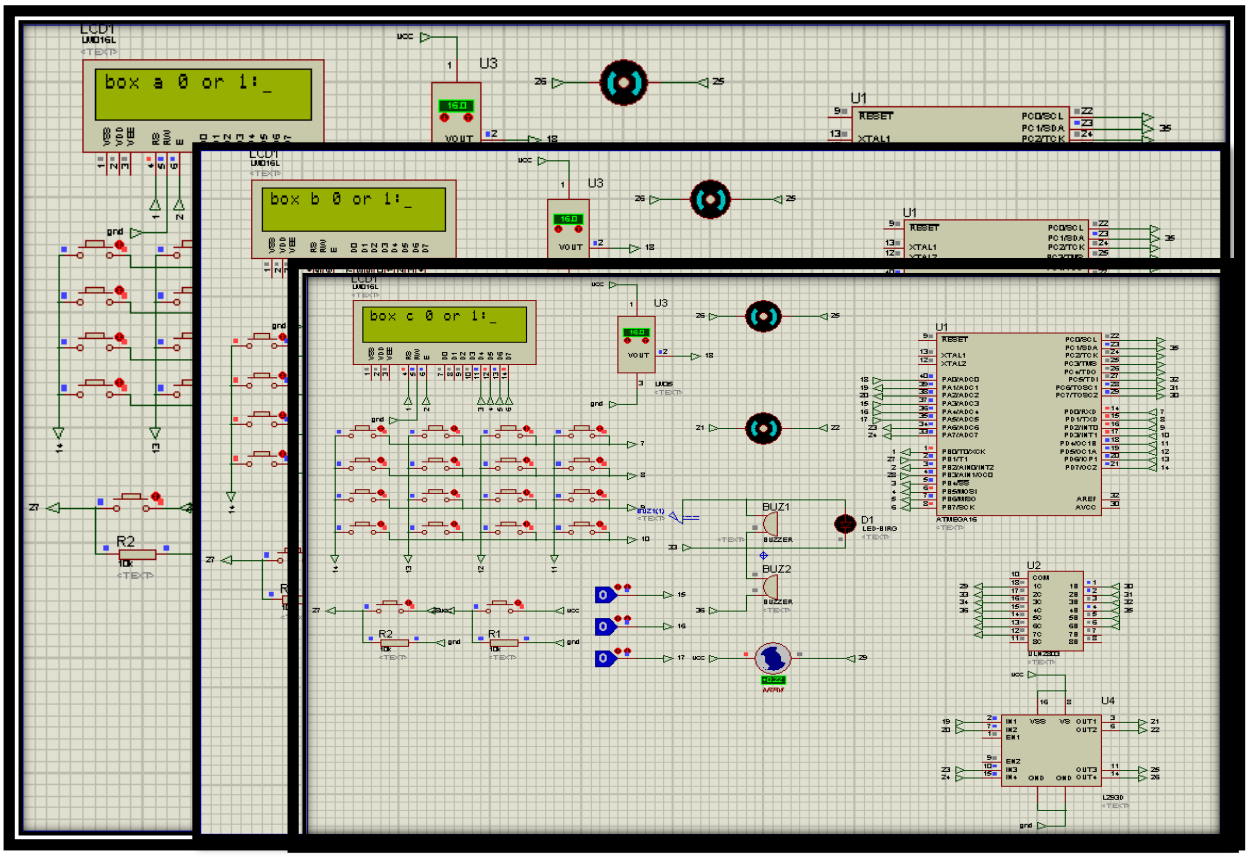

Figure 4.1: selection slot message

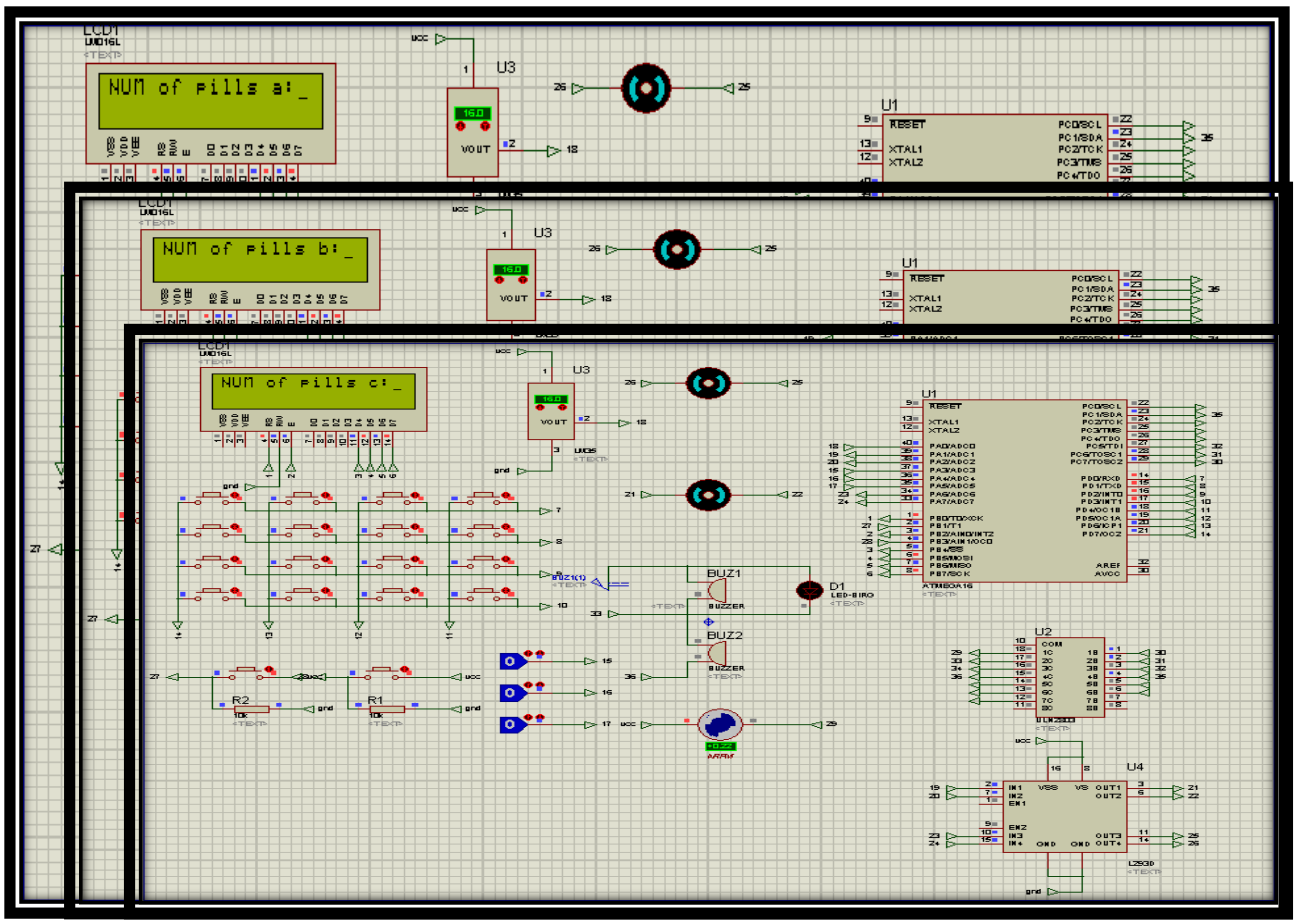

Figure 4.2: entering the number of pills

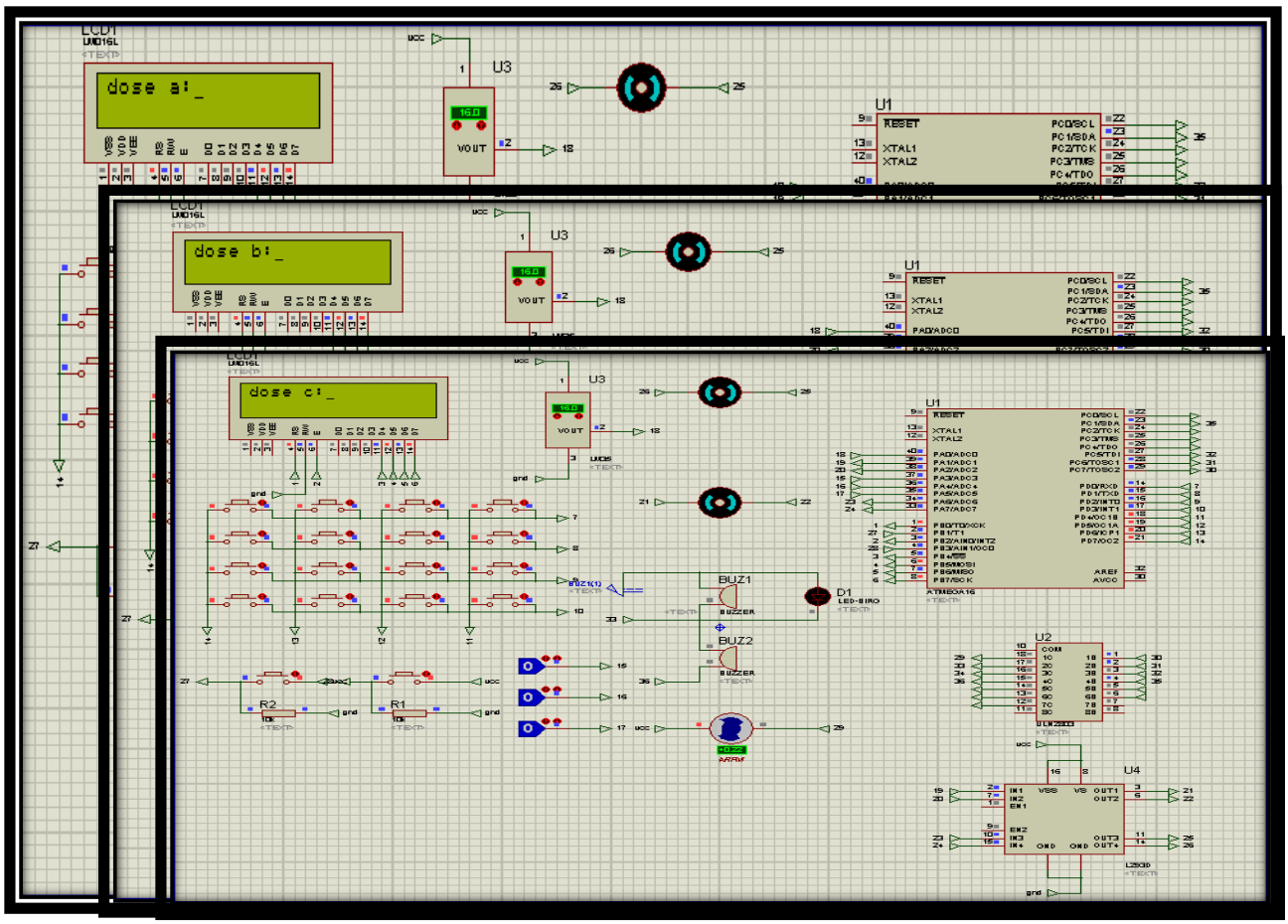

Figure 4.3: entering a particular dose

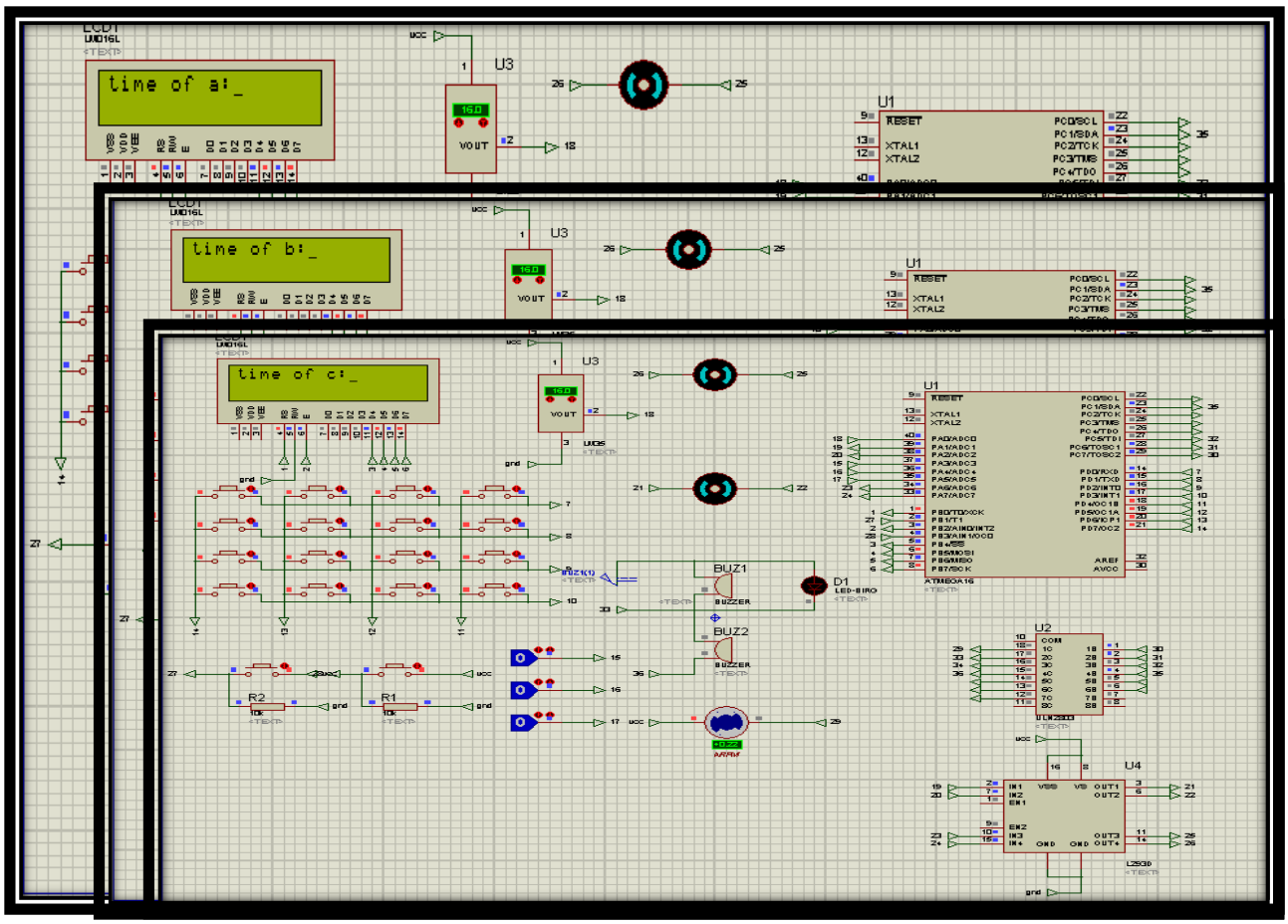

Figure 4.4: entering the time between doses

4.1.1 There are several processing in dispensing phase:

