**HOMECARE SYSTEM**

**Short-term product**

**System Requirements Specification**

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**Working Draft**

Revision History

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# 1. INTRODUCTION

The medical market is generally divided into 3 groups: home, clinical and imaging. Home medical is low cost, portable equipment that has lower performance requirement. Clinical and hospital equipment is generally higher performance and therefore more expensive.

The object of this project is to build a health monitoring system for persons at home.

* This system willmonitor health condition of users at home by measuring physiological parameters of users, analyzing and tracking abnormal parameters then suggesting recommendation for users.
* The measurement device should be able to automatically collect data without user's medical knowledge.
* The system should be a cloud system with cloud servers for communicating/processing data from remote users and cloud database for online storing/updating user's data and patient's models.
* An application which could run on multiple platforms is needed for inter-communication between measurement devices/users and servers.
* This system will provide a low price and flexible devices,friendly and light application for users at home but cloud systems with large database for practitioners, hospitals and clinical centers.

# 2.SYSTEM OVERVIEW



FIG. 1 System overview

The system comprises a measurement device to send measured physiological signals to base station; a base station which is an application running on mobile devices or PC to collect measured data, do calculations, analysis and diagnostics, and display tracking data getting from measurement device and global database; cloud servers and database conduct web services, management and global data storage.

## 2.1 Measurement device



FIG.2 Overview of measurement device

Measurement devicecollect user physiological data using Measuring unit. These data are then processed in Processingunit. Data and processed results are displayed and informed to users through User Interface unit, transferred to remote base station using Communication unit and stored for using later in Storage unit. User Interface unit allows user to directly input personal information, modify settings and manage the systems. Power unit provides the power for the whole device. Measurement device could communicate with extensional modules via the External Interface unit.

For the short-term product, we measurement device will be a wearable healthcare device (wristband) which integrate sensor modules to collect user’s body status.

The hardware structure diagram of the short-term measurement device as FIG.3.



FIG.3 Hardware structure diagram of measurement device

## 2.2 Base station

Base station is the software which runs on computer or mobile client devices. Software is the user interface to communicate with users, receivesuser’s data from measurement device to process, analyze and diagnose diseases relating to detected abnormalities. Base station could request remote calculation from servers and historical data from remote database. Base station will display tracking data and analysis results.



FIG.4 Software block diagram

User profile: to provide user information and user settings.

Heart rate monitoring: monitors parameters relating to heart rate such as heart rate, resting heart rate, cardiograph and detects whether they are in normal range or not. The tracking results will be analyzed and diagnosed for diseases relating to heart rate.

Body measurement monitoring: monitors body parameters such as BMI, ideal weight, waist to hip ratio, body fat percentage, basal metabolic rate, calories needs per day, metabolic age, lean body weight, and muscle percentage. The parameters will be used for analysis and diagnosis about obesity and other health risks.

Fitness tracking: provides heart rate tracking, pedometer tracking and calories burned during different fitness programs.

SpO2 monitoring: monitors SpO2 level of user and detects whether it is in the normal range or not. The values will be tracked for specific patients and analyzed to get the diagnostic results.

Sleep monitoring: monitors sleep activities and quality of users through their heart rate, SpO2 level, accelerometer and skin resistance sensor. The result will be used to detect sleep duration which helps to determine diabetes and obesity risk. Besides, sleep monitoring module is also to detect sleep apnea syndrome.

Mental status/Stress monitoring: monitors mental status of user such as stress, excitement, attention, daily user’s mood using tracking heart rate, skin resistance.

Skin/Body temperature monitoring: monitorsskin/body temperature of users, sets alarms if the value excesses the normal threshold and diagnose symptoms or precursors relating to skin/body temperature variation.

Fertility tracking: track body temperature of users over a long time and forecast the best time to get the best fertility.

Position monitoring: used for disability persons who needs the support from their family members or medical assistants. Movement of patients will be tracked and alarmed.

User report: create user report with required tracking parameters, graphs, diagnostics and recommendations. Data is obtained from global database. The result could be printed or exported to different formats.

Help: provide reference information.



FIG.5 System flow chart

## 2.3 Cloud servers and database

* Server: communicates with user/measurement device via the base station. Server also analyzes user's data from day to day, sends results to the base station.
* Database: is the global user data storage.

