Project Deliverable E: Revised Prototype Analysis and Test Results

Submitted by

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Acronym	Definition
LED	light-emitting diode

1 Introduction

Fran, our client needs a device that allows her to call her nurse in case of need at night. Hence our project allows her to have some support. Thus, for the success of this project, we have divided the work into several sub-tasks in order to achieve our objectives for the design day. This week, we presented the prototype to our client. Therefore, interacting with her allowed us to revisit certain aspects of our design. Indeed, changes will be made to the software part in order to adapt to the needs of our client which represents our priority. In this report, we will highlight our client's comments on our prototype and define the changes for the new prototype. We will also illustrate the tests that were carried out for the validation of our design and the plan to follow for the success of the project for the design day.

2 Client Meeting

We were able to meet our client this week. This allowed us to show our prototype and how it works. Our client has difficulty saying the words clearly. So, we suggested that she give us specific words that she would like to use. Hense, we're going to change our code accordingly to include a variety of words that she could use without problem. In addition, the series of tests that we carried out were based on any voice and not Fran's voice, so we offered to send us a recording of his voice in order to be able to test our prototype on this. We also wanted to get feedback on the use of the prototype. Our client told us that it was very easy to use after our demonstration. During our first meeting, our client told us about the importance of using the device over a distance of 16m, which we have to respect and try with our tests.

3 New Changes

3.1 Shell and Package

As mentioned in the last deliverable, we received the shells of the two devices and successfully assembled them. When fixing each device, I chose the nanometer magic double-sided tape (the product name is just like this), which is a kind of soft material similar to hot melt adhesive, good adhesion and easy to operate. And it doesn't need to be heated to use, which means it's easier to take off than hot melt glue.

3.2 The Button on Portable Unit

After receiving the shell, the team members carefully read the instructions on Github. In the process of reading, we found that a button on the PiSuagr battery board could actually enter the corresponding instructions in the command line. So, we downloaded the corresponding program in the device and interacted with each other through its own web page.