Firstly, the dose time processing (the motor rotate until receiving signal from sensor ,then door will open, the LCD display dose, led and alarm1 will be enable). Then If the wait time expired, the door will close and the led, alarm1 will be disable and alarm 2 will be enabled, lastly When the user collect the dose by pressing switch2, the alarm will stop and the door will open. These processing are shown in figure 4.5 respectively.

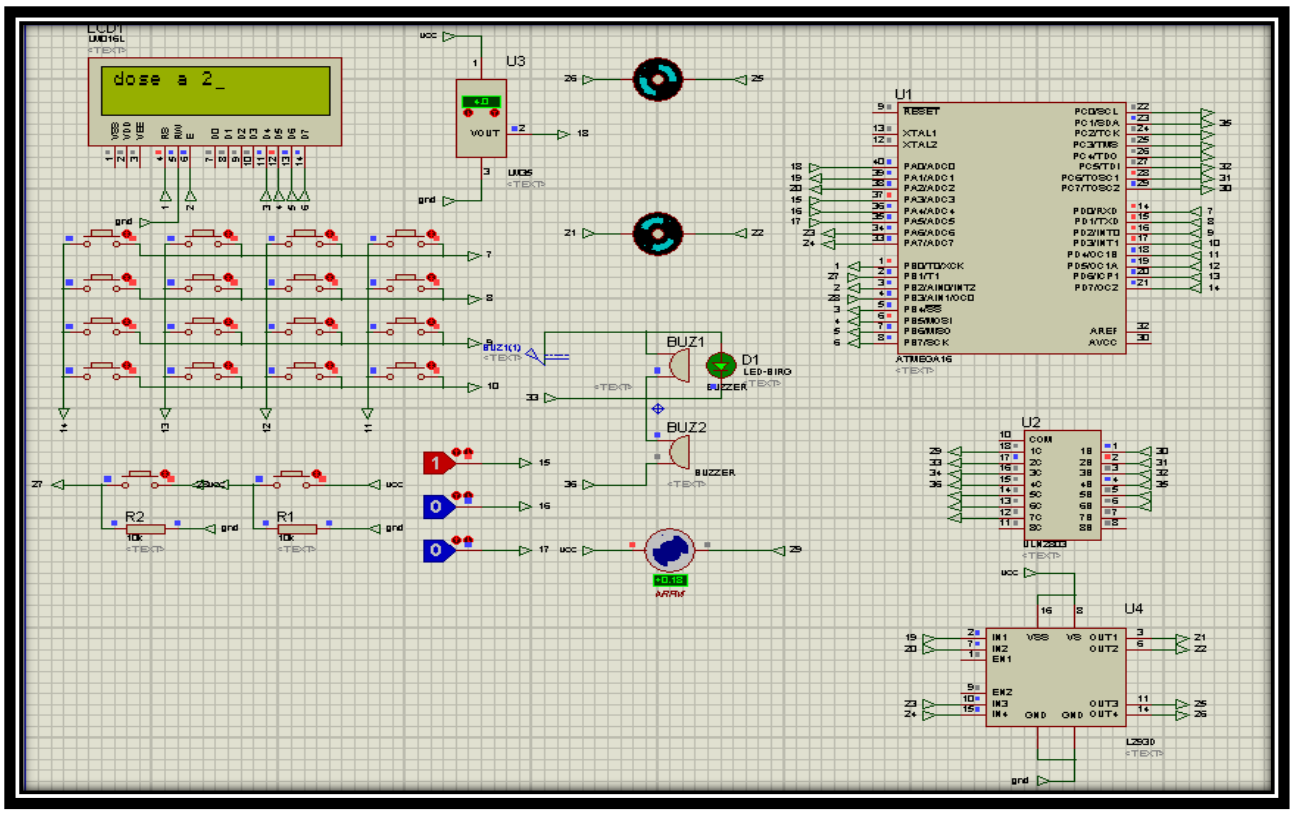

Figure 4.5: dispensing phase

4.2 Hardware implementation:

There were some problems during the implementation of the project .the lack of component in market and the biggest problem was face it, that using the servo motor instead of stepper motor because of this reason:

1. Stepper motors consume more power, produce more heat and operate at about 70% efficiency. Servomotors are more efficient yielding between 80% and 90%

2. Stepper motors draw current regardless of load. The excess power is dissipated as heat. Servomotors draw current proportional to the load resulting in low heat production

3. Stepper motors can slip if overloaded and the error can go undetected .because stepper motor is open loop control .servo is close loop control that mean it have a continuous displacement and can be accurately Positioned, whereas stepper motor motion is incremental and its resolution is limited to the step size.

