Chapter 1

Introduction

Robots! Robots are everywhere, in hospitals, homes, armies, schools,...etc. Robots are used to discover the deep space, seas and volcanoes. Robots are used in industry making goods and products, saving time and lives. Today robots give us significant effect on many branches of life, from industrial manufacturing to healthcare, transportation, and discover the places that the human can't reach them [1].

Robots are especially desirable for certain work functions because, unlike human, they never get tired, they can endure physical conditions that are uncomfortable or even dangerous, they can operate in airless conditions and they can't be distracted from the task at hand. Robots don't have to look or act like humans but they do need to be flexible so they can perform different tasks [2].

The characteristics that make robots different from regular machinery are that robots usually function by themselves, sensitive to their environment, task oriented and often have the ability to try different methods to accomplish the task [3]. Robots have main components that found in all robots, these component are base, actuators, joints, end-effector and controller.

At 1993 the prototype of agile eye was built, complete dynamic model was then established and high-performance controller based on a DSP was developed. [6]

Solved the direct kinematics, that is to say, finding each possible position and orientation of the mobile platform as a function of the active-joint variables (solved direct kinematics and invers kinematics). [7]

1.1 Serial robot

It also called open-loop manipulator. Serial robot consists of a number of rigid links connected with joints. One end of the robot is attached to the ground and the other end is free to move in space. Every joint need a motor to move it, the fixed link is called base, and the free end where a gripper or a mechanical hand is attached, is called the end effector.

Robots, basically serial robots, are used in applications that require repetitive tasks over long periods of time, operations in hazardous environments (like nuclear radiation, under water, space exploration, etc.), and precision work with high degree of reliability. Some examples of use of industrial robots are following: machine loading and unloading, palletizing, die casting, forging, press work, arc welding and spot welding, heat treatment, spraying (paint, enamel, epoxy resin and other coatings), grinding, polishing, injection molding, cutting (laser, plasma), inspection, assembly packaging, material handling. Figure 1.1 show the component of serial robot. [4]

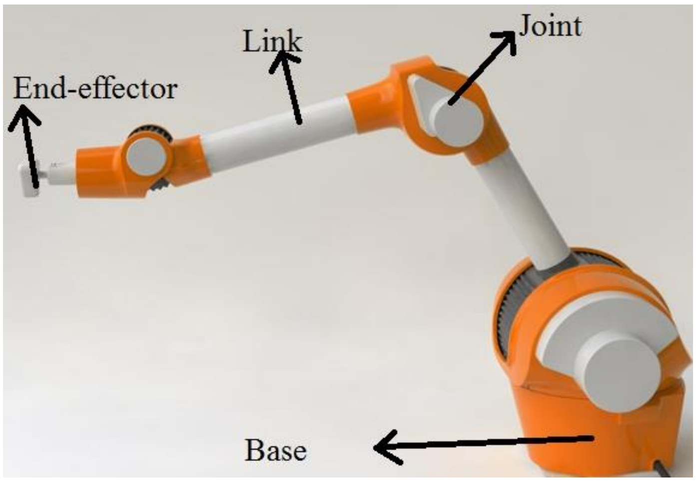

Figure 1.1: Serial robot

1.2 Parallel robot

Parallel manipulators consist of two rigid bodies, one is movable platform and the other is fixed base, connected by a number of kinematic chains. The platform is the end-effector. In each chain, only a few kinematic pairs are actuated while the other pairs are passive joints. The actuation of the chains allows the platform position and orientation to be controlled. All the chains concur to carry the external loads applied to the platform [5].

Parallel structures are more effective than serial ones for industrial automation that require high precision and stiffness, or high load capacity relative to robot weight. Due to their advantages, they have been used in a large number of applications such as astronomy, flight simulators and machine-tool industry.
Parallel manipulators are closed-chain mechanisms with one or more loops where only a certain number of pairs are actively controlled. Fully parallel mechanisms, in particular, feature two rigid bodies, termed base and platform, connected by a set of chains.

