Automation of a Commercially Available Robotic Arm

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Smart, cost-effective robotic arms are hard to come by. This project shows the steps taken to develop a cheap starting platform into an intelligent arm. The starting platform used is an OWI-535, made by OWI incorporated. This product comes as a kit, requiring about 2-3 hours of building. The starting specifications for the arm were:

- Up to a 100 gram lifting capability
- 12.6 inch horizontal reach capability
- 5 Degrees of freedom (DOF)
- Batteries act as a counterweight in the base
- Wired controller
- Built-In claw light
- Low Price (<$60)
- Plastic construction
- A spring loaded slipper clutch on each joint

A few downsides to this starting design were:

- Couldn't see any objects
- Didn't know where the arm was
- No micro controller interface
- Only can be actuated manually via the wired remote

The overall objectives for modification include:

1) Find the object. The point here is to use a sensor to locate an object that the arm can later pick up.
2) Pick up the object. Pick up the object by extending the arm, maneuvering the claw into a position that it can grab the object from, and grab it.
3) Move the object to a preset drop position. This position is set manually earlier on in the program's execution.
4) Use almost full autonomous control. This means very little should be required of the operator.

The C Stamp Board of Learning was fitted with ten MOSFET transistors (five Positive and five Negative) to drive the motors. Each motor on the arm has one of each type of MOSFET transistor.

Two sensors were tried for object detection, one being a SHARP IR Ranger, and the other an AWIT WITSonar Ultrasonic sensor. The latter was chosen because of its more applicable data output, in reflection time rather than volts. The downside to using the WITSonar is that it has a wide field of view. To correct this, blue painter's masking tape was placed in cylinders over both the ultrasonic emitter and receiver.

End Point Switches (EPS) were installed to help locate the arm. These coupled along with the time measurement of how long a joint has run from the switch and in what direction allow the C-Stamp to approximate where the arm is.

All of the sensor wires run though a 9-pin D-Sub connector and all of the joint power supply wires run through a single USB connector, both of which are affixed at the back end of the arm. The motor wires are bundled in orange property marking tape.

The logic used in this arm follows a simple path. First, get to a know position. Then move and let the operator set the position that he/she sees fit to drop the object at. Next, return to that known position and start a scanning sweep for the object. When the object is found, reach out, pick it up, and move to the standardized location a third time before moving to the drop position. Once at the drop position, release the object and return the arm to a compacted storage orientation. End the code and power down.

Mostly by trial and error, I concluded that the SHARP IR ranger was wrong for this project. I also discovered that the arm can only move when power is applied through the joint motors, via the MOSFETs. If the batteries become weak, sometime this final design of the arm will not work correctly.

The project could be continued by adding vision, a drop position beacon and finder sensor (rather than having it set by the operator), a movable base for transportation or even adding some sort of remote communication. The arm can be progressed in any direction that a developer sees fit.