

## Smart Pillow - The Future of Sleep & Talk Technology

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**ABSTRACT:** A new solution has been proposed which is able to stream or transmit voice in real-time over Wi-Fi (IEEE 802.11) with an acceptable audio and video quality. The present invention is related to the field of electronic communication devices. By implementation of Wi-Fi linked smart pillow, it ensures a comfortable and a secure mode of communication. The smart pillow has additional utility based features such as alarm and reading lights. Real time Audio and Video conferencing is nothing but to perform the live chat with respect to the two or more users with the real time audio and video transmission over the wired & wireless network. Given the credit-card sized single-board and low price, Raspberry Pi 3 Model B is the most appropriate as a portable device for our wireless requirements. On pillow switches as well as an Android app has been provided to facilitate the calling feature and control other features of the pillow like alarm, vibration, lights etc. The technique that is used, will reduce cellular charges because technique is based on Wi-Fi. Webrtc is used for real-time transmission of audio and video from one raspberry pi module to another raspberry pi module. Open source Linux based OS is used in this project to keep the cost low.

**KEYWORDS-** Smart Pillow, Raspberry Pi 3, Webrtc, Android App, USB-Soundcard

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### I. INTRODUCTION

Smartphones have become common and are widely used by people of all walks of life. The implementation of internet has further increased the communication capabilities. The advantages of the smartphone are plenty, but one should also be concerned about the health issues caused by using smartphones. The use of smart phones makes the person uncomfortable in case for longer communication. Also the rays emitting from smartphones are hazardous to health. The concept of smart pillows, allows people to contact each other who are staying over a long distance without the hustle of holding phone and carrying mobile chargers all the time. Thus the level of comfort can be increased. This electronic pillow also reduces the risk caused by using smart phones. The prior art shows electronic pillows that was used only as an alarm in order to wake up the person. These electronic pillows use smart phone in order activate it. The current invention reduces the dependency of smart phone. By connecting these smart pillows with WIFI, it can improve the way of communication. This invention enables to create a new environment to the way the people communicate. Thus this device will look like a pillow, but act as a communication device. Now a days everything is shifting to wireless technologies. An increase in number of devices which can be used for audio streaming wirelessly has been developed. But technologies like bluetooth has their own limitations, such as the device cannot go beyond a certain radius or else it will get disconnected to source device, the range cannot exceed beyond 10 meters[1]. Before Webrtc technology was not discovered people were using SIP protocol and VOIP which will give you the required result but the clarity of voice will get affected to some extent. In SIP protocol the host is situated elsewhere hence the their also exist a certain amount of lag in the transmission from source to destination[2]. One of the biggest advantage is that it forms a peer to peer connection which is always preferred[3]. Instead of buying that expensive carrier's network connection, you can make voice calls via a Wi-Fi network. Wi-Fi calling is especially useful when you're in an area with weak carrier coverage. The smart pillow can also have the advantage of charging an exterior handheld device like cell phones, by introducing a power-bank within it. The smart pillow will also have the ability to conserve the energy supplied to it. If the pillow senses that no one is sleeping on it, it will automatically shut off and thus the battery life is optimized[4]. The Raspberry Pi platform has gained wide popularity from a technical perspective i.e. not only due to its usability but also because of an excellent support and documentation, along with its low cost. Technology we have used for this project is Webrtc and Socket IO. We have used python ,javascript and node.js as scripting languages.

## II. IMPLEMENTATION METHODOLOGY

- a. Hardware Requirements
- b. Installation of the “Raspbian Jessie” OS on the Raspberry Pi module
- c. Programming in Python
- d. Node.Js
- e. Introduction and Use Of Webrtc
- f. Database
- g. Android Application
- h. Calling Application



