Project Swift - Home Automation

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***Abstract*—Home Automation is automating home to augment lives of people for providing comfort incorporated with efficiency.The devices included in these automations are important constituents of Internet Of Things(IoT).Home automation devices are connected to a central hub for operation or control.The applications include air conditioning systems,lighting control systems and smart kitchens.Project Swift aims at automating homes with the help of mobile app and gesture based recognition.Using this project smart home devices can be controlled using an app by pointing at them or leap motion based gestures. There is also an option of controlling the devices using text based recognition on the basis of tags attached on each of the devices.**

***Index Terms*—Leap motion, Firebase, Magnetometer, Accelerometer, Optical Character Recognition.**

I. Introduction

HOme automation systems are basically systems that are deployed to augment and enhance the lives of people.Easy management and time saving are some of the goals along with comfort. Hence we through this project put forward an idea of controlling home appliances by just pointing at them or through easy to use gestures. This technology is quite new in the market but is being readily accepted by people.The industry of home automation is growing exponentially. Here we present modules used and proposed method along with use case and future work in this paper.

II. Modules

A. Leap Motion

Leap motion [1] hardware, known as the leap motion controller is a sensor device that supports hand and finger motions as input without any direct contact or touching. It is USB peripheral device that observes a roughly hemispherical area using two monochromatic IR cameras and three infrared LEDs. Specifically, pattern-less IR light is generated by the LEDs and the cameras generate approximately 200 frames per second of reflected data. The data captured by the hardware is sent through USB to the host computer, where it is analysed using complex maths (not revealed by the company). This process in some way is the synthesis of 3D position data by comparing 2D frames generated by the cameras. The overall average accuracy of the leap motion controller is about 0.7 mm. Interestingly, this device can be differentiated from Kinect and other such products in this area, due to its small observation area and higher resolution.

B. Android Studio

Android studio [2] is the official integrated development environment (IDE) for Android operating system. It has been specifically designed for Android application development. Built on the frameworks of IntelliJ, Android Studio is a viable replacement for the Eclipse Android Development Tools (ADT). Some of the major advantages of Android Studio include Gradle-based build support, Android specific refactoring and quick fixes, Android Virtual Device (emulator) for debugging, etc. Three primary languages supported by the software are Java, C++ and Kotlin. Numerous APIs and SDKs available make the application development simpler.

C. NodeMCU

NodeMCU [3] is an open source IoT platform which includes the firmware running on ESP8266 Wi-Fi SoC. The term NodeMCU by default refers to the hardware chip. It is helpful in building prototype for various IOT products. Since the NodeMCU is easily programmable, and in fact, supports the Arduino IDE, it is a popular platform to work with. The chip specifications include Wi-Fi Direct (P2P), 3.3 V high voltage level, 10 microAmp to 170 milliAmp current consumption, integrated TCP/IP protocol stack, etc. NodeMCU provides an inexpensive module for communication with simplified working interface.

D. Firebase

Firebase [4] is a mobile and web application development platform. Several services are provided by Firebase such as Firebase Analytics, Firebase Cloud Messaging, Firebase Realtime Database, etc. It offers the tools to develop high quality apps, with all the essentials covered. Precisely, Firebase Realtime Database is a backend service which provides an API that allows data to be synchronised across the clients. The client libraries enable integration with popular platforms such as Android, iOS, JavaScript, Objective-C, etc. The server-side-enforced security rules for securing the data are a part of the service.

III. Proposed Method

Considering the various devices in static positions and the users approximate static position, the devices can be operated using any of the two apps or using Leap Motion. The setup consists of three NodeMCU chips with one LED (device) connected to each, placed in different directions/positions. Leap Motion Controller connected to a laptop is placed with the user, and the users position is in line of sight with that of the middle NodeMCU/device. Every device is connected to the Firebase Realtime Database via internet.

