CHAPTER FOUR

SIMULATION AND RESULTS

4.1 Introduction

MATLAB is a widely used in all areas of applied mathematics , in education and research at universities and in the industry. MATLAB stand for MATrixLABoratory and the software particularly useful for linear algebra but MATLAB is also a great tool for solving algebraic and differential equations and for numerical integration. MATLAB has power full graphic tools and can produce nice pictures in both 2D and 3D. It is also a programming languages for writing mathematical programs. MATLAB also has some tools boxes useful for signal processing, image processing, optimization, Simulink , etc . In Simulink it is very straightforward to represent and then simulate a mathematical model representing a physical system. Models are represented graphically in Simulink as block diagrams. A wide array of blocks are available to the user in provided libraries for representing various phenomena and models in a range of formats. One of the primary advantages of employing Simulink (and simulation in general) for the analysis of dynamic systems that it allows us to quickly analyze the response of complicated systems that may be prohibitively difficult to analyze analytically. figure (4.1) shows the SIMULINK block diagram of DC servo motor without controller.

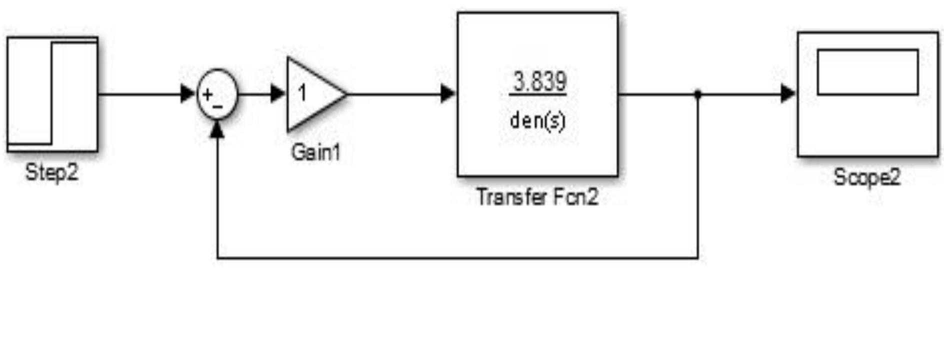

Figure (4.1) : the SIMULINK block diagram of DC servo motor without Controller

The step response of DC servo motor without controller as show in Fig (4.2).

