4 to 6 DoF Robotic ARM

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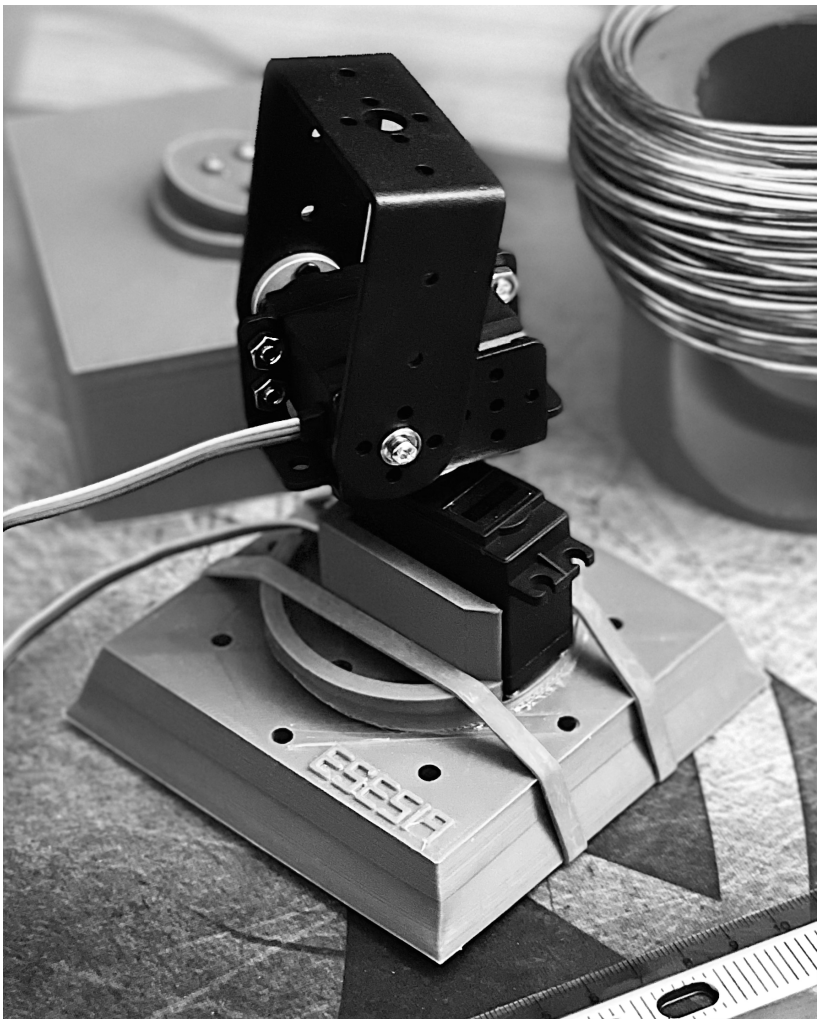
https://devpost.com/software/4to6-dof-rob-arm



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University of Pennsylvania

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Abstract

Nowadays, bionic, robotics are starting to become hot topics. To follow the pace, our team is building a robotic arm that can help users to grab some objects. Robotic arms can be found in many fields, including industrial manufacturing, medical treatment and entertainment services. They have a variety of situations and can perform certain tasks in two or three dimensions depending on the command.

Our final goal is to use the joystick to control the arm, the sub placement is using the joystick to control instead. The arm that was designed by us is only a prototype version. The final goal is that the robotic arm is strong enough to help the user to achieve some goals that the user cannot achieve without it.

Motivation

As the Abstract mentioned, robotics is really a hot topic in this century. There is a huge opportunity related to this topic. The first reason that motivates our team is that we have watched “Iron man”, and we found his suit is so cool and powerful.

The second reason is that we think using robotic arms can improve the efficiency of the task, and to some extent improve the safety of the process. Related to this idea, developing a robotic arm as an embedded system that can help the human or user is a fantastic project. From a different perspective, to optimize the performance of the robotic arm and as well as to the next level, we need to maximize the torque power of the motor or even using different mechanisms.

The final reason is that one of our team members is really interested in the robotic field, thus making a robotic arm from scratch will help the team member learn more related problems, knowledge regarding the field.

Goals

A. Milestone 1

First of all, we have to imagine the project model we want to design, and use Autodesk Fusion 360 to model our equipment. Then 3D print the parts and check the design if it meets the design scenario .Since we need to control at least four servo

motors, we need to verify if the design can meet certain angles that we wanted.(such as Does the shoulder joint can move 270 degrees? etc).

Milestone 2

We will use the joystick combined with PWM to control the movement of a single servo motor. If we can use one axis of the joystick to control the ADC to control one motor. Can we use the next axis to move the next servo motor? According to the data we have obtained, the pulse generated by PWM is different, the servo motor will rotate in different directions. It is convenient to prove the joystick is totally accurate and work for one part, like the shoulder, and then move to the next part.

Milestone 3

Finally, we need to control and test the grasping ability of the robotic arm. Our ultimate goal is to be able to grab something with this robotic arm. We will debug and test it.