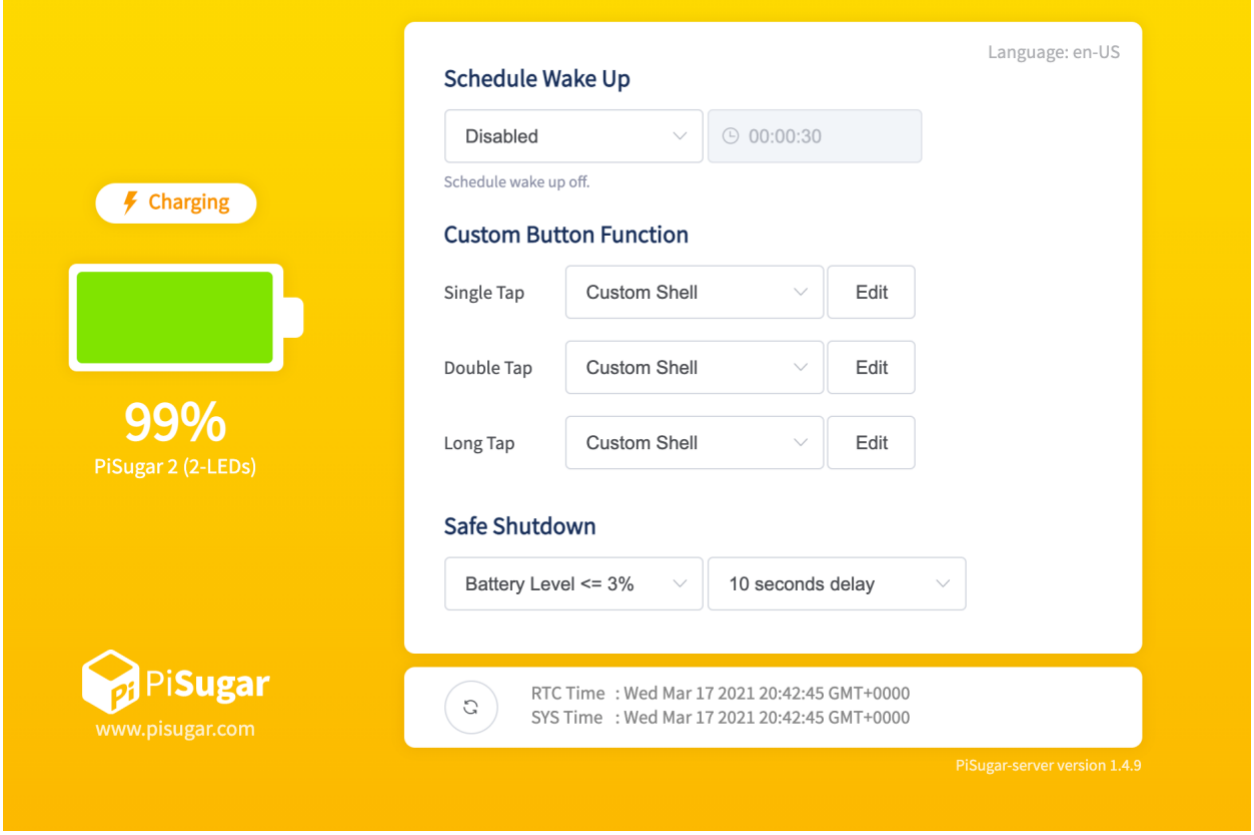

Figure1: PiSugar Management Interface

3.3 Optimized Responding Process

During the client meeting, Ms. Fleur asked us what she could do to recover the portable unit from alarming status (LED keeps red) to normal working status (LED keeps green). We never thought about this question because rebooting will solve everything.

However,it would cost a long time, 45 seconds, to boot this device and automatically run the main loop, which will be the biggest flaw of our design. So, in the past, we just abandoned the prototype where the buzzer will forever make noise until there's someone shutting it down.

Now, time changes! We have the programmable button which would definitely help us realize this function. Through I2C protocol, we write our shell command to the command register of the

motherboard. Thus, when the buzzer beeps, the assistant could just simply click the button once and she will find that there is no more noise and LED turns to green again. All the things look like the just initialization.

