ECE 445

Fall 2012

Senior Design Project Proposal

Robotic Microphone Stand

Team #24

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Introductions

Title: Robotic Microphone Stand

We decided to pursue this project, because we felt that Mark Rubel had a very real problem that we could tackle given the constraints of this class. Mark's reasons for desiring a robotic microphone stand were so compelling, in fact, that two other groups are attempting their own versions of this project. First, the audio memory of the average person is extremely short. This makes it hard to directly compare the two sounds, since by the time a producer walks into the booth, adjusts the microphone, and walks back out, his memory of what the previous sound was is no longer accurate. Second, anyone at home with a good microphone can record, produce, and distribute a song on the internet. The professionals have to evolve to attract new clients, and part of that evolution is being one step ahead in the recording environment. Also, the cool factor of a robotic microphone, gimmicky as that may seem, adds to the experience of using a professional producing service.

Objectives

Intended Functions

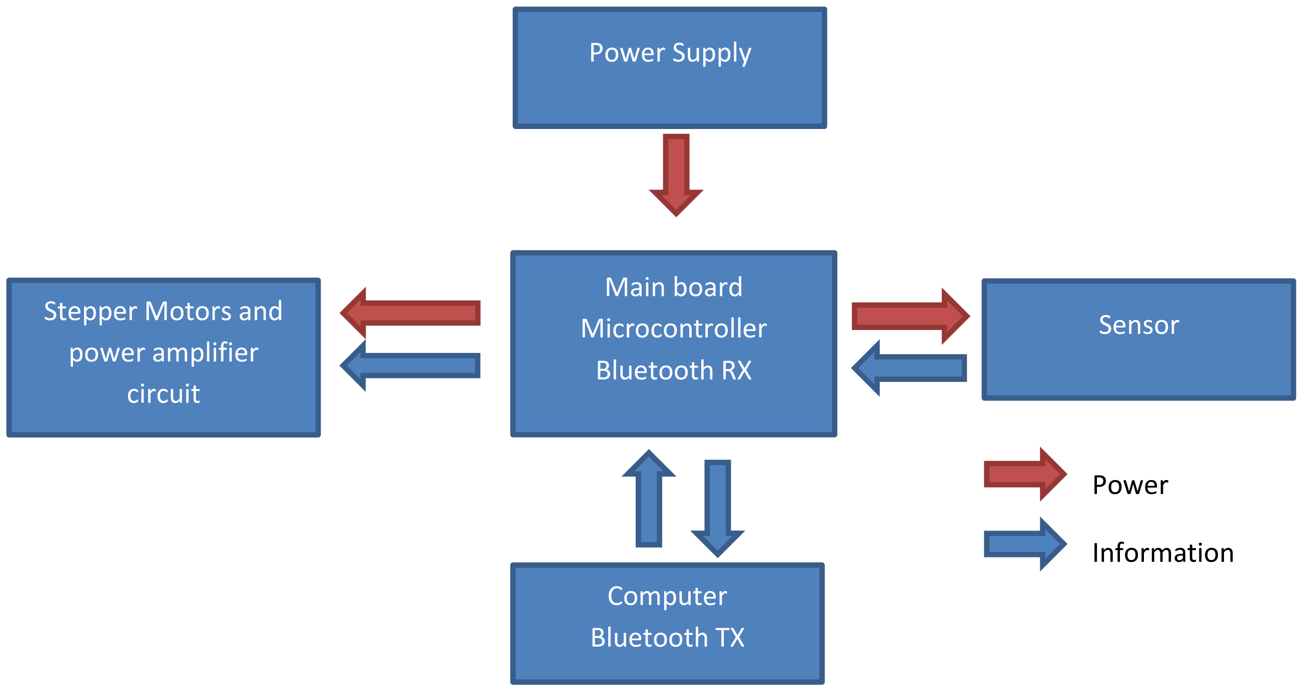
- Full translational movement of a microphone along the x, y and z axis
- Horizontal and vertical pivot capability
- Remote controlled via computer program
- Ability to store and reconfigure to stored x, y, and z positions via built in memory

Benefits

- Remote control of microphone position
- Protection of personnel from potentially dangerous recording environment
- Far less expensive than similar products

Design

Block Diagram



Block Description

Power Supply

We will likely be purchasing an AC to DC converter. The power supply will provide power to the main board. It will draw power from a standard wall socket and will convert 110V AC to 20V DC.

Stepper Motors

These motors will be powered on or off by the microcontroller, and will only be turned on when commands are issued. The stepper motor will be attached to the base of linear actuators that move the microphone position linearly. They will be driven by an amplifier circuit that draws power from the power supply and is switched on and off by the microcontroller.

