The International Journal Of Engineering And Science (IJES)
||Volume||3 ||Issue|| 2||Pages|| 12-18||2014||
ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

Smartphone Based Wearable Sensors for Cyborgs Using Neural Network Engine

Dayana Benny, Guide: Anil Antony
Dept. of Computer Science & Engineering, Jyothi Engineering College, Kerala, India

----------ABSTRACT----------
Now we can imagine a situation where human beings wear electronic skin as touch sensors for health monitoring system. There is a recent advancement in developing a system that uses wireless sensors placed on body and collected sensor information are dealt with smart phone applications. This application uses cloud computing, location data and a neural network engine to determine the current state of a patient is dangerous or not. Electronic skin modules mount spatially on human beings. The neural network engine fuses the information from multiple sensors.

Date of Submission: 25 January 2014 Date of Acceptance: 11 February 2014

I. INTRODUCTION

Android smart-phone technology and Google cloud service is applied here to implement wearable sensors for cyborgs and robots using neural network engine. The controlling of the robot is done by means of wireless through Android smart phone using the blue-tooth feature present in it. Thus the locomotive movements of robot are traced. In case of cyborgs, the extracted information regarding the patient data is the sensory parameters. This is fed in to the neural network engine. The neural network engine is running as a cloud service.Neural networks have proved to be powerful and popular tools for controlling cyborgs and robots. Cyborg is a cybernetic organism. The modern generation use wireless sensor networks distributed on skin. Global Positioning System (GPS) and cloud computing are used for this health monitoring system. It has some improved skills due to some technology. Then, these people are called as cyborg here. In part II, related works on the topic is discussed. In part III we arrived at a proposed system for wearable sensors that using Smartphone technology and cloud computing. A brief discussion about trusted computing is also done here. Wearable devices are recent advancements even though the pioneer of electronic skin is developed decades ago. Now this kind of wearable body area networks use neural network engine for fusing the data from multiple nodes. This is very helpful in Health Monitoring System and driver safety system. Later, a brief conclusion on this paper work is done.

II. RELATED WORKS

In this paper, the various works on wearable sensors are analyzed and a comparison study is done.

A. Health Monitoring System

The tactile modules on the robotic covering structure minimize the impact of collision [1]. In case of prosthetic control, the collision detection can be done by the implementation of the neural network [2].The application for health monitoring system is installed in the smart-phone [3]. Fig. 1 illustrates the health status of a patient monitored by mobile health monitoring system.

The physiological signals are analyzed using a cloud service. It is done by the help of neural network analysis. The data is fused by neural network engine. The data examiner needs to identify the version and operation smart-phone mobile to safeguard the software is worthy. After data examiners download, install and execute the software, the health monitoring system gets activated. Physiological signals instantly transmit to Google cloud platform after the collection of data. It provides reporting shown on cloud or mobile terminal. As the development of smart-phone technology, it upgrades mobile features. Smart-phone is now a hot issue in modern world and technology field. So, mobile Health Monitoring System now attracts people's attention. Here, by the usage of Apache, setup a cloud platform and provides neural network engine as cloud service for hospital authority and family members. Then they can monitor the health of the patient.

