Project: Bluetooth Audio Splitter

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Introduction

Objective

Problem:

In order to share in a listening experience, two people would need to either play the audio out loud, perhaps disturbing others such as on the plane, or acquire two pairs of wired headphones and an eighth inch cord splitter. Currently Bluetooth 5, a new Bluetooth protocol, allows for this, but only with common platforms. Such as, you can connect two pairs of Apple headphones to an IPhone, but not a pair of AirPods and a pair of Sony headphones.

Solution Overview:

Create a bluetooth splitter that can take in a bluetooth audio signal and repeat it to multiple bluetooth outputs in order to connect multiple people to one device, wirelessly. We would have a bluetooth receiver and two or more bluetooth transmitters. Most of the similar products on the market have an aux cord to the device playing the audio, but it would be easier for the user if that cord was eliminated. Our device would be platform-independent, so that you can connect a pair of Sony and a pair of Bose headphones to the same phone.

Background

Imagine that you are throwing a birthday party at your college apartment, but you don't have the speakers necessary to support how loud you want the music to be. Instead of buying a larger speaker system that can be really expensive, we would want to buy a cheaper device that can play the bluetooth audio on both speakers. This would allow people to play music on multiple devices wirelessly and have the music be the same.

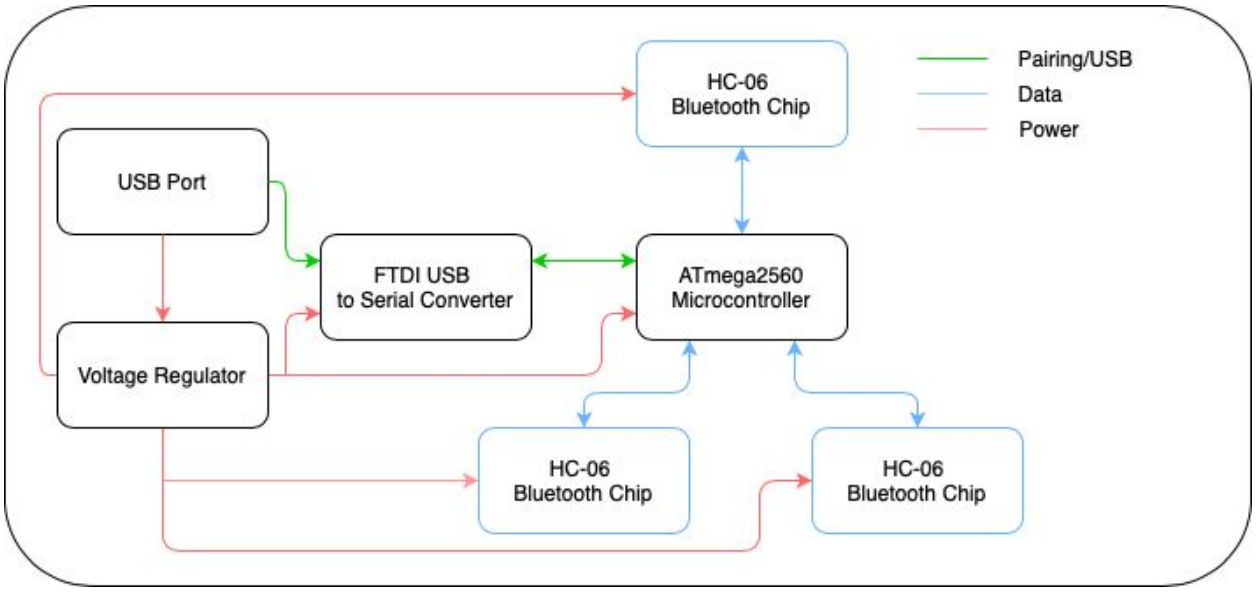
A second case would be two people watching a movie in their homes while needed it to be quiet - someone is sleeping. These people can then use their wireless headphones to listen to the audio while the rest of the room does not hear anything.

High-level Requirements

- The device must connect wirelessly to a single laptop.
- The device must send data or music from the laptop to speakers.
- The device must connect wirelessly to two speaker devices.

Design

Block Diagram



This device will need three different modules - a USB/programming module, a control module, and a power module. The programming module would simply be a USB port connected to our microcontroller to allow for programming and bluetooth pairing. The power module would be a battery supply that could be charged and would supply power to the other elements on the PCB. The control unit is the most complex part, and would include three bluetooth chips connected to a microcontroller.

