Smart Glass using Organic Light Emitting Diode: An Intelligent Head-Mounted Device

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Abstract - *Recent developments in smart technology have enhanced human life. Among it smart glass is the wearable hands free, head mounted intelligent device, performing computing activities with help of Augmented reality which involves incorporation of computer graphics onto physical objects. It includes the active data collection and data processing which made machine to human interaction possible in handsfree way. This paper insights designing of smart glass, its features and working principle. Survey of various commercially available smart glass was presented and the new smart glass was derived from them. Applications such as GPS navigation, calling, sending messages with help of bluetooth was highlighted. Several design challenges along with future possible applications were discussed*

Key Words: Augmented reality, Organic light emitting diode(OLED), Smart Glass

1.INTRODUCTION

Recent development in smart devices have led human - machine interaction in novel ways. These devices aim at providing ease to users in various ways such as handsfree which makes it portable, live recording and broadcasting through connection of various applications. This paper insights the working of smart glass made using Arduino pro-mini and OLED and its interconnection with help of bluetooth HC-05 and using android application which was developed with C programming. Many design challenges were also explored with future scope and the use of the wearable technology that is smart glass applications were explored.

1.1 RELATED WORKS

Since smart glass has been recently come up in the market, with its first invention from google glass. Due to this not much of research work has been done but various applications have been derived from it. As there is lack of privacy and security while data transferring data, authors in [1] presented the way of achieving security by changing its physical and software structure by redesigning its 6 features. These features include User Authentication, Locking Mechanism, Notification, Physical Security, Governmental Security, and Firewall. The redesigned model of smart glass achieved 16.7 percent more secured and overcame privacy issues. Author in [2] proposed recent advances in privacy and security. They proposed various security mechanisms such as for bluetooth pairing and authentication for device locking, the mechanism were achieved through encryption of data, normally bluetooth uses 4 digit pin which is easy to break and is 6 digit is not compatible with the hardware module, it uses a numeric comparison protocol, while Bluetooth traffic is protected using Asymmetrical Encryption Standard (AES), the pairing is needed to establish the symmetric keys. And using these all it protect against passive eavesdropping. As it do not have user authentication there are huge amount of chances that it may get stolen. The fact that Smart Glass don't have keyboard it is possible to incorporate lock system using the simple touch control of the Glass. But the new authentication proposed it through voice commands which uses speech recognition as its input. As google glass which was invented in 2014 was developed for micro-interactions, authors in [3] stated various interaction methods using touch, touchless and multimodal inputs for multiple interfacing devices. In [4] first commercial smart glass was manufactured in 2010, which was named as ski-goggles which had head up display equipped with organic light emitting diode display reflected with help of mirror and output on small rectangular glass of the users vision alignment .It has features like inbuilt real time location tracking also with GPS, it also notifies the user about the speed and pulse [7] rate of heart also glucose levels and the countdown timer for parachute to open. In Andrea and Kirmani et al's [5]work they proposed numerous touch inputs such as on body and on device interfaces such as finger worn devices ,arm worn devices and belt worn devices. touch input constantly and repetitively touching and interacting which ultimately makes it tedious actions. Proposed work of Zheng et .al [6] stated various hands free interaction methods with the help of hand gestures. Gesture control inputs can be of multiple types including

Pointing, Semaphoric-Static, Semaphoric-Dynamic, Semaphoric-Stroke, Pantomimic, Iconic-Static, Iconic-Dynamic, and Manipulation. Smart Glass also has been used in education proposed in [8] where it was used to scan the present student data indirectly for attendance purpose and the student data was uploaded on cloud and the teacher was able to scan the present students faces and mark attendance automatically. Smart glass also emerged to help in the education in [9] where it helped students interact with tutor also with it helped tutor to recognise whether a student is paying attention or not by real time eye sight detection. Smart glass using MEMS scanner was proposed in [10] in which was used in healthcare for recording iris contraction and functioning of it under various atmospheric conditions. Basically used as a retinal system. C.Chen et.al proposed [11] model for industrial purpose for detection of faulty equipment for ease of workers working at industrial sites under high temperature such as in nuclear power plant where the heating equipment inside AC and DC motors were scanned through infrared cameras attached on smart glass which then gives output of heating elements in terms of color, the red gives the hottest and the blue with minor heating , this was in the line of sight vision. In [12] it introduces about the GPS working interfaced through app of smartwatch and it perform basic applications as calculation, gaming , FM radio system, media player and so on, It was used to develop android operating system. The [13] paper proposed four generations of google glass. First generation used for camera interfacing through eye vision. The second generation explains the effect of light incident on vision of eyesight. The third generation explains the control mechanism and clarification of focus .Fourth generation used laser light to adjust the camera to the exact line of sight, generally called eye glass. Google glass proposed in [14] highlights virtual reality and also enlarged reality using google's android operating system, it explained using eye tap and smart grid technology, explained using fourth generation of smart glass as explained in [15] embedded on small chips. Proposed work in [16] explains about voice commands and speakers reflected through a projector on prism, they also proposed activation text for voice commands such as for voice command input, "ok glass record a picture" will give output in form of clicking picture of line of sight. For [18] application of google glass in surgical treatment using a camera is proposed which was used during surgery.