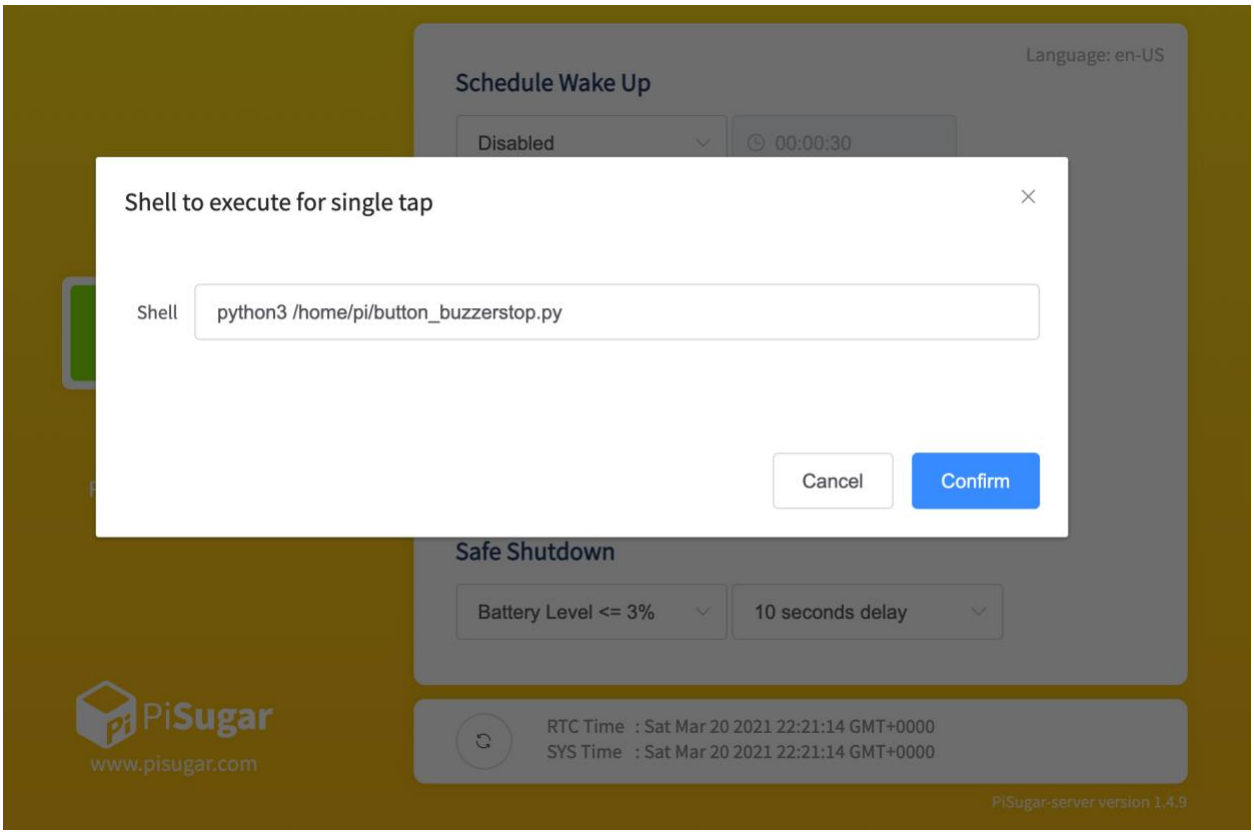

Figure2: Shell to Execute for Single Tap

3.4 More Intuitive LED on Bell Unit

As planned, we optimized the structure of the Bluetooth signal transmission code on the bell unit. It is realized the function that if the trigger signal is not successfully transmitted to the portable unit, the LED on bell unit will remain red all the time. This can provide users with a kind of visual feedback.

3.5 More Reliable Signaling Mechanism

Just like 3.3, the optimized code structure uses the "while" loop nesting "try" statements to achieve a function that if the signal is not successfully received, it will always try to send. This ensures that once the keyword is identified, there is no need for the user to trigger the keyword repeatedly until the signal is successfully sent. This is very necessary at some critical moments.

3.6 Optimize a Recently Discovered Flaw

Our team members accidentally found that within a week or so, if the two devices were not connected through Bluetooth, when they were turned on again, the two devices might lose their pairing. In the past, if you wanted to pair Bluetooth again, you had to operate in the Raspberry pi operating system, but this violated the requirement that the device had better operate independently from other external devices because you have to connect your raspberry pi to local network and give it a HDMI monitor with mouse and keyboard. Thus, we decide to use the button mentioned in 3.2 to run commands in shell to pair and connect the two devices with Bluetooth.

When pressing the button more than 1 second, then release the button. you will find the yellow shing which means you have manually pair and reconnect the Bluetooth between these two boards.

