AUTOMATIC PICK AND PLACE ROBOTIC ARM

[1] Ch.Manoj Krishna, [2] N.V. Sai Chand, [3] M.Venkat Naresh, [4] M.Vamsi Krishna, [5] Ch.Srigiri
[1,2,3,4] U G Scholars, [5]Assistant Professor
[1]Electronics and Communication Engineering
[1]Godavari Institute of Engineering & Technology, Rajahmundry, Andhra Pradesh

Abstract: In recent years the industry and daily routine works are found to be more attracted and implemented through automation via Robots. The pick and place robot is one of the technologies in manufacturing industries which is designed to perform pick and place operations. The system is so designed that it eliminates the human error and human intervention to get more precise work. There are many fields in which human intervention is difficult but the process under consideration has to be operated and controlled this leads to the area in which robots find their applications. Literature suggests that the pick and place robots are designed, implemented in various fields such as; in bottle filling industry, packing industry, used in surveillance to detect and destroy the bombs etc. The project deals with implementing a pick and place robot using Arduino for any pick and place functions. The pick and place robot so implemented is controlled using potentiometer based teach pendent. The chassis is supported for the displacement of robotic arm by four Omni wheels. The robotic arm implemented has three degrees of freedom. Many other features such as line follower, wall hugger, obstacle avoider, metal detector etc. can be added to this robot for versatility of usage.

***Index Terms* –Arduino, ARM, Robotics.**

I. INTRODUCTION

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand. The robots interact with their environment, which is an important objective in the development of robots. This interaction is commonly established by means of some sort of arm and gripping device or end effectors. In the robotic arm, the arm has a few joints, similar to a human arm, in addition to shoulder, elbow, and wrist, coupled with the finger joints; there are many joints. The design process is clearly explained in the next section with detailed information regarding the components which are used.

The design is a 3 Degree of Freedom Robotic ARM that can be easily trained to perform actions by simply moving a Potentiometer and Switches based Teach Pendant. Arduino Microcontroller board is used to read and Record the Position of Teach Pendant. Servo Motor is connected to PWM Channel of Arduino Microcontroller Board. Analog feedback servos provide a way around the complicated kinematics necessary to make robotic arms operate efficiently. Interacting with a robotic arm is lots of fun and being able to actual teach it to carry out tasks is futuristic-cool.

The end effectors, or robotic hand, can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. For example, robot arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly. In some circumstances, close emulation of the human hand is desired, as in robots designed to conduct bomb disarmament and disposal.

The pick and place robot being implemented to ease the process of sorting, process of moving heavy materials etc. Usually the transfer process of the heavy materials is being carried out, using man power and if the transfer process is repeated for a period of time, it can cause injuries to the operator. By using the particular robot the operator, will no longer have to bent and lift up heavy loads thus preventing injuries and increasing the efficiency of the work. Operator will make mistakes whether small or big in a while. In the industrial world, the industry cannot afford to take any kind of mistakes. As every mistake is costly whether interns of time, money and material.

The main objectives of this paper are

- To control the displacement of the robotic arm so that the arm can be used to pick and place the elements from any source to destination.
- To control the displacement and movement of robotic arm using potentiometer based teach pendent
- To implement a robotic arm with three degrees of freedom.

II. LITERATURE SURVEY

The system is an autonomous robotic arm which estimates trajectory and plans motion on it. A new concept called reinforcement learning which will enable the system to learn itself the path and trace it. It is based on some IEEE papers understanding and using them for this system. Some of the titles of the papers are listed below:

2.1"DESIGN AND IMPLEMENTATION OF ROBOTIC ARM BASED ON HAPTIC TECHNOLOGY"

This involves designing a haptic robotic arm, which can be used to pick and place the4 object. In this paper a robotic arm with four degrees of freedom is designed and is able to pick the objects with a specific weight and placed them in a desired location. To facilitate the lifting of the objects, Servomotors with a torque of 11kg are used. The programming is done on

ATMEGA-328 Microcontroller using Arduino programming. The input is given using a remote, which is an arm, made of polycarbonate fitted with potentiometers with a certain angle of rotation. The potentiometers detect the angle of rotation and the signals are sent to the Microcontroller accordingly.

