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A ***Project Plan*** on

**Head movement based wireless communication with speech alert for Paralyzed Person**

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**SOFTWARE REQUIREMENT SPECIFICATION**

#### CONTENTS

1. **PRODUCT OVERVIEW**
2. **EXTERNAL INTERFACE REQUIREMENTS** 
   1. **User Interfaces**
   2. **Hardware Interfaces**
   3. **Software Interfaces**
   4. **Communication Interfaces**
3. **FUNCTIONAL REQUIREMENTS** 
   1. **Functional Requirement 1.1**
   2. **Functional Requirement 1.2**
   3. **Functional Requirement 1.3**
   4. **Functional Requirement 1.4**
   5. **Functional Requirement 1.5**
   6. **Functional Requirement 1.6**
   7. **Functional Requirement 1.7**
   8. **Functional Requirement 1.8**
4. **SOFTWARE SYSTEM ATTRIBUTES** 
   1. **Reliability**
   2. **Availability**
   3. **Security**
   4. **Portability**
   5. **Maintainability**
   6. **Performance**
5. **PERFORMANCE REQUIREMENTS**
6. **DATABASE REQUIREMENTS**
7. **DESIGN CONSTRAINTS**
8. **OTHER REQUIREMENTS**
9. **PRODUCT OVERVIEW**

There are many cases of patients with partial paralysis of the body parts where in patients are not able to move some of their body part like limbs i.e. hands and legs and hence become totally dependent on others even for smaller tasks like controlling a fan’s speed on turning on/off the lights etc. This project exploits the limited head movement capability of the patients and uses movements of head as a trigger to control certain home appliances and also use voice recognition in order to recognize the voice of the patient to do similar tasks which are simple like controlling of simple home appliances and yet the patient depends on others. The idea behind this project is to reduce the dependency of the paralyzed patient on others for very simple yet necessary day to day tasks.

Apart from this we intend to add a functionality to alert people in case of an emergency situation where in there is an absolute requirement of other people to attend the patient. With a motion of the head the patient can shake his head in a particular fashion to alert others of some uncomfortable or emergency situation and the attendants of the patient need not always monitor him from close by as an alert can be created and passed on to a person far off also by using an existing cloud infrastructure.

Apart from this there is a way to monitor the real time activities of the patient and monitor all the commands that have been executed by the head movement of the patient in a span of last two hours to check for any irregularity in the behavior of the patient using a web app or android app for the same.



**2. EXTERNAL INTERFACE REQUIREMENTS**

**2.1 User Interfaces:**

The user interface includes an Android Application. The android application will be highly interactive, efficient, and attractive but would yet be simple and possess a sleek look. Also this interface will be highly user friendly and will perform two important tasks. One of them is that it would monitor the previous movements made by the patient. Another task is that it would enable the user to keep a track of patient’s head movements that patient makes as per his needs. The user interface shall be implemented using Java and a framework like Android Studio. A web application to can be implemented where alerts are triggered to keep the relatives informed in case of emergency events.

**2.2 Hardware Interfaces:**

Accelerometer Sensor is connected to the head of the patient according to the movement of the head the flex sensor bends and corresponding to that the resistance of the flex sensor changes. The output of the flex sensor is connected to the ADC where it gives digital equivalent voltage to the analog input.

Micro controller gets digital inputs from ADC. Program is burnt into micro controller which is connected with Zigbee. Zigbee is a Wireless transceiver. Where it can receive signals up to 100m. UART protocol is used to communicate between micro controller and Zigbee.

Receiver Zigbee receives the signals and transfers it to the micro controller through UART. The controller activates the relays according to the input condition. The relays activate the home appliances which is required

**2.3 Software Interfaces:**

The values are sensed from the accelerometer sensors which is then fed to the microcontroller. An embedded C program is written and embedded into it to covert the sensor value to a corresponding voltage value as its output. Further Java and a framework like Android Studio will be used to develop the Android Application and also to send the intended Gmail Alerts to the doctor. Further CSS, HTML5 etc. can be used to develop the Web Application which runs on an Apache Tomcat Server.