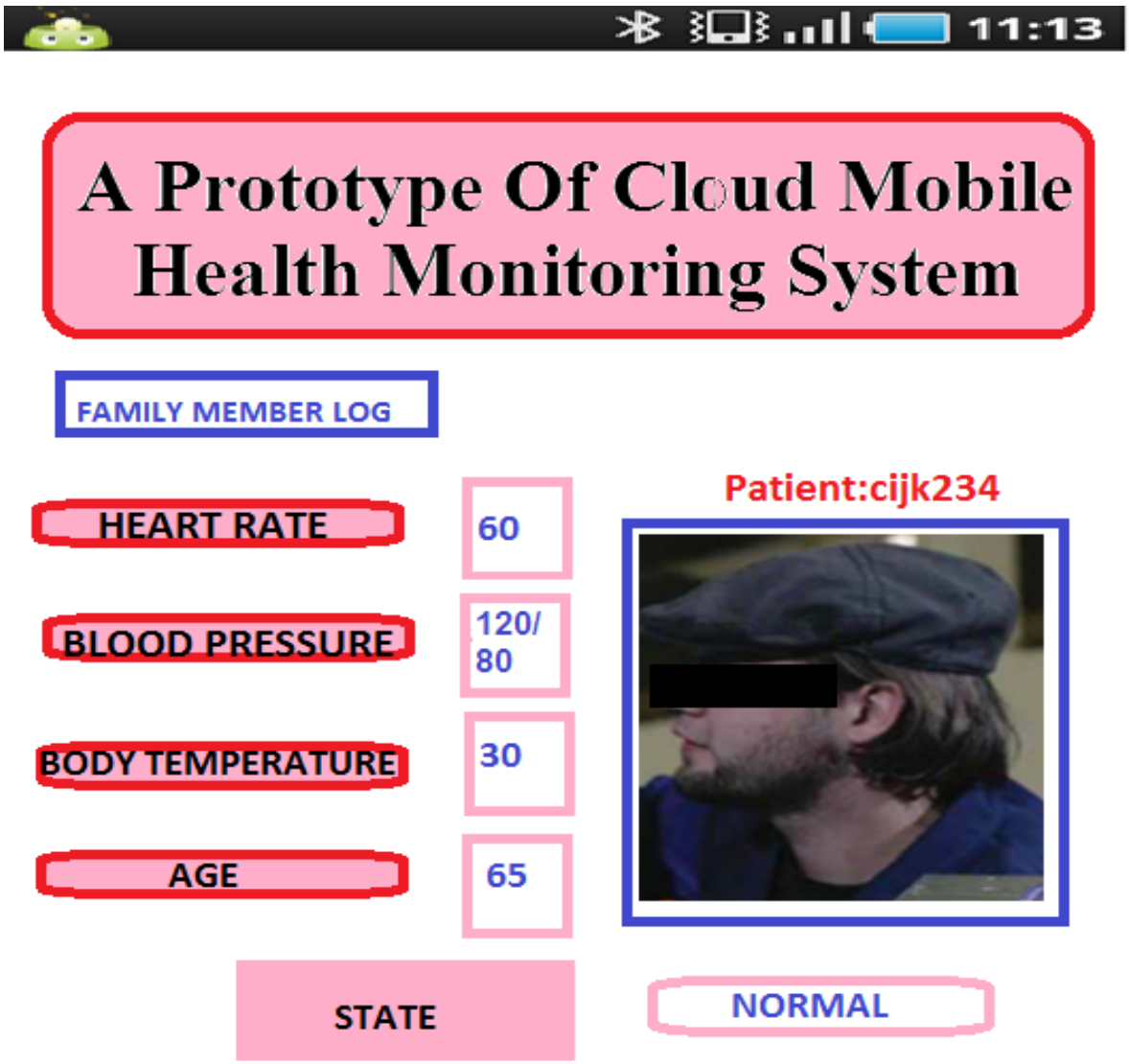

Fig. 1 Presents the health status of the patient that is displayed through a Smartphone. Sensors are used to retrieve the physiological states of the patient.

B. Electronic skin as wearable device

Flexible, textile and stretchable electronics are emerging research areas [4]. Electronic skin is a man made skin that can be stretched and wrapped like skin on people, prosthetic limbs and other robotic organs. When we consider about features of an ideal artificial skin, we will arrive at some conclusions that to make an electronic skin, we need a greater flexibility. The wiring and the materials used and the circuit should be bendable [5].By saying electronic skin it is not only meant that it is used only for tactile sensing. Some kind of wireless sensors are used to collect, measure and report the user's physiological state. Wireless Body Area Sensor Network (WBASN) to implement real time wearable health monitoring of patients [6]. This health monitoring system uses wireless sensors and smart-phone applications.

