Performance comparison of robotic arm using Arduino and Matlab ANFIS

NaserAlanabi1 , Dr. Jyoti Shrivastava2

Abstract: This paper proposed with new Synchronized Robotic Arm, which is well applied in many automotive industries, routine work related industrial engineering section where as human errors can be ignoring and suitable places, for picking objects and placing the objects from one position to another position, we designed a well-constructed robotic arm and would well perform the task as the working arm does. Highly detailed and clear cut work done with the help of servo motors is used. Our servo motor of 350oz inch is used to do the task, whereas the human being can able to handle the same task in nightmare, according to the environmental we used to do the fuzzy based robotic arm with 2dof. Predefined trim set have used to detect the angle of movement and the signals are process by Arduino (ATMEGA 328) open-source 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.

Keywords: Arduino, 2DOF, Matlab-ANFIS, Driver Circuit.

[1] Research Scholar, [2] Senior Assistant Professor[2] Department of Electrical and Electronic Engineering , College of Engineering and Technology, SHIATS, Allahabad, India.
Email :[1]nnassa1968@gmail.com, [2]jyotishri72@rediffmail.com

1. INTRODUCTION:-

At current usage of robots has been tremendously increased due to its functioning, it has been widely acclaimed in many countries by replacing the human force mainly due to its super-fast operating functionalities with minimal errors. We all know robots can be used in the branch of technology that vital roles in industrial design, heavy machinery operation and bio-surgical robots, as well as computer systems for their control, sensory feedback, and information processing. These advanced technology oriented automated machines that can well perform in the place of humans beings in dangerous envy or heavy machinery processes, or resemble humans in appearance, behavior and cognition. Many of currently available robots are inspired by nature contributing and particularly in the field of bio-inspired robotics

The main concept of creating robotics arm that can operate autonomously feedback to the initial position, as we are all know robotics are currently grown very well in all major fields and industry sector too ,commercial and military applications too. In military applications used to diminish the bombs and other hazards things, also hugely demanded in the field of mines sector.

While designing the robots we should keep one thing in mind that it has to be meet the industry standard such as ISO Standard. The essence of robotics may be more practically designed to handle the co-ordinate robots. In the background of general robotics, most types of robots would doesn't meet the expectation into the category of robotics arms.

We design the robotics arm c hange able degrees of self-rule, since selected of robots are programmed to loyally take-out detailed actions over and over again deprived of too much of difference and with a high step of accuracy. Supplementary automata are much suppler as to the positioning of the object on which they are operational or uniform the task that has to be performed on the object itself, which the robot may perhaps even prerequisite to recognize.

2. DESIGN OF ROBOTIC ARM

The 2 DOF Fuzzy based Robotic arm is connected with (Arduino) ATMEG 328 Microcontroller, here we used Open source microcontroller to perform our task, the way we connected the servo motors via motor driver L293D 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 2DOF robotic arm. During the robotic arm control from the arduino board, it senses the signal from the every individual servo 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 servo motor via L293D 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 converts them corresponding digital pulses that are then forward to the servo motors. This servo motor will acknowledge with regards to the pulse width resultant in the moment of the 2DOF robotic arm.

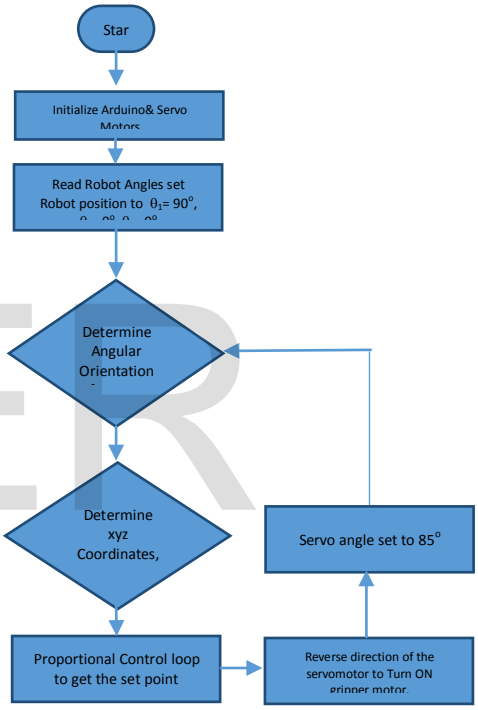
3. OPERATION PROCESS

3.1 Working Principles

The working principle can be well understood from the below figure. If we wants to handles the 2DOF robotic arm for a corresponding assigned task, it's so important to control it and it should also possess the capability of sending exact and precise orders to the robotic arm exploiter which has to be agreed out in standings of positions or velocities of its concluding effectors Secondly, it should be capable to wisdom and senses the real acquired position or velocity. Proficiencies that may be crucial one, and it's depend upon the presentation Consequently, in order to gizmo a control algorithm for the Machiavelli to decipher a specific and exact task, it is obligatory to govern its fundamental functionality which involves reliable things and which auxiliary front-runners to the development of a software program. As we know, a 2DOF Robotic arm its manipulates and senses the features of robots and sensors are essential and to be involve in the complete design to perform well.