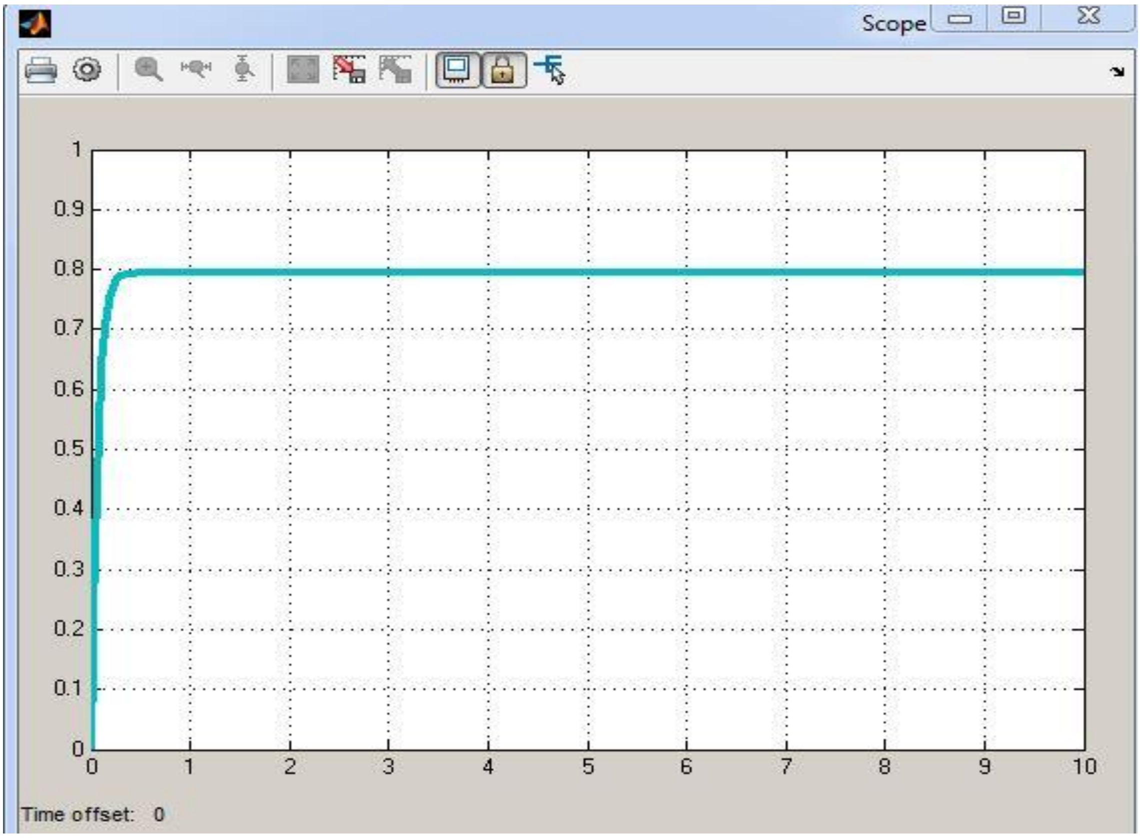

Figure (4.2): the step response of DC servo motor without controller

4.2 Simulation result is presented to evaluate the effectiveness of the PID controller.

Figure (4.3) shows the SIMULINK block diagram of position control of servo motor using PID controller .the PID controller gain selected as Kp=4.7198 ,Ki=54.2762 ,Kd=0.06912 . Figure 4.4 shows the step response of PID controller.