**Figure1. Hardware Requirements**

### A. Hardware Requirements:

1. Raspberry Pi 3 module:- The processor of a Raspberry Pi system is a Quad core 1.2GHz Broadcom BCM2837 system-on-chip (SoC) multimedia processor[5]. But it does not have internal memory so that the SD card is used for booting and storage. It also consist of BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board. This uses Linux and Debian based operating systems. We are using ”Raspbian Jessie”. The model we are going to use is Raspberry Pi 3 B+ model which has 4 USB ports. It requires 5V, 2.5 Amp power supply with micro-USB connector.
2. Headphones/Speaker: Easily available headphones/speakers are used for audio purpose[6].
3. USB-Soundcard: Easily available USB soundcard is used for taking in voice input[7].
4. IEEE 802.11 - This is IEEE standard used for the wireless Wi-Fi Network.
5. Android Phone: Easily available phone with Android OS for running Application.
6. LG OLED flexible display light
7. The vibration motor has a voltage requirement ranging from 3V to 4.5V along with a 0.06A of current. The vibration motor has an all metal component with a sizing of about less than a coin

### B. Installation of the “Raspbian Jessie” OS on the Raspberry Pi module

You must first start with getting a SD card with a memory storage of 8GB[5]. You can choose one of these operating systems such as Raspbian , Ubuntu Mate or OSMC for media streaming-- and they're all quick and easy to install. There are even operating systems that turn your Raspberry Pi into a small affordable and mainly portable PC. Begin by downloading the operating system that you want to install on the Raspberry Pi for your purpose. A Raspberry Pi-optimized version of the Linux distribution called Debian is used[5]. This distribution of Linux is easily accessible on [raspberrypi.org/downloads](http://raspberrypi.org/downloads). Select Raspbian OS(instead of NOOBS) and download the full Raspbian Jessie ZIP. The file is approximately 1.3GB, so it may take several minutes to download, depending on your internet speeds. We have used windows laptop for burning image on SD card[8].Hence we have to use Etcher. Etcher is a tool used to burn the Raspbian Jessie image on SD card. In old version of Raspbian Jessie you had to expand file system but now in the latest version it handles it on its own [5].You should remember to enable SSH and VNC[9]. It is preferable that you make the IP address of your raspberry pi static.

Follow these instruction :-

```
$sudo nano /etc/dhcpd.conf
```

Add following lines in the fileinterface

```
wlan0
staticip_address=192.168.1.210/24 #whatever ip you want
static routers=192.168.1.1
staticdomain_name_servers=192.168.1.1
```

For operating your raspberry pi through SSH in windows you will have to download third party software called PuTTY[6]. PuTTY does not include an installer package: it is a stand-alone .exe file. When you run it, you will see the configuration screen. Enter the IP address of the Raspberry Pi into the Host Name field and then click on the Open button. If nothing happens when you click the Open button, and you eventually see a message saying Network error: Connection timed out, it is likely that you have entered the wrong IP address for the Pi. If you do not know the IP address, type hostname -I in the Raspberry Pi command line. You will now see the usual login prompt. Log in using the default username and password. The default login for Raspbian is pi with the password raspberry. Once you are logged-in then you will be able to access the terminal of the raspberry pi.

### C. Programming in Python:

We started with python because it is a High Level language. This means that Python code is written in largely simple English, providing the Pi with commands in a manner that is quick to learn and easy to follow. It is also the language that is recommended by the Raspberry Pi Foundation for those looking to progress from the simple scratch to more hands-on programming. Python is published under an open-source license, and is freely available for Linux, OS X and Windows computer systems.

We have used python for scripting the client side. You can write a Python script in a standard editor like Vim, Nano or LeafPad, and run it as a Python script from the command line. Just navigate to the directory or folder where script is saved (use cd and ls for guidance) and run with python, e.g. python hello.py

### D. Node.Js

Node.js is an open source server framework. Node.js uses javascript on server. In java script everything works in a single event loop or single thread fashion. Runtime is asked to perform an operation, providing a callback function and then moves on to do something else during the execution of the event loop. After the operation has been completed, a message is enqueued along with the provided callback function. When an asynchronous operation is to be performed it will be enqueued to queue and will be executed in future tick of event loop. At some point in the future, the message is dequeued and the call back is fired. But in recent node.js these call backfubctions are replaced with promises. It can be used to access the database to either modify the data, add data or delete data in your database. A Web Server is a software application which handles HTTP requests sent by the HTTP client, like web browsers, applications and returns web pages or any other form of information in response to the clients. We have used javascript as scripting language for server side. A database of users is also maintained with their respective information. As Webrtc doesn't provide us with a provision for signalling hence we have to provide another way for it i.e. using sockets. Node uses similar form of the EventEmitter, and is located in places such as Server, Socket and the 'http' module. It's useful when we need to emit more than one type of state change from a single instance.