Basically, a robotic manipulator and sensors manufacturers provides a set of function slow level features of robots and sensors are needed to be integrated within the full software applications which are then it is there are many other sensing, platform

Flow Chart



3.2 Manual Control:

We would like to go for the manual control to do extra option for our system performance that very essential inour desired positions. In case of compulsory positions that the inverse kinematics mode can't estimate their desired angles, we may use the manual control as an alternative. Basically, manual control be made up ofof a set of series of analog inputs, such as key switches, that are connected with the Arduino atmega 328 microcontroller which will infer the values and forward a command to the servo motor driver circuitry. In order to appliance this, a master control board, as shown, should be built to work as an connection with the robotic arm via connected wires. We did the maximum Possible implementation includes an

understanding various feature where the Arduino microcontroller stores positions in memory and by a keypad or a series of switches we may recall these positions.

3.3 Testing and Validation

Several tests we suppose to relish the final version before that we go for testing our robotic arm, were able to meet the industry standard or not, so we go for testing our hardware and validating the every individual components, the test includes every part of the hardware to the microcontroller, we test the hardware by sending the set of commands to the hardware to test the performance to know the working principle, to a servo motor that turned on or off depending on the command.

The servo motors were verified and confirmed subsequently by guiding dissimilar direct pulses to every single servomotor and validating the reply of touching to the right position. We jumble-sale a mark to recognize where the preliminary position was and the final position of the motors is strong-minded by sending a warning sign with the microcontroller and, in turn, it is interpreted by the servo and associated to the signal on condition that by the key pads, consequential in the rotation to the desired position. During this test, the servo motor was inconsistence with the robot arm system for the reason that of an inappropriate polarization.

The servo motor driver unit was correspondingly tested using the software to send commands to the microcontroller which lead the set of specific instructions to the driver which had one motor associated to modification the situation according to the commend. It is significant to notification that at the commencement of the project a different servo motor driver was selected but several problems related to the communiqués and wiched between them and the microcontroller were present. So we pick a driver that sanctions the data to be sent directly from the computer to it with only a USB wire, so the microcontroller would only be used in case of the implementation of manual control.

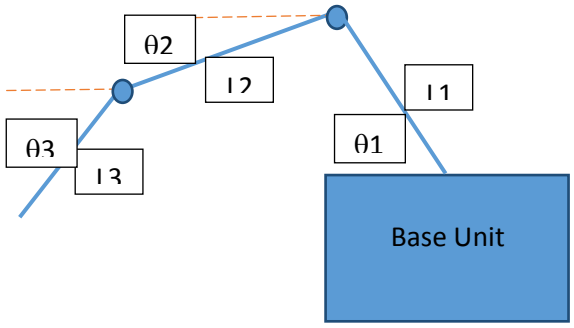
Testing and authentication of the robot arm is one of the responsibilities that require stretched out time because several repetitions are desirable. Throughout our tests, we face many issues arise as: few are they are wrong angle designs, wrong regulation of the motors, problems with the physical angle and situation measurements, and one of the servo motors burned since of an overload that wasn't predictable and projected.

3.4 Distance Determination:

$\phi = \arcsin(d1-d2/l)$

$X= ((d1+d2)/2) * (\sin d90-\phi)/(\sin 90-\phi-\theta)$

3.5 Arm Kinematics



$X = \sum_1^3 \cos(\theta i)\, Li$

$Y = \sum_1^3 \mathrm{Sin}(\theta i)\, Li$

3.6 Physical Constraints

L1 = 3.5 inch whereas $20<\theta<145$;

L2=2.45 inch whereas $-135 <\theta_2-\theta_1<0$

4. RESULTS AND DISCUSSIONS:

This paper presents that the same concept done in Matlab with ANFIS and comparing with Arduino Microcontroller for performance comparison, from that we come to conclude that our simulated results very close to the hardware results in terms of high degree of accuracy, orientation results.

4.1 Movement Range of Servo Motors :

As Servo motors contains that is has less than a 180^o span. it can limits the servo motors where observed from its servo motors specifications. But actual real range for all kind servo motors was lies between 125-142 degrees,

from this we observe that real functionality of robotic arm is slightly differs from the standard ones.

4.2 Consumption of Current:

The consumption of current depends upon the load and its types of motion of the robotics arm. We observe there are few levels of current consumption.