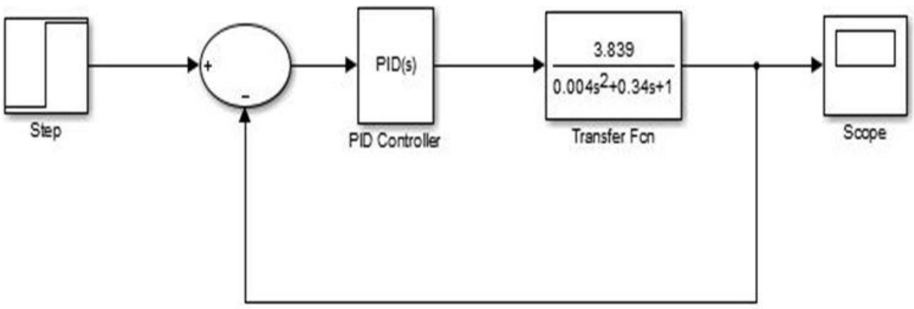

Figure 4.3: the Simulink block diagram of PID controller

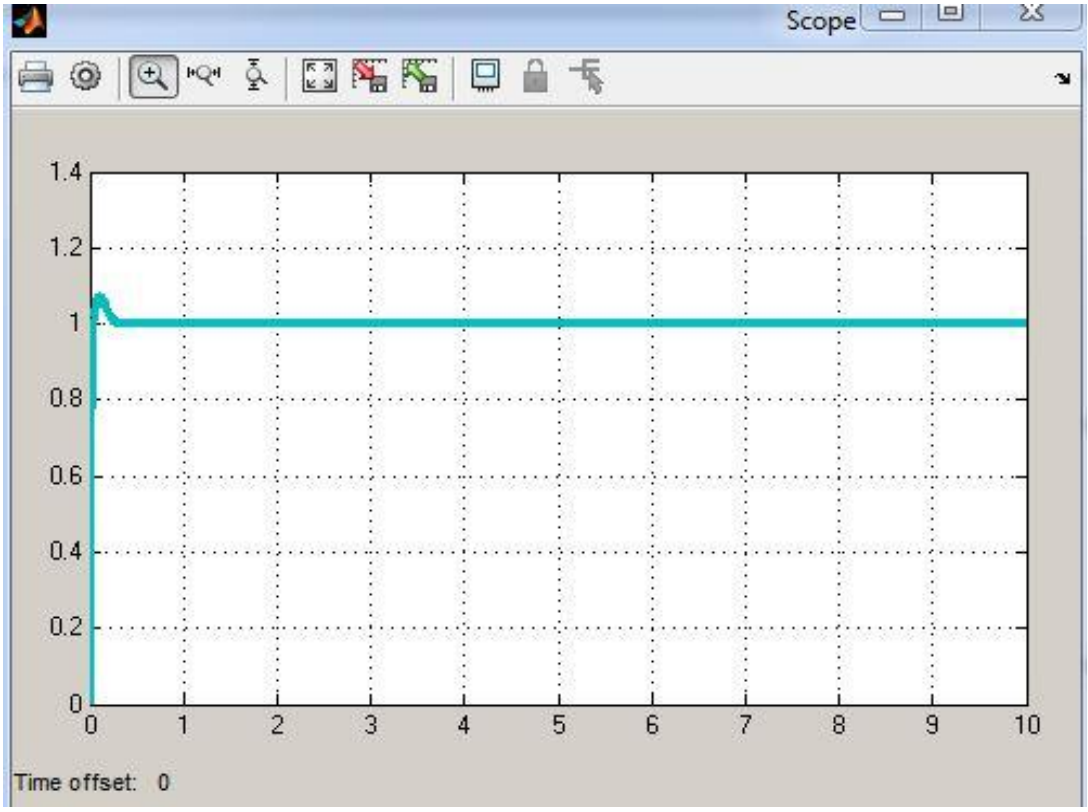

Figure 4.4: the step response of PID controller

4.3 Simulation of (5*5) Fuzzy Logic Controller

Figure 4.5 shows the Simulink block diagram of (5*5) fuzzy logic controller. Figure 4.6 shows the step response of (5*5) fuzzy logic controller