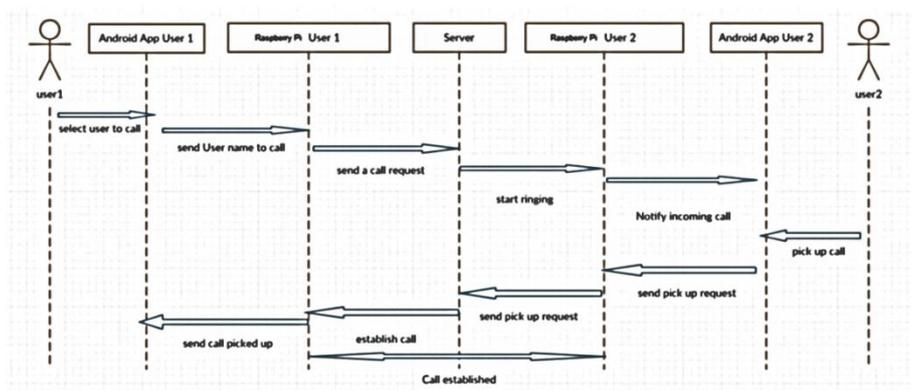


Figure2. Flow of how call gets established between two users through signalling sockets.

### E. Introduction and Use of Webrtc :

WebRTC is what enables you make a voice or video call from the web, using any browser compatible with Webrtc. Initially you had to do an Add on for Webrtc support but now almost every browser has in-built support for Webrtc. The RTC stands for “Real Time Communication”. In the past it was only possible to be able to make a voice or video call, you needed special hardware, like a video telephone or video conferencing equipment. In just a few lines of code, the browser is able to capture data from the user’s webcam and microphone. Webrtc has made very simple to incorporate this real-time audio visual stream into a basic

JavaScript object. Although framework used for deploying WebRTC is written in JavaScript, the APIs allow the application to treat these JavaScript objects as simple video and audio objects when used in HTML5.

Coordination in communication is processed using Signalling. Exchange of information should take place in order to set up a 'Call' by a WebRTCApplication:

- Control over the communication kept using the session control messages.
- Error messages.
- Media metadata such as codecs and codec settings, bandwidth and media types.

WebRTC has three different features:

- User media – User is able to gain access to computer's microphone and camera through html
- Peer connection – This is an implementation of a peer-to-peer connection between two browsers. This connection can be used to communicate the user media and/or data from the data channel between peers.
- Data channel – Once peer connection is established, channel is used to send data from one peer to another.

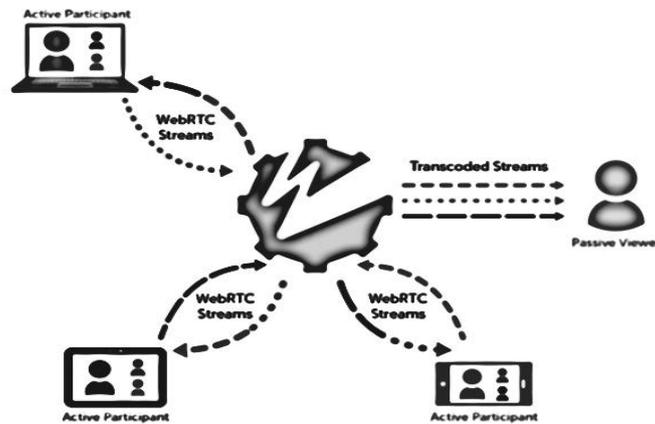


Figure3. Webrtc communication

**F.Database**

Database is a structured collection of data. But we have used a relational type of database management system as any caller's information such as his phone number, email id, etc is a structured data. For this purpose we have used MySql. MySql is a relational database management system. SQL means structured query language. Consumers contact information , his token\_id, his list of favourites ,his socket\_id ,etc is stored in the database. And whenever it is required we can fetch that data from this database and modify it according to our usage.