Sensor Elements

Bump sensors signal the microcontroller to prevent the motors from running when the microphone is at the bounds of the frame. This prevents damage to both the frame and the motor. There will also be rotary encoders to track the angular location of the motors, which we can use to track the location of the microphone.

Main Board

The main board will house the microcontroller and Bluetooth receiver circuitry. It will also have any power circuits that are required to step up or step down the voltage that will go to the stepper motors or sensor elements. Any logic circuit required to process all of the sensor array data will be located on the main board.

Computer controller

The microcontroller will be sent signals from a computer, broadcasting to the microcontroller via Bluetooth. There will be a user interface to issue commands and to save or restore microphone configurations.

Requirements and Verification

Feature Requirements

Power Supply

- Will accept 110V AC and convert it into 15V DC

Stepper Motors

- Must be able to resolve 5mm linear step size

Main Board

- Must send signals to the amplifier circuit of the stepper motor for motor control
- Must be able to store and read location data to built-in memory
- Must be able to receive instructions from the Bluetooth TX from at least 5 meters away through a wall

Computer Controller

- Must be able to send commands from a distance of at least 5 meters away through a wall with a visual interface

Sensor Elements

- Must signal the microcontroller when the microphone reaches the ends of the frame
- Must be able to resolve the angular equivalent of the 5mm linear step size requirement

Verification

Power Supply

- Test the output of the AC to DC converter on an oscilloscope to ensure it meets the output voltage and any ripple or load regulation requirements for running the motors and microcontroller.

Stepper Motors

- Test that the stepper motors work with a DC power supply

Main Board

- Measure output of amplifier circuit on oscilloscope to ensure it will sufficiently power the stepper motors
- Store and recall at least one microphone configuration in the on-board memory
- Send one packet of information between the computer controller and the Bluetooth receiver

Computer Controller

- Send one packet of information between the computer controller and the Bluetooth receiver

Sensor Elements

- Test the output of the bump sensors on an oscilloscope for sensitivity and proper output
- Be able to distinguish between two rotary encoder positions

Tolerance Analysis

The most critical component of the microphone stand is the stepper motor control and how find it can resolve movements in the x, y and z directions. The accuracy of the stepper motors will define how well the final product accomplishes the goal of remote microphone relocation. The concern is that we will not be able to resolve sufficiently small linear movements, which would limit the consistency of the final product. Besides purchasing the correct motors, the movement resolution will be defined by how well our motor controller is written. It must work well enough to meet the 5mm linear step size we have set for ourselves. We will do a rigorous analysis of how small can we resolve movement in any direction, and make sure that we can precisely control the microphone’s movement

Costs and Schedule

Labor

Dennis	$35/hr * 160hr * 2.5	$14000
Alejandro	$35/hr * 160hr * 2.5	$14000
Total labor costs		*$28000*

Parts

- TI MSP430	$4 each
- Bluetooth Transceiver x2	$12 each
- Stepper motors x3	$20 each
- Rotary encoders x5	$4 each
- DC servos x2	$13 each
- Bump sensors x6	$1 each
- AC to DC converter	$10
- Materials for base and stand (physical structure)	$30
- Amplifier and logic circuits on main board	$10
Total parts cost	*$190*
Project Total Cost	**$28190**

Schedule

Week of	Dennis	Alejandro
8/26	Brainstorm ideas, find partner	Brainstorm ideas, find partner
9/2	Brainstorm ideas, find partner	Brainstorm ideas, find partner
9/9 – Approved RFA	Brainstorm ideas, find partner	Brainstorm ideas, find partner
9/16 – Proposals Due	Learn MSP430/pick DSP	Mechanical design
9/23 – sign up for Design review	Continue MSP430, research Bluetooth interfacing	Amplifier circuit, sensor logic, order parts
9/30 – Design review	Set up microcontroller and Bluetooth	Assemble structure
10/7	Continue interfacing with Bluetooth	Assemble structure
10/14	integrate sensors and motors with microcontroller	Program movement control
10/21	Design and submit PCB v1	Program movement control
10/28 – Individual progress review	Design final UI	Program movement control
11/4 – mock presentation signup, mock-up Demos	Design final UI, design and submit PCB v2	Test power supply, sensor testing
11/11	Testing	Tolerance analysis
11/18	Design and submit PCB v3 (if needed), prepare demo	optimization
11/25 – presentation signup	Presentation and final paper	optimization
12/2 - Demos	Presentation and final paper	Optimization
12/9 – Presentations, final paper	Presentations and final paper	Optimization