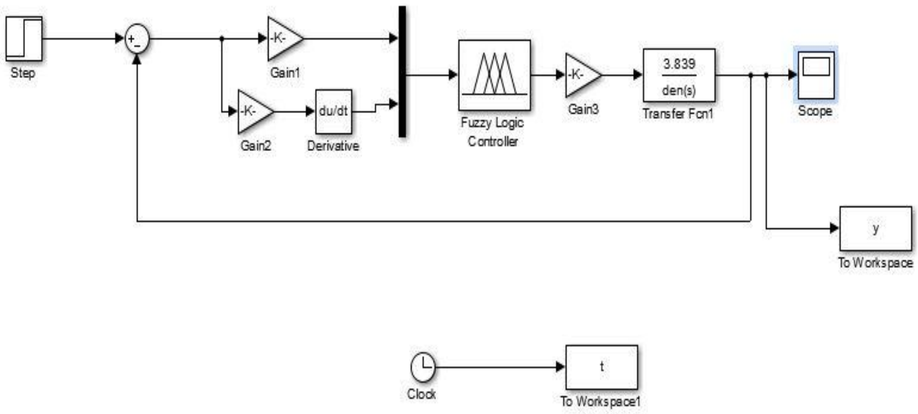

Figure (4.5): the block diagram of (5*5) fuzzy logic controller

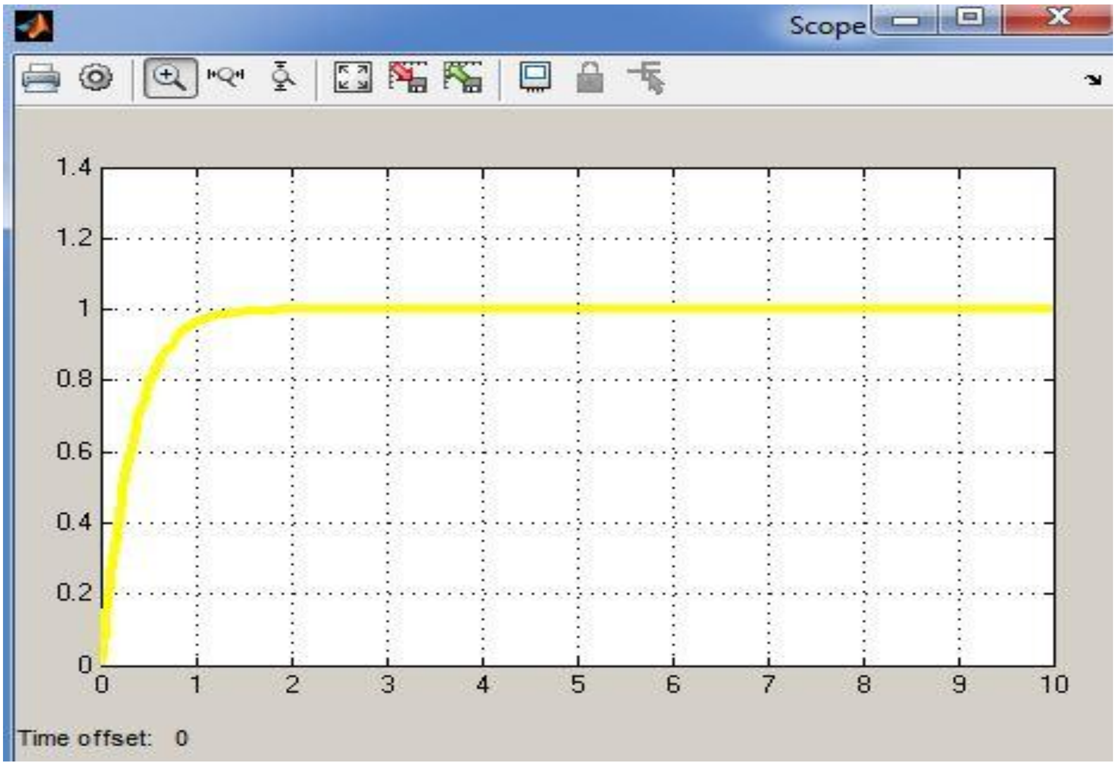

Figure (4.6): the step response of (5*5) fuzzy logic controller

4.4 Simulation of DC servomotor by using two controller (PID and FLC)

Figure (4.7) shows the Simulink block diagram of position control system by using two controllers.Figure (4.8) show the step response of position control system using two controllers

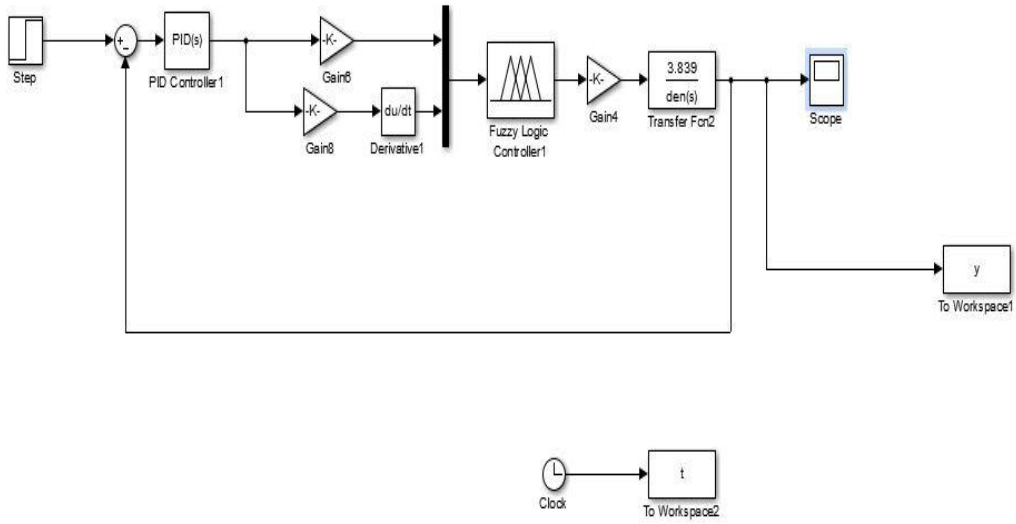

Figure 4.7: the Simulink block diagram of PID with fuzzy controller

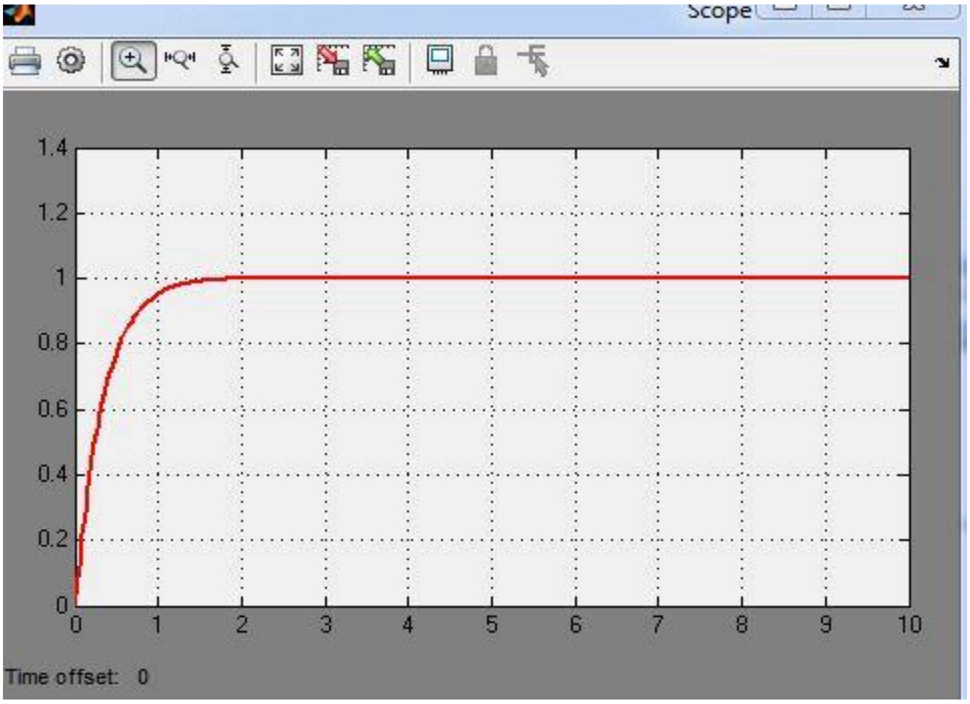

Figure (4.8): the step response of position control by using PID with fuzzy controller

4.5 The MATLAB/SIMULINK model of the servo motor

Figure (4.9) shows the step response of position control system without controller, with PID controller, with LFC controller, and by using two controller (PID and FLC).