2.2 "IMAGE PROCESSING AND RECOGNITION SYSTEM FOR A ROBOT ARM CONTROL"

Image processing (IP) and recognition system is based on continuous monitoring of environment with sensors and responding accordingly. These are considered intelligent as their behaviour is completely based on changes in environmental system and triggered associated programmed actions.

2.3 "THE DEVELOPMENT OF THREE D.O.F. ROBOT ARM FOR INTELLIGENT ROBOT"

The motion is guided by the manually operated controller or a program that guides the appropriate motion and actions of robot. .The degrees in which the robotic unit make moves or acquires motion necessarily contribute to improvement of operation. Every added or updated motion represents ease of operation in certain operating context. Hence, the idea that a circular rotatable base may prove very useful as it is less costly and less time consuming for an assembly to rotate rather than to turn it.

III. EXISTING WORKS

M.Cianctietti, A.Arienti, B.M.Follador, B.Mazzalai, P.dario they get inspired by the Octopus to and make an interesting model in robotics due to its high dexterity, variable stiffness and very complex behavior. In this experiment they study the key features and patterns of movement of Octopus arm and this features and patterns and patterns of movement are that is elongation, shortening, bending and reaching etc. used for guide the movement of actuator. They conclude that the concept proposed for the mechanism at the base of the robotic arm inspired to the Octopus muscular hydrostat where successfully implemented on mock-ups and the corresponding models have been modified and validate.

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Mohamed an aspirant from IIT Bombay introduced a Pick and place robotic arm controlled by Computer vision. Here the robot picks the object at a specific orientation only. The gripper used here is a mechanical gripper. So it can't handle the object safely. Objects in a specific orientation are only picked up by the robotic ARM.

Anush from Maharashtra introduced Design and Fabrication of Pick and Place Robot to Be Used in Library. Here the robot pick up the books from library and deliver this to the destination. The robotic arm used here can handle objects in any orientation. RFID tags are used to identify the books. This system is capable of doing this specific task only and it's a line following robot. Each RFID has its own path, and this makes the system more complex

N F Begum of Germany is designed an Autonomous android controlled robot design using wireless energy. Here the system works according to voice commands or speech delivered by the user and the robotic arm is capable of picking up the objects of any type and in any orientation. RF technology is used so line of sight is a major constrain in communication.

T Yoshimi from Japan. Introducing a system for picking up operation of thin objects by robotic arm with two fingered parallel gripper. Thin objects like paper and plastic cards are picked up by this robotic arm. The objects may slide down due to the use of parallel gripper. This method does not provide safety of the object. Mohd Aliff, Shujiro Dohta, Tetsuya Akagi, flexible Hui Li the aim of study is to develop the land light weight actuator and applied into has flexible hose robot arm. In this paper, the Slavic Master's degree height flexible control and the trajectory control of the robot arm are proposed. This robot arm has 3DOF i.e. bending, expanding and contracting and will be applied into has device for human wrist rehabilitation. In this paper the analytical model of year has flexible hose robot arm is proposed for Slavic Master's degree height control in trajectory control.

IV. PROPOSED WORK

This Robotic Arm is interface with Control Switches i.e. Record and Play Button. User has to Press Record Button to Train Robotic Arm Movement using Teach Pendant. The proposed system block diagram and architecture of Robotic ARM is shown in Fig. 1 & 2.

Teach Pendant Consist of Three Potentiometer of 10K Ohms. Using this Potentiometer user can control the Position of the Robot. After every desired position user has to Press Record Button, to save that position in Microcontroller Memory. 10 instances can be recorded at a single event of Robotic Operation Then user has to Press Play button to continuously operate the movement, that user has recorded previously. This System is designed using Arduino Uno Development Board, LCD and Servo Motor as Major Building block of the Entire system. Arduino UNO Board works at a speed of 16 Million Instruction per second. LCD 2X16 is used to monitor Robotic ARM Operations Such as Record and Play events.

This System is also equipped with Vehicle Mobility using DC Geared Motors. User is provided with a Wired Remote Control, this Control is used to Move this Robot in Forward, Backward, Left and Right Direction.

