Wearable Device for Restaurant Operational that Employs People with Hearing Impairment

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Abstract. Speed in serving consumers is one of the top priorities in restaurants. To provide fast and precise service, it needed a device that is able to help the operational system at restaurant. This research focus on creating a device that can help operational system at restaurant that can be controlled using the smartphone. The device is designed to combine several components that were merged into a wearable device. The result is wearable devices that can last 7 hours 34 minutes with 2 hours charging time, average operating distance 35.3 m, and 5% error glitch.

Keywords: Restaurant, Android, Wearable Device, Firebase.

1. Introduction

One of the benefits that can be felt from technological developments can be applied to help human jobs [1, 3]. Developments in the food sector are also felt. The real evidence that can be seen is the increasingly rapid competition carried out by many restaurants both in the variety of food, service, room decoration, and so on [2]. A good restaurant must have a good service factor as well as fast and correct food serving desired by the customer. In situations where the restaurant is crowded with customers, waiters are required to work quickly to serve customer orders and deliver orders. By being demanded to work fast the servants sometimes lose their concentration of work which consequently results in mistakes [1, 4].

The most common mistakes occur due to misunderstanding in receiving information. In the delivery of information such as calling a waiter, delivering food, delivering food bills, using sound media [4]. Using sound media to convey commands or information is less effective especially if the conditions of the restaurant are very noisy and crowded. One way to overcome this problem is the need for a tool that can send or receive commands without going through voice media [5].

The main objective is to study the distance of the wearable device connected to the router, the conveniences of the device for the users, and power needed by wearable devices during operations. The expected benefit is a system which can be felt for companies, especially restaurants, are that restaurant operations are easier in taking orders to deliver food, clean tables, and other tasks. And extra provide benefits for people with hearing impairment to be able to work efficiently.

Scope of this study includes: Three prototypes to conduct the experiment, each device uses a 0.96" graphic OLED LCD, a Wi-Fi network through a router as an access point, a total of 10 barcodes available to represent customers table. The control system uses Wemos D1 mini ESP-8266 and using the Android operating system at least version 2.1 for the smartphone.
2. Methodology

2.1 Hardware

Figure 1 shows the outline of the system to be designed in this design where each device is connected to each other and has their respective functions. The designed device can be attached on hand. The OLED LCD device, Wemos D1 Mini ESP-8266 and vibration motor, were made into a single device. A small lithium polymer battery is use for the power source. The smartphone functions as a wearable device control by communicating through wireless networks to the Wemos D1 Mini ESP-8266. Smartphones are divided into two, namely smartphones for cashiers and smartphones for at the desk. In the system there is also a database as storing data variables to be used in the communication process between smartphones.

The process that occurs includes identification and confirmation. The identification process that occurs is the Wemos D1 Mini ESP-8266 identifies the commands given by the smartphone. While the confirmation process occurs when the smartphone sends command data to the wearable device and then when the wearable device has undergone the command, the wearable device will send the confirmation data back to the smartphone. Confirmation data contains information that the command has been executed or has been completed.

Figure 2 shows the Wemos D1 Mini ESP-8266 is the control centre of the system. Wemos D1 Mini ESP-8266 is connected to an OLED LCD, vibration motor, charger module, push button and battery. OLED LCD functions to display the command display for users. Vibration motor serves to provide notification to the user in the form of vibration. The charger module functions to charge the battery.
push button as a button to confirm the user against the commands given. The battery functions as a power source for all devices.

2.2 Software

![Flow Diagram](image-url)

**Figure 3.** Main flow diagram of software
Figure 3 shows the flow diagram of the whole system on Android which is divided into two parts, namely the flow diagram on the table application and the flow diagram on the cashier application. In the table application, when it is first started there is a system initialization that is connecting to the database. Then it displays a menu display on the screen that requires the user to scan the barcode so that the table application knows which table the number is in use. When the command is sent, the table application sends data to the database to be processed by the cashier application where the cashier application is the communication control centre. Then the command is displayed on the application table menu and continuously updating data from the database.

In the cashier application, the initial process is to initialize the system to connect to the database and check connections between wearable devices, then display the menu on the screen. If the command and number buttons are pressed, then the submit button is pressed, the cashier application sends data to the database and displays on the list menu after that send the command to the wearable device. The table application displays the "waiting" status and continuously checks whether the button on the wearable device is pressed. If pressed the status changes to "progress". If the button on the wearable device is pressed again, the command will disappear and be stored in the history list. The process of the desk application and the cashier application exchange data across the database so that the commands sent by the desk application will be seen in the cashier application and vice versa the commands sent by the cashier application will be seen also in the table application.