4. Feedback control with servomotors gives a much faster response time compared to stepper motors.

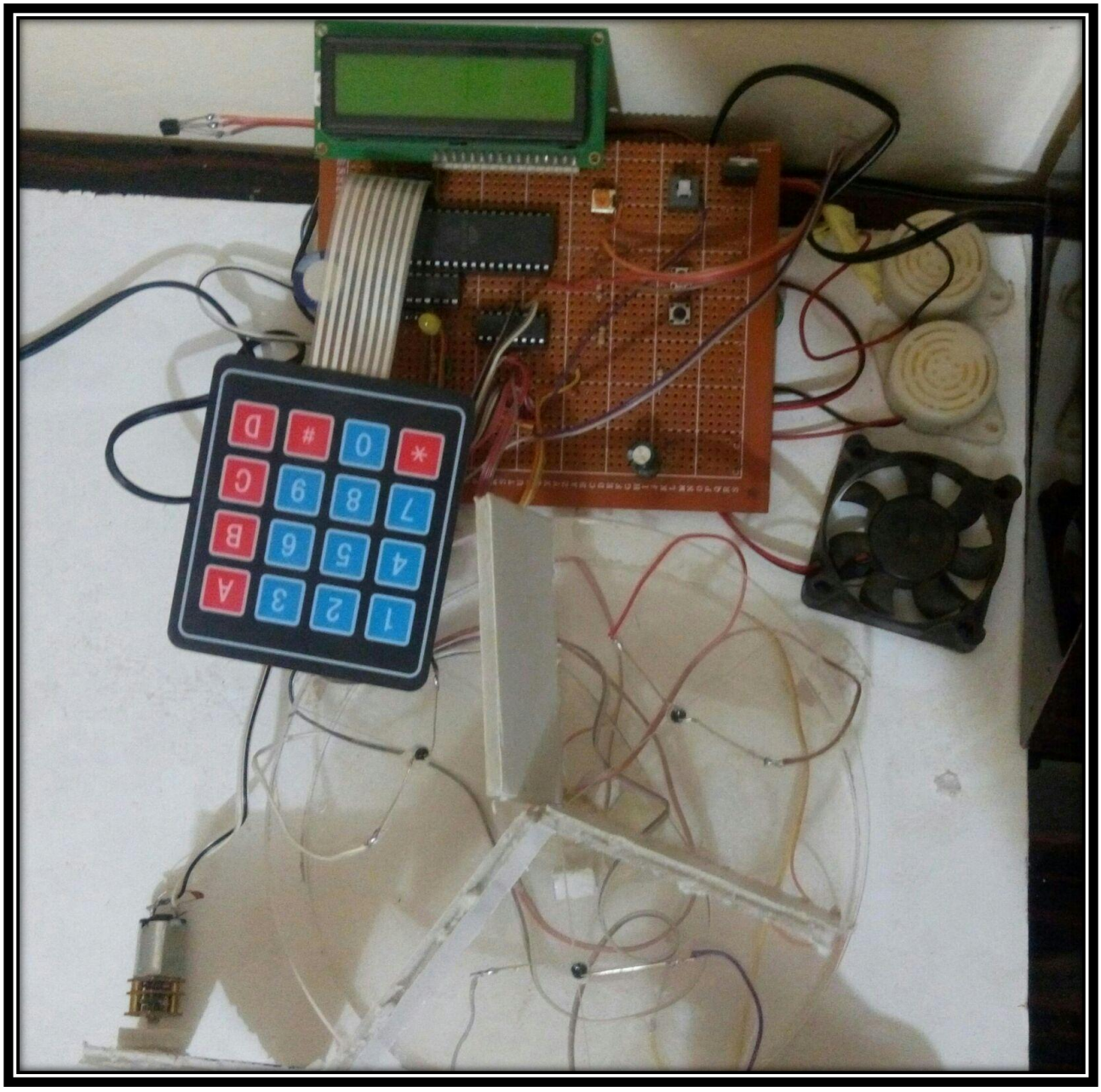

Figure 4.6: Hardware implementation (a)

Figure 4.6: Hardware implementation (b)

Chapter Five
Conclusion and Recommendations

Chapter Five

Conclusion and Recommendations

5.1 Conclusion:

This project is attempted to develop and design a complete automatic system. The overall operation is facilitates the users by alarming and dispense a multiple pills at required times. This achieved using a microcontroller interfaced with an alphanumeric keypad, an LED display, a Motor Controller, an Alarm system, a multiple pill container and dispenser. This system is very cost effective and will be helpful for the Elderly population.