The power supply consists of a step-down transformer 230/12V, which steps down the voltage to 12V AC. This is converted into DC using bridge rectifier. Ripples are removed using a capacitive filter and it is then regulated to +5V using voltage regulator 7805 and +6V using 7806 Voltage Regulators, which is required for operation of the microcontroller, Servo Motorand Voltage Regulator 7812 is used to regulated 12V DC. This Voltage is used to drive Motor in Clock Wise and Anti Clock wise direction.

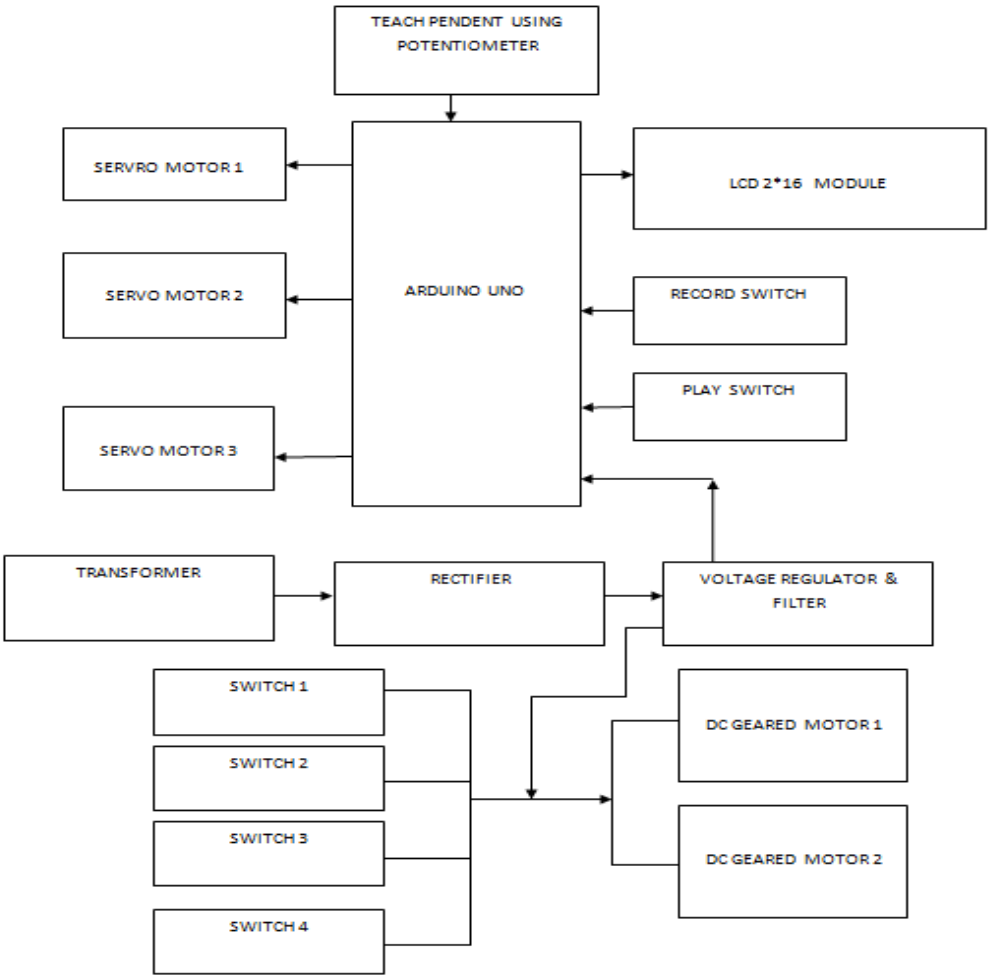


Fig. 1 Block diagram

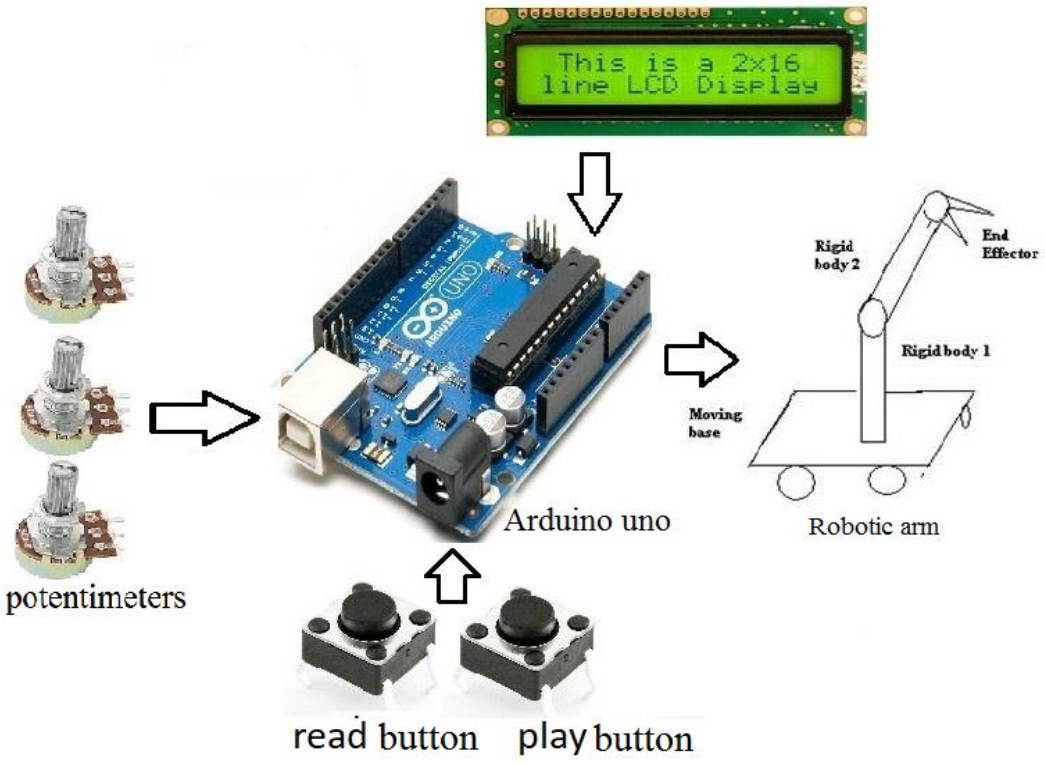


Fig.2 Architecture of robotic arm

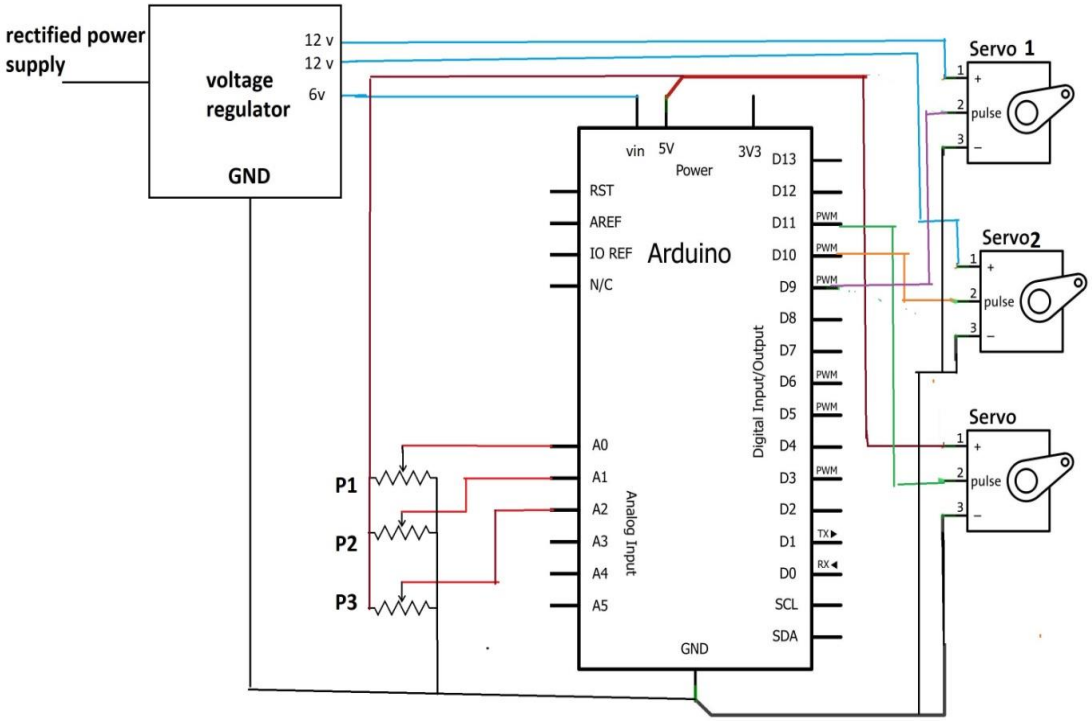


Fig. 3 Circuit diagram of robotic ARM

Servo motors are self-contained mechanical devices that are used to control the machines with great precision. These are found in many applications from toys to industrial automation. There is various kind of motor, but servo motors are especially designed for