**G.Android App:**

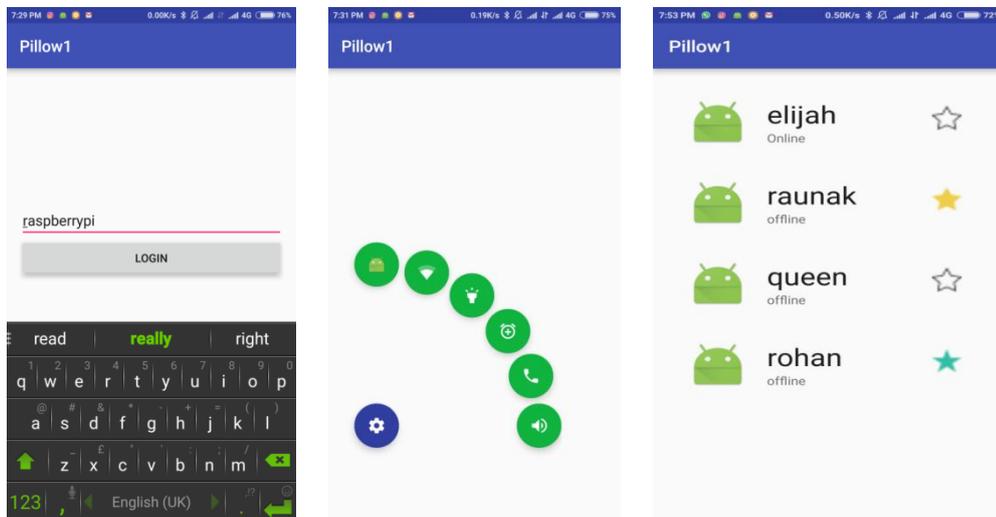


Figure 4. (a) Login Page

(b) Home Screen

(c) Contact List

As shown in above figures, Fig 4(a) shows login page of the application where you enter the name of raspberry pi you want to get connected. When you are logged-in then only home screen will be displayed which is shown in Fig 4(b). Now when you click on menu and select the calling option, now you will get to a screen shown in fig 4(c) where you will be able to choose which user to call. Similarly options has been provided for turning ON the reading lights, setting alarm, etc. You can also select three favourites for speed dial from hardware switches which are provided on switch board. Android App communicates with raspberry pi with the help of RFCOMM Protocol. A simple set of transport protocol, made on top of the L2CAP protocol called Bluetooth protocol RFCOMM involved in providing emulated RS-232 serial ports (up to sixty simultaneous connections to a Bluetooth device at a time).

**H.Calling Application:**

1. Setup client side code on both the raspberry pi. Then start the app on two phones and login to raspberry pi by entering their names respectively but make sure they are paired with raspberry pi first.
2. Either place a call by app or by pressing the button on the switch panel (Fig 10). Using app you can call any user but using hardware button you can only call one of the three users regarded as your favourites.
3. Similarly we have given option for receiving and rejecting the call both in app and switch board. When a call is placed a normal calling process can be seen as shown in Fig 9.
4. When second user accepts the call a link gets established.
5. Audio and video communication is achieved between these users.