Position analysis of a parallel manipulator involves a direct and an inverse kinematic problem.
In general, the inverse problem is trivial, since it asks for the chains angle when the position and orientation of the platform are given with respect to the base. On the contrary, the direct problem, which calls for the position and orientation of the end-effector when the situations of the actively controlled pairs are given, it is a difficult problem for which no general procedure has been found yet and for which closed-form solutions are only available for certain architectures, sometimes satisfying a number of geometric conditions [3].

There are two main cases of parallel manipulator planar manipulator and spatial manipulator, Figure 1.2: spatial manipulator is an example of planar manipulator.

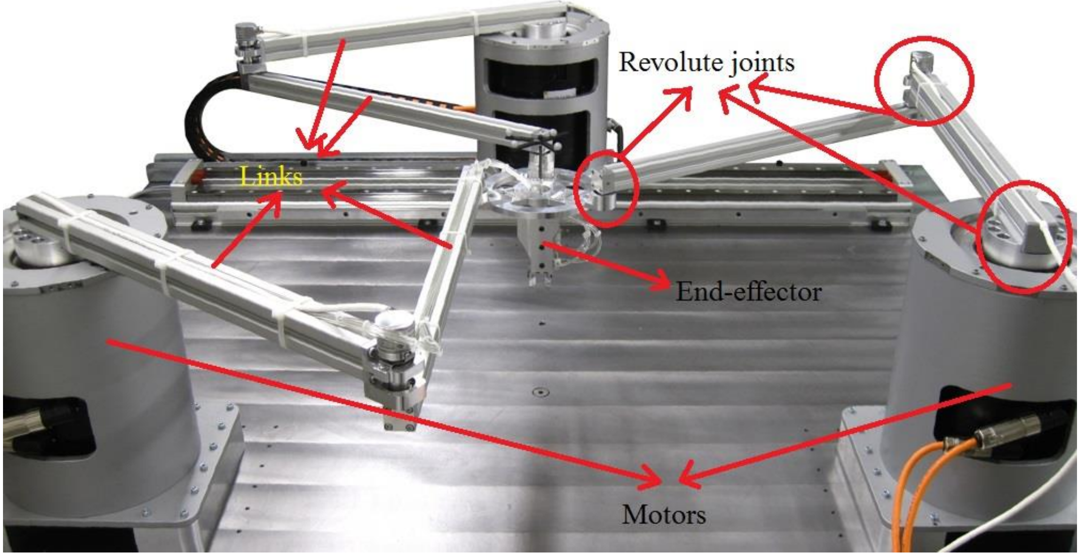

Figure 1.2: spatial manipulator

As shown in Figure 1.3, a 3-DOF spherical Parallel Manipulator is an example of spatial manipulator, it used in many applications, and its end-effector can be attached to laser, camera and can be used for welding and other application [3].

