Initial Project and Group Identification Document

Solar Powered Bluetooth Bridge

Department of Electrical Engineering and Computer Science
University of Central Florida
Dr. David Hagan & Dr. Lei Wei

Senior Design 1

Group 10

Phillip Bent	phillipbent@knights.ucf.edu	CpE
Taylor Griffith	t.grifith@knights.ucf.edu	CpE
Johnnie Greene	johnnieagreene@knights.ucf.edu	PSE
Sidney Jean-Baptiste	njgiants1021@knights.ucf.edu	EE

INTRODUCTION:

Time and change are two constants on Earth that is not being altered or halted any time soon. As times goes on, there is constant change and improvement in technology. With the change in technology, comes the evolution of entertainment and how humans take in that entertainment. The sound and listening experience has evolved throughout the course of modern time. Specifically, the surround sound experience and sounds and vibrations through speakers. Everything from the surround sound music experience to music at a party, things have changed. Speakers now have capabilities to wirelessly connect to everything from phones, laptops, television etc. and be able to play the sounds of those devices. Unfortunately the devices only have the capabilities to connect to one wireless speaker device at a time. With our project we'll have to capabilities to connect two wireless speakers at a time and both wireless speakers play the same sounds.

Our objective is to create and produce a hub that wireless connects to various wireless speakers that will transmit the sounds from a device, i.e. cell phones, laptops, or television. This hub will transmit the data to the speakers through Bluetooth capabilities. The hub will have controllability through the selector options on the hub for the speakers within the proximity of the Bluetooth's reach.

There are some similar existing products existing in the market. The biggest difference between our project and the current products on the market is the limitations on those products have. The products on the market the wireless speaker set connected to the central hub and set for surround sound. The central hub is created for the specific speakers sold in the specific set. That hub doesn't have the capabilities to connect to other speakers from other companies without manipulation. There is also a similar product to our hub project. A product called the Cassia Hub. One of the biggest difference between our hub and the Cassia Hub is the portability. Their hub must be connected to an outlet to work and our hub will be able to be used without having to be plug and play.

This project provides opportunity for growth in all facets for all members in the group. Our group is diverse and composes of two computer engineers, a photonics engineer, and an electrical engineer. There's room in this project for all members to create, expand, and exercise our technical skills.

DESIGN SPECIFICATIONS:

Sensing:

Motion sensing on this device while allow for the hub to automatically turn itself on and off depending on if a person is within a certain amount of feet of the hub itself. Our sensing component will search for motion within the x-y plane. This is one of our energy saving features that will allow the hub to conserve its power.

Bluetooth:

One of the most essential and prevalent components to our Solar Powered Bluetooth Bridge would of course be the Bluetooth component. Our bridge would heavily rely on the ability to receive a stream of data and replicate it; this would become burdensome and annoying with the use of wires, we remedy this by substituting the wires with radio waves or Bluetooth to be specific. This would be handled by the Bluetooth audio transmitter and receiver that would be connected to our microcontroller.

Bluetooth is a standard for the short-range wireless interconnection of cellular phones, computers and other electronic devices. Bluetooth operates in a specific band of 2.4 to 2.485 GHz and uses a technology known as frequency hopping to prevent devices operating at a comparative frequency which would cause interruptions. This added feature actually determines the viability of this project and without it would possibly cause major complications between the multiple transmitters. This feature is achieved by constant signal hops around the frequency at approximately 1600 times per second. Constant changes in the wavelengths ensure that even a consistent signal will not interrupt for longer than $1/1600^{th}$ of a second.

The process of connecting Bluetooth devices together begins with the pairing of devices or the connecting of devices that you want to communicate with each other. This initial starting point also poses a potential problem for the development of our Bridge that we seek to address which is the pairing of multiple devices. We hope to address this issue with the connecting of each Bluetooth transmitter to the corresponding speaker to be connected via LCD screen for the selection of each device. This connecting over ad hoc, short range networks are known as piconets, which usually consists of 2 to 8 devices. When this piconet is established on a device, the role of master is played by the leading device and all others connected to the piconet will play slave.

Microcontroller and Software:

Another quintessential piece to this puzzle would be the microcontroller and the software that is involved. The overall goal is to mimic usual Bluetooth functionality but on a larger scale with multiple devices. The Bluetooth services would include features such as pairing, not to mention the sending and receiving of Bluetooth radio waves, these instructions will be feed from the microcontroller along with a list of others.