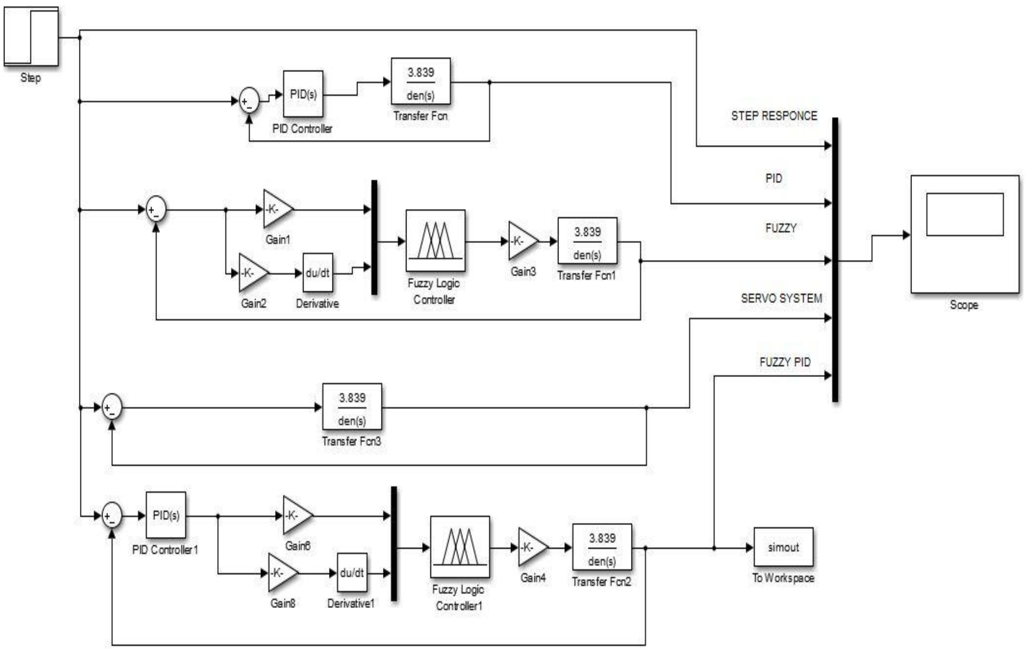

Figure 4.9: MATLAB/SIMULINK model of servo motor using FLC and PID controller

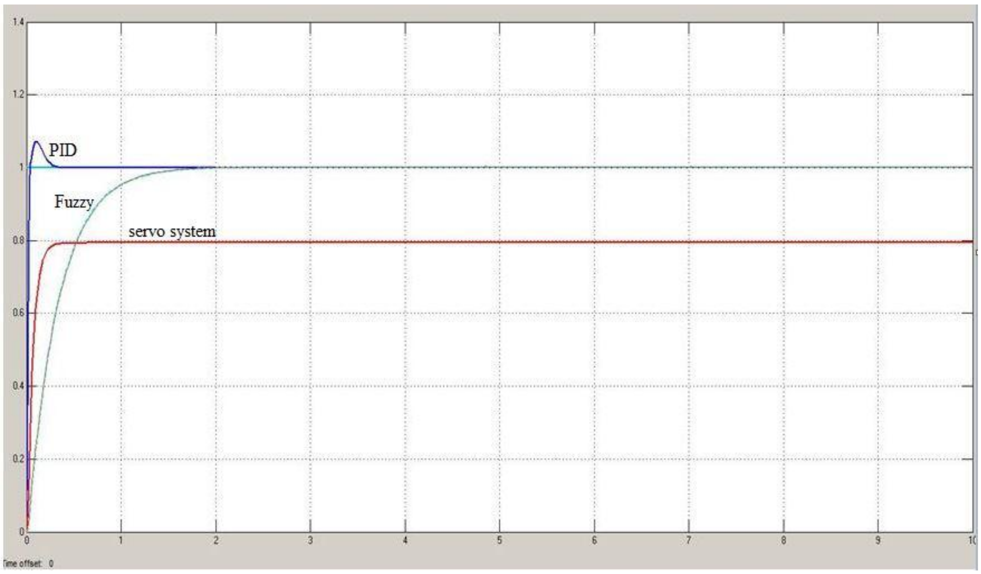

Figure 4.10: the step response of servo motor using FLC and PID controller.