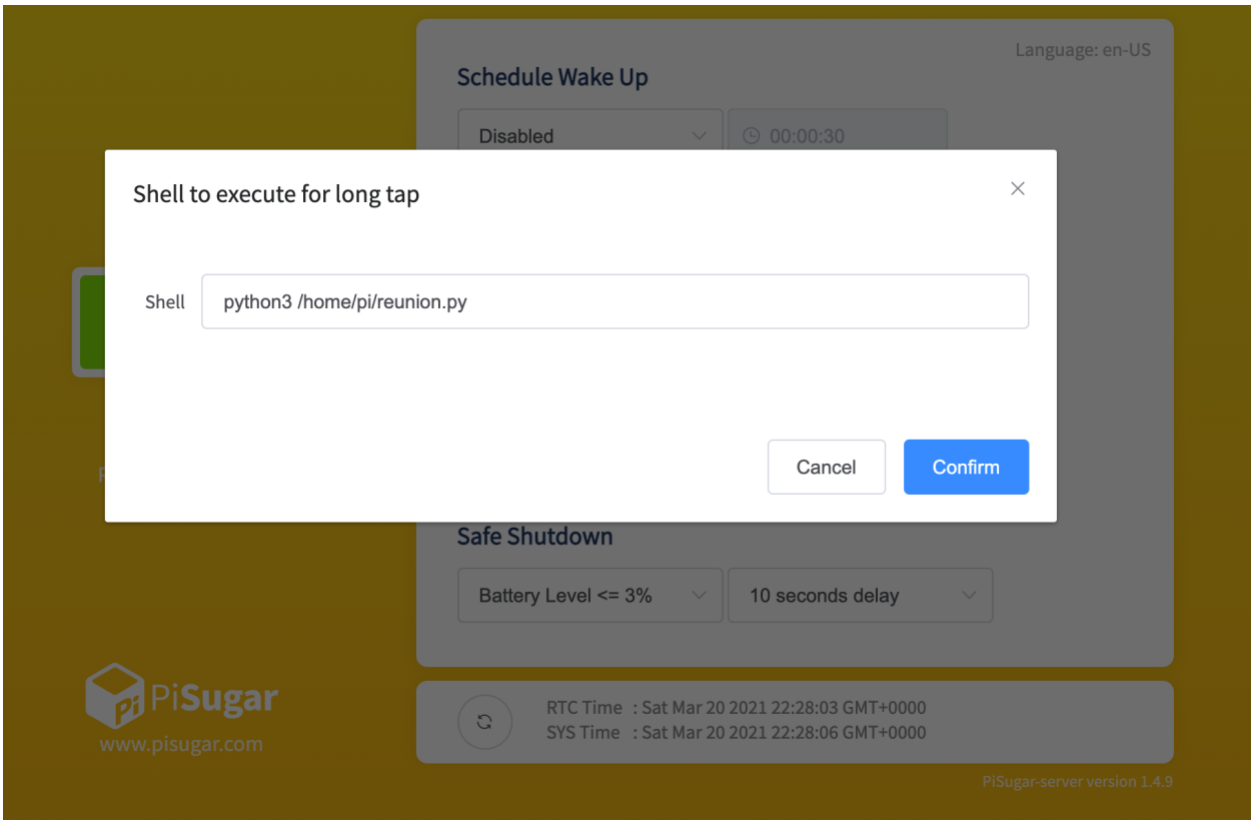

Figure3: Shell to Execute for Long Tap

3.7 New Keywords

During the client meeting, Ms. Fleur told us Ms. Fran may have trouble saying our keyword “hey come on” clearly. After the discussion and adjustment, we finally determined to use “hey yeah hey yeah” as the latest keywords because these two words are the ones Ms. Fran could say most clearly. The reason why we repeat twice is to significantly improve the anti-jamming ability of keyword recognition in a noisy environment.

4 Prototype

Now we are going to show the corresponding functions of each port and button of the product.