The microcontroller will also play a role in governing the other auxiliary devices; such as the sensors, that will instruct the Bluetooth hub to turn off after no human detection is detected for the specified amount of time. And lastly programming of the LCD screen that will show the devices paired with and other specified options

Solar Panel:

An important feature of our product is its portability. Having the ability for our product to be able to be used for home use as well as outdoor use will set out product apart from every other product on the market. Our solar panel will allow us the capability to keep our hub charged throughout a long outdoor gathering as well as recharge the battery for its next use. Since our hub will not require a great amount of energy to run on we can then use the excess power to charge the devices that are connected to the hub.

Project Constraints:

With our hub being portable, the size of the hub must be a well-proportioned. For outdoor capabilities we're marketing our design to be suitable for that of tailgating or BBQ events. Therefore, our design must be no larger than that of the speakers we are connecting too. Also, for ease of travel a handle to carry around our hub must be added to that of our hub.

As well as just the physical characteristics of hub, constraints for powering the hub is taken in consideration. While our hub is charging via our solar powered charger, it must still have the capability to play. Also, the hub must produce enough output voltage to power all the components of our hub. Another constraint is having substantial battery life when the hub is not charge. Most tailgating, party, and BBQ experiences go on for at least 2 hours at a time. Our hub's rechargeable battery unit must be able to have that life of power if the charger is not in use. In addition to the charger would need a plug in port for indoor use.

The range of the Bluetooth should support effective use of our design and the version of Bluetooth should correspond to most of the devices we hope to connect to. Additionally the sensing medium used should detect human activity at a predetermined interval to conserve energy. All of the constraints presented are attainable and with careful planning and cooperation should be achieved.

Specifications:

Marketing Requirements:

- motion sensing

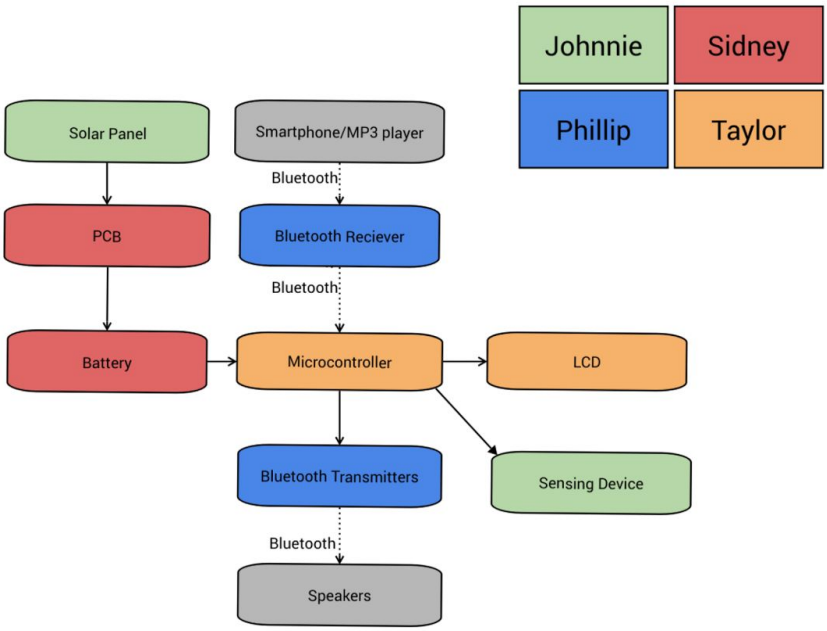
- Connect up to 2 wireless speakers
- No Bigger than one cubic foot
- No heavier than 10lb

Engineering Requirement:

- Charged solar powered
- Rechargeable battery Unit
- at least 2 hour battery life when fully Charged
- input 5.25v @ 2A

Block diagrams:

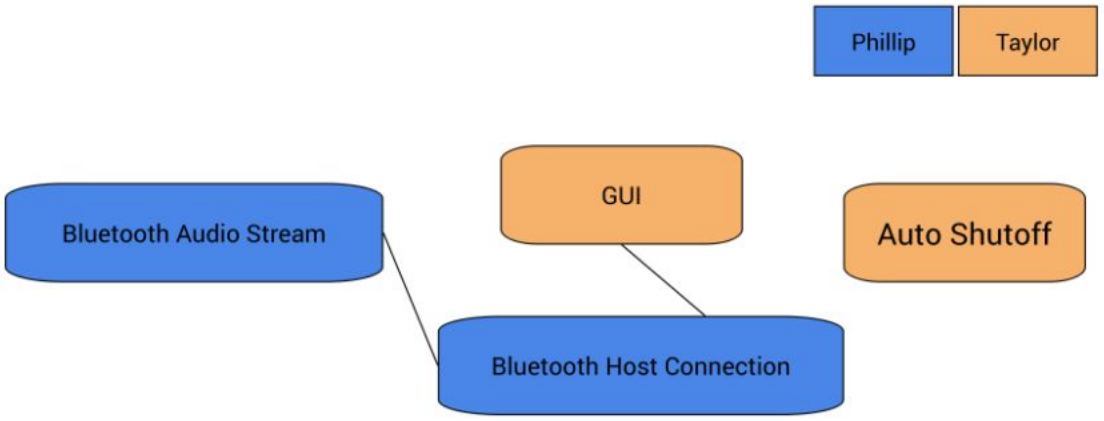
Hardware:



- Solar Panel - Device used to charge/extend battery life.
- PCB - Printed Circuit Board used for the interconnectivity of the electrical components.

