

**DESIGN AND PRODUCTION OF ROBOT BY USING MICROCONTROLLER****MOSTAFA ABDULGHAFOOR MOHAMMED**

Instructor at al-imam al-aadam university college , Baghdad

Abstract

This project concerned to control (7) servomotor in (x, y, z) coordinates by using microcontroller type PIC18F45K22 device which can programmed with computer using Micro-C language after compiled to assembly language and to Hex-file, this way control using coordinate by coordinate which control the state of cycle by PWM signal to give high accuracy of rotating the arm of robots.

The axes to which controlled of robot first given password that display on LCD using the keypad and then remote control to moving the robot axes coordinates

Introduction:

The necessity for the many uses and high of needing for doing some operations and movements and in different envelopes that do not help humans to work because of dangers leading to injuries eloquent when he work in places that are containing chemicals or radioactive materials which is being high impact on the human race, especially that has high effect on the hormones and enzymes and the Cancer causes, So ,Use robots. These robots are have an programmed arms to do the required work with high accuracy and with movements in different directions. The control process on these arms is being by special program is prepared for the intended purpose.

The robots are consider of micro devices, that can be controlled on them by using special programs written in several languages, including languages (MB, MC, MP),this is language microcontroller, and after writing the required software then it is being converted into files format (HEX-FILE), and then loading it on microcontrollers and turn this to control on robot's arms, which controls the movement of servomotors (Servomotors). These motors contain engine Direct Current (DC) connected with the group of electronic circuits which are assimilated by power transistors that limit its rotation direction as well as torque.as for The number of cycles are controlled it by generating tuning pulses, type (PWM) by microcontroller, this tuning pulses are programmed in a specific time, depending on the

counter, which is programmed by the Special Program of microcontroller (Timer Counter) and connecting to the electronic circuit of robot [1].

The manufacturing of robots were controlling by computers, an example of that (Host Computer) and it have little storage memory, these robots have limiting movements, of what led to the limitation of the functions [2].

Abbreviations:

LCD : Liquid screen.

MB : Micro BASIC language.

MC : Micro C language.

MP : Micro Pascal language.

DC : Direct Current.

PWM : tuning pulse.

EEPROM : electrical scanning memory , (read-only).

SPI : the conductions with electronic devices.

I2C : entry to integrated circuits systems.

USART : synchronous communication and an asynchronous communication for receiving and sending data.

UART : asynchronous connection for receiving and sending data.

MOSFET : transistor is type of semiconductor works under the influence of the field.

Components of Robot

Been manufacturing robot have an arm consist of (3) movements of the three axes and consisting of two parts, the electric part which represents three parts (source of nutrition, microcontroller circuit to control the robot, group of organizers of voltages, with the display screen for the operating codes and dimensional control on robot) either the mechanical part represents mode of tying of the movement's arms by using the automatic motor (Servomotors) and the process of organizing the balancing for arms of the robot by using lead material and the fixing base and toothed of the handle Movement [3].

1. The electrical part

It is represent the main part which is in it the precise control on the arms of the robot, as in Figure (1) the electric circuit scheme.