C. Wireless Body Area Sensor Network (WBASN)

A WBASN for health monitoring consists of multiple sensor nodes that can measure and report the user's physiological state. These sensors are placed on the human body. Sensors can be worn as stand-alone devices or can be built into jewelers, applied as tiny patches on the skin, hidden in the user's clothes or shoes, or even implanted in the user's body [7]. WBASN forms the lowest tier, Tier 1 of a multi tiered medical information system for health monitoring. The WBASN can include heart sensor, motion sensors. Tier 2 encompasses the personal server, which is responsible for doing some works and they provide an interface to the wireless sensor nodes, medical server and user. Tier 3 includes a cloud medical server accessed via the Internet.

The last tier may contain other servers, like emergency services. There is a server called medical server and it keeps electronic medical records of registered users. It gives different options to the users as services. It is the right of the medical server to entertain only the right users and to allow health monitoring session medical record uploading and to analyze the patterns obtained from the information, find major disorders of health for contacting emergency medical service givers, and forward the new instructions like some tips on exercises prescribed by doctors to the patients.

D. Bed Side Monitor

It is ICU (Intensive Care Unit) monitor. In Fig. 2 We can see a model of "bed side monitor". The outlook of this device looks like a computer monitor or television. The output of this instrument is continuous waveforms or numbers. Heart rate (HR), Blood Pressure (BP), body temperature, breathing rate and oxygen level in blood is monitored by this device.

Fig. 2. This is a model of "Bed side monitor" which displays the body's important functions by means of continuous waveforms or numbers [8].

Many sensors are mounted on patient's body. Commonly used sensing devices are oxygen saturation probe for sensing oxygen saturation in blood and ECG dots for retrieving ECG signals. By means of wires these devices are connected to the monitor. Then the monitor displays the signals. If the state of patient is abnormal then the device produces an alarming alert. Thus the caregivers get alerted and the patient gets the necessary care. Sometimes due to some movements of the patient, the sensors get detached from the body. Then also the alarm gets functioned to provide alert message to care givers. When we consider about the design of this device, we can see that the heart of this device is memory and timing board. The timing is provided by the master clock. There are two channels of parameter waveform.

The signals are retrieved by the sensors by means of sensor devices placed on the patient's body. Two channels of parameter waveform are converted into two channels of digital waveforms. This process is done by ADC (Analog to Digital Converter) and the inverse of this process is done by DAC (Digital to Analog Converter). This stored data is displayed in an analog form of wave. The abnormal situations are occurred in cases of deep coma stage and the irregular waveforms generated due to the delta arise. They are formed in result of brain damage. Those abnormalities are detected by EEG decoders. The abnormality in heart rate is detected by ECG and sensor devices for measuring body temperature are also attached to the patient's body in order to collect vital signals of the patient. Then these data are analyzed and the system will alert the care givers in case

of abnormalities caused to the patient. In Fig. 3 the part1 depicts the connection of sensor devices in the patient's body. The various sensor devices are sensors retrieving HR, BP, body temperature etc. The part 2 is the wireless connectivity of the device and part 3 is the power supply. In part 4, the audio feedback, power switching, USB protection etc are depicted. Part 5 is a very efficient application of this "bed side monitor". It has data uploaded for patient monitoring and effectively alerts the nurses and other staffs simultaneously.

E. Trusted Cloud Data Sharing

In this new era, we can see that most of the mobile applications use cloud computing for the storage of data. Now there is mobile cloud and special infrastructure for mobile. Now people spend more time on their Smartphone rather than using desktop PCs and laptops. So the Smartphone become an inevitable factor in our everyday life. Moreover, we can see that while sending an alert message to family members according to the Hospital monitoring System, giving alert message to mobile phones is desirable. This routine as a main advantage that the family members as well as hospital