3. Results

3.1 Hardware and software results.

The results of the design are applications contained in the Android operating system and wearable devices. On wearable devices in Figure 4there is a 0.96" OLED LCD to display commands to the user, there is a push button to receive commands, there is a battery as a power source for the device and there is a switch to activate or deactivate the device.

![Wearable Device](image)

The application on android is used to make a booking system made into two applications, namely for the cashier and table. The application contained in the cashier is used to send orders that are already listed on the list. While the application contained in the table or table is used only to register orders that will later be received by the database which is then forwarded to the smartphone contained at the cashier.
3.2 Maximum Distance

Testing is done by bringing each wearable device away from the beacon router. Ping tests are carried out continuously by carrying the wearable device farther until the ping test results show a timeout indicating that the connection between the router and the wearable device has been lost.

| Wearable Device | Farthest Distance (m) |
|-----------------|----------------------|
| Device 1        | 35.8 m               |
| Device 2        | 34.7 m               |
| Device 3        | 35.4 m               |

The usage of the data from the wearable device is 813 bytes on standby mode, 1075 byte when receiving a message and 1104 when receiving erase command.

3.3. Battery test

The battery capacity used is 1500 mAh. The wearable device must continue to run for at least 8 hours in correlation for the restaurants working hour. Two experiments were carried out to see the condition on wearable devices. The first in Table 2 is to test duration of a wearable device stays in standby and the second in shown in Table 3 is to test duration of a wearable device lasts when being used continuously by sending commands along with vibrations every 10 seconds. All data is measured from the max condition of the battery 4.11 V to 3.22 V.

Table 2. Wearable device usage in standby mode

| Wearable devicenumber- | Duration (hours) |
|------------------------|------------------|
| 1                      | 7:55             |
| 2                      | 7:40             |
| 3                      | 7:40             |

Table 3. Wearable device usage in busy mode

| Wearable devicenumber- | Duration (hours) |
|------------------------|------------------|
| 1                      | 6:33             |
| 2                      | 6:30             |
| 3                      | 6:15             |
Table 4 and Table 5 show the charging time and condition of the device. Experiments are carried out with the condition of the battery has run out, while charging the wearable device is turned off and using a mobile charger with a voltage of 5 V and a current of 2 A.

| Table 4. Charging duration. |
|-----------------------------|
| **Wearable device number** | **Duration (hours)** |
| 1                          | 2:00               |
| 2                          | 2:09               |
| 3                          | 2:07               |

| Table 5. Charging condition |
|-----------------------------|
| **Duration (minutes)** | **Wearable Device number -** |
|                          | 1       | 2       | 3       |
| 30                       | 60 %    | 63 %    | 60 %    |
| 60                       | 85 %    | 89 %    | 87 %    |
| 90                       | 92 %    | 96 %    | 93 %    |
| 120                      | 100 %   | 99 %    | 99 %    |

3.4. Glitches and Error

The test aims to see how many errors are generated. The condition in question is the condition of the device working optimally to the point where an error occurs or beyond the normal use limit of the tool. These errors occur due to limitations of the system on the device. In wearable devices, the condition is set by pressing and holding the push button continuously on the wearable device. Whereas on Android Application, conditions are set by continuously sending commands to wearable devices together (less than 1 second), the results are shown in Table 6.

| Table 6. System response in error conditions |
|---------------------------------------------|
| **Device** | **Error occurred** | **Anomaly cause** | **Solution** |
| **Wearable Device** | Glitch in LCD display if the button is continuously pressed | The LCD still keeps the previous buffer. | Buffer cleared and refresh rate increased to every second. |
|                 | Push button bounce effect | The firmware responds to slow and some loop done inefficiently | Bounce is set by using software and additional hardware. |
| **Android** | Command is not sent when device is on standby mode | State difference in software when offline and online | A process is added to accommodate the offline mode. |
| | Multiple devices not detected when the device is doing almost the exact time | The proses of registering in Firebase database can only detect the last device registered | A 20 ms delay is given for command form the device. |

Conclusion

This study addressed the capabilities wearable device to help an operational system at restaurant that can be controlled using the smartphone. The device is designed to combine several components that were merged into a wearable device. The result is a wearable device that can last 7 hours 34 minutes with 2 hours charging time, with average operating distance 35.3 m and 5% error glitch.
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