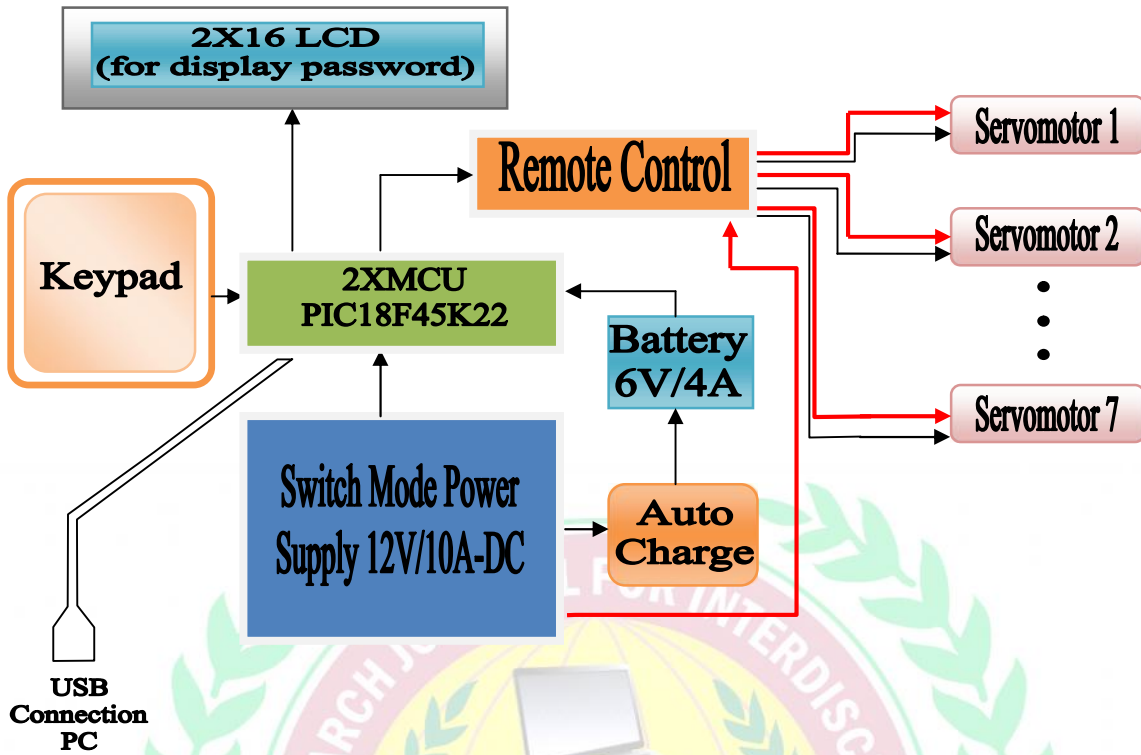


Figure (1) the electric circuit scheme

The electrical part of the robot as in the figure above, consists of the voltage regulator which provides all parts departments of robot with the nutrition of (12) volt and with current of (10) AMP and it is from type (Switch Mode Power Supply) and this block is working on reduction of voltage source (220) volts / AC to DC value (12) V / (10) Ampere which is feeding microcontrollers circuit after reduce by the voltage regulator is type (5A/7805) to (5) Volt, this microcontrollers include two microcontrollers which type of (PIC18F45K22) for the robot's arms, and group of inserting the codes to the Liquid screen and the remote control system to operate the robot [4]. Are also charging the battery (Source Reserve) to supply the motor mechanism for robot arms in case the main source of failure in order to keep the movement of the arms of the robot in the field of high precision.

1.1-Microcontroller

We used type of the microcontrollers which have specifications is different from other kinds, type (PIC18F45K22) from origin of company (Microchip) and its number (2). The first is to control the automatic motor for robot's arms, and the other to use the digital codes to operate robot by inserting it via the keyboard and displaying it on the liquid screen. We used language (Micro C), that special with programming of microcontrollers after converting this language to formula (HEX-File) by using program (Microprog) and then download the file format (HEX) on the microcontrollers. Rapid loading technology is used instead of using

programmer for programming microcontrollers to facilitate the downloading of software from computer to microcontroller directly by using link (USB) and this operation is by using special program [5] [6]

This type of controller distinguish with the following specifications:

-Fast response with the microprocessor for him

-has architecture (8) bit

Capacity (1024) bytes of memory EEPROM-

addresser memory program that has capacity of (64) KB-

addresser memory Data that has capacity of (4) KB-

capability of operations processing of (16) Mega / sec-

instructions have capacity of (16) bits, and data capacity (8) bit-

Priority to respond to interruptions-

- it has little consumption of electrical power (100) Nano AMP in the case of Hibernation

-With little consumption of electrical power range (500) Nano AMP in the case of Timers micro internal oscillator (16) Mica Hz-

Use (4) oscillators with value (64) Mica Hz-

Use (2) chronological timers with value (64) Mica Hz-

Secondary oscillator (32) kHz for chronological timer 1-

17-28 (-transformation channel from the gleeing case to digital case with accuracy

-10 bits

-More than (7) timing system and include (4) with capacity (16) bit timing

And (3) timers have (8) bit-

Using Technology (SPI) as well as (I2C) and (USART) and (UART-)