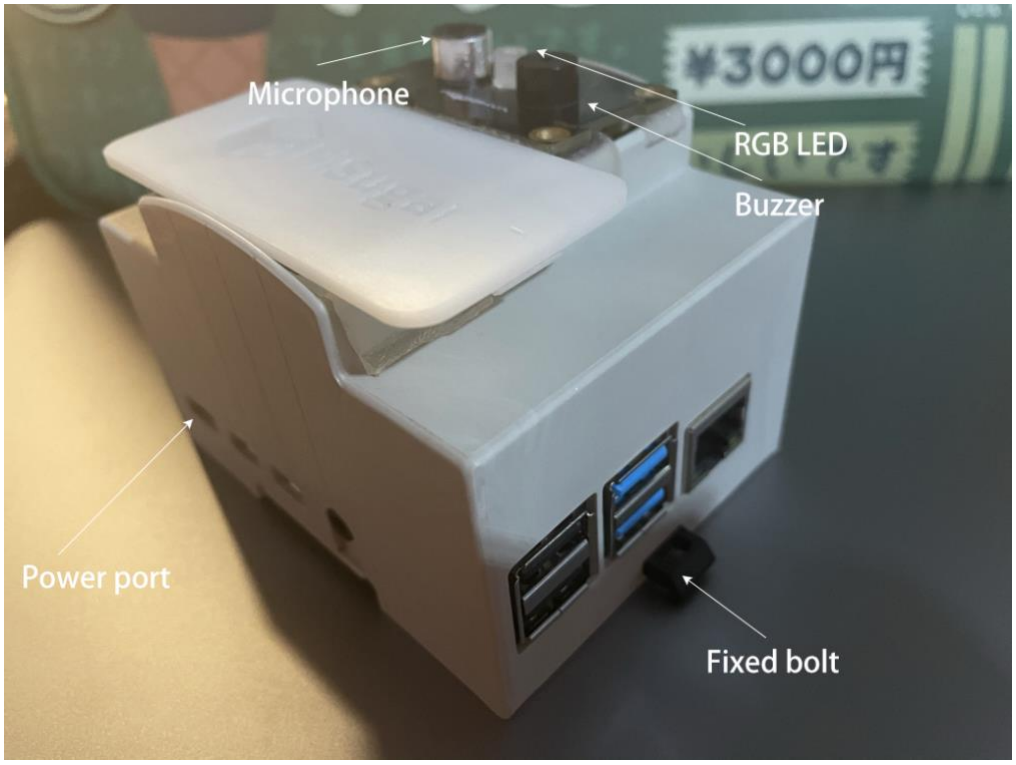

Figure4: Functional Instruction of Bell Unit

The ports or modules marked with white arrows here are the parts that users will use in our product.

It can be seen that the nano-magic tape has excellent performance in pasting. At the same time, we also use the accessories of the shell to seal the product, so as to ensure that the internal circuit of the product will not accumulate dust, but also can play some role in waterproof protection.

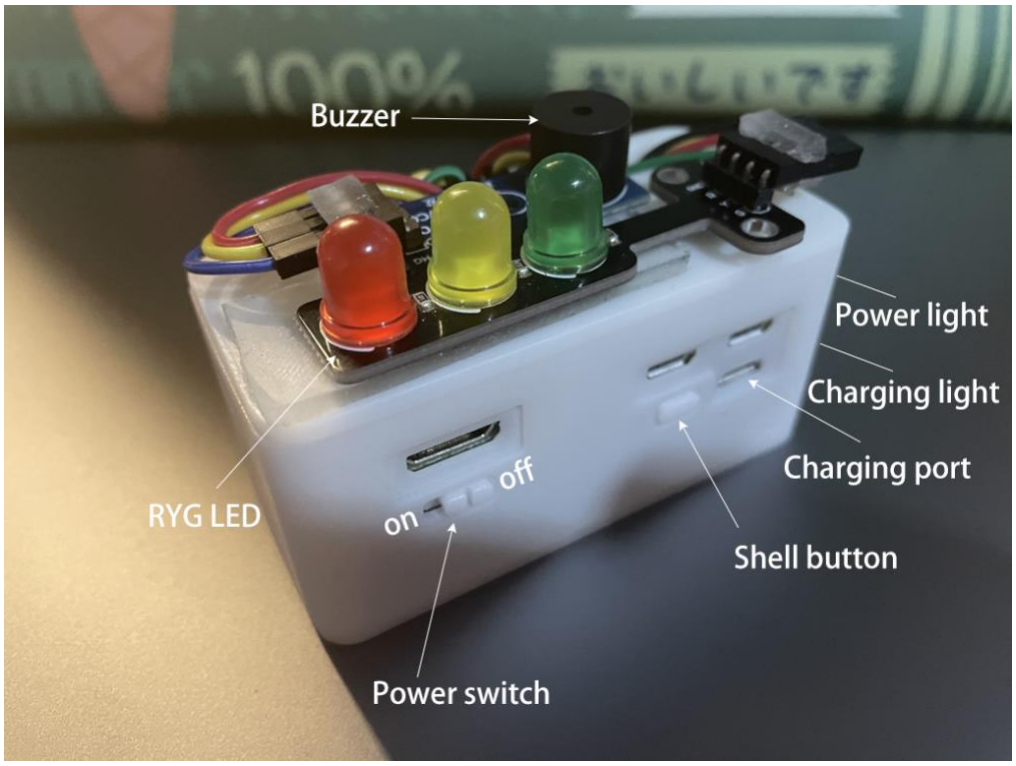

Figure5: Functional Instruction of Portable Unit

We have indeed tried various ways to put the LED and buzzer in the shell, but this seems impossible. Even if the wire is not taken into account, the LED is so big that we could not close the lid of its shell . And after the buzzer is placed in the shell, the volume of the beep is greatly reduced, and we are worried that it will not serve as a reminder and warning. Therefore, we decided to fix it outside the shell with nano-magic tape. Also, we fixed the exposed electronic devices and made it waterproof.