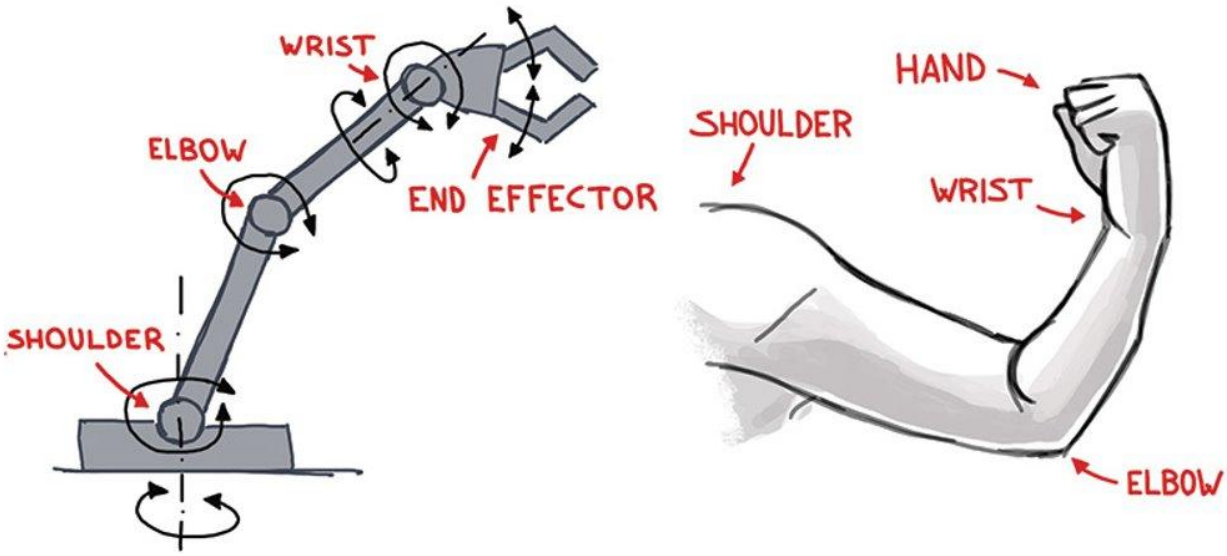
B. Final Demo

For our end result, we need to combine each model and test if it is available to execute. We want the robotic arm to be able to move with a joystick, and the hand part of the robotic arm to be able to grab tennis balls.

Methodology

Firstly, by defining the problem, like what we want to build from this project. Secondly, Pick the input device and output device. For this problem, we picked a joystick as an input device and serval servo motors as output device. (servo motors are the most fit solution for this problem) Then, learn more information about each component, order them, test and use them. Lastly, solve the problem with a set goal.

For the design approach, after having the idea, brainstorming. Then make it in the design tool. After the part gets printed, check it, if it works, then use it as the final version. If not, change the dimension and start the process again.



For this project, our ultimate goal is to control the movement of a robotic arm and grasp objects through a joystick. We used Arduino Uno as our MCU and used C to compile the results we wanted.

Secondly, we will use a joystick combined with PWM to control the direction of arm movement. However, since our mechanical arm has six servo motors, the number of Timers is far from enough. Therefore, we will think of other ways to control the six servo motors separately. This will be one of the most difficult problems to solve in our project.

Components

What major components do you need and why?

1. Servomotor: According to the change of PWM value, to change the degree of movement of each part of the arm.
2. Joystick: Read the value of its ADC to control the size of the PWM pulse, thus controlling the movement of the arm.
3. 3D printed units: As the skeleton and base of the robotic arm.
4. Arduino uno: The microcontroller on the board can be programmed by programming language, compiled into binary files, and burned into the microcontroller. That is, we will write the program to achieve the input of the command.
5. Wires, LED and other small components may be used in the future.

Evaluation

1. The movement of Robotic arm is controlled by a lever. The criterion is that we move the lever in such a way that the arm moves in the same direction. We want the result to be roughly the same direction, and we'll try to get as accurate as possible.

2. The hand of the robotic arm can grab a tennis ball or other small object. We are judged by being able to grab objects and hold them until we send the end message and then let go.

Timeline

Week	**Task**	**Assigned To**
Week 1: 11/09 - 11/15	3D design	Ziyang Gao
Week 2: 11/16 - 11/22	Code for arm to move	Minyi Hu
Week 3: 11/23 - 11/29	Testing if it is movable	Both
Week 4: 11/30 - 12/06	Code it for grab the object	Minyi Hu
Week 5: 12/07 - 12/10	Combine and testing	Ziyang Gao

Proposal Presentation

Presented.
Link for PPT:
https://docs.google.com/presentation/d/1xlCH4bXigoyp3gewH34KnzwRBzHrnHY8y51tPCjaAHg/edit?usp=sharing

References

1. Sébastien Mick et al., January 01, 2001, Reachy, a 3D-Printed Human-Like Robotic Arm as a Testbed for Human-Robot Control Strategies, November 11, 2021, https://www.frontiersin.org/articles/10.3389/fnbot.2019.00065/full
2. J. Hu et al., "A robotic ball catcher with embedded visual servo processor," 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems, 2010, pp. 2513-2514, doi: 10.1109/IROS.2010.5648912.
3. H. Salman, M. S. Rahman, M. A. Y. Tarek and J. Wang, "The Design and Implementation of GPS Controlled Environment Monitoring Robotic System based on IoT and ARM," 2019 4th International Conference on Control and Robotics Engineering (ICCRE), 2019, pp. 93-98, doi: 10.1109/ICCRE.2019.8724268.