Development of Robotic Arm using Arduino and Matlab R2016a

Prof. R. G. Hirulkar[1], Pradnya Gajbhiye[2], Pooja Badukale[3], Renuka Kapse[4], Nikita Ghulaxe[5], Mohammad Arsalan Hakim[6]

[1] Prof. Dept. of Electronics and Telecommunication, Prof. Ram Meghe Institute of Technology and Research, Amravati, Maharashtra, India.

[2,3,4,5,6] Students, Dept. of Electronics and Telecommunication, Prof. Ram Meghe Institute of Technology and Research, Amravati, Maharashtra, India.

---***---

Abstract - *Robotics arms are used in lifting heavy objects and carrying out tasks that require extreme concentration and expert accuracy. This study mainly focuses on the accuracy in control mechanism of the arm while gripping and placing of objects. The system facilitates the detection of an object within its limitations. A user interface is abandoned with the system by giving manually input on the desired destination. Here we can implemented this project by a MATLAB based graphical user interface (GUI) which control the movement of a robotic arm. The commands to move the arm to left , right, up and down and also to hold or release the object are sent from the GUI and processed by Arduino Uno board connected to the computer. Camera mounted on top of the arm will make the user able to see the position of an object thus will help him to feed the command.*

Keywords: MATLAB, GUI, Arduino Uno, Camera.

1. INTRODUCTION

These days' people always needed additional help systems. With the rapid increase in the flow of information, people are now guided to search for different markets and people have entered the competition to manufacture quality products cheaply. Automation systems are also needed to realize this. Because standardized automation systems are required to minimize errors as well as to have experienced and well-trained employees for quality products. Because of their physical characteristics, people needed to use auxiliary machines in places where their strength was not enough. These machines, which are operated with the need for human assistance in advance, have been made to operate spontaneously without the need of human power with the progress of technology. The most used tools in automation systems is robots. robotic systems; mechatronics engineering, mechanical engineering, electrical engineering and computer engineering have all come together to work together. A robotic arm by definition is a robot manipulator, usually programmable, with functions similar to a human arm. The end effectors can be designed to perform any desired task such as welding, gripping, spinning, dropping etc., depending on the application. The robotic arm can be autonomous or controlled manually, which imparts to it the characteristic to be used to perform a variety of tasks with great accuracy. In this study we are implementing it using MATLAB to track the human arm using different X and Y axis to control the robotic arm.

2. LITERATURE REVIEW

Robotic arm is a one of the type of mechanical arm. The arm is programmable, with same Functionality like a human arm. Types robot arms depend on the its range, working Capability and reach. The robot is generally used for pick and place work, plotting and Handling arc welding. Its range is mostly 2 dimensional. Cylindrical robot is also used for the above mentioned working categories, but since it operates in a cylindrical coordinate system, It can be used to do the operations more precisely and accurately, Furthermore it also has a wide reachable range. Spherical robot works on the polar Coordinate system. The robot arm is mainly used for pick and place work. It has rotary joints to provide flexibility in a plane. Then for a three dimensional reach. It is usually combined with other mechanisms. Articulated robot has three rotary joints. Parallel robots are used in the mobile platform handling cockpit flight simulators. the gripper is an end-of-arm device often used in material handling applications. Generally, the gripper is like a device which is capable to generate enough grip force to retain an object while the

robot performs a task such as pick-and place operation. Any gripper is also capable to perform the task of opening and closing with some prescribed amount of force over many years of daily operation. The gripper gives some flexibility to the components at the pick-up point. Angular jaw gripper open and close around a center pivot point, moving in a n arcing motion.

3. BLOCK DIAGRAM
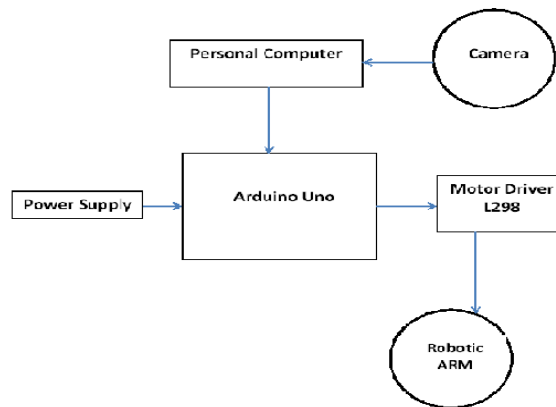
Block diagram of robotic arm

4. DESIGN OF ARM

The Robotic arm is connected with (Arduino) ATMEG 328 Microcontroller, here we used Open source microcontroller to perform our task, the way we connected the motors via motor driver L298 with Arduino Board. We used to trim set to adjust the angle of rotation plays an important task. The servo motors are attached with the body of robotic arm. During the robotic arm control from the arduino board, it senses the signal from the every individual motors. This corresponding value is fed back to the micro controller, when there is position displacement and angular velocity varies, corresponding values fed-back to the controller. Here arduino will read the analog signal and process and control back to the motor via L298 motor driver. Here we programmed the fuzzy rule in the programming part, according to the error rate the microcontroller programming will rectify the error and repeat the process until it reaches the correct position. During every process the it will converts those corresponding digital pulses that are then forward to the motors. This motor will acknowledge with regards to the pulse width resultant in the moment of the robotic arm.

