Dynamic Telecommunication Stand

Group 72

Mock Design Review

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Block Description

Motor unit
The motor unit is the mechanic part for the robotic arm. It contains motor driver and servo motors. The motor unit has the input from microcontroller as a control signal and it is powered by the power unit. The output of this unit is the motor motion.

Motor drivers
The motor driver is controlled by the microcontroller and it will change the voltage output to the two servo motors. This will direct a 6V line to the motors, but will only output high then signal from the microcontroller is high. This unit is necessary because the Raspberry Pi cannot output enough voltage to power the servos.
Servo Motor

The motors are two identical servo motor. They provide 51 oz/in stall torque at 6V and are used to move the phone holder to any angle within $180^\circ$ forward direction.

Schematic

This is the circuit analog band filter schematic, the pass band is between 300kHz to 4kHz which is the human voice.
## Requirements and Verifications of Robot Arm Module

<table>
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<th>Requirement</th>
<th>Verification</th>
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<td><strong>Robot Arm Module</strong></td>
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| The vertical motor should be able to stay within 10° in 10 minutes while standing by | 1) Connect the motor encoder to the computer.  
2) Power the system but don’t input any command  
3) Draw the motor angle along time using matlab |
| The vertical motor should have tilt angle between -40° to +40° (horizon is 0°) | 1) Connect the motor encoder to the computer.  
2) Power the system and input command signal that change the tilt angle in one direction until the robot arm stops, repeat it towards to the other direction.  
3) Draw the motor angle along time using matlab, ensure the angle above 40° in both side. |
| The overshoot for both motors should be less than 10%                       | 1) Connect the motor encoder to the computer.  
2) Power the system and input command signal to a certain angle.  
3) Draw the motor angle along time using matlab, ensure the overshoot is less than 10% |
| Power system should provide output 6V +/- 10% 5V +/- 5% at up to 250mA each   | 1) Connect the output of the power module to voltmeter  
2) Power the power module  
3) Ensure the voltage of the output satisfied the requirements |
Calculation and Plot

For our sound source recognition task we will use the concept of triangulation and far field assumption. Normally, sound waves reach a microphone in a spherical shape, like the curvature shown in the figure above. However, if the acoustic source is far enough, the curvature could be estimated to be a plane wave. Thus, figure (2) will hold.

This assumption will simplify the calculation greatly.

The simplification is that the signal phase difference between the two microphones- denoted by the red X's- will be directly proportional to the dT, the perpendicular distance the plane wave has traveled over the time difference. Thus, we can use only two microphones to figure out the angle of the acoustic source with the equation:

\[ \theta = \cos^{-1}\left(\frac{dT}{d}\right) \]

The dT will be figured out by the phase difference of the signals received by the two microphones. We simulated a cosine sweep signal that spans from 300Hz to 2000Hz coming from a 20 degree angle with a sample rate of 8KHz. With a d of 20cm. Theoretically, this should result near a 4 sample phase delay.

\[ dT = \frac{\text{number of samples delay} \times \text{speed of sound}}{\text{sample rate}} \]

\[ \text{number of samples delay} = \frac{8000 \times 0.2 \times \cos 20^\circ}{342} \approx 4 \]
As a simulation result the cross correlation gave us quite a clear result of 3 samples delay. Thus, with this sample rate and chosen accuracy it should be feasible to distinguish the delay with some precision error.

Safety Statement

Our group will follow the ECE 445 safety guidelines. No one will ever be in the lab alone. We will also make sure power is disconnected when modifying any circuits. When working on the circuitry, we will carefully consider the voltage supplied and current running through the circuit. We will also wear goggles during soldering and wash our hands afterwards, following the soldering safety guidelines outlined by Carnegie Mellon University.

The device itself should not cause harm to its users. We will ensure that the machine’s arms do not move too volatilely or quickly so that no one is injured by the machine. We will also need to ensure no wires are exposed to the end user and that no part of the machine will be hot enough to cause damage.
Citations