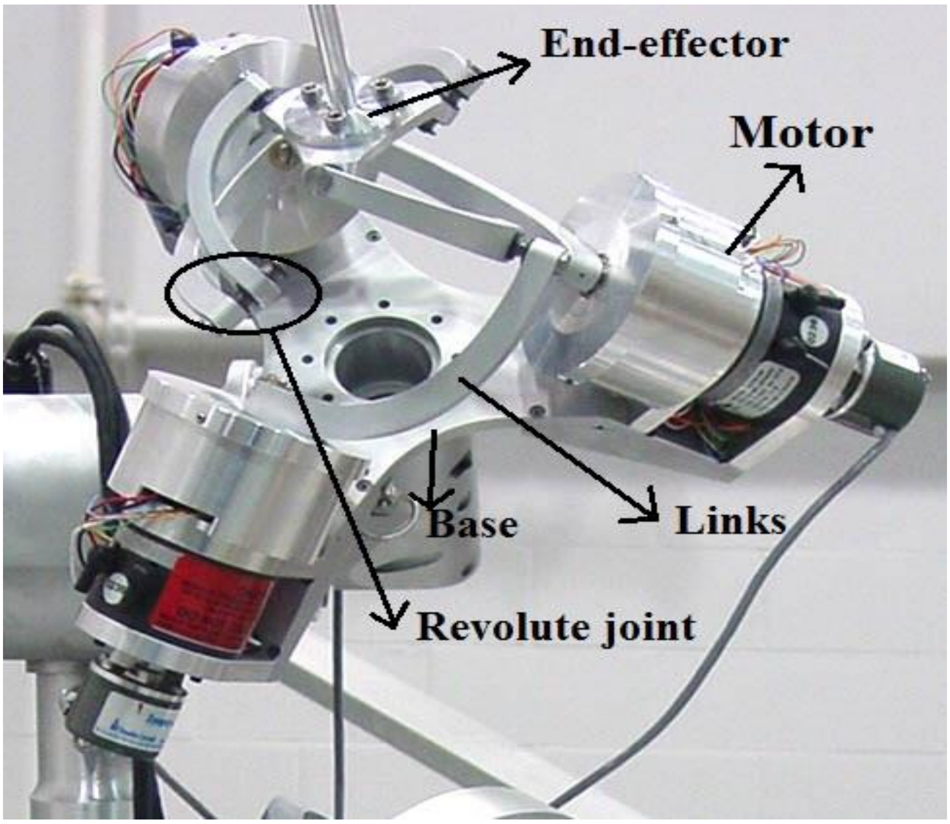

Figure 1.3: 3-DOF spherical parallel manipulator

1.3 Motivation

In this project the design and building of the Agile Eye robot was complete, controller and run the project was done. The project can be used in educational, industry and other application. The project can give high speed, acceleration and accuracy, different tools can be objected on the end-effector.

1.4 Problem definition

There are two problems, the first is that the angle of motor shaft are known and need to determine the orientation of the end-effector, it's known as forward kinematics. The second one the orientation of the end-effector is known and need to determine the angle of motor shaft, this problem is known as inverse kinematics.

1.5 Problem solution

To solve the previous problem we need two functions one for forward kinematics and other one for inverse kinematics.

1.6 Time table

- Stage 1: Select the idea
- Stage 2: Preparing for the project and collecting data
- Stage 3: Project Analysis

  In this step we analyzed the data that we collected then study the possible design options that we have in order to decide the best design.
- Stage 4: Determine the project requirement

  After choosing the best design we determine the detailed mathematical model for the system.
- Stage 5: Documentation the project

  Documenting the project will begin from the first stage to the last stage.

For next semester

- Stage 6: make the hardware available

  In this stage, the needed hardware devices will be brought for the next steps, motors, switches, sensors, belt, shaft rolls, gears, and speed reducers.
- Stage 7: build up the machine and finishing

  All the project equipment's and devices will be bought if there is an available source in the market, then go to lathe to prepare the mechanical parts.
- Stage 8: testing the machine

  Detect if there is an error occurred and making a report about that.
- Stage 9: finishing the graduation final report

  All documentation has made is to be checked and done in this stage. Every change in it is to be added and to be noticed that something is changed.
- Stage 10: Preparing for the final presentation.

  The presentation will be prepared to show our work.

Table1: Time table for first semester

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
S1	■	■	■												
S2			■	■	■	■	■	■	■	■	■	■	■		
S3				■	■	■									
S4							■	■	■	■					
S5				■	■	■	■	■	■	■	■	■	■	■	■

Table 2: Time table for second semester

Week / Task	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
S6	■	■	■	■													
S7	■	■	■	■	■	■	■	■	■	■	■	■	■				
S8					■	■	■	■	■	■	■	■	■				
S9												■	■	■	■		
S10														■	■	■	■