

**Software Requirements Specification**

**for**

**EKG Using Cloud Services**

**Version 1.0**

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**Revision History**

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| --- | --- | --- | --- |
| **Name** | **Date** | **Reason For Changes** | **Version** |
|  |  |  |  |
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**1. Introduction**

**1.1 Purpose**

The purpose of this document is to provide an informative description of the Electrocardiography Cloud Services. More precisely, an enhancement on the overall system. Further, this document shows both functional and non-functional requirements, as well as other requirements such as features, and the system interface.

**1.2 Document Conventions**

This Document was created based on the IEEE template for System Requirement Specification Documents

**1.3 Intended Audience and Reading Suggestions**

This SRS document is applicable to Developer, System Architect, System Tester, System Manager, and stakeholder.

The remaining sections of this document are organized in the following order, in Selection 2 an overall general description of the project is discussed. Section 3 provides external interface requirements that include user GUI, software, hardware, and communication interface. Section 4 gives the domain model. Whereat section 5 discusses system features, which include use cases and functional requirements. Finally, non-functional requirements are covered in section 6.

**1.4 Product Scope**

This EKG Cloud Service system delivers an improvement over existing EKG systems. This system will facilitate the process of viewing and monitoring patient records by healthcare professionals. Furthermore, the system allows healthcare providers to deliver personal and reliable services towards patients’ overall experience. That encompasses advance alerts for critical changes in their EKG study, in conjunction with maintaining scalability, security, and accuracy. Also, to grant patients real-time access to their records. Thus, system administrator can implement any necessary modification.

**1.5 References**

1. Hsieh, Jui-chen; Hsu, Meng-Wei; ‘BMC Medical Informatics and Decision Making’ <https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/1472-6947-12-77>

2. Nasiff Associates, Inc. ‘CardioCard EKG Module’

<https://nasiff.com/ecg_restingbt.html>

3. Amazon Web Services – Internet of Things Framework,

<https://aws.amazon.com/iot/>

# Health and Human Services, ‘Summary of the HIPAA Privacy Rule’,

<https://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html>

**2. Overall Description**

**2.1 Product Perspective**

*<Describe the context and origin of the product being specified in this SRS. For example, state whether this product is a follow-on member of a product family, a replacement for certain existing systems, or a new, self-contained product. If the SRS defines a component of a larger system, relate the requirements of the larger system to the functionality of this software and identify interfaces between the two. A simple diagram that shows the major components of the overall system, subsystem interconnections, and external interfaces can be helpful.>*

**2.2 Product Functions**

*<Summarize the major functions the product must perform or must let the user perform. Details will be provided in Section 4, so only a high level summary (such as a bullet list) is needed here. Organize the functions to make them understandable to any reader of the SRS. A picture of the major groups of related requirements and how they relate, such as a top level data flow diagram or object class diagram, is often effective.>*

**2.3 User Classes and Characteristics**

*<Identify the various user classes that you anticipate will use this product. User classes may be differentiated based on frequency of use, subset of product functions used, technical expertise, security or privilege levels, educational level, or experience. Describe the pertinent characteristics of each user class. Certain requirements may pertain only to certain user classes. Distinguish the most important user classes for this product from those who are less important to satisfy.>*

**2.4 Operating Environment**

*<Describe the environment in which the software will operate, including the hardware platform, operating system and versions, and any other software components or applications with which it must peacefully coexist.>*

**2.5 Design and Implementation Constraints**

*<Describe any items or issues that will limit the options available to the developers. These might include: corporate or regulatory policies; hardware limitations (timing requirements, memory requirements); interfaces to other applications; specific technologies, tools, and databases to be used; parallel operations; language requirements; communications protocols; security considerations; design conventions or programming standards (for example, if the customer’s organization will be responsible for maintaining the delivered software).>*

**2.6 User Documentation**

*<List the user documentation components (such as user manuals, on-line help, and tutorials) that will be delivered along with the software. Identify any known user documentation delivery formats or standards.>*

