SLEEP APNEA MONITORING AND DIAGNOSTIC SYSTEM USER MANUAL

Team Snooze

Version 1.0
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User Manual

Version 1.0

Contents

A. Introduction

1. Purpose Document

This document has been created to provide users a look at how the product system works and how to set up the product correctly. With addition to giving administration maintenance tips.

2. Scope

This information is beneficial to first-time users and system management in handling the systems.

B. System Description

A. Key Features

Features of this system are sensor systems that measure different patient physiological variables:

- Temperature
- Body Movement
- Oxygen Saturation
- Heartrate
- Airflow Movement

Also contained within this system is an Android™ application that allows for wireless Bluetooth™ sensor connections to each of the aforementioned sensor system. This application will calibrate and aggregate data from the sensors to be uploaded to cloud storage systems. It will also take an audio recording of the patient that will be uploaded to cloud storage systems.

The last feature of this system will be the cloud storage and processing systems. These systems will take sensor data, graph and score that respective data, and store/archive the data into appropriate secured areas in storage for administrator (physician) use.

B. Inventory

Sensor Systems
- 1 x Temperature Sensor System
    - 500mAH battery w/ USB charging adapter
- 1 x Body Movement Sensor System
    - 500mAH battery w/ USB charging adapter
- 1 x Heartrate & Oximetry Sensor System
    - 500mAH battery w/ USB charging adapter
- 1 x Airflow Microphone Sensor System
    - 500mAH battery w/ USB charging adapter

Smartphone Application Systems
- 1 x Android Smartphone
  - USB charging adapter (micro/mini/type-C)
  - Snooze Application Installed.

Cloud Systems
- 1 x AWS S3 Instance (running)
- 1 x AWS EC2 Instance (running)
- 1 x AWS Lambda Instance (running)
- 1 x Windows/Linux/Mac OS X Computer
  - To access web interface for cloud systems.

C. Environment

For software compilation and ability to upload code to the Arduino Nano microcontrollers, Arduino IDE will be needed [**Download Here if Required**]. For code compilation of the Android™ application, Android Studio IDE will be needed [**Download Here if Required**].

The Hardware used for this project consists of:

- 4 Arduino Nano Microcontrollers w/ 500mAh battery packs.
  - 1 x NTC Thermistor
  - 1 x Sparkfun Reflective Particle Sensor (Heartrate & Oxygen Saturation)
  - 1 x Electret Microphone & Amplifier MAX4466
  - 1 x 3-Axis Accelerometer
  - 4 x LM2577 Mico USB DC Voltage Regulator Step Up Boost Converter
  - 4 x JY-MCU HC-06 Bluetooth boards
- Android™ Smartphone
- Computer
  - For AWS systems access (cloud services).

Access to wireless internet (Wi-Fi) will be required for the operation of this system.

D. System Operations

Normal systems operations entail sensors successfully connecting to the smartphone/smartphone application over Bluetooth. These sensors will transmit data to the smartphone application, which will then transfer all data files to the AWS cloud systems once the session has ended. AWS systems will process those files into individual graphs and summaries for the physiological variables that are tested in this system.

C. Product Installation

A. First-Time Users

First time users will be required to download the specified software to compile and upload modules of this system to their respective hardware. First-time administrators (physician) that will manage the cloud system will need to make no changes to the Amazon Web Services cloud systems as they will be in their working, default configuration upon use.

B. Access Controls

End-User (Patient) will be required to create an account upon first use of the Android™ application. They will have no access to any created data from the sensor systems.

Physician will be required to be an administrator of the Amazon Web Services account where data will be stored and processed. They will have full access to all patients that have been registered and have uploaded data to the cloud services.

C. Installation

After downloading the software from the Github linked [**here**], open your Arduino IDE software. Within Arduino IDE, open the individual sensor '*.cc' files within the IDE. For each corresponding sensor (example: ard_temp_sensor.cc -> Temperature Sensor microcontroller), verify/compile and upload the code to each respective sensor system over a mini-USB connection.

For the Android™ application, download the application (file ending in '.apk') from the Github linked [**here**] to your smartphone. Once downloaded, please install that application to your smartphone. Once installed, turn on the Bluetooth function of your smartphone in the Android™ device settings. Also make sure that your smartphone is connected to an internet source, either through Wi-Fi, or 'Mobile Internet' from your phone services provider.