5 Test

Requirements	Testing	Results
The device can quickly identify the voice of our client.	Test the interval time between speaking finished and recognition	Less than 1 second
	Test the success rate of recognition	10/10
The device's ability to recognize sound will not be affected by background noise.	Use the computer to play some three episodes of Friends season 6 to see if voice recognition will be mistakenly triggered by the sound in the play.	In a period of more than two hours, the product was triggered only once by mistake.
	Say the key words while playing the TV series, and observe the probability of success.	The volume must be increased, or the success rate of recognition will decrease (7/10). If the volume is properly increased, the success rate of recognition can still be maintained at (10/10).
The device can quickly send alarm information to the staff.	Test the interval time between speaking finished and buzzer beeping	From 1s to 5s. This is based on the distance between two devices and the

		connection quality of Bluetooth.
It is best that the device can run without a network.		Yes! We use Bluetooth instead of network.
The operating device does not need to be borrowed through other devices such as mobile phones and computers.		Yes! In view of this, we have also made a special optimization.
The size of the transmitter is suitable for fixing on the table, and the size of the receiver is suitable for keeping in the pocket.	Measure the volume of the two devices and the weight of the portable unit	The volume of bell unit is 9cm*7cm*7cm=441cm^3 The volume of portable unit is 7.5cm*3.4cm*5cm=127.5cm3 The weight of portable unit is about 130g
The device uses fixed power sources and sockets to provide power		Yes!
The receiving end is prompted by optical signal and sound signal,		Yes!

and the transmitting end only uses optical signal.		We have LEDs and buzzers on both devices. They will function properly.
The device has a good plastic package, preferably waterproof		Yes! They both have nice shells and somehow waterproof.

Table1: Requirement Checking

	Range	**Ideal Parameter**	**Final design**
Cost/cad	90～120	110	119
Weight(Receiver)/g	110～425	200	130
Volume(Receiver)/cm^3	72～256	100	127.5
Volume(Emitter)/cm^3	500～2000	750	441
Power Source	socket or battery	socket	socket for bell unit battery for portable unit
Alarm Duration/s	5	5	5
Noise Loudness/dB	60~70	60	56
Light Brightness/cd	110	110	unable to measure but enough

Table2: Benchmark Checking

It can be seen that the basic parameters of the final design are all within the acceptable range, and except for cost and weight, the other parameters are very close to the ideal parameters, most are even better.

6 Conclusion

At this point, with the full cooperation of the team members, we have basically completed the design and verification of the device. After discussion by the members of the group, we revised our plans for the next few weeks as appropriate.

In the coming week, we will continue to optimize keywords and speech recognition functions according to our customers' choices. At the same time, continuous testing is carried out to find and resolve more loopholes and deficiencies.

Appendix

```
1   import RPi.GPIO as GPIO
2
3
4   GPIO.setmode(GPIO.BOARD)
5   GPIO.setwarnings(False)
6   GPIO.setup(16, GPIO.OUT) #buzzer
7   GPIO.setup(18, GPIO.OUT) #green
8   GPIO.setup(22, GPIO.OUT) #yellow
9   GPIO.setup(36, GPIO.OUT) #red
10
11
12  GPIO.output(16, 0)
13  GPIO.output(18, 1)
14  GPIO.output(22, 0)
15  GPIO.output(36, 0)
```

button_buzzerstop.py

```python
#! /usr/bin/python3

import RPi.GPIO as GPIO
import os
from time import sleep


GPIO.setmode(GPIO.BOARD)
GPIO.setwarnings(False)

GPIO.setup(22, GPIO.OUT) #yellow

GPIO.output(22, 1)
sleep(1)
GPIO.output(22, 0)
os.system("bluetoothctl")
os.system("pair DC:A6:32:F1:89:72")
os.system("connect DC:A6:32:F1:89:72")
```

reunion.py