5.2 Recommendations:

- Provide cold storage conditions maintained by using refrigerators and freezers for pills that may be degraded rapidly when kept at room temperature or even at cool places.
- Dispensing the drugs with appropriate information and voice counseling.
- Develop the system by adding more container to contain largest number of medication and fit more than one patient.
- Add more function that give the dispenser capability to notify the user by send a message or email.
- Remind user when the pills less than a critical limit.

Reference:

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Appendices A

APPENDIX A

1-Fatima Ibrahim Ahmed (industrial).

2-Safa Hamid Nasir (industrial).

3-Maram Ismail Mahmood (Computer and network).

4-Mohammed El-siddeq (Computer and network).

APPENDIX A: Simulation Code

```
$regfile = "m16def.dat"
$crystal = 8000000
Config Lcd = 16 * 2
Config Lcdpin = Pin , Db4 = Portb.4 , Db5 = Portb.5 , Db6 = Portb.6 , Db7 = Portb.7 , E = Portb.2 , Rs = Portb.0
Config Kbd = Portd , Debounce = 10
Config Adc = Single , Prescaler = Auto , Reference = Internal      'TEMP SENSOR Start Adc
Dim T As Integer
Config Pina.3 = Input                    'IR a
Config Pina.4 = Input                    'IR b
Config Pina.5 = Input                    'IR c
Config Pinb.1 = Input                    'button 1
Config Pinb.3 = Input                    'button 2
Config Porta.1 = Output                   'out servo1 motor1
Config Porta.2 = Output                   'out servo2 motor1
Config Porta.6 = Output                   'out servo motor2
Config Porta.7 = Output                   'out servo motor2
Config Portc.1 = Output                  'BUZZER1
Config Portc.6 = Output                   'BUZZER2
Config Portc.7 = Output                   'FAN
Enable Interrupts
Enable Urxc
On Urxc Display1
```

```
Dim Key As Byte
Dim A As Byte
Dim X As Bit
Dim Y As Bit
Dim Z As Bit '-----------------------------------------
Dim X1 As Integer
Dim Y1 As Integer
Dim Z1 As Integer '-----------------------------------------
Dim X2 As Integer
Dim Y2 As Integer
Dim Z2 As Integer '-----------------------------------------
Dim X3 As Integer
Dim Y3 As Integer
Dim Z3 As Integer '-----------------------------------------
Dim X4 As Integer
Dim Y4 As Integer
Dim Z4 As Integer '-----------------------------------------
Dim X5 As Integer
Dim Y5 As Integer
Dim Z5 As Integer '-----------------------------------------
Dim Xt As Integer
Dim Yt As Integer
Dim Zt As Integer '-----------------------------------------
Dim Jj As Integer
Dim Xtt As Integer
Dim Ytt As Integer
Dim Ztt As Integer '-----------------------------------------
Dim Xt1 As Integer
Dim Yt1 As Integer
Dim Zt1 As Integer '-----------------------------------------
Dim Xtt1 As Integer
```

```
Dim Ytt1 As Integer
Dim Ztt1 As Integer '---------------------------------------------
Dim Xt3 As Integer
Dim Yt3 As Integer
Dim Zt3 As Integer '---------------------------------------------
Dim Xttf As Integer
Dim Yttf As Integer
Dim Zttf As Integer '---------------------------------------------
Dim Xttv As Integer
Dim Yttv As Integer
Dim Zttv As Integer '---------------------------------------------
Dim Hhh As Integer
Dim Hh As Integer
Dim Vv As Integer
Dim Vvv As Integer
Dim Ccc As Integer '--------------
Dim I As Integer
Dim J As Integer
Dim K As Integer
Dim L As Integer
Dim C As Integer '--------------
Dim G1 As Integer
Dim Cc As Integer
Dim Fff As Integer '--------------
Locate 1 , 1
Lcd "    WELCOME  "
Waitms 1000
Cls
Do
'-----------------------------------------------choooooose
Cls
```

```
Waitms 100
 Locate 1 , 1
Lcd "box a 0 or 1:"
B:
T = Getadc(0) / 4
  If T > 35 Then
  Portc.7 = 1
  End If
    If T < 35 Then
  Portc.7 = 0
  End If
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
X = A

Locate 2 , 1
Lcd A
Elseif A >= 16 Then