**2.7 Assumptions and Dependencies**

*<List any assumed factors (as opposed to known facts) that could affect the requirements stated in the SRS. These could include third-party or commercial components that you plan to use, issues around the development or operating environment, or constraints. The project could be affected if these assumptions are incorrect, are not shared, or change. Also identify any dependencies the project has on external factors, such as software components that you intend to reuse from another project, unless they are already documented elsewhere (for example, in the vision and scope document or the project plan).>*

**3. External Interface Requirements**

**3.1 User Interfaces**

The following illustrations are mock ups of the type of user interface that can be expected on the final product. There are three types of users for the system: patients, doctors/nurses and EKG specialists, and system administrators.

**Patient Interface**

The patient has the most limited amount of accessibility to the software. The patient is only responsible for attaching the EKG leads in the home setting and starting the data logging software on the tablet as shown in Fig. 3.1:

Graphical user interface

Description automatically generated

**Fig 3.1: Patient side tablet view. Note that inaccessible features are grey.**

**Doctors, Nurses and EKG Specialists**

Doctors, nurses, and EKG specialists can access the EKG system by mobile device or web browser. The user interface for these users are shown in figures 3.2, 3.3, 3.4, and 3.5.

**Graphical user interface

Description automatically generated**

**Figure 3.2: Login page for web users.**

**Graphical user interface, table

Description automatically generated**

**Figure 3.3: Patient directory page for web users.**

**Graphical user interface, text

Description automatically generated**

**Figure 3.4: Patient record view (web browser)**

**Graphical user interface

Description automatically generated**

**Figure 3.5: Patient record view (mobile)**

**System Administrators**

System administrators use the same log in screen to sign into the system admin web portal. They are taken to the interface in figure 3.6:

Graphical user interface, application

Description automatically generated

**Figure 3.6: System Administration Dashboard**

**3.2 Hardware Interfaces**

Since this system is meant to complement medical equipment, an attempt has been made to incorporate as much existing hardware as possible to avoid lengthy approval processes by the FDA. As such, the 12 EKG leads and EKG Data Acquisition System (DAQ) use existing hardware. The DAQ chosen is the Nasiff CardioCard Mobile. It connects directly to the EKG leads and communicates wirelessly via Bluetooth to a tablet in the patient’s home. Figure 3.7 shows the EKG DAQ. It may also be connected via USB.



Figure 3.7

**3.3 Software Interfaces**

The following is used as software interfaces:

* Amazon Web Services - Cloud Environment

Amazon Web Services has all of the tools necessary to implement this system across web browsers and mobile devices. Amazon RDS will be used as an SQL database. Amazon S3 File Storage is used to house EKG files for use by the core web service. The doctor’s mobile device interfaces directly with the core web service through an application. Otherwise, the core web service interfaces with the web portal for use with web browsers.

**3.4 Communications Interfaces**

Communication interfaces to be used:

* Bluetooth
* USB
* HTTPS
* Wi-Fi
* Ethernet

Bluetooth or USB may be used to transfer the raw EKG data to the collection device. The collection device requires an internet connection. The data is then transferred via HTTPS to the Amazon Cloud service. Once in the cloud, the data can be accessed from a client device through HTTPS. The client device may be networked via ethernet or Wi-Fi.

**4. Domain Model**

<Sometimes, this section is optional. However, it may be important to have it since domain model may give more useful as well>

**5. System Features (Use Cases)**

*<This template illustrates organizing the functional requirements for the product by system features, the major services provided by the product. You may prefer to organize this section by use case, mode of operation, user class, object class, functional hierarchy, or combinations of these, whatever makes the most logical sense for your product. You should Use-case diagram>*

