A Rudimentary Design Of Wearable Computing Device
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Abstract — The recent growth in technology has led to the advancement of wearable computers. These so-called wearable computers are one step ahead and can function as our own PDA (Personal digital assistant). This paper aims to give a comprehensive elucidation on the requirements to design such a wearable computing device. The wearable computing device can be programmed to facilitate multiple applications. The interfacing of Bluetooth module present inside the device with an android device is also explicated in this paper.

Keywords—Wearable computing device, Arduino Pro Mini, HC-05 Module, DS1307, RTC, OLED display, Verxion.

I. INTRODUCTION
Currently, technology and humans have become inseparable. Smartphones have changed the lifestyle of human beings. These smartphones are mobile phones built on portable computing platforms with advanced ability to interact with humans. They are driven by powerful operating systems such as Symbian, iOS, Android etc. and are usually incorporated with communication protocols such as Bluetooth and Wi-Fi. Among these, Android OS is famous for its customizability and open architecture allowing the user to decide what they want. This enables us to establish a communication even between a microcontroller of open source and a smartphone thus aiding us to construct a custom wearable computing device. As stated earlier, many means of communication is offered by a smartphone. Yet, the wearable computing device is built with Bluetooth capabilities as it has an intermediate range of reach and the overall cost of setup is inexpensive. Thus this study focuses on developing a wearable computing device and establishing a communication between the wearable’s Bluetooth module and the smartphone by designing a simple application that can be run on the smartphone.

II. METHODOLOGY
A. Wearable Computing Device
The wearable computing device features a 0.96” OLED display along with a DS1307 RTC module. The device runs on an Arduino Pro Mini microcontroller. This microcontroller is capable of running an embedded operating system and obtaining information from the android smartphone via HC-05 Bluetooth module present inside the device. We named the operating system as “verXion”. This embedded OS is designed to be compact and efficient at resource usage. The device runs on a 3.7V lithium-ion polymer battery. The battery is rechargeable by means of an electrical switching circuit. Timekeeping is achieved by the use of an RTC module which keeps the time in memory even in the case of power failure, thus enabling to display the right time even after rebooting the device. The RTC module uses a CR2302 button cell. The device also features four push buttons for functions such as select, back, up and down respectively. This helps to navigate through the menu and select options. The device is programmed and modified by connecting it to the Arduino IDE via TTL to USB adapter. With this device, we can get important information about weather and receive text messages quickly and conveniently directly from our wrists. Apart from displaying time and date on the home screen, the device offers a menu from which weather and text updates can be selected and acquired. The device, however, supports only a one-way communication i.e. it can only receive data from the smartphone. The device is at the receiving end of the communication.

Fig. 1 Booting screen
**B. Control Application**

Control application gives the weather and text updates to the wearable computing device. The control application uses a weather API provided by OpenWeather Map. Information such as temperature, humidity is obtained using the weather API. The app was created using Android Studio. Apart from bringing in weather updates, the app also intimates the wearable computing device with text message alerts. This facilitates the viewing of such texts right away on the wearable without the necessity of opening the phone. The wearable can receive one message at a time. At the advent of next message, the previous message is erased and the latter one is stored. This application is supported on any android device with Bluetooth capabilities. The application consists of a home screen from where the information about the weather is displayed. The text alerts are present right underneath the weather updates. A list picker menu is available from which the wearable is selected and the connection is established. Once the connection is established, the app indicates the user that the connection was successful. Now, the wearable gets a live feed continuously from the app. The app can also run in the background. The app is the only way to communicate with the wearable other than the Arduino IDE. In order to fulfill the entire functionality of the wearable, it must be always connected to the smartphone. The user interface of the application is really lucid. There is only a one-way communication between the wearable and the smartphone.

**C. Constructional Details**

The wearable computing device consists of the following parts:

1. Arduino Pro Mini with Atmega 328 microcontroller
2. HC-05 Bluetooth module
3. DS1307 RTC module
4. 0.96" OLED display module
5. Power Source along with charging circuit
6. Basic Framework

The assembly details are explained in the following steps:

**Step 1-Board:**

*Arduino Pro Mini:* It contains ATmega 328 microcontroller. It has 14 digital input/output pins, 6 analog inputs, an on-board resonator, a reset button. Conducting holes are present for mounting pin headers. A six pin header can be connected to an FTDI cable to provide USB power and communication to the board. The microcontroller runs at 16 MHz. It contains 32 KB of flash memory enough to store the embedded OS for this project.

**Step 2-Time Keeping and Communication:**

*DS1307:* The primary purpose of this wearable is to display time and date. This is achieved by means of using an RTC (Real Time Clock) module. This module is battery backed and allows the microcontroller to keep track of time even if the power is lost. The module successfully runs on a 3.3V. The module uses I2C for communication with the microcontroller. The time is uploaded to the module with the help of computer through Arduino IDE.
HC-05: The connection between the smartphone and microcontroller is established by the means of HC-05 module. This is easy to use Bluetooth SPP (Serial Port Protocol) module, developed for wireless serial connection setup.

Features:
- Provides typical -80dBm sensitivity.
- Supports up to +4dBm RF transmits power.
- Low Power 1.8V Operation, 3.3 to 5 V I/O.
- PIO control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

The name and slave/master configuration can be done using AT commands.

Step 3-Display:
OLED Module: The display module features a 0.96” monochrome OLED screen. The designation is 128x64 which gives a pixel density of approximately 8533 PPI. The display module comes in two interfaces “SPI” and “I2C”. However, only I2C display module is used in this project. No backlight is required as the display makes its own light. The board runs on both 3.3 V and 5 V supplies. “U8GLIB” and “AdafruitSSD1306” libraries are used for the text and the graphics displayed.
III. FUNCTIONING OF THE WEARABLE
The battery should be first fully charged before installing it into the wearable. Once charged fully, the battery is inserted and the wearable is turned ON. The display opens up with a booting screen with the OS name on it. After the loading is complete, the home screen shows up. The user then connects the wearable to his phone. The wearable is itemized in his “Bluetooth devices” menu. Once connected, the wearable will get a continuous feed from the smartphone. The user can access and navigate through the menu using the push buttons. The user can view the updates even from a distance of 10m from his phone.

IV. CONCLUSION
In this paper, the design and implementation of the wearable computing device are presented and developed using Arduino microcontroller and an android smartphone. Since a lot of update possibilities is available, upgradation of the wearable is kept as a future scope. The construction of the wearable is both simple and cost efficient compared to existing technologies. As a final thought, the wearable can be ameliorated further and instigated in large scale.

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REFERENCES