4.6 Comparison and Discussion

In order to validate the control strategies as described above, digital simulation were carried out on a converter DC servomotor drive system whose parameters are given in pervious chapter. The MATLAB/SIMULINK models of system under study with the two controllers are shown in figure (4.3), and (4.5). First a comparison has been made between the maximums overshoot, rise times and settling time illustrated in table (4.1)

Table (4.1) comparison between, maximums overshoot ,rise times and settling time

Controller	Ts(sec)	Tr(sec)	Overshoot MP
PID	0.218	0.0344	8.87%
Fuzzy	1.34	0.721	0%

4.7 Software

Computer simulations have become a useful part of mathematical modeling of many natural systems to observe their behavior. It allows the engineer to test the design before it is built for real. The simulation for the project were performed in PROTEUS program SIMULINK. These software applications are widely used in control engineering, for both simulation and design.

4.8 Procedure of Simulation

Before simulation can be run, the procedure is illustrated step by step :

First step : the PROTEUS program is chosen from program menu and PROTEUS program is chosen from ISIS7 professional.

After clicking the ISIS7 professional a work area appears as in figure (4.11).

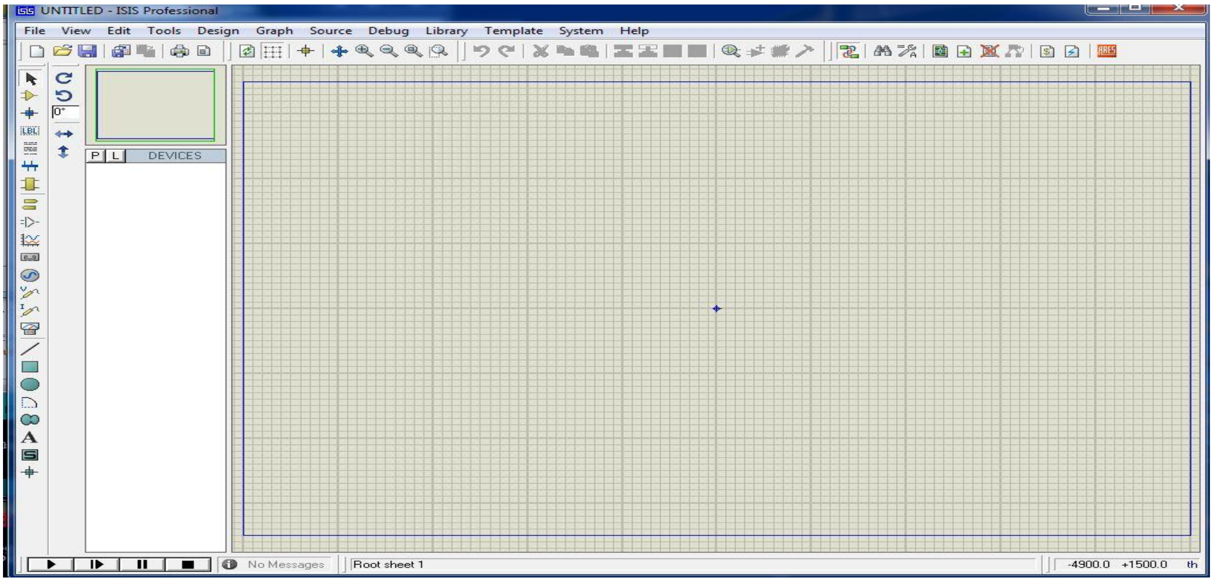

Figure (4.11) the work area

Second step : the tools needed for the design is chosen as in figure (4.12).