Nutrition voltage ranging from 1.8-5,5 volts-

The tolerance temperature (-40/125) degrees Celsius-

it has conductionfeet with (40) as in Figure (2)-

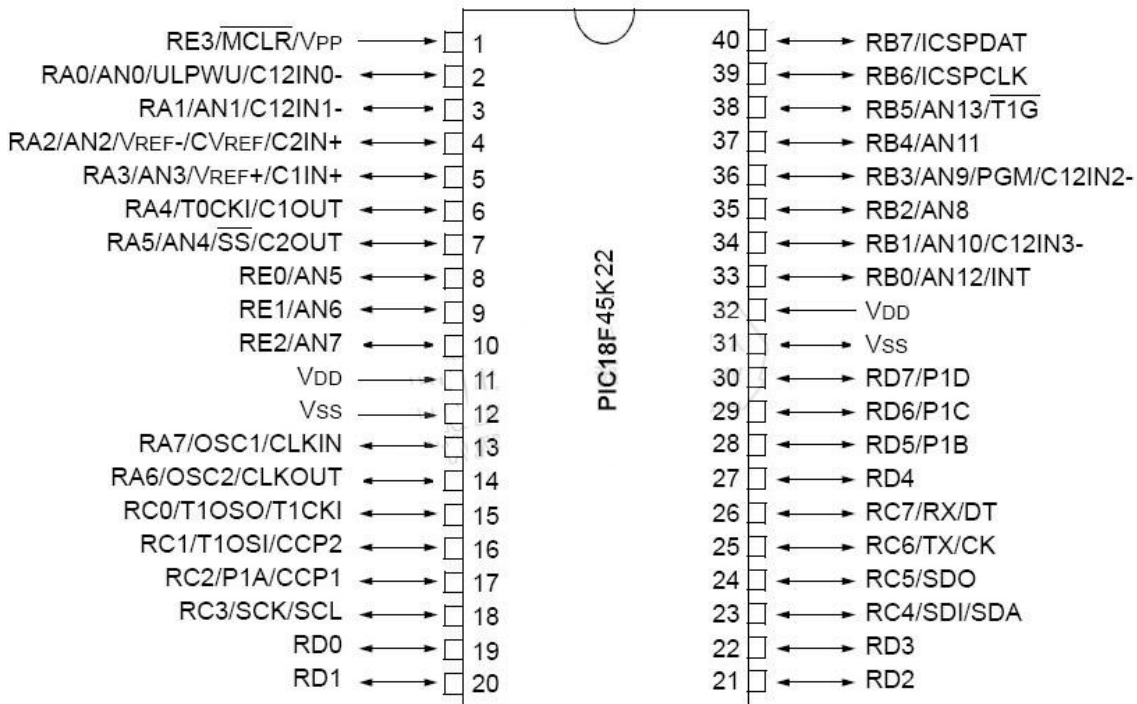


Figure (2) the microcontroller, type of PIC 16F 45K

22

2.1 -The automatic engine (Servomotor)

we used (7) of automatic engines to move the arms of the robot from type (Futabs) as shown in Figure (3) have Special Features include:-

Speed (70) rpm.

.Maximum torque (4.8 kg / cm)

Angle of rotation (360) degrees.

Nutrition voltage (4.8 to 6) Volt / DC.



Figure (3) The servomotors (Servomotor)

The mechanical part of the servomotors consists as in Figure (4) of three parts, container of the gears and container of the electronic parts and the part latter is cover of the electronic parts. and the gears are connecting with the engine of the direct current to reduce the rotation speed and increase the rotation torque. also containing (Ball Bearing) an associated with main axis which is be outside from the servomotors [7].

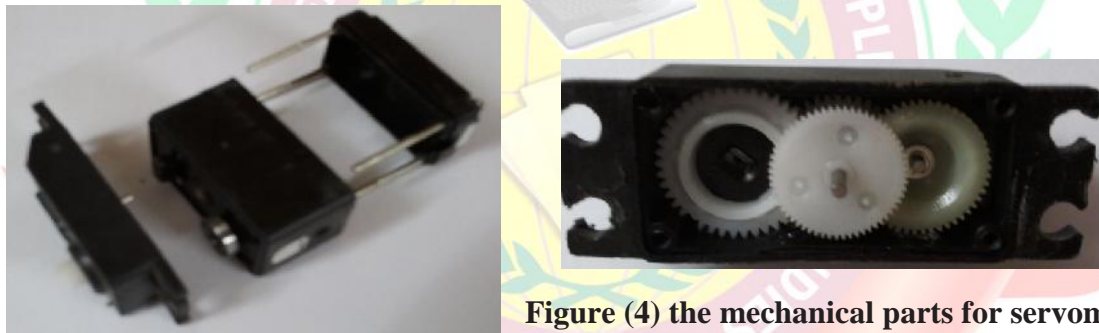


Figure (4) the mechanical parts for servomotors

as for the part electric is contain an engine that operate with voltage

(4-5.5) VDC and electronic circuit is contain of an integrated circuit converts the pulses to the type (PWM) that is come from the microcontroller through control wire and it is send out to ability transistors from type (MOSFET) number four tied as shape of bridge and according to the input signal, as in Figure [5] [8].