A. Data Collection and Identification

1) Shake app: The app uses magnetometer readings to identify the device to be operated. User first needs to calibrate the positioning by pointing the smartphone along the line

of sight to the middle device. User can now point to any device and shake the smartphone slightly to control a particular device. The shift in the magnetometer reading is used to calculate deviation from the line of sight to identify the device to be controlled. The amount of shake and distinction between movement of the smartphone is identified using accelerometer readings.

2) OCR app: The app allows user to scan a particular text label to identify the device to be operated. Whenever any text appears in the camera interface, it is recognised and highlighted using Optical Character Recognition (OCR) [5]. Once the user taps on the highlighted text, it is matched with the label of each device and hence, the device to be controlled is identified.

3) Leap: The user is required to perform predefined gestures associated with each of the device to operate. Leap Motion Controller is programmed in JavaScript using LeapJS libraries. It continuously tracks the environment for hand gestures and once a gesture is recognised, it is matched with predefined gestures to identify the device to be controlled.

B. Data updation to Firebase

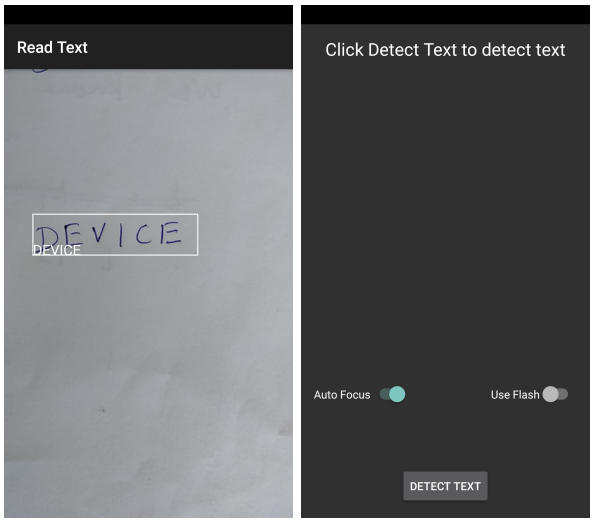
This step is common to all. Once the device to be operated is identified, the apps as well as the HTML program running on the host computer of Leap Motion Controller send the signal to corresponding path in the Firebase Realtime Database. The database consists of three paths for three devices. The signals sent reverse the data stored in that particular path (ON/OFF).

C. Data reception and actuation

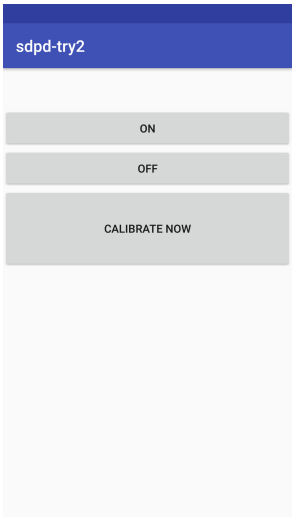
All the NodeMCUs are programmed to continuously poll with the Firebase Realtime Database to check the status of data in their corresponding paths. Every time the data is updated in the database, NodeMCUs also receive the corresponding signal and thus, control the state (ON/OFF) of the devices/LEDs connected to them.

IV. Pictorial Description

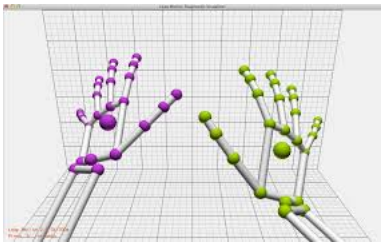
A. OCR App



B. Shake App



C. Visualizer Leap Motion



V. Use Cases and Future Work

The light and room control space is changing rapidly with the introduction of IoT. It's adhoc and simple. The link between your lighting system,audio control and garden is Internet of Things. It can also be extended to areas like energy management and security systems. Healthcare is also included in smart home solutions among which assisted living is also included. Other applications include alarms or notifications on intrusion detection, panic buttons, heat detector and gas leak detector.

Affordable products can be made for day to day use involving automation. Our project can be scaled up to automate all devices at home and controlling them through a single app over the internet just by pointing at them or through gestures.

References

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