**CHAPTER 2**

**BACKGROUND THEORY**

The background theory was carried out throughout the whole research to increase knowledges. This chapter deals with types and required components for the robotic arm control system. This chapter is discussed about the features and specifications of robotic arm control system.

**2.1. Background Theory of Robotic Arm Control System**

Bluetooth controlled pick and place robotic vehicle is used in a wide variety of material transfer applications. Basically, the machine takes a product from one spot in the manufacturing process and places it into another location. A good example is a robot picking items of a conveyor belt and placing them into packaging boxes.

Robots can eliminate human operation of hazardous tasks such as chemical spraying or heavy lifting. Pick place robots have high return on investment when consistent shaped parts or containers are handled. Unlike human operators, robots also have the ability to work for an extended time.

A programmable multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motors for the performance of a variety of tasks. Robotic arm is constructed with acrylic sheet according to the requirement with three degrees of freedom in order to perform the required task. The task required is to press a switch and to rotate the knob. The gripper is designed such that it performs the above task by controlling the arm through programming. Torque required at each link is calculated and required motors are chosen. Base motor is used for arm control in left and right direction. Elbow joint motors are used to provide arm up and down movements. The gripper joint motor is used for close and release.

**2.2. Robotic Arm and Gripper**

Servo motor is used to control the gripper movement, for opening and closing of the gripper. The servo motor receives its signal from the controller for performing

multipurpose manipulator programmable required axes. The parameters such as Degree

of Freedom, Work volume, Payload, accuracy, repeatability, acceleration and robot kinematics are considered before designing the robotic arm. The robotic arm movements are controlled by servo motor. Its motion is restricted by placing the IR sensor and programming the controller accordingly to limit the robotic arm’s movements.

**2.3. Articulated Arm Robots**

Articulated arm robots are generally used to perform risky, treacherous and highly repetitive and obnoxious works. This entire system is controlled by a trained operator using a portable device like a teach pendant to a robot to do its work manually. The main prospective is not the working of the robot, but how it is to be safeguarded in a regular usage in the industries.

The maintenance depends only on technical operators, how hazardous the use of the robot system is its environment conditions, positions, initialization requirements, technical errors and other functions. In this combination, they need to use safeguarding methods like repetition and backup systems and the entire thing should be monitored by a human operation. As the entire system is to be controlled by an electric device, they are two controllers’ servo and non-servo.

The use of servo controller gives immense feedback about the robot system and that continually monitors the robot axes which are correlated with the position, velocity and the entire data is stored in the robot’s memory. Whereas the non-servo controllers do not have the feedback criteria and the system is controlled through very finite switches.

**2.4. Literature Survey of Remote-controlled Pick and Place Robot**

Similar and related titles of Remote-controlled Pick and Place Robot are 8051 microcontroller based pick and place robot, zigbee based pick and place robot, distributed sensing and control framework for mobile robot, an autonomous self-replicating robotic system.

2.4.1. 8051 Microcontroller based Pick and Place Robot

A picked and placed robot is used to pick and an object from one place to others

places. Firstly, a robot with help of ATMEL Microcontroller and stepper motor are designed. Here the user uses two stepper motors whose rotations are controlled microcontroller. One stepper motor is used for horizontal rotation and another motor is used for vertical rotation. The motors are set to their position. With the help of microcontroller first horizontal motor is made to rotate and it is made to wait until the vertical motor arm picks up the article. Figure 2.1 shows the block diagram of 8051 microcontroller based pick and place robot.



Figure 2.1. Block Diagram of 8051 Microcontroller based Pick and Place Robot

Vertical motor arm is rotated down words and the electromagnetic coil is energized with the help of relay. Then the vertical motor arm is made to rotate upwards and made to wait until the horizontal motor is rotated to destination. After the horizontal motor reaches the destination, it made to wait until the vertical motor arm is moved downward. After the vertical arm is moved downward coil in vertical arm is made to de-energies, this makes the article released at the destination. Then both the motors are brought to the initial position, it finds wide Application in welding, parts handling or transfer, Assembly Operations, Parts Inspection Military uses, etc.