# 3. SYSTEM REQUIREMENTS

## 3.1 Hardware Specifications

* Performance
  + Fidelity: The measurement device should meet the medical class 2 standard.
  + Battery longevity: The measurement device should work 2-3 days on fully charged battery.
  + Noise robustness: The measurement device can work in noisy environment, high activity.
* Durability
  + Weather resistance: The measurement device shall be designed to provide maximum weather resistance.
  + Shock and vibration resistance:The measurement device shall be designed to provide optimal shock and vibration resistance for uninterrupted monitoring.
  + Water resistance: The measurement device shall be designed to provide water resistance ability (not for first prototype).
* Calibration
  + Self-calibration: on software command, the device shall compute gain and offset corrections relating to high-precision internal reference.
  + Interval: recommended whenever ambient temperature varies more than +/- 5/10oC
* User friendliness
  + Key layouts: efficient placement and appropriate sizing of keys
  + Graphic user interface: simple and intuitive GUI
  + Audio: different tones for different warnings
  + Vibration
* Media Access
  + External interface: provide external interfacing through USB and blue tooth BLE
  + Storage: could have built in storage and external storage through microSD card
* Environment
  + Operating Environment
  + Storage Environment
* Safety and Standard
  + Safety requirement
  + Electromagnetic compatibility
  + CE compliance
* Power requirement: 3.7VDC

## 3.2 Use case

Refer use case suite in excel file.

## 3.3 Functional Requirements

Refer feature set in excel file.

## 3.3 Non-Functional Requirements

### Usability requirements

Our main criteria for making the system usable is the difficulty of performing each high-frequency use case. Difficulty depends on the number of steps, the knowledge that the user must have at each step, the decisions that the user must make at each step, and the mechanics of each step.

The user interface should be as familiar as possible to users who have used other web applications and windows desktop applications.

Details:

* Support learnability with principles of [Instructive Interaction](http://www.foruse.com/articles/instructive.htm)
* The customer may want extensive on-line help as well as printed manual.

### Reliability and up-time requirements

Web hosting service should provide smoothly service with high reliability, having good physical sever security and disaster recovery plan. Reliability factors to consider are length of time in business, financial strength, success track record, physical server security, disaster recovery plan.

Details:

* Look for the right mix of reliability and affordability.
* Network uptime guarantee should be 99.9% to keep our site running smoothly

### Security requirements

Access will be controlled with usernames and passwords.

Only administrator users will have access to administrative functions, average users will not.

Details:

* Passwords must be 4-14 characters long
* We will use encrypted communications (SSL) for the website
* We will use SSH channels to encrypt communications between servers, database and clients.

### Performance and scalability requirements

The performance of a computer system depends on much more than the raw processing power of its hardware. The way that hardware is configured, the way resources are allocated and managed, and the way the software is written can have significant impacts (good or bad) on the system’s ability to meet its performance goals.

The scalability property of a system is closely related to performance, but rather than considering how quickly the system performs its current workload, scalability focuses on the predictability of the system’s performance as the workload increases.

Right now we don’t have clear performance and scalability requirements, just considering some requirements while designing and developing.

Details:

* Optimize runtime memory use.
* Acceptable running time for login procedure, analysis, etc.
* Number of users: from thousands to hundred thousands

### Maintainability and upgradability requirements

Maintainability is our ability to make changes to the product over time. We need strong maintainability in order to retain our early customers. We will address this by anticipating several types of change, and by carefully documenting our design and implementation.

Upgradability is our ability to cost-effectively deploy new versions of the product to customers with minimal downtime or disruption. A key feature supporting this goal is automatic download of patches and upgrade of the end-user's machine. Also, we shall use data file formats that include enough meta-data to allow us to reliably transform existing customer data during an upgrade.

### Supportability and operability requirements

Supportability is our ability to provide cost effective technical support. Our goal is to limit our support costs to only 5% of annual licensing fees. The product's automatic upgrade feature will help us easily deploy defect fixes to end-users. The user guide and product website will include a troubleshooting guide and checklist of information to have at hand before contacting technical support.

Operability is our ability to host and operate the software as an ASP (Application Service Provider). The product features should help us achieve our goal of 99.9% uptime (at most 43 minutes downtime each month). Key features supporting that are the ability to do hot data backups, and application monitoring.

### Business life-cycle requirements

The business life-cycle of a product includes everything that happens to that product over a period of several years, from initial purchase decision, through important but infrequent use cases, until product retirement. Key life-cycle requirements are listed below.

Details:

* Customers must be able to manage the number of licenses that they have and make informed decisions to purchase more licenses when needed
* The product shall support daily operations and our year-end audit
* The customer data shall be stored in a format that is still accessible even after the application has been retired

## 3.4 Environmental Requirements

### Application program interfaces ([APIs](http://readyset.tigris.org/nonav/templates/glossary-std.html#api)) must be provided

Details:

* We must implement the[API](http://readyset.tigris.org/nonav/templates/LINK-TO-STANDARD) for communication between measurement device and base station.
* We must implement the [API](http://readyset.tigris.org/nonav/templates/LINK-TO-STANDARD) for communication between base station and managing server.

### Data import and export requirements

Details:

* The system will store all data in a standard SQL database, where it can be accessed by other programs.
* The system will store all data in an XML file, using a [standard DTD](http://readyset.tigris.org/nonav/templates/LINK-TO-STANDARD).
* The system will read and write valid .XYZ files used by other applications