Functional Overview

Programming Module

USB Port
A USB port will allow us to communicate with the Arduino. We can use the Serial Monitor to pair the various devices to the Bluetooth chips.

Requirements: UART communication fed into the FTDI chip.

FTDI USB to Serial Converter
FT232R chip that allows us to program the Arduino on the PCB via the micro USB port we are using to power the device.
Requirements: Convert USB to Serial so we can communicate from the laptop to the arduino mega mind

Control Module

Microcontroller
The microcontroller, an ATmega2560, will run communication between the Bluetooth modules. The mega was chosen for its 4 RX/TX ports, as this will allow us to run serial communication on all three devices at the same time.
Requirements: The microcontroller must be able to communicate through UART with the 3 RX/TX ports. We may need the I2C or SPI protocols.

HC-06 Bluetooth Chip 1
A Bluetooth chip, such as the HC-06, will be used to connect from an audio transmitter, such as a phone or laptop.
Requirements: Must have RX/TX ports in order to communicate through UART with the microcontroller and pair with a phone or laptop. Minimum communication rate: 9600 bits per second.

HC-06 Bluetooth Chip 2
A Bluetooth chip, such as the HC-06, will be used to connect to an audio receiver, such as a speaker.
Requirements: Must have RX/TX ports in order to communicate through UART with the microcontroller and pair with a speaker. Minimum communication rate: 9600 bits per second.

HC-06 Bluetooth Chip 3
A Bluetooth chip, such as the HC-06, will be used to connect to an audio receiver, such as a speaker.
Requirements: Must have RX/TX ports in order to communicate through UART with the microcontroller and pair with a speaker. Minimum communication rate: 9600 bits per second.

Power Module

USB Port
Power will be supplied through the USB port and distributed through the voltage regulator.
Requirements: Needs to power three 3.3-5V Bluetooth chips, and ATmega2560 microcontroller.

	ATmega2560 Controller	HC-06 Chip	FTDI
Operating Voltage	5V	3.3-5V	1.8-5V
Input Voltage (recommended)	7-12V	3.3-5V	4-5V
Input Current	500 mA		
Operating current		30~40mA pairing 8mA operating	15mA

Voltage Regulator:
The voltage regulator needs to clean input voltage from the USB and send the required voltages to the various components.
Requirements: Have output of around 5V and 3.3V depending on the chip it is supplying voltage to HC-06 or ATMega2560.

Risk Analysis

One of the larger risks associated with this project is making sure that we can properly connect the bluetooth efficiently. This aspect is partially device dependent, so we have been researching the best devices to make sure the connections can succeed in a timely fashion. This is something that we have researched, but could end up being more complicated once we have the devices. Ultimately, since most setups are very specific models that could be outdated, we have to be careful about ensuring that the devices we get will be able to perform all the functions we need. We believe that we have done this, but there is still some risk of things not going according to plan.

A secondary issue we could come across is the latency between the devices and the speakers or headphones. We would want to ensure that the sound from the transmitting device reliably reaches the edge devices and does not transmit to one device more reliably than the other. When researching this issue, we have not found much evidence suggesting that this would be a struggle, but it is something we will need to keep in mind as we finalize our product.

Lastly, we could run into issues with the storage of a buffer while we are processing the input. In most of the articles we have come across, it appears as though no extra storage is required, but given that we might want to add more features to our device, there is a possibility that we will need a larger buffer. This is something we will need to keep in mind as we get towards the advanced functionality of our project.

Ethics and Safety

When reading the codes of conduct by IEEE and the ACM, we can see that the general trend is that engineers must take responsibilities for their actions, and that they must look out for the safety and wellbeing of the people. Our product does not get around any laws, and we will be careful about the power that we are putting into the device.

The largest safety concern would be overpowering our device. We have added a voltage regulator in our design, so that we never overheat our devices, subjecting our users to risk or harm.

There are not many things that people can do to misuse our product. The only chips on the device are bluetooth, and they are not easily used for interfering with other signals. We must be careful about what we allow the users to access when setting up the device.

We have seen similar devices for audio splitting for wired devices. Since this is the most comparable device to the device we are building, we believe the ethical implications will be similar.

We will strive to keep the safety of people as our highest priority when building this product.