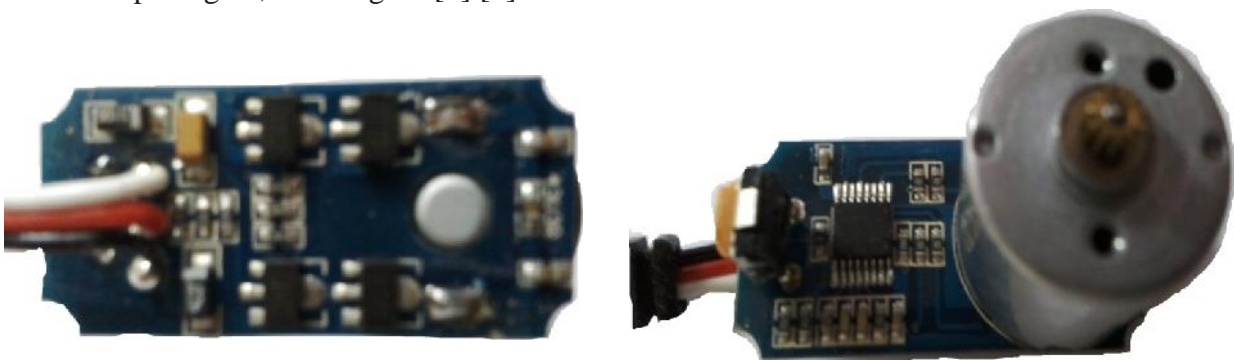


Figure (5) the electric parts of the servomotors

Remote control system Consists The system of control remotely for electronic circuit and containing reception part and include of circuit which is consisting of two electronic circuits, the reception circuit , and microcontroller circuit, private for giving the programmable commands to switch on the relay and private for connecting nutrition of (6) volts to servomotors of the robot and has been linked with it, connector is semiphotic per Servomotors located in the lower arm to denote connecting the nutrition for engines of robot and its equipment. the reception circuit's nutrition is DC source of (12) volts. either the transmission part ,it is small circle can be borne by the hand and contains keys of the operating, it is be transmission system, it working reluctantly is encrypted, as shown in Figure (6).

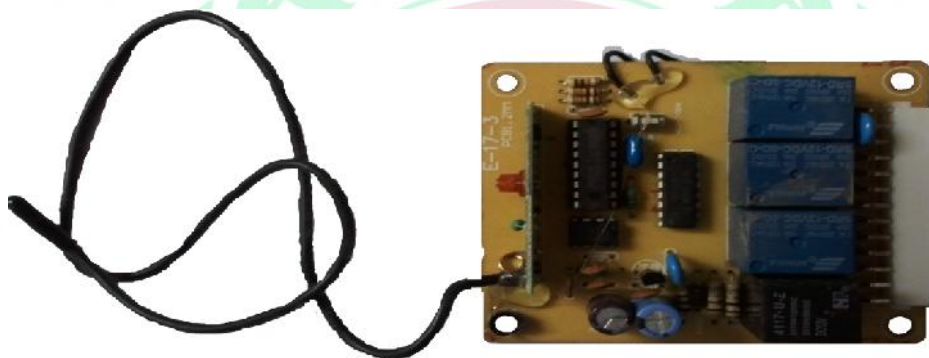


Figure (6) remote control system's parts

4.1- the display screen and keyboard

Used the Display screen manufactured by the company (Microchip) type (Winstar) liquid type and dimensions of writing (2X16) character, and has been linked the screen with microcontroller, private to writing programmable encryptions, to move robot after inserting it by using the associated keyboard with microcontroller . After inserting keys of encryptions is writing on the screen, the robot is ready to do the desired job, be the phrase (ROBOT IS READY), as shown in Figure (7) the form of screen and the appeared writings on it, in addition to the electrical chart in Figure (8) shows manner of linking the screen with microcontroller and nutrition points of screen ,and the keyboard is composed of matrix of buttons be linked with an easiness with the microcontroller, the symbols and numbers are using to create secret number private to switch on the robot, and the Figure (9) shows the keyboard [9].



Figure (7) the display Liquid screen (LCD)

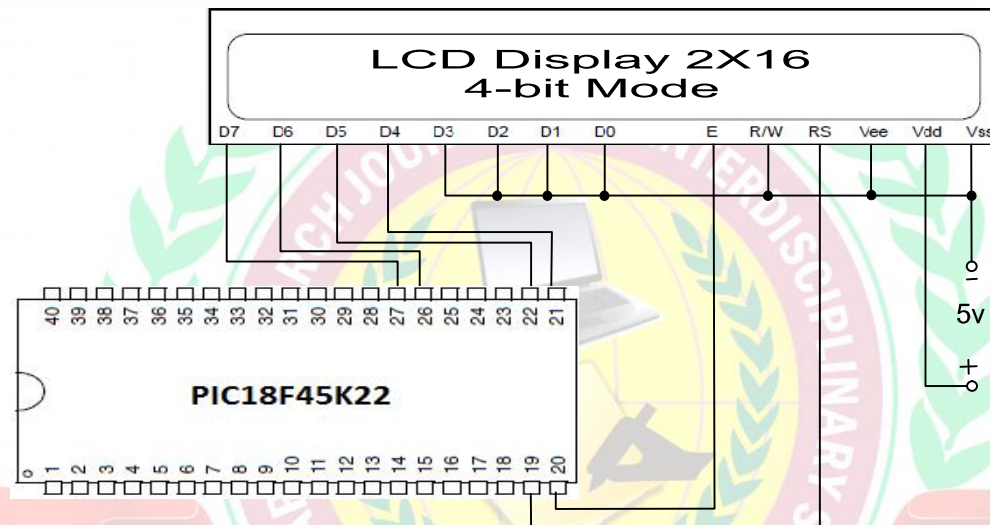


Figure (8) the electrical chart to linking the display Liquid screen (LCD)



Figure (9) the Keyboard (KEYPAD)

2- The Mechanical part.

The mechanical part of the robots is consists several parts and these parts are linked with each other to the servomotors, including that is have two engines, and other have one engine, and includes [10] :-

2-1: the handle arm

The part that contains two of the moving toothed are working to hold on parts that are required to hold on it, These toothed are including one tied to servomotors and private with the handle, and the other is meshing with him and the two are made of material (Fiber Glass) and it is consider the main part which defines the functions of the robot, and Figure (10) shows the parts of handle.