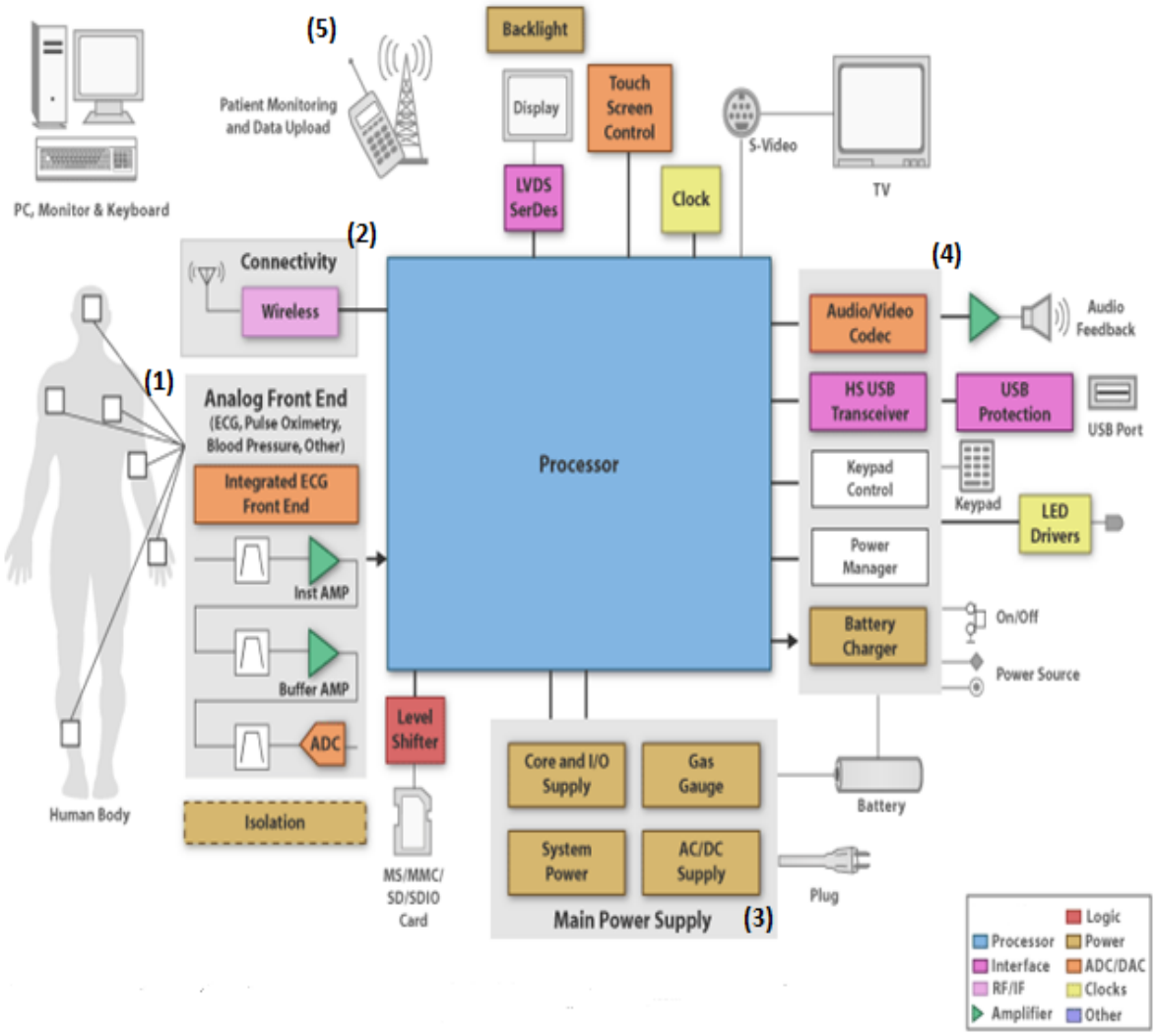

Fig. 3 Illustrates the block diagram of "bed side monitor" [9].

authority is get alerted by the messages send from the Smartphone which collects the necessary information based on sensory signals by incorporating use of accelerometer. This collected information is stored in the cloud storage system. Then there arise a question that whether this cloud storage system is trusted or not. Trusted cloud data sharing can be done even on untrusted cloud storage by means of implementing trusted server. In this paper, the cloud storage data is accessed by family members of patient and medical authority.