specific angular position to control the machines. Usually the servo motor is used to control the angular motion among from 0° to 180° and 0° to 90°. The servo motor working principle based on the PWM (pulse width modulation) pulses. The circuit diagram of robotic ARM is shown in Fig. 3.

A Servo motor is one of the most commonly used motor for precise angular movement. The advantage of using a servo motor is that the angular position of the motor can be controlled without any feedback mechanism. The servo motors are usually used in commercial and industrial applications. They are also widely used as in drive systems such as robots, aero planes etc.

Servo motor working principle mainly depends upon duty cycles. It uses Pulse Width Modulated (PWM) waves as control signals. The angle of rotation is resolute by the pulse width of the control pin. Here the servo motor used for angle of rotation from 0 to 180 degrees. We can control the precise angular position by varying the pulse among 1ms to 2ms. The servo Motor working principle is shown in Fig. 4.

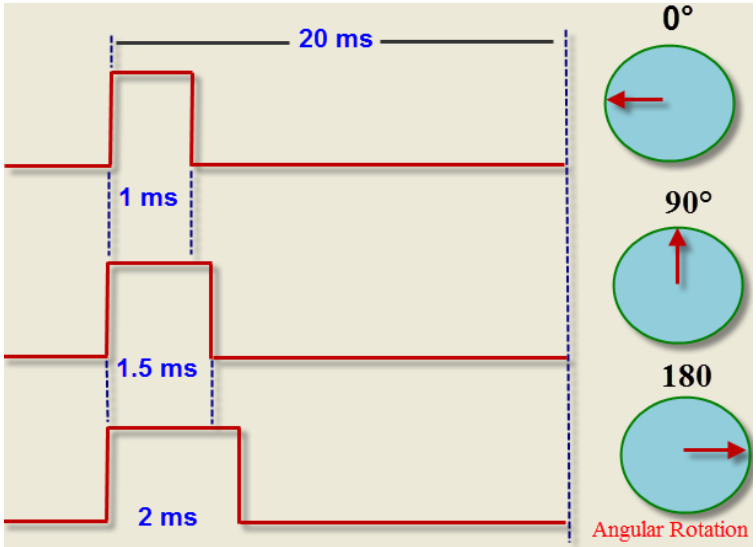


Fig. 4 Servo Motor Working Principle

The servo motor working principle mainly depends upon the 'Fleming left hand rule'. Basically servo motors are adapted with DC motors, a position sensor, a Gear reduction, and an electronic circuit. The DC motors achieve powered from a battery

and run at high speed and low torque. We assembled shaft and gear connected to DC motors then we can increase and decrease the motor speed gradually.

The position sensor senses the location of the shaft from its fixed position and sends the information to the control circuit. The control circuit decodes the signals accordingly from the position sensor and compares the actual location of the motors with the preferred position and accordingly controls the direction of rotation of the DC motor to get the necessary position. Generally the servo motor requires 4.8V to 6 V DC supply.