2-2: the rotor part of the handle arm

It is the responsible part on rotation of the handle arm of robot with degree of (360) degree on the left and right, consists one part be connected by one engine, as in Figure (10).

2-3: The upper animate part (the short arm)

It represents the part that move the group of handle arm, and the rotor part at it, and it associated with them by using two servomotors, one of them is rotate inverting the other and controlled by using the control electric wire same by the microcontroller. the using of two motors is increasing torque of the rotation of the arm, as shown in Figure (10) parts of the upper short arm

2-4: The bottom animate part (the long arm)

This arm is considered the more important because of the extension to longest distance, it's linking with the upper short arm ,with instrumentality of two of servomotors and the rotary bottom rule of the robot, also by other two motors, it is the part that contains on nutrition distribution board for all the servomotors except the engine of rotary bottom rule of the robot, as well as reference blue lamps for denotation on the interfacing of nutrition for engines and also contains on the conduction's points, to transfer signals , type (PWM) from microcontroller to engines, as well as containment of the arm on the lead material to equalize balance of the robot arms. Figure (10) shows in detail .the arm's parts

2-5: the rotary rule

It is considered the base which be the robot is based on it and contains as in Figure (10) on iron base is square the shape, and it is enveloped by an layer fabricated from aluminum, and fixing inside it (Boll Bearing) with disc form, the external terminal is fixing with iron rule, and the other is boarder and installed on it aluminum disk carrying the robot body completely, and this disk is fixed with an servomotor axis for rounding the robot's body with an rotational movement in two directions and with an angle (360) degree. Substrates are used to install the base on one horizontal level to all corners of the iron rule.