The details of patient are stored in the cloud system. Suppose, consider a situation by which a family member named as TRUDY attempts to collect details of a patient whose details are not suppose to be accessed by him. Then the trusted server which acts like a third party auditor would not allow this activity. Here, trusted computing is taken place. Untrusted cloud sometimes attempts to take data stored in it. Then trusted server will not allow the cloud server to access the data. Only the data owner can manipulate the data, If data owner give his credentials to access the data to somebody, they can also access the cloud data. Here, data owners have unlimited access over the data and cloud has no rights over the data.

F. Signal Extraction and Neural Network Engine

Nowadays, one of the major applications of wireless sensor networks is monitoring of heath and related services. A huge number of sensors are dispersed in surroundings to aggregate and analyze data. In health monitoring system that can worn by user are some recent advancements. Sensors are mounted on the human body and these sensors are connecting the patients to analyze the physiological parameters on-line. The physiological parameters analyzed are heartbeat rate, blood pressure and temperature of body. Fig. 4 illustrates the input nodes, hidden layer and output of neural network used in the health monitoring system. In mobile HMS (Health Monitoring System), the physiological state of patient is analyzed and derives a conclusion whether his state is serious or not. Information retrieved by the Smart-phone and it is given to a neural network engine which uses a back propagation algorithm to fuse the data from the various sensors. Then the derived result is converted into binary result. Here, a hidden layer is used. The neural network implemented here is a neural network. This neural network is based on perception. Initially some samples are collected from the application. Then these samples are trained. To determine the worst situation of patient in a piece of data, some accepted norms are used. The Encog Neural Network Framework for .Net [10] is used to develop the neural network engine. Two weighted synapses such as hidden layer and connecting hidden layer is used. The output layer is connected by hidden layer. For this type of HMS, the sensor nodes are worn by user. Each node can decode the EMG (Electromyography) and EEG (Electroencephalogram) signals of the patient. The power to sense, sample, process and communicate wireless is the features of neural network used here.

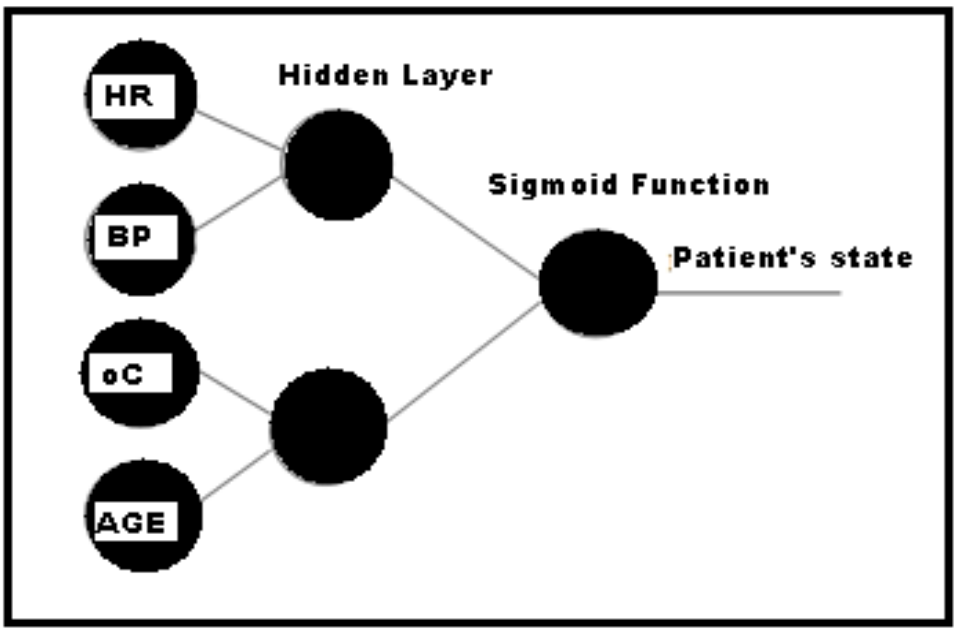

Fig. 4. Overview of a neural network used for health monitoring. The neural network engine fuses data from four inputs and uses one layer of hidden perceptions to calculate the sigmoid function