**2.4 Communication Interfaces:**

SMTP is the communication protocol used to send Email Alerts to the doctor which uses port number 25. Further for the Web Application HTTP protocol is used which runs on port number 80. Also a wireless signal is used as the communication interface between the wearable computing kit and the Android Application running on the mobile device of the user. Also a voice message is played out to the user upon the receipt of the wireless signal indicating emergency alert and serves as another type of communication interface between the Android Application and the user.

**3. FUNCTIONAL REQUIREMENTS**

**3.1 Functional Requirement 1.1: Tracking of the head movements**

The head movements can be constantly monitored by the user in the android application and thus can take preventive measures.

**3.2 Functional Requirement 1.2: Status Check**

Patient’s status is checked continuously and provided in the android app.

**3.3 Functional Requirement 1.3: Online Monitoring**

The values sensed by the accelerometer sensors can also be monitored online with the help of a web application. This is particularly helpful when the user is alone and others want to monitor his/her status.

**3.4 Functional Requirement 1.4: Handle Emergency Events**

The user is provided with an Emergency head movements to trigger the alerts and also to activate the buzzer.

**3.5 Functional Requirement 1.5: Attention of Surroundings**

Once the buzzer has been activated by the user and he/she has drawn the attention/help of the people in the surroundings, it can be turned off with the help of reset button.

**3.6 Functional Requirement 1.6: Maintaining History**

The Android Application also maintains a log/history of the sensed values which be accessed at any time.

**3.7 Functional Requirement 1.7: Voice Message Alert**

The Android application also has the functionality of converting the wireless signal into a corresponding voice signal in order to provide a voice alert.

**4. SOFTWARE SYSTEM ATTRIBUTES**

**4.1 Reliability:**

The reliability of the product depends on the lifetime of the accelerometer sensors and the accuracy of the measurement. As lifetime and accuracy is high the system is reliable. Further the android application would be rigorously tested to ensure that the application does its intended tasks in real time and doesn’t generate fake alerts due to some bugs.

**4.2 Availability:**

The basic functionality of the system is always available as long as the device is worn by the user. For android updates and status monitoring internet connectivity is needed.

**4.3 Security:**

Only the authorized phone of the user must be capable of receiving the alerts and more over the data readings stored in the android application must be kept safe and thus authentication and authorization can be added

**4.4 Portability:**

One of the features of Java is that it is architecturally neutral i.e. the code is machine/platform independent. Thus the same application can run on different Android phones and its backward compatible with respect to a specific Android phone version.

**4.5 Maintainability:**

The Android application needs to maintained and updated in case of any bugs. Updated applications will be free from bugs and also some design oriented changes can be incorporated to make the interface more user-friendly and attractive.

**4.6 Performance:**

The product’s performance is measured in terms of response of the appliance when the head based command is given. A product with high performance will be delivered. Performance is high if the throughput is high, latency is low, response time is less and system dependability exists.. Performance is also affected by the speed of internet connectivity for updating the web application and also for sending emergency Alerts.

**5. PERFORMANCE REQUIREMENTS**

The only way in which systems will meet their performance targets is for them to be specified clearly and unambiguously. In order to assess the performance of the product the following are clearly specified:

* **Response Time**- It depends on the microcontroller used as it needs to execute the embedded program to convert the sensor value into a voltage signal and then needs to transmit the Bluetooth signal. The response time needs to be low.
* **Workload**- Even if the workload on the system is increased the performance doesn’t degrade as Rensas RL78 microcontroller has a 16bit CISC architecture. RL78 is designed specifically for ultra-low power applications enabling customers to build compact and energy-efficient systems at lower cost.

**6. DATABASE REQUIREMENTS**

A database is used to provide persistent offline storage as it keeps a log of the values sensed by the accelerometer sensors along with the date and time. The database used needs to be a relational database, for example MySQL can be used.

**7. DESIGN CONSTRAINTS**

1. **Space**: The amount of space occupied by the embedded program must be less as it needs to be incorporated into the Rensas RL78 microcontroller. Further the android application must be of size less than 20MB.
2. **Application memory Usage**: The amount of memory that is cache as well as main memory used must be low while executing the embedded program. This is to meet the requirements of the microcontroller.

**8. OTHER REQUIREMENTS**

1. **Documentation:** A detailed user manual which is easy to follow must be developed and also an online demonstration of how to use the product must be available.
2. **Android version:** The application developed must be simulated on the latest Android version and also it needs to be backward compatible.