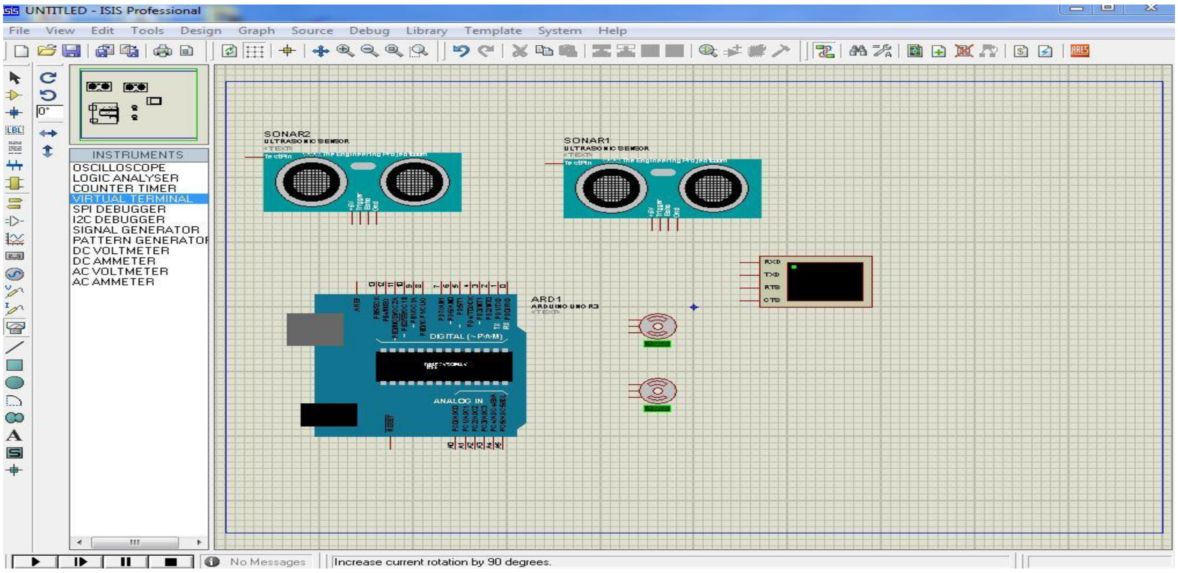

Figure (4.12) all tools required for Dish Operating.

Third step : after choosing all tools needed in the design, the tools are assembled as shown in figure (4.13).

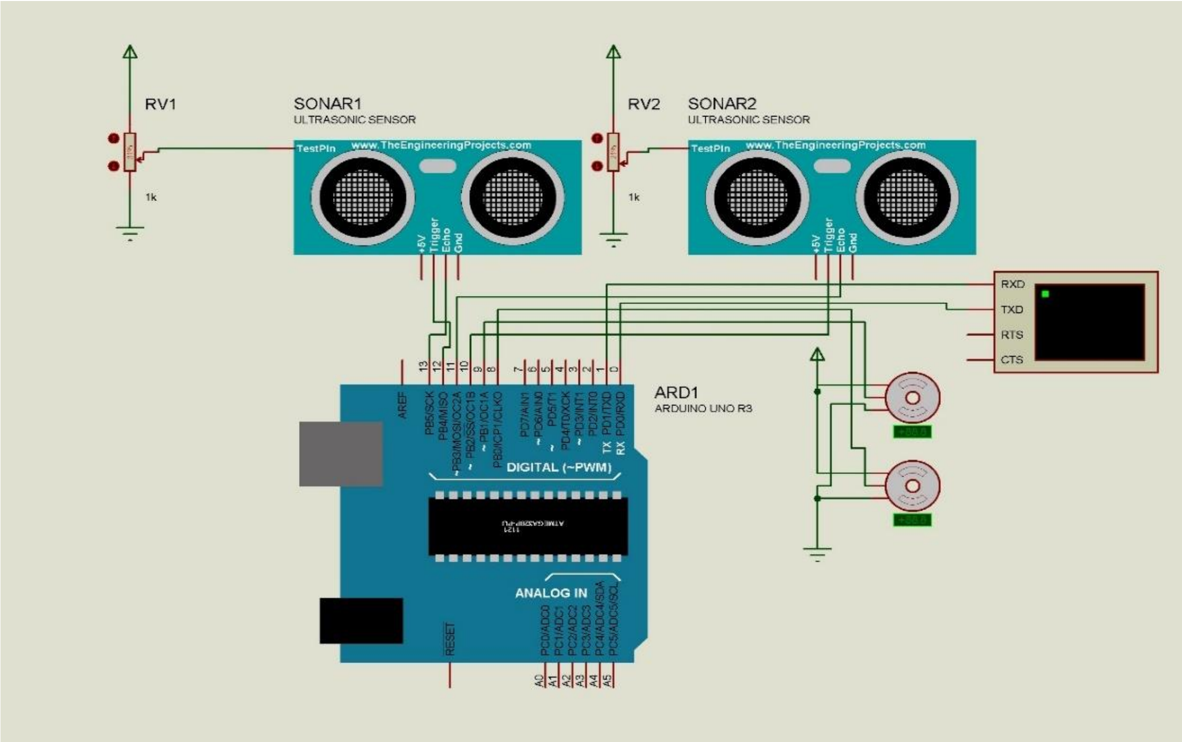

Figure (4.13) : the main circuit design

✓ Operation of the satellite dish system

The main component of the circuit diagram in fig (4.13) are : two servo motor, tow ultrasonic ,IRF sensor and arduino.