Goto B
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "box b 0 or 1:"
Bb:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Y = A
```

```
' Locate 2 , 1
Lcd Y
Elseif A >= 16 Then
Goto Bb
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "box c 0 or 1:"
Bbb:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z = A
Lcd Z
Elseif A >= 16 Then
Goto Bbb
End If
Waitms 500
'-------------------------------------------------- number
Cls
Waitms 100
 Locate 1 , 1
Lcd "NUM of pills a:"
B1:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  X1 = A
 Locate 2 , 1
```

```
Lcd X1
Elseif A >= 16 Then
Goto B1
End If
Waitms 500
B2:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  X2 = A
Lcd X2
Elseif A >= 16 Then
Goto B2
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "NUM of pills b:"
B11:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Y1 = A
 Locate 2 , 1
Lcd Y1
Elseif A >= 16 Then
Goto B11
End If
Waitms 500
B22:
```

```
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Y2 = A
Lcd Y2
Elseif A >= 16 Then
Goto B22
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "NUM of pills c:"
B111:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z1 = A
    Locate 2 , 1
Lcd Z1
Elseif A >= 16 Then
Goto B111
End If
Waitms 500
B222:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z2 = A
Lcd Z2
```

```
Elseif A >= 16 Then
Goto B222
End If
Waitms 500
'--------------------------------------------------------------------
Cls
Waitms 100
 Locate 1 , 1
Lcd "dose a:"
C:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
X3 = A
Lcd X3
Elseif A >= 16 Then
Goto C
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "dose b:"
Cc:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
Y3 = A
' Locate 2 , 1
Lcd Y3
Elseif A >= 16 Then
```

```
Goto Cc
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "dose c:"
Ccc:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z3 = A
Lcd Z3
Elseif A >= 16 Then
Goto Ccc
End If
Waitms 500
'---------------------------------------------------- time
Cls
Waitms 100
 Locate 1 , 1
Lcd "time of a:"
B10:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  X4 = A
Lcd X4
Elseif A >= 16 Then
Goto B10
End If
```

```
Waitms 500
B20:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  X5 = A
Lcd X5
Elseif A >= 16 Then
Goto B20
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "time of b:"
B110:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Y4 = A
Lcd Y4
Elseif A >= 16 Then
Goto B110
End If
Waitms 500
B220:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Y5 = A
Lcd Y5
```

```
Elseif A >= 16 Then
Goto B220
End If
Waitms 500
Cls
Waitms 100
 Locate 1 , 1
Lcd "time of c:"
B1110:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z4 = A
Lcd Z4

Elseif A >= 16 Then
Goto B1110
End If
Waitms 500
B2220:
Key = Getkbd()
A = Lookup(key , Eee)
If A < 16 Then
  Z5 = A
Lcd Z5
Elseif A >= 16 Then
Goto B2220
End If
Waitms 500
Gosub V
Loop
```

```
Eee:
Data 1 , 4 , 7 , 10 , 2 , 5 , 8 , 0 , 3 , 6 , 9 , 12 , 13 , 11 , 14 , 15
V:
X = X
Y = Y
Z = Z
Xt = X1 * 10
Xtt = X2 + Xt
Xt1 = X4 * 10
Xtt1 = X5 + Xt1
Xt3 = Xtt1
Yt = Y1 * 10
Ytt = Y2 + Yt
Yt1 = Y4 * 10
Ytt1 = Y5 + Yt1
Yt3 = Ytt1
Zt = Z1 * 10
Ztt = Z2 + Zt
Zt1 = Z4 * 10
Ztt1 = Z5 + Zt1
Zt3 = Ztt1
  Xtt = Xttv
   Ytt = Yttv
    Ztt = Zttv
If X = 0 Then
Xtt = 0
Xtt1 = 0
End If
If Y = 0 Then
Ytt = 0
Ytt1 = 0
```

```
End If
If Z = 0 Then
Ztt = 0
Ztt1 = 0
End If
If X = 1 Or Y = 1 Or Z = 1 Then
Gosub V1
End If
Return
V1:
Do
  T = Getadc(0) / 4
  If T > 35 Then
  Portc.7 = 1
  End If
    If T < 35 Then
  Portc.7 = 0
  End If
Decr Xtt1
Decr Ytt1
Decr Ztt1
Waitms 1500
Gosub Display
   Loop
   Display1
   T = Getadc(0) / 4
  If T > 35 Then
  Portc.7 = 1
  End If
    If T < 35 Then
  Portc.7 = 0
```

```
  End If
   If Cc = 1 Then
   Ccc = 1
    Portc.1 = 1
    Portc.6 = 0
     Porta.1 = 0