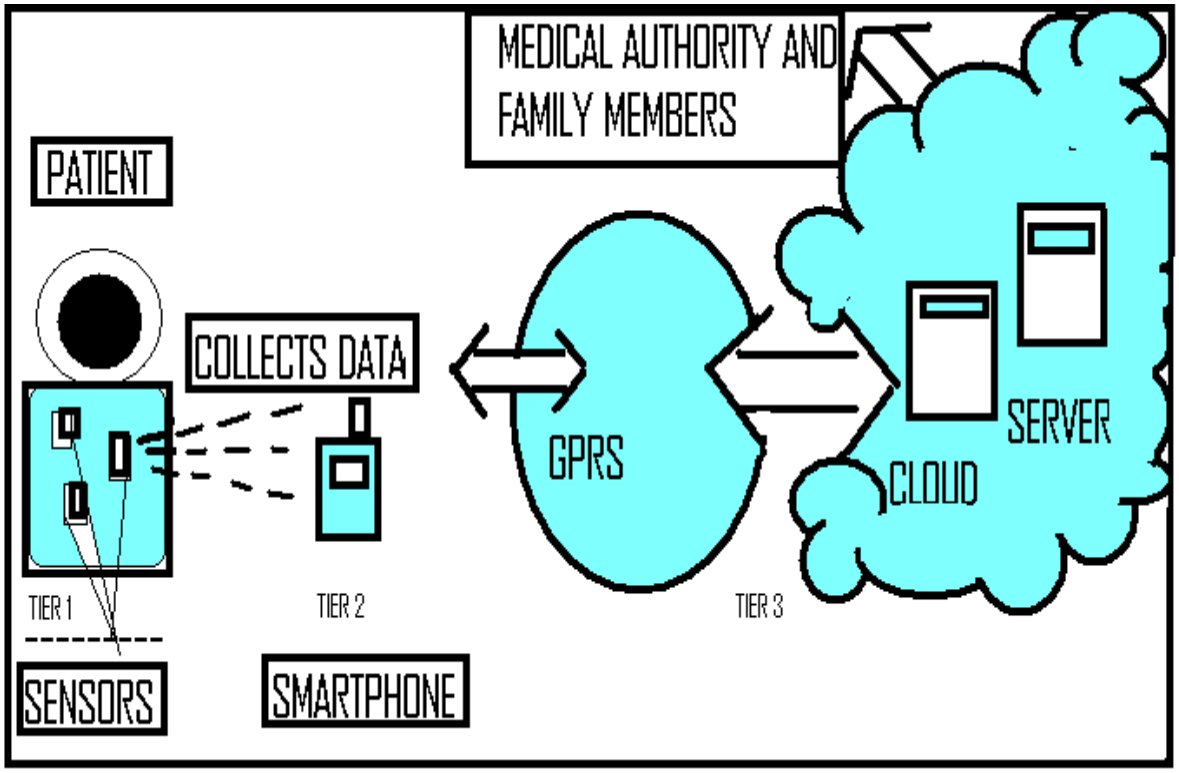

Fig. 5 The system architecture of Smartphone based wearable device and health monitoring

The measuring and reporting of the physiological state of patient is done by sensor network nodes. The physiological sensors are ECG (Electrocardiogram), EEG, EMG. The system includes other sensors that can serve as location finder of user and also manipulate the states of users. The various states of patient may be lying, sitting, walking, running etc. Information corresponding to 540 instances is used to train the data. If measurement of the sigmoid output is higher than 0.5, patient is in a serious state otherwise he is normal. The wearable electronic skin is collecting the physiological signals and it is converted into a neural network.
If measurement of the sigmoid output is higher than 0.5, patient is in a serious state otherwise he is normal.