**5.1 Use Case 1**

*<Don’t really say “Use case 1.” State the feature name in just a few words.>*

***5.1.1 Name:***

***5.1.2 Goal:***

***5.1.3 Input:***

***5.1.4 Output:***

***5.1.5 Main Scenario:***

***5.1.6 Pre-condition:***

***5.1.7 Steps:***

*5.1.7.1 Step1:*

*5.1.7.2 .*

*5.1.7.3 Step n:*

***5.1.8 Post-condition***

***5.1.9 Exceptional Scenario 1***

***5.1.10 Example***

**5.2 Use Case 2 (and so on)**

**6. Other Nonfunctional Requirements**

**6.1 Performance Requirements**

* Due to the significant and pressing nature of many electrocardiogram results, the EKG cloud service should be available to all users at all times. That is, the cloud service should be accessible at all hours of the day, every day of the week, and every week of the year.
* EKG data input stream will be limited by the user’s internet connection/speed. Once the data is in the file storage, however, the maximum response time for accessing the data files should be 5 seconds in order to better facilitate rapid responses from the medical team(s).
* The file storage will be replicated over multiple independent cloud servers to decrease the risk of failure. If a failure occurs on the initial file storage server, the database will point to a different server in order to keep the data transaction seamless.
* Uptime and downtime for the system will be continuously evaluated so that necessary maintenance operations will occurs during times that have the least probability for negatively impacting users.

**6.2 Safety Requirements**

* The SQL database will simply store pointers to files in the Amazon S3 file storage. This will increase speed of database requests and insure that the database is not capable of modifying or interfering with the EKG data.
* EKG data will not be allowed to be deleted, and will instead be archived on the user side.
* The system will maintain log files which will allow data recovery and allow system admins to recognize points of failure in order to communicate inefficiencies with the development team.
* Database restore points will be created frequently in order to allow the database to rollback to a previous state.

**6.3 Security Requirements**

* Users (patients and/or medical staff) will not have direct access to the Amazon RDS database or the Amazon S3 file storage. Only authorized members of the software development team will have access to these.
* Users will have unique IDs, and their passwords will be required to be at least 8 characters long, case sensitive, and include letters, numbers, and symbols.
* Accounts for medical staff will be generated and confirmed by the clinics/hospitals/etc. using the software in order to insure that only authorized medical staff are able to access the software. Additionally, the respective medical facilities will be responsible for determining which nurses or attendants belong to a specific doctor’s team.
* Doctors will be required to verify patients as users before patients are allowed to submit data. Likewise, patients will be required to confirm that they are sending data to the correct doctor. This is an extra precaution to insure that patient data is not erroneously sent to unintended users.
* Doctors will confirm the privileges allowed for each member of their team.
* Database encryption will be employed as an additional precaution against data interception.

**6.4 Software Quality Attributes**

* Adaptability: This is a measure of the software’s ability to adapt to changes in its environment. By using our database to point to files, we allow more efficient options to be easily interchanged in the future.
* Availability: This is a measure of the system’s ability to be accessed when needed. Scheduling maintenance during calculated downtimes allows the software’s unavailability to be limited and impact the fewest users.
* Portability: This is a measure of the software’s ability to be used within multiple environments. By providing a web portal, we allow the software to largely be impartial in regards to operation on user devices.
* Reliability: This is a measure of the system’s ability to be error-free over a given period of time. The replication of our file storage allows for quick recovery options if a file storage server fails.
* Usability: This is a measure of the software’s ability to be efficiently and effectively used by users. The high availability, portability, and reliability of our system combined with a simple user interface helps to insure a positive user experience that is characterized by ease of use.

**7. Other Requirements**

*<Define any other requirements not covered elsewhere in the SRS. This might include database requirements, internationalization requirements, legal requirements, reuse objectives for the project, and so on. Add any new sections that are pertinent to the project.>*

**Appendix A: Glossary**

*<Define all the terms necessary to properly interpret the SRS, including acronyms and abbreviations. You may wish to build a separate glossary that spans multiple projects or the entire organization, and just include terms specific to a single project in each SRS.>*

**Appendix B: Analysis Models**

*<Optionally, include any pertinent analysis models, such as data flow diagrams, class diagrams, state-transition diagrams, or entity-relationship diagrams*.>

**Appendix C: To Be Determined List**

*<Collect a numbered list of the TBD (to be determined) references that remain in the SRS so they can be tracked to closure.>*