Bluetooth Cochlear with WiFi Power

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1 Introduction

Since the world develops, more and more attention is paid to the health field, especially to helping the disabled.

This project is cooperated with Nurotron, a medical company producing the artificial cochlear. The final aim for this project is to help the victims of the congenital deafness. The artificial cochlear will be planted into the patient's body and it will help the patient to hear the certain frequency of sounds which he can not hear before.

The incidence of this disease is 3 in 10 thousand people. In China, it is estimated that thousands of new born babies are suffering from this disease every year. However, once the medical treatment was all imported, the price for the imported cochlear was 150 thousand each. Since this project and the cooperated medical company break into the market, the price for the treatment has been halved. It is helpful to the victims.

The project we have done is not an actual artificial cochlear. It is just a prototype, like a microcontroller. The main chip in the microcontroller is CSR 8670. The CSR company has a high reputation in the field of Bluetooth communication and CSR 8670 is one of the most popular chips that have been engineeringly used.

2 Artificial Cochlear

2.1 Brief Introduction

Figure1 is a shot of the CSR8670 chip. The key part on it is the chip itself. The other are all external extensions. The are 7 buttons on the board, a reset button, a reset button and five normal programmable buttons. As shown in the Figure1, there are also a soundbar interface and a headset interface installed on the board, which are the same as that on a laptop. The RS232 port is a link between the board and a computer which is debugging on it, through which data can be transferred without a bluetooth connection double-sidedly.

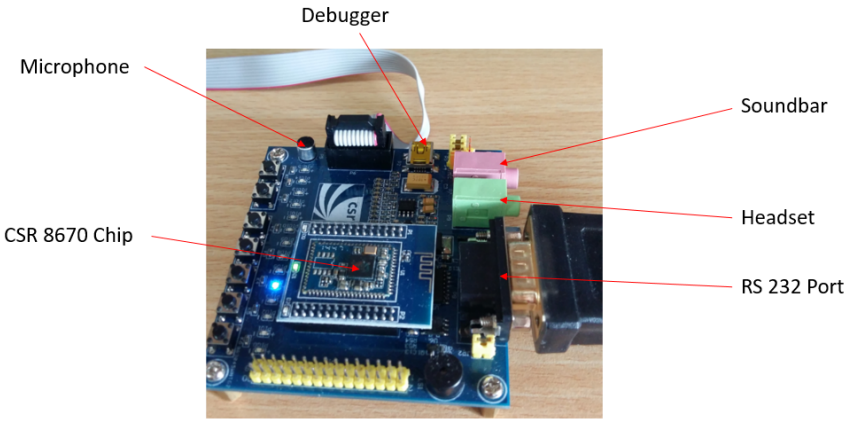

Figure 1: Brief Shot of CSR8670

2.2 Function

The first phase of this project has already finished. In this semester, we have done a prototype demo for the Bluetooth cochlear. The basic functions for the demo includes searching, pairing and voice transmission. The user has to search for the Bluetooth device at first by the mobile phone itself. Then he has to pair the Bluetooth device. If the mobile phone has already paired the device, it does not need to search for it any more. It just needs pairing. Once the paring has been completed, any voice on the phone can be heard by the earphone which is inserted on the device. That is the voice transmission. The voice transmission is constructed on the protocol SPP (serial port profile). The protocol serves a lot for the advanced part.

In the advanced part, the functions has to be done by the applications on the mobile phone. The advanced part includes command controlling and file transferring. These functions are based on GAIA. The GAIA library is a Bluetooth communication protocol using SPP. With the commands controlling function, we can adjust the volume of the sound.

We have also built mobile applications for android and ios each.

2.3 Difficulty

There are several difficulties we are facing in this project.

1. The speed of the file transferring function is quite low. It is just about 2.5 KB per second. This is because the file transferring function is constructed on the Gaia library and SPP protocol. The Gaia library provides synchonous file transferring and voice transmition. Thus the bandwith for file transferring function is limited. Further more, the chip itself seems not able to process too much data.