2. HARDWARE REQUIREMENTS

1) 128×64 OLED display Module (SSD1306)

2) Aruino Pro mini

3) Bluetooth HC05

4) Connecting Wires

5) 3.7v Li-On Battery

6) Jumpers

2.1 HARDWARE DESCRIPTION

In our project we have used an Arduino Pro Mini board to control all the operations.

• The Arduino Pro Mini is dedicated for the users who require flexibility, low-cost, and small size. Please make Fig. 1. Block Diagram a note that there are 2 versions of this board –one is operating at 5v and another is operating at 3.3v.

• Here we used an arduino pro mini with 3.3v operating voltage. And it is programmed using the Arduino Software (IDE), our Integrated Development Environment which is common to all our boards and it runs online as well as offline.

• The 4 pin OLED and Bluetooth module HC-05 can also work on 3.3v, so all of these modules can be powered by a single 3.7v Li-on.

• Lithium-ion battery or Li-on battery is the compact, lightweight, rechargeable and is the perfect option for portable or wearable devices. • Li-on is of 3.7v so here a problem arises that all modules required 3.3v but because of 3.7v Li-on battery the all modules gets damaged. To overcome this issue we are connecting Li-on battery to raw pin of arduino pro mini which converts it into 3.3v.
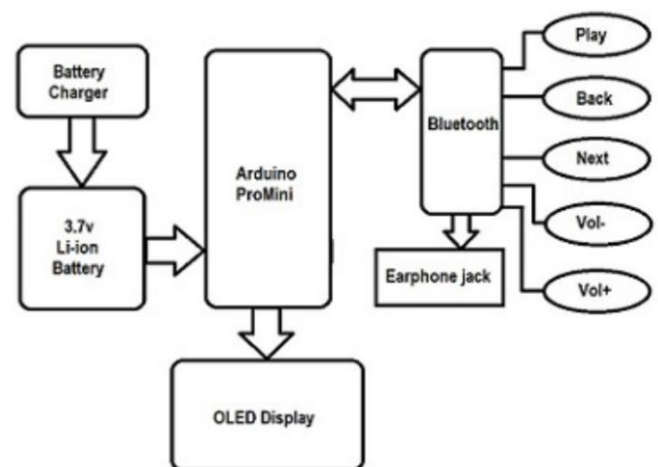

Fig. 1. Block Diagram

Fig. 2. OLED output

The following operations that are applied during the whole project:

•Receiving Notifications e.g. calling, text messages, whatsapp notification.

• Global Positioning System.

•Time, Date and Battery Percentage.

1) Notifications: Android notifications are supported on Glass through Notification Sync. When the Android system sends a notification on a user's phone, it also appears on OLED screen. Notifications on OLED screen works synchronously with your Android mobile phone. When you cancel the notification on either of the devices, the system rejects the notification on the other one. Notification may include the whatsapp notification, text messages or calling notification.

2) GPS: The GPS NEO-6M receives a signal through each GPS satellite. The satellites will transmit the particular time the signals are sent. So the travel time of the GPS signals from three satellites and their exact position in the sky, the GPS receiver can appoint your position in 3 dimensions - East, North and Altitude.

3) Time, Date and Battery Percentage: When Arduino pro mini and OLED interface with Android App, it will access the data of mobile through bluetooth connectivity and it will display on OLED screen.

3.SOFTWARE HARDWARE INTERFACING

Google's Android operating system, Android Studio is the main and official integrated development environment (IDE) built on JetBrains' IntelliJ IDEA software which is designed only for Android development. It is available for download on Windows, macOS and Linux based operating systems. It has replaced the Eclipse Android Development Tools (ADT) which was a primary IDE for native Android application development. Kotlin is also a language used for app development which is a replacement of Java as Google's preferred language for Android app development.

When we connect the android app with the HC-05 bluetooth of Smart Glass, the device will send the data which is in the form of strings to the Arduino through Bluetooth. The data in the form of Strings includes current Date and Time and also incoming call or text is transmitted. The transmitted data is received by Arduino which is then displayed on OLED screen.

3.1 ANDROID APPLICATION SECTION

• Now we move on to the Android Application Part. Establishing a connection is based on the client-server model. The server socket is created by a server which waits for incoming connection requests, then the client socket is created by client which sends a connection request to the server.

• The second socket is generated when the server accepts this request which is used to communicate with this client which makes it possible to send and receive data both ways.

• Set permissions: First, we set the permissions in the Android Manifest file. Bluetooth and Bluetooth Admin are needed.

• Check Availability of Bluetooth: We use the Bluetooth Adapter class to check Bluetooth's availability. Phone's built-in Bluetooth module is represented here. To check if our device has Bluetooth to start with we will use this class. To check if Bluetooth is enabled or not, we can call up the system's dialog window asking the user if to turn Bluetooth on

• Display the list of paired devices: Now that we have checked Bluetooth's availability and we turn it on to display the list of paired devices. We use the getBondedDevices method for this purpose. To display the most useful data like name and MAC address we just add each bonded device to the list. If there are no paired devices, display a toast message to inform the user. We get a MAC address from this device when you click an item on the list. Then it is sent to the next screen via intent and a second Activity is started. To get the MAC address identifying our Bluetooth device was the main thing behind this process. Now we are on the second screen and we have collected the MAC address that was previously sent.