Ultrasonic sensor have 4 terminals (Vcc , GND, Triger , Echo),the Vcc connected with the voltage supply (+5v) ,GND connected with the ground of the circuit ,Trigger of ultrasonic **1** connected to pin **12** and echo connected to pin**13**,and trigger of ultrasonic **2** connected to pin **11** and echo connected to pin **10** in arduino.

Each servo have three wires (Red, Yellow, Brown) ,the red wire connected to (+5v), brown wire to ground of the circuit. In servo-motor**1** yellow wire connected to pin **9** ,and the yellow wire of servo-motor**2** conected to pin **8** in arduino.

The IRF sensor connected with other circuit components ,which have three terminals (Vcc , GND, OUT) .The Vcc and GND connected the to the Vcc and ground of circuit ,OUT terminal (which represent the input signal of the desired frequency) connected with pin**7** in arduino.

The servomotors move in two axis (x,y) to looking for the desired frequency as a response to the signal come from the IRF sensor. Which recognized by pressing one of the remote bottoms one , two and three. When press one the IRF sensor receive the signal and send it to arduino to move the motors in order to research the first satellite. The motors continue research until find the satellite or reset by press the bottom three. Pressing the bottom two repeat the same process but searching is for the second satellite. the main parts of the system shown in Figure (4.14).

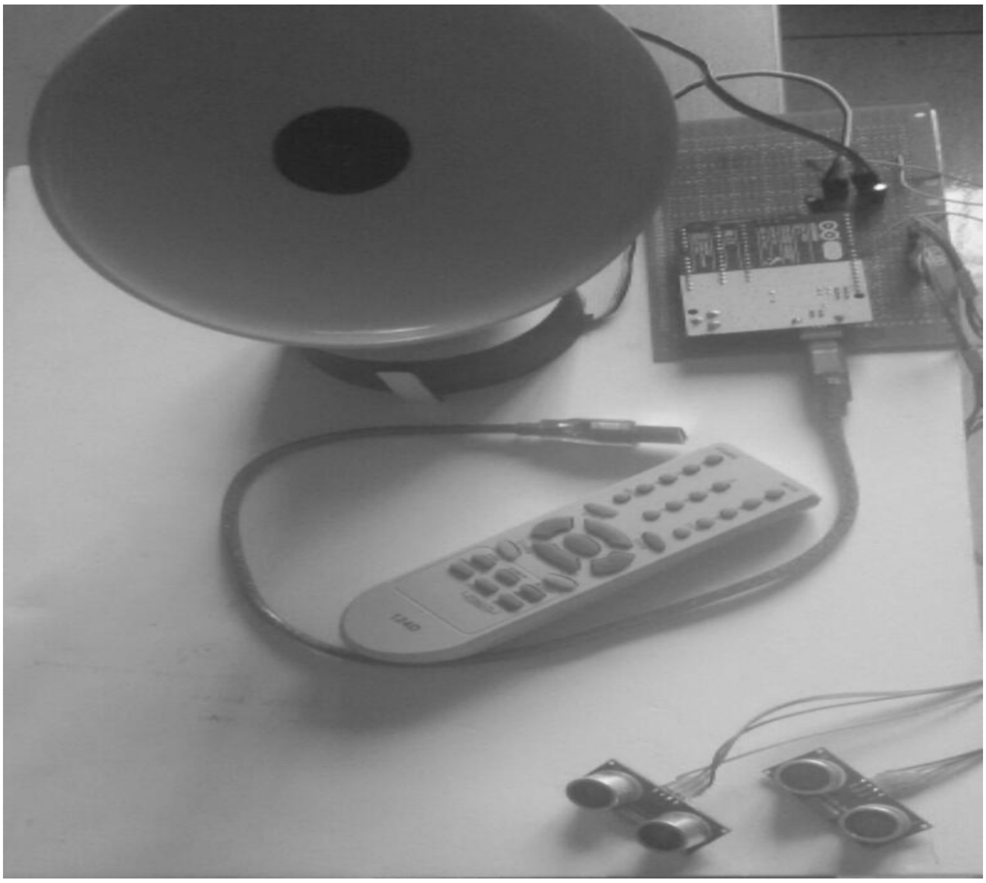

Figure (4.14): Main parts of the system