2. The powering problem. Traditonal artificial cochlears contains batteries in it. Since this artificial cochlear has to be planted into the patient鈥樷榖ody, it will be difficult and more importantly, it's uncomfortable for the patient to change the batteries. Thus we come up a new idea to deal with it. It is Wireless powering.

3 WiFi Power

3.1 Brief Introduction

WiFi Power is one type of Wireless Power. The concept Wireless Power is suggested by Nikola Tesla in 1890. The first wireless chargin device is invented in 2007 using electromagnetic waves.

无线充电方式	电磁感应式	磁共振式	无线电波式	电场耦合式
英文	Magnetic Induction	Resonance	Radio Reception	Capacitive coupling
原理	电流通过线圈，线圈产生磁场，对附近线圈产生感应电动势，产生电流	发送端能量遇到共振频率相同的接收端，由共振效应进行电能传输	将环境电磁波转换为电流，通过电路传输电流	利用通过沿垂直方向耦合两组非对称偶极子而产生的感应电场来传输电力
示意图				
传输功率（W）	数W-5W	数KW	大于100mW	1-10W
传输距离	数mm-数cm	数cm-数m	大于10m	数mm-数cm
使用频率范围	22KHz	13.56MHz	2.45GHz	560-700kHz
充电效率	80%	50%	38%	70%-80%
优点	适合短距离充电；转换效率较高	适合远距大功率充电；转换效率适中	适合远距离小功率充电；自动随时随地充电	适合短距离充电；转换效率较高；发热较低；位置可不固定
挑战（限制）	特定摆放位置，才能精确充电；金属感应接触会发热	效率较低；安全与健康问题	转换效率较低；充电时间较长（传输功率小）	体积较大；功率较小
解决方案供应商	Ti，Powermat，Splashpower等	MIT，Intel，日本富士通	Powercast	Murata村田制作所竹中工务店

Figure 2: Four Types of Wireless Power

Nowadays, there are four types of Wireless Power. The wireless charging devices sold in the market are mainly the magnetic induction type. The method we'd like to use in the project is the radio reception type. The theoretic power for it is about 100 mW and the frequecy for it is about 2.4 GHz. It is actually the frequency of WiFi in the air.

3.2 WISP

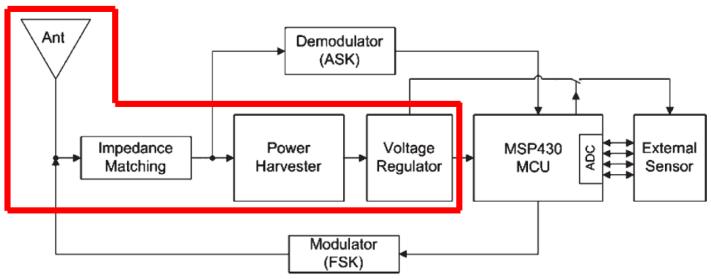

Figure 3: Wireless Identification and Sensing Platform

WISP means wireless identification and sensing platform. In my project, I only need the sensing platform but the identification part is duplicated. Thus I just need the items in the red box in Figure3.