3.1 ARDUINO CODE

• After app is created we transmit the data from phone to Arduino once it is connected to HC-05 Bluetooth Module. After data is received by Arduino a code is written to print the data received from phone to the OLED screen. We use the AltSoftSerial and Adafruit Libraries to run the code. The link for arduino and android code is available at [17] link. Receiving data: The Reception of Data is not complicated. Because in microcontroller Hello world is just LED blinking but here, Hello World is little bit advanced. It is achieved by changing the state of LED as and when Data is received through Bluetooth.

Pairing devices: The establishment of Bluetooth connection is done by pairing them. Device pairing takes place only once. The process looks like this: Enable the Bluetooth HC-05 of device then it will be visible to the surrounding. Then we choose other device when we scan for other device. When Bluetooth Module is detected Pairing request is send to other device. A pop-up message is shown up in our Android Device naturally the password is 1234 or 0000, When the password is right we will see that our Bluetooth device is in the paired devices section.
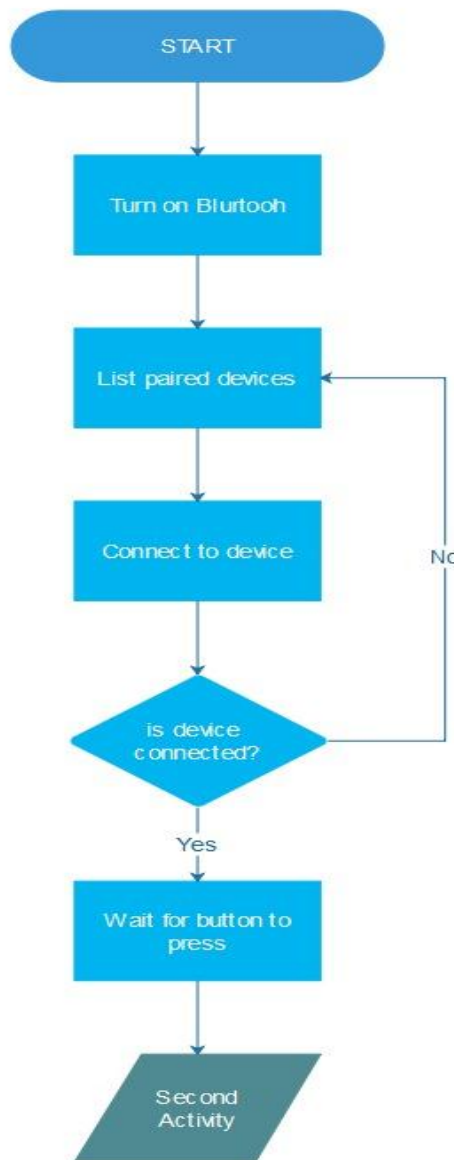

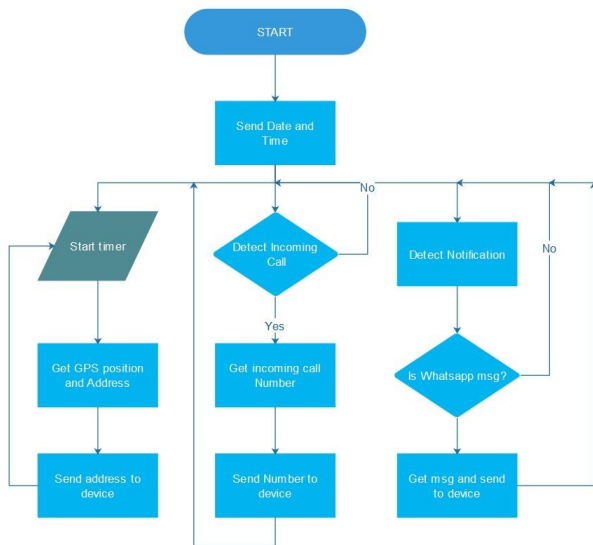
Fig.3-Flowchart of Bluetooth Connection

Fig -4: Working flowchart of applications implemented

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

4. CONCLUSIONS

After successful uploading of the code for displaying textual content on arduino IDE, from the arduino terminal the output will be displayed on an OLED screen. This will give the following result. For interfacing bluetooth module with arduino, the code is uploaded to arduino with help on serial monitor and using application named bluetooth terminal which is available on google play store can be searched and connected to the bluetooth module. Once you have done so, the OLED display will be displaying the data with help of serial monitor the two way transmission is possible. This will give following output. In similar way for other applications the smart glass structure is to be connected with bluetooth and further applications such as calling, text messages, date, time, battery percentage, GPS navigation can be performed. For further modifications, small vibrating motor can be added for notifying the incoming call and messages and make it vibrate when the call notification is displayed.

Power is the constraint in micro electronic structure and hence power is being provided with a 3.7v LiPo (Lithium Polymer) battery.

Fig. 6. Smart Glass

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