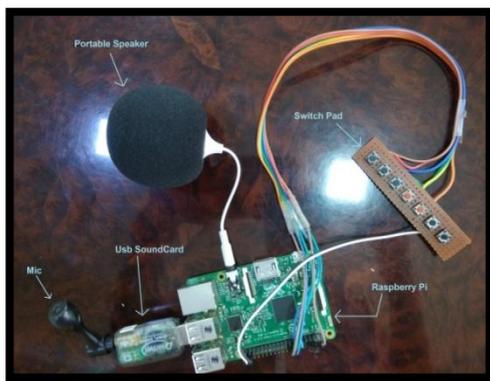
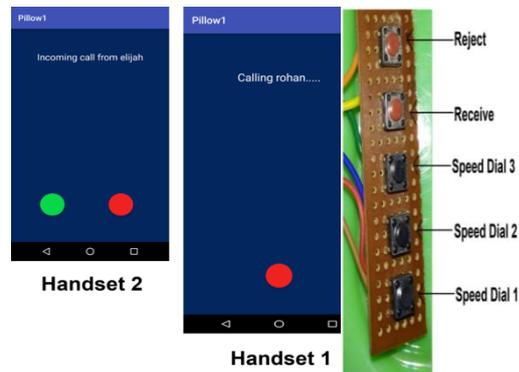
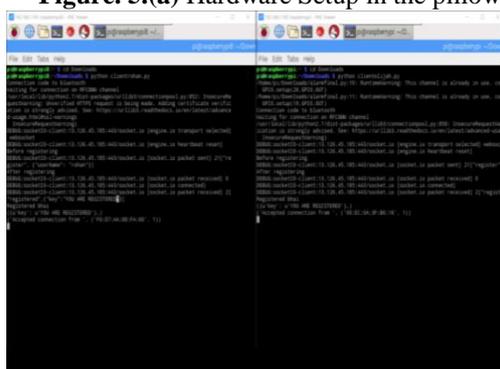


Figure. 5.(a) Hardware Setup in the pillow

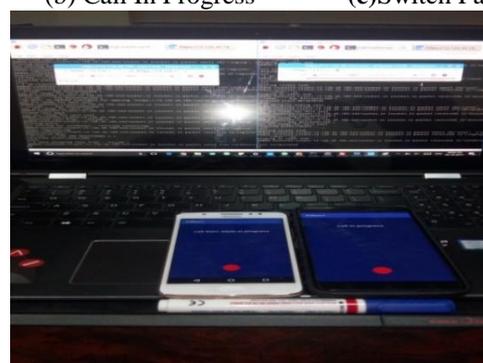


(b) Call In Progress

(c) Switch Panel



(d) Setup on raspberry pi



(e) Call Established

**III. RESULT**

1. A smart electronic pillow is used as a device to communicate with each other and this reduces the dependency to hold the device in case of a long conversation.
2. Wireless LAN or Wi-Fi is used as medium in order to establish communication between the smart pillows and can also transfer songs/music etc., between the devices as well as more than 2 devices.
3. The smart pillow can also be used as a device which act as alarm and also as charging point in order to charge the individual’s mobile and also if the pillow senses that no one is sleeping on it, it will automatically shut off and thus the battery life is optimized

4. The smart pillow also has a provision for LG OLED flexible display light this can be used if the user is unable to catch sleep he / she can read a book or novel without disturbing the other person sleeping besides by using the lights embedded into the pillow.
5. When the alarm goes off not only the music will start playing but also the vibrating motors will also start vibrating to wake up the person.



Figure 6. Prototype - smart electronic pillow

#### IV. CONCLUSION

The smart pillow is an electronic pillow which can be adapted as a communication device. The wireless LAN or Wi-Fi is used to establish contact between the smart pillows. The smart pillow comprises of single board processing unit which on activating with the help of smartphone, is used to access the wireless network. Internet is playing an important role in connecting people to one another. So devising a system of connecting people over Wi-Fi so that one can not only chat through text but also communicate with the person was the main aim. This technology can also be used in hotels where if the person is sleeping on the pillow he /she can call for housekeeping or reception via a click of a button that is provided within the pillow. This technology can also be used in hospitals where patients are suggested complete bed rest and the person gets bored so he/she call anyone from their pillow with just a press of a button as well as other people can leave messages for him and he can listen to them while sleeping on the pillow. By using WebRTC it was possible to transmit audio and video in real time securely because mainly it is peer to peer and now we don't need to design any media engines or filters which were needed to be designed when the concept of WebRTC was not present. In past many people have used VOIP as a tool for connecting people but WebRTC is better because it is light weight and one of the biggest advantage is that it is open source.

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