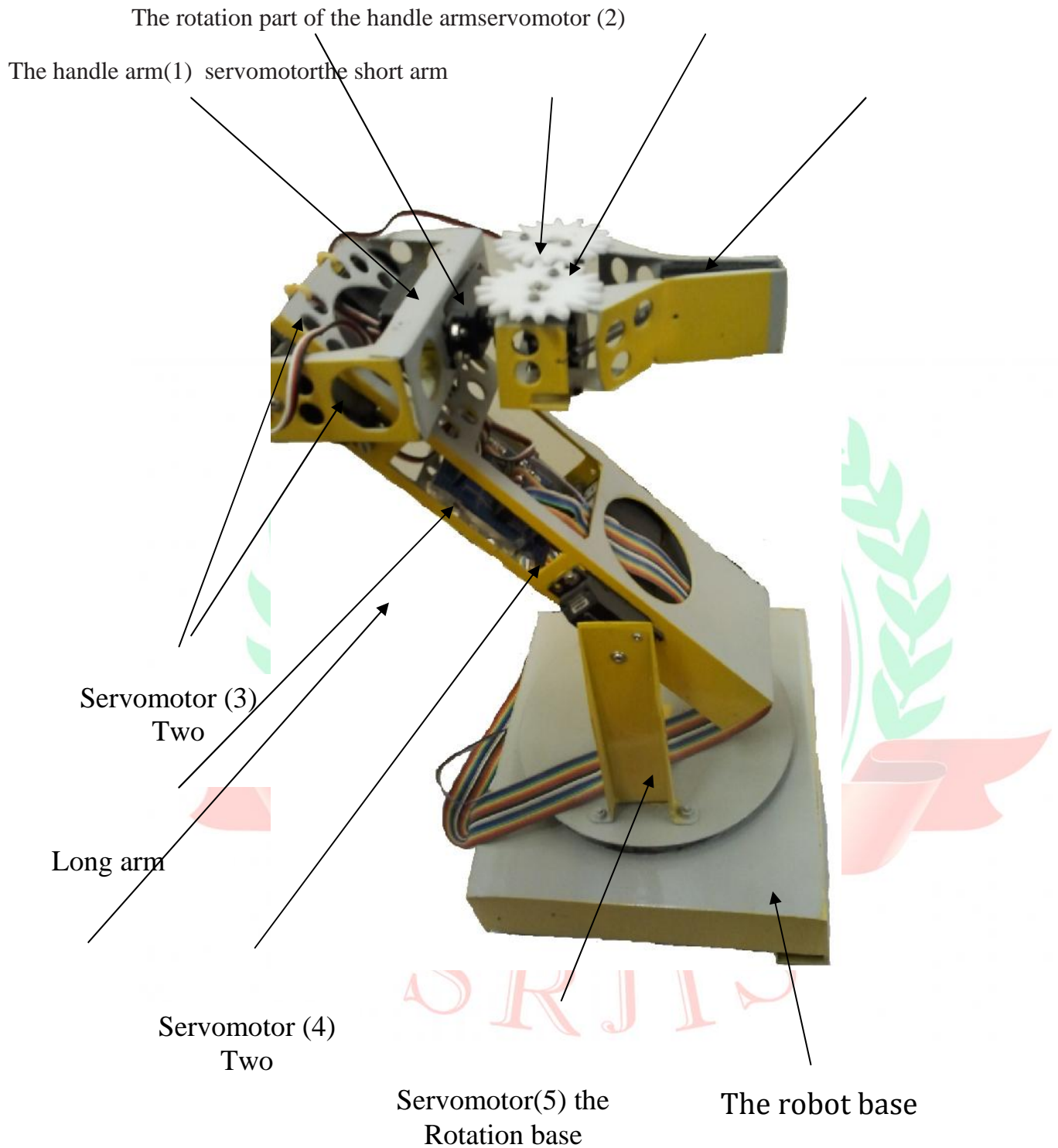


Figure (10) clarify parts of the robot

The private Programs of the robot

By Using two microcontrollers, was written two programs, the first to move the robot by putting up an body is cylindrical the shape, from an location to an location at an angle

(180) degree, and in Figure (12) shows the Algorithm chart for the first program. while The second program is using to insert an private encrypted been stored in the microcontroller to moving the robot and by using the keyboard and Display Liquid screen to insert and show the data, and Figure (11) shows the Algorithm's chart for the second Program . all the programs were written with language of (Micro C) , that was transferred to an programs in the form of files (Hex file), by using an program (Microprog) that produced by Microchip company, then were loaded in the microcontrollers with using an program (Bootloader) and with using an connection (USB) as shown in Figure (13). an algorithm is Sequencing steps of the program and private to control the movement of the arms of the robot is consist of two programs for each controller. the first microcontroller and private with enter the encryptions for interfacing the nutrition to the servomotors for the robot. in Figure (11) shows the program algorithm.

while The second controller is used to give an pulses from type (PWM) is limited according to movement of the arm and this is completed with way of an forming these pulses by using an chronological counter (TIMER2) to move the servomotors according to function by which the robot is programmed for implementing it as shown the program algorithm in Figure (12) and the program is written by language (MICRO C) in Supplement No.(1).