2.4.2. Zigbee based Pick and Place Robot

This robot is used for pick the object from one source and place that objects in the destination. Some industrial works are harmful for humans; these kinds of robots are mainly used to avoid that kind of risk and consuming enough time and avoid labors

involved in the work. Humans are tired for hard work such as assembly line, material handling. This robot does all those things and it mainly reduces the manual work. This robot is designed at low cost as well as highly efficient. This system is to give the way for providing bigger effective robot for industrial applications. In earlier system, pick and place robots are controlled by using Keypad. According the input given by the keypad the robot picks the object and places it into its destination. Moreover, these pick and place robots are operated manually. In order to overcome this human intervention, the new system is going to control the robot using RF. Figure 2.2 shows the block diagram of zigbee based transmitter section. Figure 2.3 shows the Block Diagram of Zigbee based Receiver Section.



Figure 2.2. Block Diagram of Zigbee based Transmitter Section

This system uses RF decoder to control the robot. Every key will be having a unique tone, which is decided by combination of keypad’s column frequency. On the receiver end, the set of frequency are spitted in accordance to their row and column frequencies from which the key pressed the robotics arms are controlled with the help of relays. The RF signals are fed to the microcontroller and the controller in turn controls the robot, i.e, pick the object from the source and place into its destination and also the movement of the robot. Figure 2.3 shows the Block Diagram of Zigbee based Receiver Section.



Figure 2.3. Block Diagram of Zigbee based Receiver Section

2.4.3. Distributed Sensing and Control Framework for Mobile Robot

Its main task is to transport a package from a pickup station to a drop-off station. The package transportation is done by wheeled mobile robot (WRM) with a gripper system in front of it, which works as a lifting device. The package availability on pickup station is done by a pushbutton on the platform of the station. Also, there is another pushbutton set up at the drop-off station to check whether the package has successfully sent.

To achieve this control scheme, they having a mobile unit and static unit, wireless communication is more adequate. Infrared and radio frequency commutations are chosen as their communications scheme. These communications schemes are sending and receiving data with serial communication. WMR setup by servomotors: movement of the MMR, IR ranging system; distance detector, Fire-stick II (IR transmitter): transmit data to base station, RF receiver: receive data from base station, Gripper system: the lifting device, Counterweight: to balance the moment of the WMR.

The basic directional motion required for this project is forward, backward, left

and right. The whole motion is preprogrammed in the Basic Stamp on the WMR. The motion is done in two modes: calibration (open loop) and measurement (closed loop). The made at each path is selected by trial-and-error. Since calibration and trial- and-error might not work well all the time, they tried to use this ranging sensor to improve the WMR motion control.

2.4.4. An Autonomous Self-Replicating Robotic System

This robot consists with four subsystems: controller, left tread, right tread, and gripper / sensor subsystems. All subsystems are connected to others using magnets and shape constraints. The two light sensors in its navigation system to detect objects and also to track lines.

In this design and descriptions, LEGO RCX is used for controller the subsystem

which fit inside a classis. The classis’s sides are used to connect to the left and right treads. The gripper/sensor subsystem is comprised of 9V LEGO DC motor, set of rack and pinion gears used to drive the left/right of the gripper, a set of electrical connections and two light sensors (one is pointed downward, other the other is pointed forward). In control and programming shows the grasping process consists of an aligning push towards the subsystem, and closing the gripper to grasp the subsystem. On the other hand, the assembly process consists of the opening the gripper to release the subsystem, and aligning push forward to snap the subsystem to the controller. The replication process takes two minutes and fifteen seconds per cycle. Although each subsystem is required to place in its starting location, errors in initial position and orientation are not very critical. There were slight errors during the grasping process in a few experiments caused by improper placement of the subsystem.

**2.5. Summary**

This chapter refers about previous paper for this project. The above papers were used 8051 Microcontroller, decoder, encoder, servo motor, gripper, horizontal stepper motor, RF transmitter, RF receiver, LEGO DC motor and relay for pick and place robot. In this system, robotic arm control is used Arduino Mega, servo motor, Bluetooth module, DC motor, CA2596 (DC-DC) Converter and android phone. The main components of robotic arm control system will be described in the next chapter.