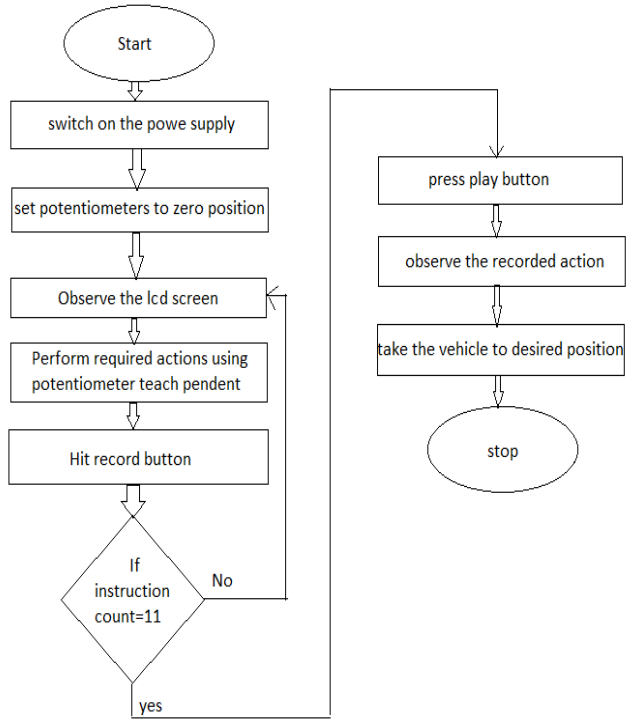


Fig.5 flow chart 1

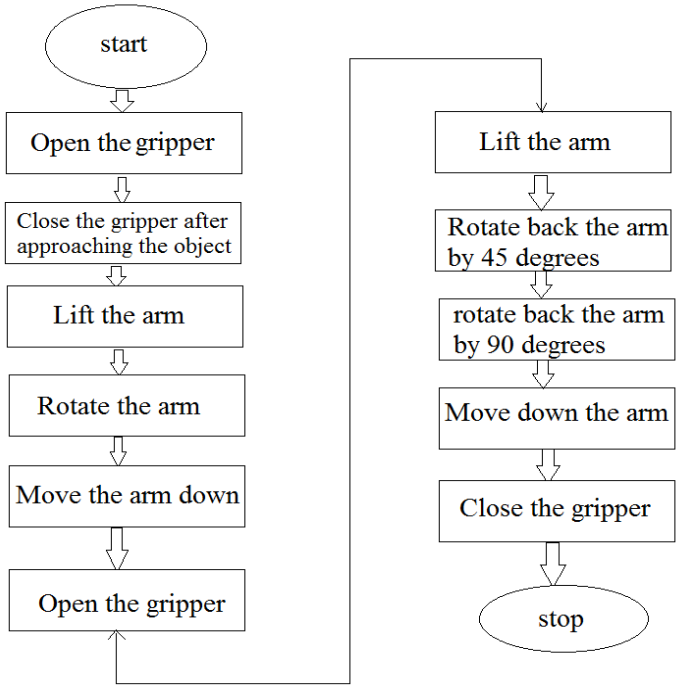


Fig.6 flow chart 2

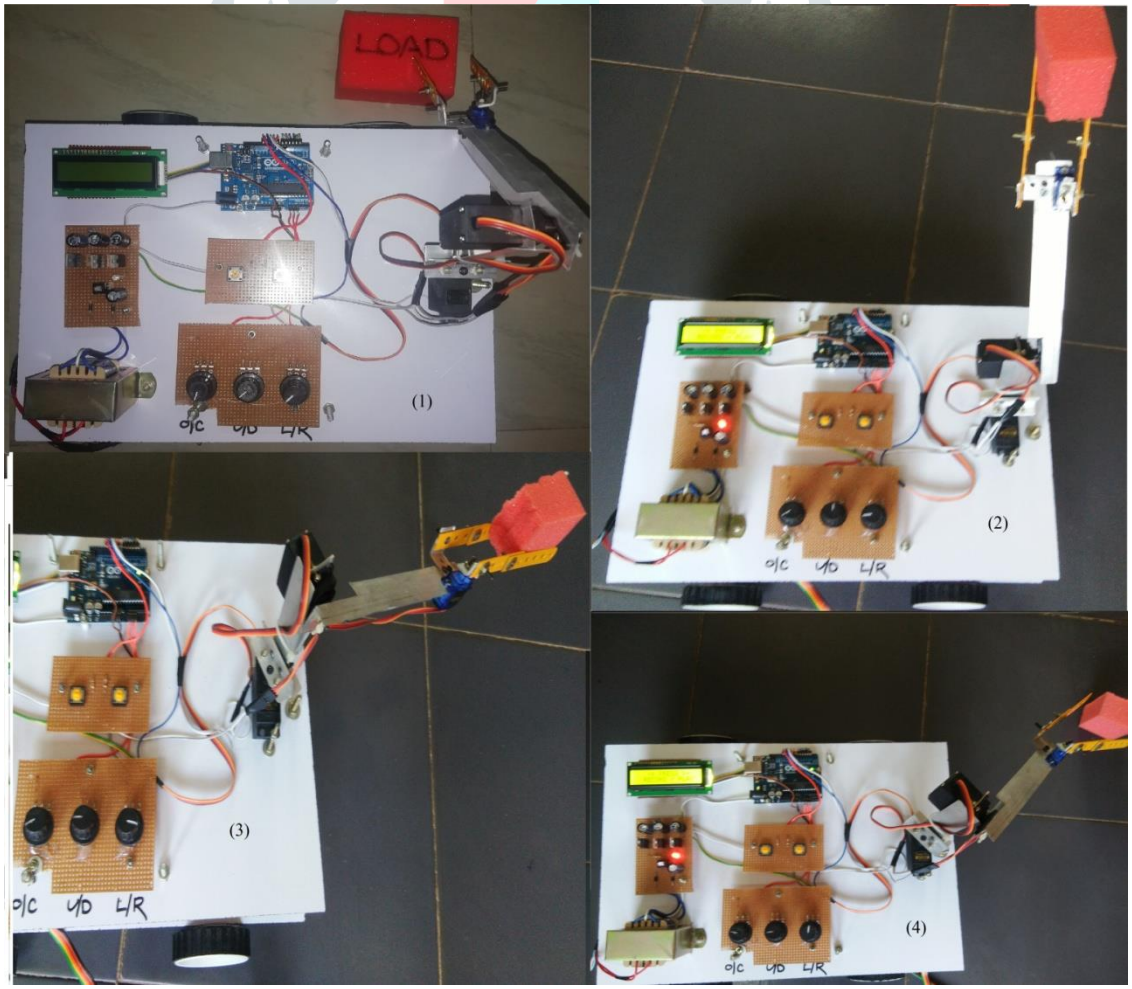
V. RESULTS AND DISCUSSION

Using the Servo and EEPROM libraries:

Declare the servos. One is the bottom (base) servo, counting up each joint until servo three which is the gripper: Calibrating the servos requires recording the minimum and maximum values for both the degrees and feedback. These are integers, so we will declare all these variables for each servo. We also want to create integer variables to hold the calculated replay values for each

servo. Declare and integer variable to store the EEPROM address used to read/write servo values and a Boolean variable to keep track of whether we have recorded arm motion or not. The setup function will start serial output for debugging; attach each servo to their digital pins, set the LED on pin 13 to output and set the record and playback button pins to inputs. The easiest method for calibrating the servos is to start them all out at 90 degrees then step through each servos motion starting from One and ending at Five to record the analog feedback values when the servos are positioned at their minimums and maximums. The micro servos used tended to have a good minimum of 30 and maximum of 150. The gripper servo (Five) worked will with minimum 20 and maximum 180. When each servo is at its minimum, we read the analog value from the respective servo analog pin and store it in the respective variable. After this is complete, we place the servos back a 90 then detach them to both save power and to allow them to be moved by our own hands. The main code polls the state of the record and replay buttons. When the record button is pressed, the Arduino LED lights up to know its time to move the arm in the positions you want. The analog feedback values are read then converted into servo degrees and finally written to the EEPROM. When the replay button is pressed the stored servo positions are read from EEPROM and written to their respective servos. After recording or replaying, each servo is moved back to 90 then detached. During the replay after the values have been read from EEPROM, there are a series of if statements that control the writing of the servo values. The reason for these conditionals is to create a smooth playback from one recorded position to the next. A quick calculation of the difference between the servo position being read now and the next servo position tells us how to step between those values as we write them to the servos. Instead of writing 120 then 130 to the servo, we want to write every value between 120 and 130 with a short delay in order to create the smooth motion.