- Battery - Rechargeable battery for on the go use.
- Microcontroller - Device used to hold a simple OS for GUI purposes.
- Sensing Device - Component used to detect motion in the room.
- Bluetooth Transmitter - Device needed to send audio wirelessly to speakers.
- Bluetooth Receiver - Device needed to receive signal from host device.
- LCD - Color display for easy interaction.
- Speakers - The Bluetooth speakers that the bridge will connect too.
- Smartphone/MP3 player - The host device that will be used to stream the audio files.

Software:



Project Budget:

The budget for our solar powered Bluetooth Bridge is composed of all the parts needed to make a deliverable device that meets our specifications. The prices that are listed below are the average costs for similar components from online sources, more exact numbers will be updated once we refine our research down to a single component that fits our needs. We do not have a sponsor for the Bluetooth Bridge, so the cost to develop our device will be split among the group members.

Item	Price	Quantity	Cost
Microcontroller	$35	1	$35

Bluetooth Transmitter	$10	4	$40
Bluetooth Receiver	$10	1	$10
LCD	$40	1	$40
Motion sensor	$20	3	$60
3D printed Case	$150	1	$150
PCB	$30	1	$30
Solar Panel	$200	1	$200
Misc	$50	1	$50
Total			$615

Milestones:

Job	Start	End	Responsible	Submission
Senior Design I				
Group Assimilation	5/16/2016	5/23/2016	Everyone	Y
Brainstorming	5/23/2016	5/30/2016	Everyone	
Project Report				
Initial Document-Divide and Conquer	5/23/2016	6/3/2016	Everyone	Y
Table of Contents	6/29/2016	7/1/2016	Everyone	Y
Current Draft of Senior Design (15 ppp)	6/3/2016	7/8/2016	Everyone	Y
Final Document Due	7/8/2016	8/2/2016	Everyone	Y
Research & Design Preparation				
Bluetooth	6/3/2016	7/11/2016	Phillip & Taylor	

Microcontroller and Software	6/3/2016	7/11/2016	Phillip & Taylor	
Solar Panel	6/3/2016	7/11/2016	Johnnie	
Sensors	6/3/2016	7/11/2016	Johnnie	
Power Source/PCB	6/3/2016	7/11/2016	Sidney	
Integration Testing				
Ordering of Parts	7/1/2016	7/11/2016	Everyone	
Bluetooth	7/11/2016	8/5/2016	Phillip & Taylor	
Microcontroller and Software	7/11/2016	8/5/2016	Phillip & Taylor	
Solar Panel	7/11/2016	8/5/2016	Johnnie	
Sensors	7/11/2016	8/5/2016	Johnnie	
Power Source/PCB	7/11/2016	8/5/2016	Sidney	
Senior Design II				
Initial Design	8/22/2016	10/10/2016	Everyone	
Testing & Experimentation Phase	10/10/2016	11/10/2016	Everyone	
Finalized Design	11/10/2016	11/20/2016	Everyone	Y
Final Report	TBA	TBA	Everyone	Y
Final Presentation	TBA	TBA	Everyone	Y

Decision Matrix:

The initial project idea we planned on going forward with for our Senior Design project was a 3D thermal mapping drone. However in order for us to pass the ABET requirements for

electrical, computer and photonics engineering we would've needed to develop our own range detection laser device which ended up being too much work to finish within a 40 week period.

The next project idea we started to roll with was a Solar Powered Bluetooth bridge that would allow multiple Bluetooth speakers to be in sync and playing the same music, the system could be in stereo to simulate a surround sound environment or mono so that the sound covers more area. The device would be battery powered with the capability to charge the device via solar panel. Though when we brought this project idea to the photonics professor he wasn't completely satisfied with the solar panel being the only photonics component so we decided to add a motion sensing component and that seemed to satisfy the ABET requirements.

Citation List:

- http://cassianetworks.myshopify.com
- http://www.wirelesscommunication.nl/reference/chaptr05/spreadsp/fh.htm
- https://www.rei.com/learn/expert-advice/solar-chargers-portable-power.html
- http://www.cnet.com/news/small-scale-solar-power-comes-to-electronics/
- https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/how-pirs-work