During the initial nonmoving state, it consumes very low-slung like 0 to 120mA, though the robotics arm starts stirring to the target starved of needs of much of great torque, in the course of that moment it consumes around 120mA to 350mA, when the robotics carries some kind of loads, due to its overcoming the primary instant of inertial for masses, the normal range take a place. But when its reached the full load condition to consumes around 350mA to 600mA

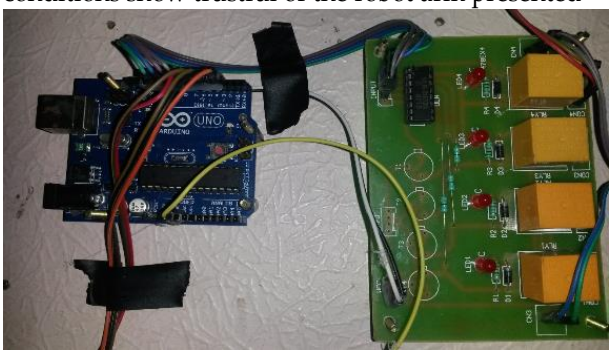
5. CONCULSIONS:

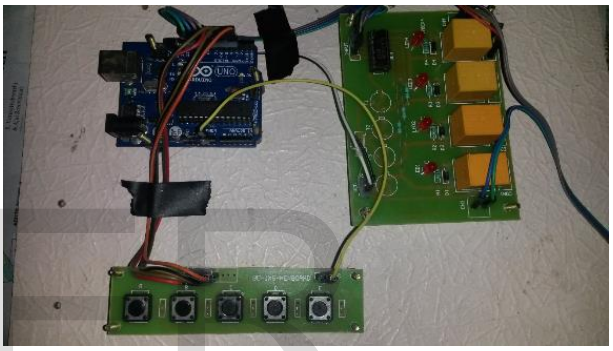
This paper presents the design, enlargement and execution of robotic arm, which has the endowment to bring about the various tasks, such as handling the material. The robot arm was designed and built from plastic where servo motors were used to interconnection between arms and accomplish arm movements. Though, the rotation range of the motor is less than 180º span, which greatly decreases the region reached by the arm and the possible positions. The design of the robot arm was limited to four degrees of freedom since this design allows most of the necessary movements and keeps the costs and the complexity of the robot competitively. The end effector is not included in the design because a commercially available gripper is used since it is much easier and economical to use a commercial one than build it.

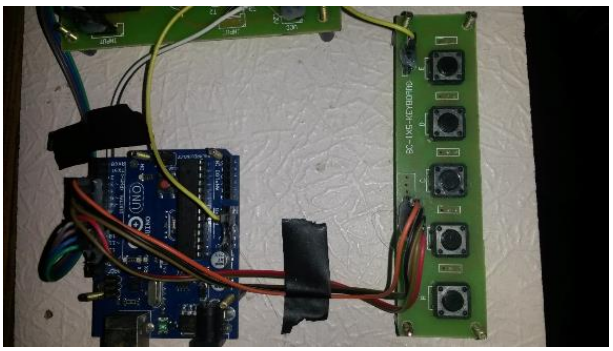
During design, we faced some difficulties due to the way of joining thin fiber related plastic material .we use screws and nuts to interconnect the mechanical junction to furnish it, a small feature was designed which allowed tie with the bolts and nuts deprived of having to screw in the thin plastic layers.

To control the robot arm, this papers approaches are implemented with a Arduino Open-source microcontroller, a Motor driver, and a computer-based simulation (Matlab – Anfis) performance. This system has exceptional features and appearances that allow suppleness in controlling and programming process, which was executed using matlab simulation part to for better understanding, how things are done; besides it could also be implemented in a full manual mode. This robotic arm is distinction with others as being much cheaper than available robot arms, also it can be paralleled compared all of its movements from Matlab Simulation.

Several tests were carried out to validate the robot arm where the testes covered both the particular elements and the overall system; results at different operating conditions show trustful of the robot arm presented







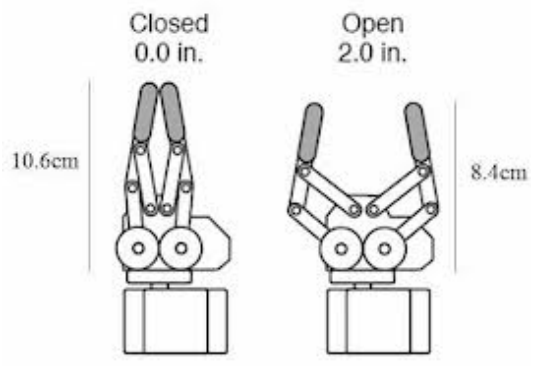


Fig 4. Robotic pic arm opening and closing

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