Manipulator control and training based on hand motion detection

——Project Proposal

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Problem

present situation

- Most of the automatic control and learning training of manipulator are based on **visual target recognition.**
- We want to train the manipulator to do the task the human assigned to them.

what we want to do ?

- Training an auxiliary desktop robot arm based on the **recognition of human hand posture**.
- People just need to move their hands, and the robotic arm can act accordingly.

Related work

1. RoboTurk: A Crowdsourcing Platform for Robotic Skill Learning through Imitation.

2. Dual Ring: Enable Subtle and Expressive hand interaction with Dual IMU Rings.

3. InDexMo: Exploring finger-worn RFID motion tracking for activity recognition on tagged objects.

4. https://learn.microsoft.com/en-us/windows/mixed-reality/design/direct-manipulation

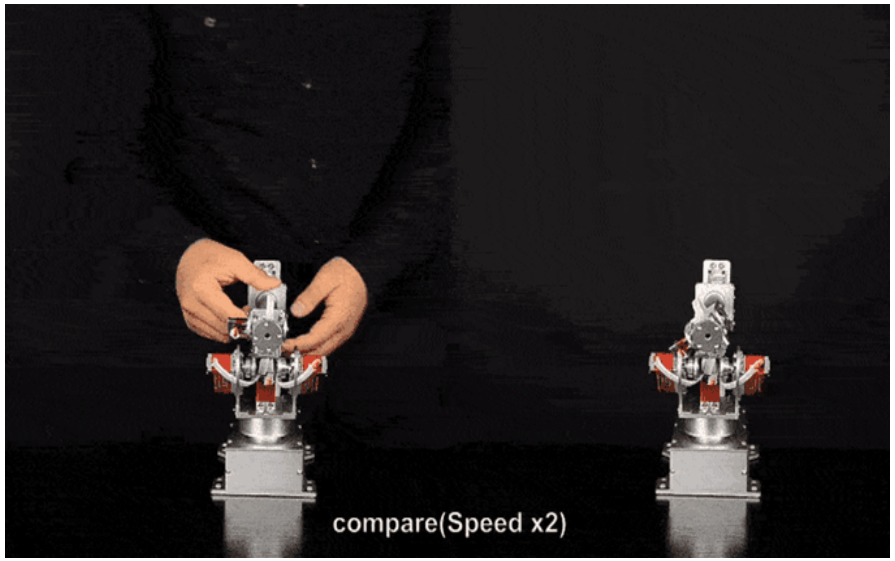
5. https://circuitdigest.com/microcontroller-projects/diy-hand-gesture-controlled-robotic-arm-using-arduino-nano#:~:text=We%20will%20again%20use%20the%20same%203D%20printed,with%20an%20MPU6050%20Gyroscope%20and%20a%20flex%20sensor.

6. https://github.com/xeecos/RoboticsArm

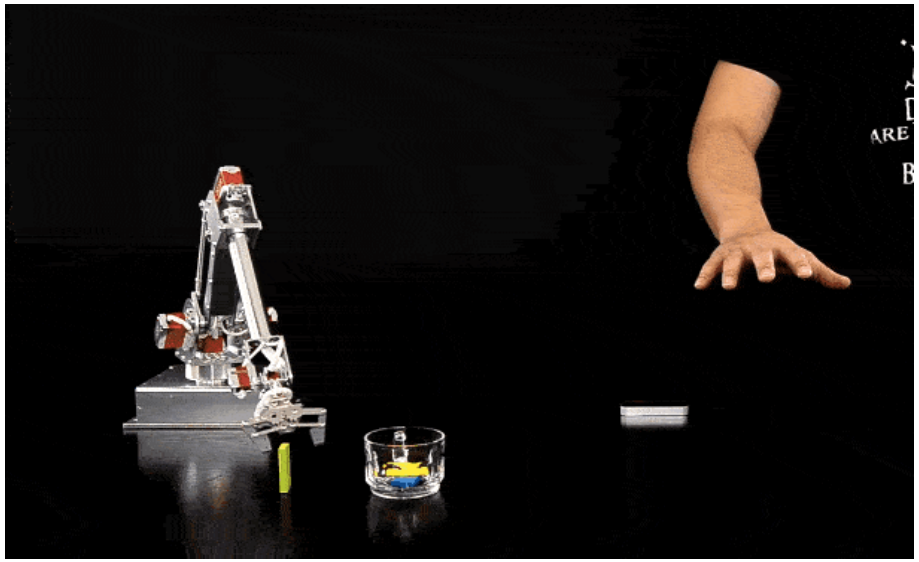
7. https://www.techjuice.pk/this-kickstarter-backed-350-robotic-arm-can-mimic-your-hand/

Related work

Classical teaching program



hand control



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Control Method

The control problem

- Position pose control
  - More accurate
  - However the solution of forward and inverse kinematics reault in too complicated controller will have real-time data transmitting problem, which we have tested.

- Velocity control
  - The control method is relatively simple. (Projecting the realtive velocity of hands to the manipulator)
  - However, sacrifice accuracy.

Data dedection

1) Visual recognition

- Using joint recogniton of hands by using camera.
- Works out the real-time position and velocity.
- Send commends to the manipulator.

2) Sensor (Six or nine dimensional IMU sensors)

- Get real-time velocity and acceleration of hands.
- Works out the velocity and acceleration information is transmitted directly to the robotic arm.

Method

Constantly feed data to the robot arm through manual control movement in different desk tasks.

Manipulator learns what is the best approach to move to work on a task and how it apply force to move and grab objects(if we have moment sensor).

Evaluation Criteria

- **In the simulation environment/real robot arm can follow the movement of the human hand to carry out the corresponding attitude movement.**
- **The robot arm is moved by human hand control. The path planning and movement of the manipulator are trained. Improve the robot arm's ability to complete the assigned task without target visual recognition.**

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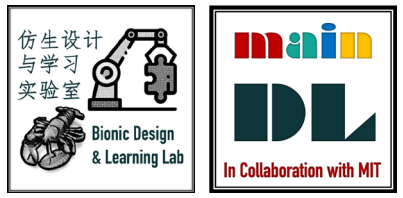

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