Porta.2 = 1
Waitms 100
Porta.1 = 0
Porta.2 = 0
   If Pinb.3 = 1 And Ccc = 1 Then
   Cc = 0
   Ccc = 0
   Portc.1 = 0
   For I = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
Porta.6 = 0
Porta.7 = 0
Waitms 10
If Pina.3 = 1 Then
 Cls
    Waitms 100
Locate 1 , 1
Lcd "dose a " ; X3 ;
Xtt1 = Xt3
     I = 1000
  Waitms 100

Porta.6 = 0
```

```
Porta.7 = 0
Portc.6 = 1
Waitms 300
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
End If
End If
 Next I
 End If
  If Vv = 1 Then
  Vvv = 1
   Portc.1 = 1
   Portc.6 = 0
    Porta.1 = 0
Porta.2 = 1
Waitms 400
Porta.1 = 0
Porta.2 = 0
   End If
  If Pinb.3 = 1 And Vvv = 1 Then
  Vv = 0
  Vvv = 0
  Portc.1 = 0
  For J = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
Porta.6 = 0
```

```
Porta.7 = 0
Waitms 10
If Pina.4 = 1 Then
 Cls
    Waitms 100
Locate 1 , 1
Lcd "dose b " ; Y3 ;
Ytt1 = Yt3
     J = 1000
  Waitms 100
Porta.6 = 0
Porta.7 = 0
Portc.6 = 1
Waitms 300
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
  C = 1
End If

  Next J
  For Jj = 0 To 500
 If Pinb.1 = 1 Then
       Cls
    Cc = 0
 Porta.6 = 1
Porta.7 = 0
Portc.6 = 0
Waitms 400
```

```
Porta.6 = 0
Porta.7 = 0
 Portc.6 = 0
Waitms 200
Porta.1 = 0
Porta.2 = 1
Waitms 300
Porta.1 = 0
Porta.2 = 0
        End If
       Next Jj
       Gosub Display1
  End If
  If Hh = 1 Then
   Hhh = 1
    Portc.1 = 1
    Portc.6 = 0
     Porta.1 = 0
Porta.2 = 1
Waitms 400
Porta.1 = 0
Porta.2 = 0
   End If
   If Pinb.3 = 1 And Hhh = 1 Then
   Hh = 0
   Hhh = 0
   Portc.1 = 0
   For K = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
```

```
Porta.6 = 0
Porta.7 = 0
Waitms 10
If Pina.5 = 1 Then
 Cls
   Waitms 100
Locate 1 , 1
Lcd "dose C " ; Z3 ;
Ztt1 = Zt3
    K = 1000
  Waitms 100
Porta.6 = 0
Porta.7 = 0
Portc.6 = 1
Waitms 300
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
End If
  Next K
  End If
If Xtt1 = 0 Then
Gosub St1
End If
If Ytt1 = 0 Then
Gosub St2
End If
If Ztt1 = 0 Then
Gosub St3
```

```
End If
Return
Return
St1:
 For I = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
Porta.6 = 0
Porta.7 = 0
Waitms 10
If Pina.3 = 1 Then
I = 1000
   Cc = 1
 Cls
   Waitms 100
Locate 1 , 1
Lcd "dose a " ; X3 ;
Xtt1 = Xt3
  Waitms 100
Porta.6 = 0
Porta.7 = 0
Portc.6 = 1
Waitms 300
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
Waitms 2000
End If
```

```
 Next I
 For Jj = 0 To 1000
If Pinb.1 = 1 Then
     Cls
 Cc = 0
Porta.6 = 1
Porta.7 = 0
Portc.6 = 0
Waitms 400
Porta.6 = 0
Porta.7 = 0
 Portc.6 = 0
Waitms 200
Porta.1 = 0
Porta.2 = 1
Waitms 300
Porta.1 = 0
Porta.2 = 0
      End If
     Next Jj
  Gosub Display1
  Waitms 100
  Gosub V1
 Return
St2:
 For J = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
Porta.6 = 0
Porta.7 = 0
```

```
Waitms 10
If Pina.4 = 1 Then
Ytt1 = Yt3
    J = 1000
  Waitms 100
   Cls
    Waitms 100
Locate 1 , 1
Lcd "dose b  " ; Y3 ;
Porta.6 = 0
Porta.7 = 0
Portc.6 = 1
Waitms 1000
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
Waitms 2000
 If Pinb.1 = 1 Then
    Vv = 0
    Vvv = 0
 Porta.6 = 1
Porta.7 = 0
Waitms 400
Porta.6 = 0
Porta.7 = 0
 Portc.6 = 0
Waitms 200
Porta.1 = 0
Porta.2 = 1
```

```
Waitms 300
Porta.1 = 0
Porta.2 = 0
End If
Waitms 7000
Gosub Display1
End If
Waitms 100
 Next J
    Waitms 100
  Gosub V1
Return
St3:
 For K = 0 To 1000
Porta.6 = 0
Porta.7 = 1
Waitms 10
Porta.6 = 0
Porta.7 = 0
Waitms 10
If Pina.5 = 1 Then
Ztt1 = Zt3
   K = 1000
 Waitms 100
 Cls
   Waitms 100
Locate 1 , 1
Lcd "dose c" ; Z3 ;
Porta.6 = 0
Porta.7 = 0
Portc.6 = 1
```

```
Waitms 1000
Porta.1 = 1
Porta.2 = 0
Waitms 300
Porta.1 = 0
Porta.2 = 0
Waitms 200
 If Pinb.1 = 1 Then
    Hh = 0
    Hhh = 0
 Porta.6 = 1
Porta.7 = 0
Waitms 400
Porta.6 = 0
Porta.7 = 0
 Portc.6 = 0
Waitms 2000
Porta.1 = 0
Porta.2 = 1
Waitms 300
Porta.1 = 0
Porta.2 = 0
End If
Waitms 2000
Gosub Display1
End If
Waitms 100
  Next K
        Waitms 100
   Gosub V1
Return
```