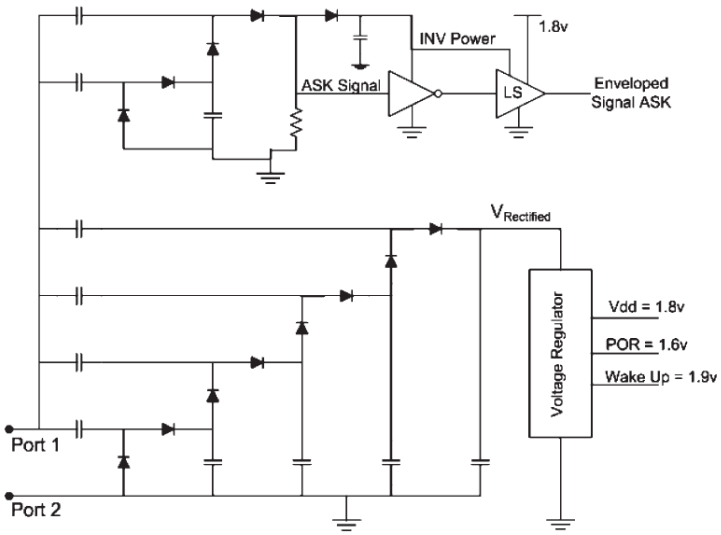

Figure 4: WISP Schematic Diagram

Figure4 shows the schematic diagram of the WISP method. It can be divided

into three parts: the antenna, the impedance matching circuit and the amplifier circuit. The input of the antenna can be seen as an AC voltage and the impedance matching circuit can maximize the input of the antenna. One level of amplifier can change the AC voltage to DC and increase it by two times. In my demo, I use two levels of amplifier and the voltage is increase by four times as shown in Figure5. The output can be up to 20 mV DC.

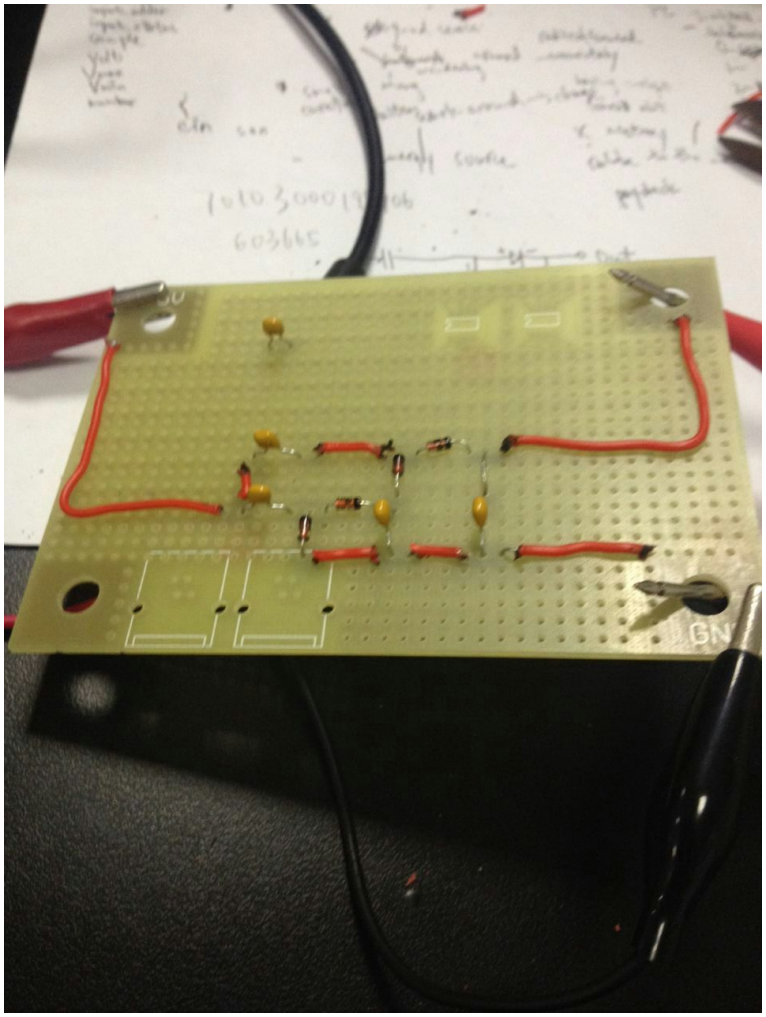

Figure 5: WISP Demo

4 Conclusion

The project is dealing with the bluetooth artificial cochlear. We have done a prototype for it and we apply the WiFi power method to the cochlear. The project result is good and it passes the acceptance check of Nurotron.