III. THE PROPOSED SYSTEM

The wearable electronic skin is collecting the physiological signals and it is converted into a neural network. For this kind of HMS, some concise sensor networks are used. High storage capacity and power of organizing are the inevitable features of WBSAN. Many sensor nodes are in this network. Vital signals of the patient are analyzed by each sensor node. The proposed system architecture is depicted in Fig. 5.

The neural network engine is running as a cloud service. The neural network engine fuses the information from multiple sensors and makes a conclusion that whether the patient is in a dangerous situation or not. The sensor nodes measure and report the user's physiological state. Not only these sensors but also the system consists of sensors that can help to analyze the user's location, and also manipulate the user's states. The various states of patient may be lying, sitting, walking, running etc. The extracted information regarding the patient data is the sensory parameters. This is fed in to the neural network engine. The proposed system illustrates general system architecture of a medical monitoring information system that includes a personal server at Tier 2 and a series of medical servers in the cloud at Tier 3.The cloud service enables a smooth functioning of the health monitoring system. The Smartphone manipulates the signals decoded by the sensors with the help of a device called accelerometer. Then by means of GPS, the information regarding the patient is fed into the cloud server. Here, without bothering whether the storage is trusted or untrusted, the data is safe and not misused. This is done by the implementation of the trusted server in between the sender and receiver. Then only data owner can manipulate the data. The cloud also does the reporting of the information retrieved by the neural network engine. Neural network engine is running as a cloud service. The each node represents data and by means of backpropogation, the accurate data is retrieved via Smartphone. HTML and Python can be used as coding languages for the front end.

IV. CONCLUSION

Neural networks are used as powerful tools for controlling cyborgs. By implementing wearable sensors, the ability of them can be enhanced. The physiological signals retrieved by the sensors are analyzed using a cloud service. It is done by the help of neural network analysis. The data is fused by neural network engine. The main applications of wearable skin can be seen in mobile cloud health monitoring system. This health monitoring system minimize the enormous costs spend by people in hospitals since such health monitoring is happening real-time by simply being in home. It can be also used in many applications such as driver safety mechanisms. Thus it can make him alert while driving and also the current physiological state of the driver can be analyzed lively by a monitoring system by smart-phone technology and cloud computing. The design metaphor of wearable skin is human skin and basic principles of sensing are derived from it.

REFERENCES

[1] M.H. Lee, *Tactile Sensing: New Directions, New Challenges*, (The International Journal of Robotics Research, 2000)
[2] Dean A. P, *Neural Network Vision for Robot Driving*, (Carnegie Mellon University, 1989)
[3] V. K. Varadan , *e-Nano Ex Sensor System: Smartphone-Based Roaming Health Monitor* , (Journal of Nanotechnology in Engineering and Medicine, 2011)
[4] Ali Javery, *User-Interactive Electronic Skin for Instantaneous Pressure Visualization*, (Nature Materials, 2013)
[5] Someya. T, *An Ultra-Lightweight Design for Imperceptible plastic electronics*, (Nature Materials, 2013)
[6] Abderrahim. B, *A New Architecture of a Ubiquitous Health Monitoring System:A Prototype Of Cloud Mobile Health Monitoring System*, (BELKAID University, Tlemcen,Algeria, 2012)
[7] M. Yong-Lae Park, *Design and Fabrication of Soft Artificial Skin Using Embedded Microchannels and Liquid Conductors,* IEEE SENSORS JOURNAL, VOL. 12, NO. 8, (2012)
[8] http://www.nihonkohden.com/products_en/type/mon/bsm6000.html
[9] Small Form Factor Computers Go Ultra-low Power,(http://www.techbriefs.com/component/content/article/1096-et/features/16202-small-form-factor-computers-go-ultra-low-power), (Tech Briefs, 2013)
[10] Mohamed.F, http://code.google.com/p/encog-java(Algeria, 2009)