5. ARDUINO UNO

The arduino uno is a microcontroller board based on the ATmega 328.The arduino uno has 14 digital input and output pins. From these 6 pins also used as PWM outputs. It also has 6 analog inputs, 16 MHz of ceramic resonator, a USB connection, power jack, an ICSP header, and the reset button. The uno board has a resistor pulling the 8U2 HWB line to ground, making it easierto put into DFU mode. We can powered the arduino uno by the USB connection or with an external power supply. the arduino uno operates at a voltage on 5V. And the input voltage is from 7-12 V (recommended). And the limited input voltage is 6-20V. it also has the flash memory of 32 KB of which 0.5 KB used by bootloader. The arduino uno also does the serial communication. It communicate with the computer, another arduino, or other microcontrollers .the arduino uno can be programmed by arduino software.

6. MOTOR DRIVER

The L298 is dual full bridge power driver. It is an power integrated circuit which is used for to drive the resistive and inductive load. The device contains 4 push pull drivers with an separated logic inputs. There are two enable inputs also provided for power down and chopping. Driver is capable of driving loads up to 2A continuously. It is operated on the supply voltage up to 46V. The total saturation voltage is 3.4V max at 1A.it is an over temperature protected. The L298 operates in switched and L/R regulation modes. The L298 has 25W power-tab package for low installed cost. It has individual logic inputs for each driver. It also has the channel-enable logic inputs for driver pairs. the logic inputs to the L298 have high threshold i.e. 1.85V and hysteresis to provide trouble free operation in noisy environments.

7. OPERATING PROCESS

This is a project in which MATLAB based GUI communicates with Arduino through a USB data cable. In this system we have a robotic arm with a camera implemented on its top. this camera will continuously keep an eye on the object in front of it thus makes it possible for the user to know the position of object and perform the task. the user can move the arm to left, right, up and down. he can also pick, hold and release the object according to his need. For these you have the different buttons on GUI. You can send commands to Arduino to move the arm in a specific direction by pressing the corresponding button in the GUI. When we push a particular push button, it executes the callback function which is corresponding to that push button in the MATLAB program. Within that function, instructions to set/reset the digital I/O pins of Arduino are executed to drive the motors in the desired direction. Here we are using 3 motors in this system to make the movement of arm more accurate. Based upon the button pressed, the robotic arm move to the specified location, pick it up and releases the object.

8. FLOWCHART:

The flowchart of robotic arm using arduino uno and MATLAB R2016a is shown in above figure. We are operating the arm using GUI(graphical user interface) screen through matlab coding.
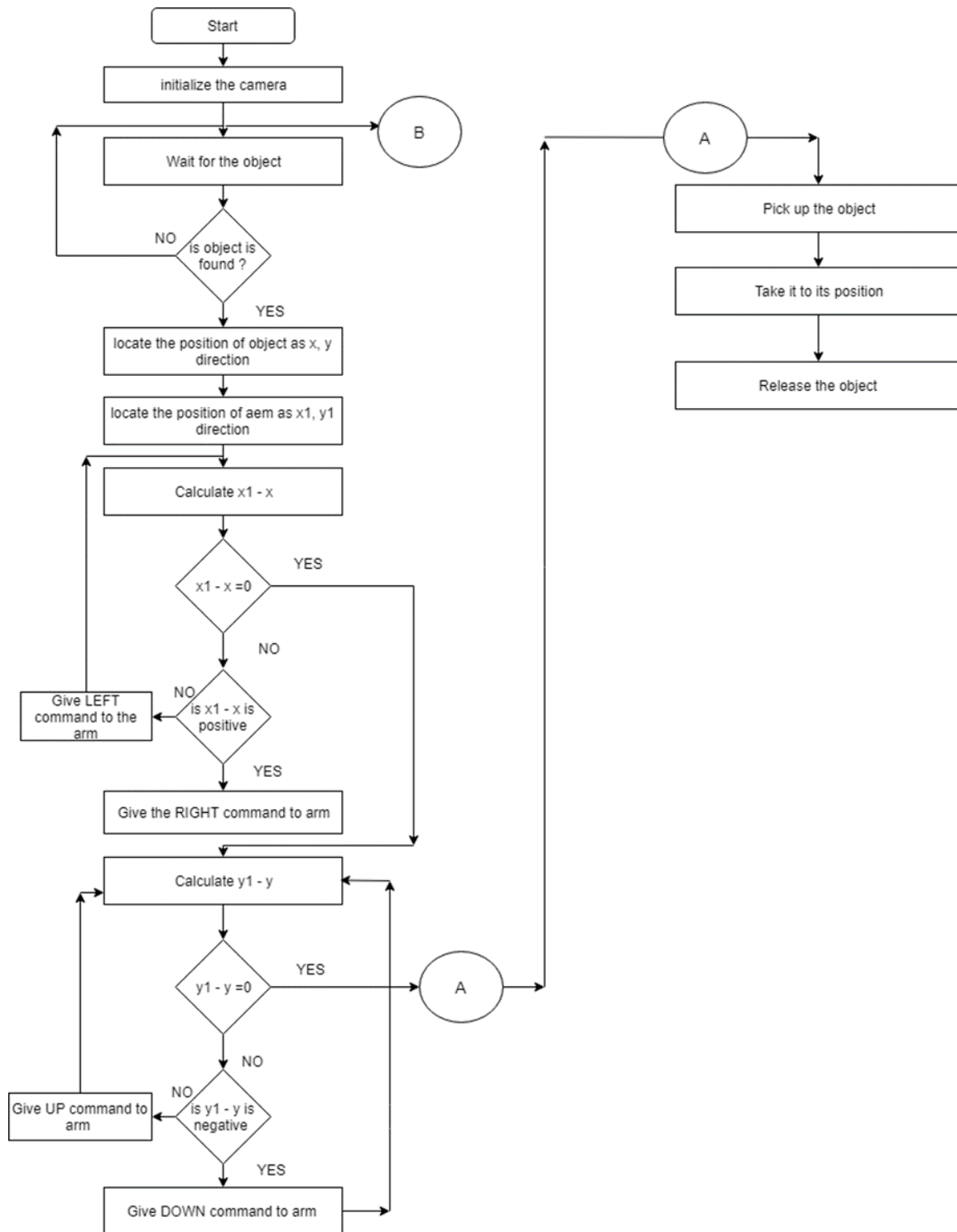
Flowchart of robotic arm