Finally, connect the battery packs to each individual sensor system. This will automatically turn on each sensor system.

In the Android™ application, register a user account within the application and log into the application with those credentials. Once inside the application, navigate to the Bluetooth Synchronization item, and click the 'Bluetooth Synchronization' button at the bottom of the screen. Click 'Make Discoverable' -> 'Yes', and then click 'Search'. Pair each sensor system that shows up in the list by pressing those items and typing the Bluetooth pairing code. Once all sensors have been paired, you can go back to the application's Main Menu and press 'Start Recording' to begin.

D. Configuration

Each sensor system will be assigned a unique device identifier name that corresponds with their function. If the sensor system does not have a unique device identifier name pre-configured, differentiate between sensor systems through hardware MAC address strings.

E. Starting the System

Start the system by opening up the Android™ application on the user's smartphone. Once open, take each battery pack and connect it to the open lead on each sensor system. This will cause the sensor system to start up. Once all sensor systems have been paired and calibrated, the user may start the data recording within the main menu of the application. To start the cloud instance, access the AWS Console and navigate: **Action -> Instance Status -> Start.**

F. Stopping the System

Press 'Stop Recording' within the Android™ application and remove the battery packs from each sensor system (unplug). To stop the cloud instance, access the AWS Console and navigate: **Action -> Instance Status -> Stop.**

G. Suspending the System

The sensor system does not support suspended operation. To stop the cloud instance, access the AWS Console and navigate: **Action -> Instance Status -> Stop.**

D.   Step-by-Step Usage

A. Instructions

Proper use and functionality of this system would be that data files will be successfully created and stored on the AWS cloud storage system. From those data files, a scoring report will have been created in the respective folder, along with each sensor data file having been graphed and compiled into a .pdf file.

B. Conventions

There are currently no error messages that will be relayed within the system. If data is not being produced properly, please check that all connections have been made (physically or wireless connections).

C. Errors, Malfunctions, & Emergencies

There are currently no error messages that will be relayed from the individual sensor systems. If no power is being received by a sensor, power indication lights on the microcontroller (green light) or on the BT module (red light) will not light up. If this occurs, please check to see if the battery connection is fully connected, and that the battery has been charged.

Error messages associated with the smartphone application are listed in the section **below**.

AWS cloud systems do not display any error messages to the user. If a malfunction in AWS systems are found, please contact AWS help personnel [**Link Here**].

D. Messages

The potential error messages that may emerge during use are:

- Login failed. The provided username does not exist.
- Login failed. The provided username or password is incorrect
- Sign up failed. Invalid phone number format.
- Could not connect to Bluetooth sensors. Please try again.

Messages shown during normal operation:

- Successfully connected to sensors.
- Recording in session.
- Ended Recording session.

E.   Quick Reference

Hardware Required:

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For Installation: See **Pg. 5, Section C-C**

F. Appendixes

Reference Documents

Reference Documentation is located at Team Snooze's Github repository linked below:

- https://github.com/Kinaesthetics/Snooze_OSA

Glossary

EEG: Electroencephalography

- Test that measures electrical activity in your brain.

EOG: Electrooculography

- Test that measures the voltage between the front and back of the human eye.

EMG: Electromyography

- Test that measures muscle response to a nerve's stimulation of that respective muscle.

EKG: Electrocardiography

- Test that measures the electrical activity of your heart over a period of time

FDA: USA Food and Drug Administration

- USA Federal Agency that is responsible for the protection and promotion of public health through supervision of various industries such as food safety, etc.

IDE: Integrated Development Environment

- Software application that provides comprehensive tools for programmers doing software development.

OSA: Obstructive Sleep Apnea

- Sleep disorder that causes breathing to stop and start during sleep in a non-periodic manner.

Oximetry:

- Test that measures the oxygen saturation in one's bloodstream.

Physiological:

- Characteristic of normal functions of living organisms.

PTAF: Pressure Transducer for Airflow

- Sensor that measures respiratory pressure changes.

RIP: Respiratory Inductance Plethysmography

- Test that measures the movement of the chest and abdominal wall.

RSA: RSA SecurID

- 2-factor authentication for a user on a network resource. System was developed by Security Dynamics.

Thermistor:

- Sensor that measures temperature.

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