Note the if statement for the replay button: if recorded digital Read Instead of just executing a replay when the replay button attached to digital pin 6 is pressed, it will execute a replay if the Boolean variable recorded is true. This is why the servo motion is replayed right. After recording because the recording code sets the variable recorded to true - before the code even gets to this if statement. The only reason for this is so the first replay happens without needing to press the replay button right after you record a motion. If you do not want the arm to automatically replay its motion after recording, remove the recorded or to make the line: if (digital Read (6)) instead. The final step is to upload the Arduino sketch to the board. As soon as the Arduino resets, the arm should start its calibration routine by moving each servo through its range of motion. When this completes the arm will be positioned straight up and the servos will deatch, allowing you to manipulate the arm without power being applied. At this point you can press the record button. The onboard LED will light up which means its recording. Move the arm around any way you like then press the record button again to stop recording. The arm will straighten up again then immediately replay the motion it learned. When the replay is complete the arm will position itself straight up again. Press the replay button to replay the last learned routine, or teach the arm another motion sequence with the record button. The overview of proposed work is shown in Fig. 7.



1-Setting potentiometers to zero position 2-Picking the object
3-moving arm to desired position 4-releasing the arm

Fig. 7 Overview of Proposed work

VI. CONCLUSION

The main focus of this work was to design, and programme robotic arm .The robot arm was designed with three degrees of freedom and talented to accomplish accurately simple tasks, such as light material handling the robot arm is equipped with several servo Motors which do links between arms and perform arm movements. A microcontroller that drives the servo motors with the capability of modifying position

The programming is done on ATMEGA-328p Microcontroller using Arduino programming. The potentiometers are also used to detect the angle of rotation and the signals are then sent to the microcontroller. In today's world, this Robotic arm has turned out very benevolent. Besides Robotics and Automation, these kinds of arms have applications in other fields also.

The robot so programmed for pick and place operation can be made versatile and more efficient by providing the feedback and making it to work on own than any human interventions. It can be made possible by image processing tool interfaced with this Arduino. The features that can be added on to improve its efficiency, make it operate on its own thought without any human intervention are line follower, wall hugger, obstacle avoider, metal detector, bomb diffuser etc.

REFERENCES

[1] C. F. Olson, Lab. JP, Technol. CIo, Pasadena, ―Probabilistic self-localization for mobile robots‖; IEEE Transactions on Robotics and Automation 16,1, 55-66, 2000.
[2] R.B. Gillespie, J. E. Colgate, M. A. Peshkin, ―A general framework for robot control‖; IEEE Transactions on Robotics and Automation, 17,4, 391-401, 2001.
[3] Devendra P. Garg and Manish Kumar, ―Optimization Techniques applied to multiple manipulators for path planning and torque minimization‖; Engineering Applications of Artificial Intelligence 15, 3-4, 241-252, 2002.
[4]. C. Trinkle and R. James Milgram, ―Complete Path Planning for Closed Kinematics Chains with Spherical Joints‖; SAGE International Journal of Robotic Research 21, 9, 773- 789, 2002.
[5] M. Gemeinder and M. Gerke, ―GA-based Path Planning for Mobile Robot Systems employing an active Search Algorithm‖; Journal of Applied Soft Computing 3, 2, 149158, 2003.
[6]. ―Six-servo Robot Arm‖ from www.arexx.com.cn on 13-11-2011 pg: 1-18
[7]. Jegede Olawale, AwodeleOludele, Ajayi Ayodele, ―Development of a Microcontroller Based Robotic Arm‖, in Proceedings of the 2007 Computer Science and IT Education Conference pg: 549-557.
[8]. ―Six-servo Robot Arm‖ from www.arexx.com.cn on 13- 11-2011.
[9]. ―Robotic Arm‖ - www. NASA explores. com
[10]. ―Robot software‖ from Wikipedia, the free encyclopedia on 04-3-2012
[11]. ―ATMEL – short notes‖, www.atmel.com
[12]. ―Arduino MCU‖, - www.arduino.com
[13].―Servomotors & system design components‖, - www.bhashaelectronics. Com
[14] Robert J. Shilling "Fundamentals of robotics analysis and control ".
[15] GORDON McCOMB" The robot builders' bonanza ".
[16] www.wikipedia.com/robotic.
[17] G. J. Monkman" Robot Gripper ".
[18] http://www.instructables.com/
[19] J. M. Selig "Introductory Robotics"
[20] Andrease Wolf "Grippers in Motion"
[21] www.SocietyofRobots.com