9. OBSERAVTION

The developed robot arm at reference condition covers maximum arc of the radius R =29cm and possible to extend further. The minimum radius that arm can cover is r =26cm.
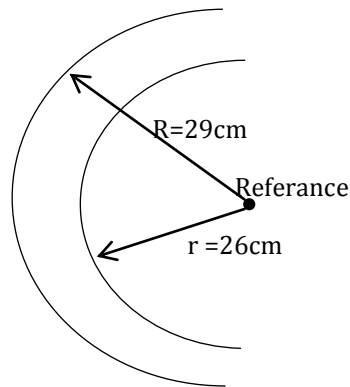
Arm is moving in semicircle,

Therefore

The area of coverage of the arm will be $A = 1/2\pi(R-r)^2$

$$= 0.5*3.14(29-26)^2$$

$$= 14.13 \text{ sq.cm.}$$

For the base, the angle of one complete rotation is 180^0.

The arm calibrates itself in two rotations of the base. Every rotation is of 180^0.

10. APPLICATION

The robotic arm may be used in situations where the shortest path between two points is needed. This system is called as dynamic system because without going to reference position every time it calculate the shortest path for the change in change in object position while other may be called as static system.

- Robotic arm with intelligence of finding shortest path can be used in terrain navigation.
- Industrial robot arms can be outfitted for multiple applications, from welding, material handling, and thermal spraying, to painting and drilling. The robotic arm with intelligence of finding shortest path if designed suitable for specific task can be used for all the application mentioned above.
- The robotic arm so designed can be used where work done and time required doing that work is to be minimized, such as mounting component on PCB.

11. CONCLUSION

In this paper the implementation of robotic arm control with matlab based and arduino interface. The arm is controlled by the matlab and it will listen all the instructions through arduino. This is a very easily implemented straight forward method to coupled man-machine interface. The purpose of this article was to make an arguing UNO control a motor accurately. The gear motor reached the specific angles of movement that we pre-programmed and it repeated it over and over.

12. FUTURE SCOPE

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. 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. WMHW Kadir, RE Samin, BSK Ibrahim. Internet controlled a robotic arm. Procedia Engineering, 2012.

   Mohd A. K. Yusoffa, R. E. Saminb, B. S. K. Ibrahim

2. Wireless mobile robotic arm", International Symposium on

3. Electric Electronic Technology-step and servo motors, SVET, 2007.

4. https://www.arduino.cc/en/Main/arduinoBoardUno

5. Baxter, B.S. ; Dept. of Biomed. Eng., Univ. of Minnesota, Minneapolis, MN, USA ; Decker, A. ; Bin He," Noninvasive control of a robotic arm in multiple dimensions using scalp electroencephalogram", Published in: Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on , 6-8 Nov. 2013

6. Yagnamurthy, S.S.S. ; NIT Warangal, Warangal, India ; Chandra, M.S. ; -PSO algorithm", Published in: Engineering

7. —Arduino MCU‖, - www.arduino.com

8. Vijayan, A. ; Amrita Sch. of Biotechnol., Amrita VishwaVidyapeetham, Kollam, India ; Medini, C. ; Singanamala, H. ; Nutakki, C., "Classification of robotic arm movement using SVM and Naïve Bayes classifiers", Published in: Innovative Computing Technology (INTECH), 2013 Third International Conference on 29-31 Aug. 2013.

9. Hicks, P. E. (1994). *Industrial engineering and management.* McGraw.