Functional Specification

Year: 2019 Semester: Fall Team: 10 Project: Gesture controlled smart home

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Assignment Evaluation:

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| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Functional Description** | 4.5 | x3 | 13.5 | Inline |
| **Theory of Operation** | 4.5 | x3 | 13.5 | Inline |
| **Expected Usage Case** | 5 | x3 | 15 | Inline |
| **Design Constraints** | 5 | x3 | 15 | Inline |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** | 5 | x2 | 10 |  |
| **Formatting and Citations** | 5 | x1 | 5 |  |
| **Figures and Graphs** | 4 | x2 | 8 |  |
| **Technical Writing Style** | 5 | x3 | 15 |  |
| **Total Score** | 95 | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

General Comments:

*Relevant overall comments about the paper will be included here*

1. Please follow the errors highlighted by the document editor.

1.0 Functional Description

The portable gesture remote lets the user control smart home devices that are connected to IFTTT by showing the device different gestures. The device connects to WIFI directly after starting. When using the device, the user would use different hand gestures to select different devices to control, as well as to change the settings of the devices. As a prototype, the device would connect to Philip Hue by default. After the remote is connected to WIFI, The user can swipe up, down, left, right to turn on and off the Hue and adjust the lighting.

2.0 Theory of Operation

The gesture-control smart home begins with reading human gesture using the gesture sensor. The gesture data is then sent to the microcontroller. The LCD simultaneously displays current command given by the user. After interpreting the message from the user, the microcontroller sends the message to a WiFi module using the UART protocol. Since the WIFI module has very sensitive connection, we will use it directly instead of putting it on the microcontroller board. The WiFi module takes the input message from the microcontroller and delivers to IFTTT in order to control Phillip Hue.[Appendix 1]

3.0 Expected Usage Case

Gesture controlled smart home is a device that has functions similar to Google Mini or Amazon Alexa. It is designed to be used in environmental conditions where hand gestures are more convenient for users to control their home devices than voice commands. The device is intended to be in a portable setting where users can carry it with them at all times and recharge it if necessary. As for the nature of users, anyone with the ability to make hand gestures can use the device.

**4.0 Design Constraints**

4.1 Computational Constraints

Primarily, the computational functions for the Smart Remote will be:

- accumulation and communication of data from the gesture sensor to the microcontroller

- accumulation and communication of data from the microcontroller to the WiFi module

- communication of the WiFi module to IFTTT

- interfacing the LCD display in order to display relevant information

After microcontroller receives gesture data from the sensor, it translates the data based on the operation codes saved in memory and communicates with WIFi module to connect to IFTTT. Microcontroller will then communicate with the LCD screen to display the current status. Since it takes time to deliver the message to the LCD and IFTTT, there would be some timing delay before the sensor could move on to do the next gesture reading. We would need to take that into account during the software development.

The microcontroller needs to be able to interface with multiple devices, sensor, WiFi module, memory, and LCD screen, via I2C and UART or SPI protocol, and perform all operations multiple times per second (except for the memory). As the non-volatile memory, EEPROM will be used, and the time constraint will be depending on how often it will be read.

4.2 Electronics Constraints

The major components the gesture-control smart home will utilize are as follow: wireless sensor, WiFi module, microcontroller, LCD, and a rechargeable battery. The anticipated interfaces for these devices will be UART, I2C, and SPI. Sensor and LCD communicate with microcontroller via I2C, and the WiFi module does that through UART or SPI. [1][2][3]

Since the device would be portable with a rechargeable battery, the microcontroller and display screen we choose to use are required to be low power. To store the sensor inputs we would need an EEPROM as a buffer before sending it to the microcontroller. [3]

4.3 Thermal/Power Constraints

The gesture remote is designed to be portable therefore the device does not have to be plugged in all the time. As a result, battery power would be a huge factor for the project. The device will be using a rechargeable battery that is supposed to last for a few hours. In the case where the device is out of battery, user will have to plug in to recharge the battery. However, users will still be able to use the device while battery is still charging. Additionally, since the device is being used directly by the end user, it is expected that the device does not overheat. [3]

Since the device is assumed to be operating in an environment with WIFI connection and smart home devices, we expect the user to be using the device indoors, usually in an office or home setting. The operation would then be at room temperature.

4.4 Mechanical Constraints

Since the Gesture Controlled Smart Home will be portable, the device should be small and light enough that can be held by hand. At the same time, it also needs to be large enough to clearly display the current status.

The gesture sensor will be facing front inside the device, and since we are using an optical gesture sensor, the packaging on the front would need to be somewhat transparent - most ideal material would be dark glass, or with an opening for the sensor. Another environmental constraint is that due to the sensing area of the optical sensor, at least 5 inches of free space is required above the device.

The charging port will be on the side of the device close to the batteries. Therefore, Gesture controlled Smart Home would need to be kept out of water.

4.5 Economic Constraints

The Gesture Controlled Smart Home targets everyone in the market, so it would be affordable for every family. Though the device is similar to Google Home or Alexa Assistant, the device has some additional features. The Gesture Controlled Smart Home is portable and more user friendly as in it can be used without language barriers and for users with hearing and speech difficulties. In order to compete with similar devices in the market, the team proposed a price target of $70-$80 per device.

5.0 Sources Cited:

[1] Avenet SIlica (2013) *How to connect STM WiFi module to STM32F0-Discovery*

<https://brancaboard.readthedocs.io/en/latest/STM32F0Discovery.html>

[2] Instructable Circuits (2019) *Control Devices Using Google Assistant*

<https://www.instructables.com/id/Control-Devices-Using-Google-Assistant-/>

[3] Digi-Key (2019) *SparkFun RGB and Gesture Sensor - APDS-9960*

<https://www.digikey.com/catalog/en/partgroup/sparkfun-rgb-and-gesture-sensor-apds-9960/56724?utm_adgroup=Programmers%20Dev&slid=&gclid=Cj0KCQjw753rBRCVARIsANe3o46rjf2okP5WkDmB_0YmvVu9YuWn5xS3FiyOm42nhe2ZU42IuuC0ujMaAvMGEALw_wcB>

Appendix 1: Functional Block Diagram