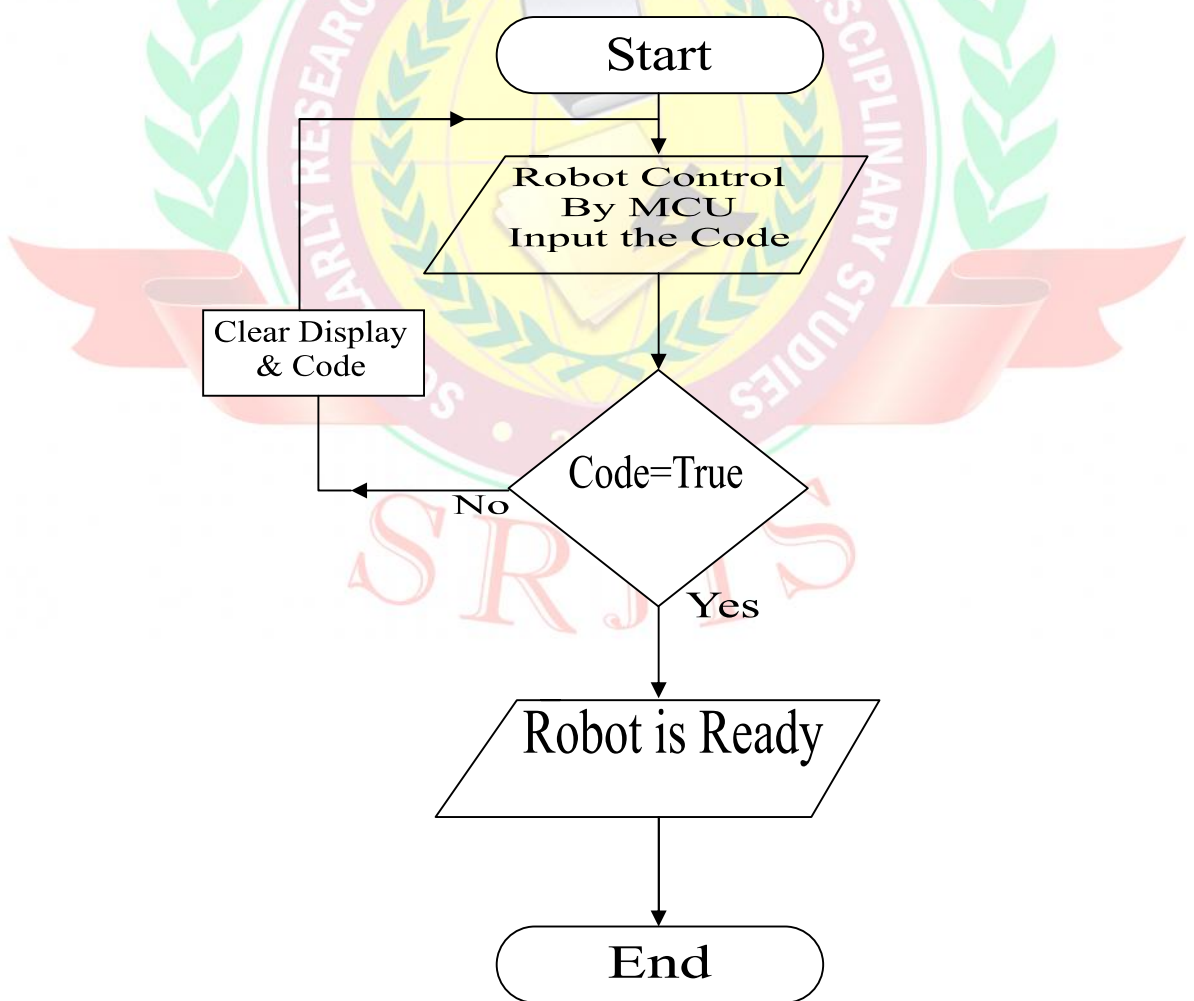


figure (11) program algorithm the first microcontroller to insert encryptions

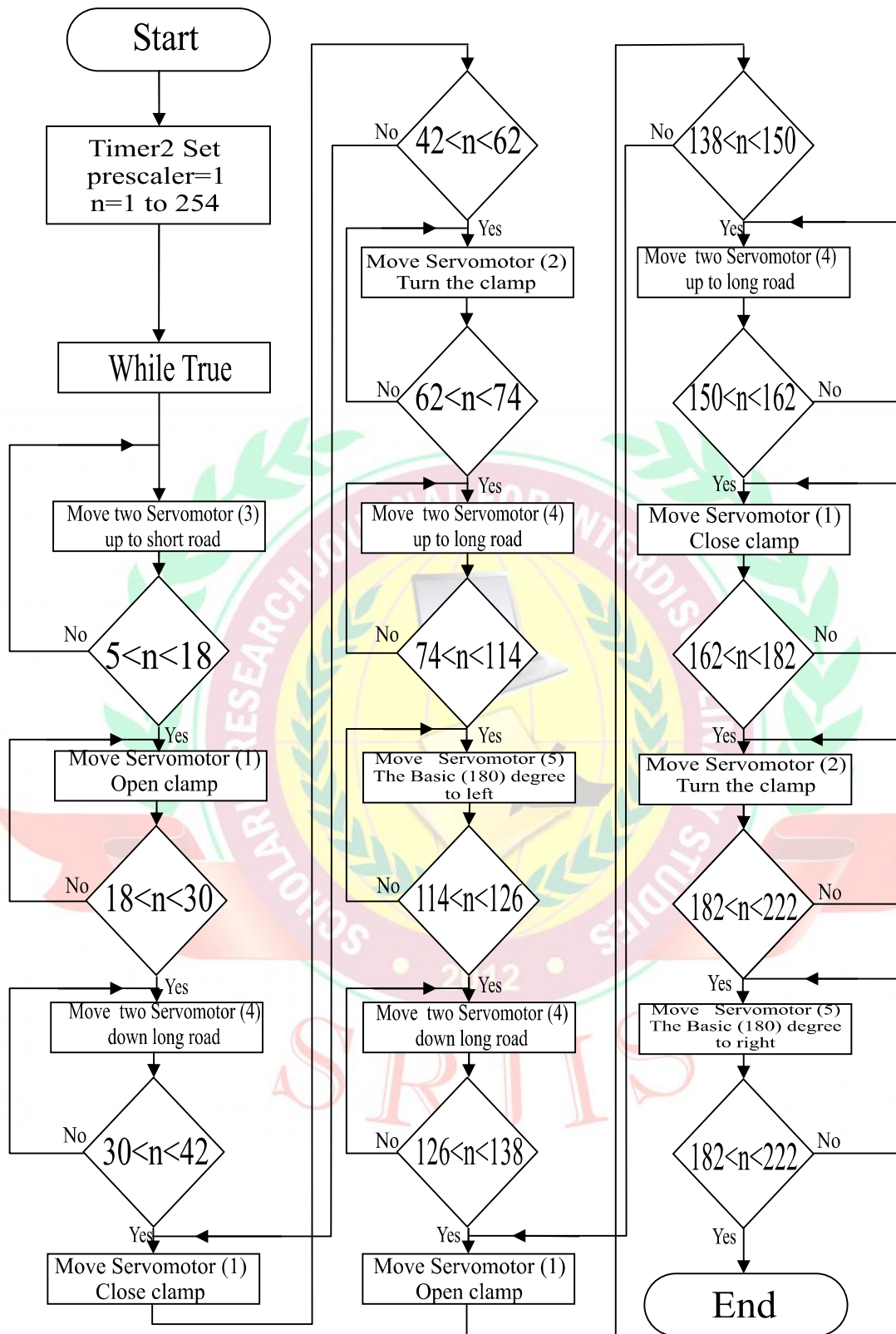


figure (12) program algorithm the second microcontroller to insert encryptions

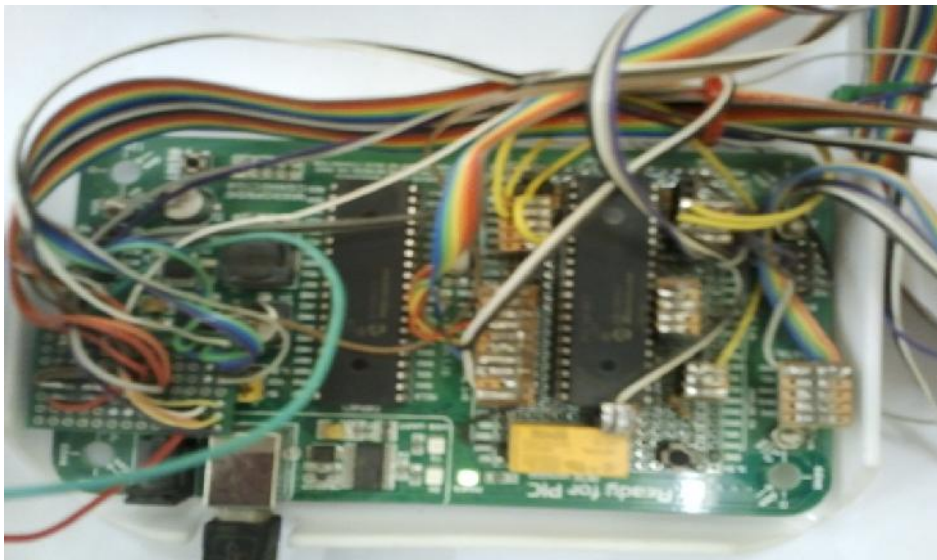


Figure (13) the electronic board of the micro-controllers with a connection (USB)

Android operating principle:

After connecting nutrition to source AC (220/AC) with voltage regulator which works to reduce and transform voltage to a direct current with value (12) volt, with output current amount (10) AMP by using method (Switch Mode), in this case is accomplished the nutrition of power distribution board, consisting of group of voltage regulators, number (2), one of them has a high-capacity to feed the servomotors of the robot as well as charging the spare source (battery) private with robot, and the other is to feed microcontrollers as well as the ability organizer's (12) volts to feed the control system from far, with the addition to the Liquid display screen.

Then appear on the screen is (ROBOT CONTROLLED BY MCU) and then (INSERT CODE), is inserted the following encryptions (1,432,012) by using the keyboard that is associate with the microcontroller and installed on the main control board, as in Figure (14) then appears a phrase (ROBOT READY) is then connected nutrition to the system of control remote, and when press on the play operate on remote, is conduction nutrition for the microcontroller which is private to control arms of the robot then operation lights blue in the main arm of the robot and the (5)denotation lamps of the nutrition conduction of to the .servomotors



Figure (14) the main control board

After a period of three seconds to read the special program with movement of robot in the microcontroller the movement of the arms is started, according to that process that has been programmed to control the movement of arms and after the completion of the program the robot is stopped. The program was written for the purpose of carrying a piece of cork in the form of a small barrel and convert it from one site to another site at an angle (180) degrees.

CONCLUSIONS:-

The control process on a robot is composed of (7) mechanism engines must be the programming process for microcontroller has high accuracy from where computation of generating the pulses by the chronological timer which is used by the microcontroller and this pulsations are be limiting with a high accuracy to move these engines with an accurate movement to doing the wanted function that the robot is performed it , and it is executed some of wanted stops to control the movement of the robot and the process of generating the balance of the robot's arms from the resultant heaviness from the difference in a dimensions and lengths of the Arms so was presentation and delay in some movements that is required to implementation it, in addition to use, two motors in the main Arms (the short arm,the long arm) to increase the wanted torque to move these arms,to completion controlled on them in the same tense time broadcasted in the loop conditional.

The study of arms balancing of the robot ,that help on capability of programming the robot with a different programs, to do many functions that can help of itin many spheres of medical and engineering and the self-absorbed watching systems ,that from the difficulty for the human-hands to do these jobs and with a high accuracy.

References:

- 1-Smart hand system for robotics and teleportation, (1986), Bejczy,A.K&Jau.B.M.
- 2- Robotics in service,(1989), Engel Berger.
- 3- Industrial engineering and management, (1994),McGraw-Hill.
- 4-Microproccerssor and interfacing, programming and hardware, (2004), McGraw-Hill.
- 5- Architecture and programming of PIC18F45K22 MCU,(2004),microelectronic.
- 6- Embedded C,(2002),Pont,M.J.
- 7- Intelligent robotics,(1992),Valavanis ,K.P.,&Saridis.

8- Programming and interfacing the MCU,(2000),Yeralan,S.,& Emery,H.

9- Introductory robotics ,(1992),Selig,J.M.

10- Robot arm with controller,(2009),Scorpio technology.

