**Software Requirements Specification**

**For**

**An Intelligent Medical Diagnosis Tool**

**Version 2.2 approved**

**Prepared by Kekirunga Jean**

**Kisiga Timothy**

**Mugisa Best**

**Nabuufu Ereth**

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Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Date** | **Reason for Changes** | **Version** |
| Kekirunga Jean | 3rd November, 2019 | Modifying the Project Name | 2.0 |
| Kisiga Timothy | 1st November, 2019 | Adding system interfaces | 1.1 |
| Kekirunga Jean | 26th October, 2019 | Updating the Use-case and Context diagram | 1.1 |
| Nabuufu Ereth | 24th October, 2019 | Adding UML diagrams | 1.1 |
| Mugisa Best | 21st October,2019 | Updating the functional requirements | 1.1 |

# Introduction

## 1.1 Purpose

The purpose of this document is to present a detailed description of the expected features and functionalities of the system to be developed and implemented; an Artificial Intelligence Deep-Learning Diagnostic tool that can recognise diseases with minimal human-oriented diagnosis.

This document further explains the operating environments, interfaces, functional requirements, non-functional requirements and software attributes for the system.

## 1.2 Document Conventions

This document follows the IEEE format; bold faced font has been used for emphasis, headings and sub headings. Highlighted words are used in the glossary and italicized text is used in the diagram labelling.

## 1.3 Intended Audience and Reading Suggestions

This document is intended for mostly the doctors of Mulago Hospital, system development team, project managers and supervisors, plus the system testers.

## 1.4. Product Scope

The system to be built is an artificial intelligence deep-learning tool with web-based features. The main purpose of this system is to help doctors quickly recognise diseases with different symptom patterns in patients.

Other objectives of this project include;

* To collect ground-truth data that can be used to map diseases to symptoms.
* To build an intelligent disease recognition system.
* To test and validate the use of both Artificial Neural Networks (ANN) and Convolutional Neural Network (CNN) as a hybrid method for Feature selection and Feature extraction in machine learning.

## 1.5. References

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# 2. Overall Description

In this part, background information about specific requirements of the system will be provided briefly. General issues that affect the product and outline of the functional requirements will be mentioned too. In short, this section will mainly give information about product perspective, product functions, constraints, assumptions and dependencies.

## 2.1 Product Perspective

This product is one of Medical diagnostics. Medical diagnostics are a category of medical tests designed to detect infections, conditions and diseases. Today, AI is playing an integral role in the evolution of the field of medical diagnostics. [Recent healthcare AI industry research](https://emerj.com/ai-market-research/machine-learning-in-healthcare-executive-consensus/) suggests that around a third of all healthcare AI SaaS companies are focusing partly or exclusively on diagnostics – making it one of the largest focus areas for burgeoning start-ups in the field.

The Institute of Medicine at the National Academies of Science, Engineering and Medicine [reports](http://www.nationalacademies.org/hmd/~/media/Files/Report%20Files/2015/Improving-Diagnosis/DiagnosticError_ReportBrief.pdf) that “diagnostic errors contribute to approximately 10 percent of patient deaths,” and also account for 6 to 17 percent of hospital complications. It is important to note that physician performance is typically not the direct cause of diagnostic errors. In fact, researchers attribute the cause of diagnostics errors to a variety of factors including:

* Gaps in communication among clinicians, patients and their families.
* Malpractice in Health institutions
* Inefficient collaboration and integration of health information technologies (Health IT)
* A healthcare work system which, by design, does not adequately support the diagnostic process.

To address these challenges many researchers and companies are leveraging artificial intelligence to improve medical diagnostics. These medical diagnostics fall under different categories.

* **Chat bots**: Companies are using AI-chat bots with speech recognition capability to identify patterns in patient symptoms to form a potential diagnosis, prevent disease and/or recommend an appropriate course of action.
* **Oncology**: Researchers are using deep learning to train algorithms to recognize cancerous tissue at a level comparable to trained physicians.
* **Pathology**: Pathology is the medical specialty that is concerned with the diagnosis of disease based on the laboratory analysis of bodily fluids such as blood and urine, as well as tissues. Machine vision and other machine learning technologies can enhance the efforts traditionally left only to pathologists with microscopes.
* **Rare Diseases**: Facial recognition software is being combined with machine learning to help clinicians diagnose rare diseases. Patient photos are analysed using facial analysis and deep learning to detect phenotypes that correlate with rare genetic diseases.

**THE CONTEXT DIAGRAM OF THE INTELLIGENT MEDICAL DIAGNOSIS TOOL.**



#### Figure 2.1 The context diagram for the Intelligent Medical Diagnosis Tool

## 2.2 Product Functions

The system should perform the different functionalities as listed below.

* The system shall capture the details of the patient i.e. Name, Age, Medical history, etc.
* The system shall capture the patient circumstances and reported symptoms.
* The system shall perform a prognosis from the patient circumstances entered.
* The system shall recommend the appropriate laboratory tests that a patient should undertake according to the prognosis done by the system.
* The system shall compute the correlation between the actual diagnoses from the laboratory reports and the system prognosis.

**THE USE CASE DIAGRAM FOR THE INTELLIGENT MEDICAL DIAGNOSIS TOOL.**

*Figure 2.2 The Use-Case Diagram for the Intelligent Medical Diagnosis Tool*

## 2.3 User Classes and Characteristics

We carried out some interviews with some doctors from Mulago, because they are the expected users of this system, to find out their characteristics.

|  |  |
| --- | --- |
| **User group characteristics** | |
| **System name**: *Intelligent* *Medical Diagnostic Tool* | Interviews completed for users’ groups selected |
| **User group***: Doctors of Mulago Hospital* | |
| **CHARACTERISTICS** | **POTENTIAL USER REQUIREMENTS** |
| **Size of user group:** Not defined |  |
| **Age range:** 18- 70 years | Given particular consideration to older groups who may be reserved about advanced technology. |
| **Gender:** Roughly equal numbers of males and females |  |
| **Language and Culture:** English will be the main language | Will not include other language options |
| **Educational level/ qualification:** Bachelors graduate in the medical field | Design for people who are expected to have a basic and general understanding of computers and how they work. |
| **Physical limitations/ Disabilities:** None |  |
| **Special skills:** None |  |
| **Experience with similar systems:** 100% of the users have had an experience with web systems. | * Use highly supportive interface with clear logical structure. * Use terms that users will understand (Doctor-jargon). |
| **IT Experience:** Good | * Use highly supportive interface with clear logical structure. * Use terms that users will understand (Doctor-jargon). |
| **Knowledge of task:** High |  |
| **Previous training:** From experience with Medical systems |  |
| **Motivation to use:** Medium | Make system appear attractive and usable to the user |
| **Discretion to use:** Users may decide not to use the product | * Make system easy to use. * Increase response time of the system. * Reduce the occurrence of failures |
| **Likely concerns:** Security issues (unauthorised access) | * Ensure design that allows privacy. * Strengthen security issues. |
| **Other relevant characteristics:** Not yet defined |  |
|  | |

## 2.4 Operating Environment

The software will be able to run on computer desktops and laptops connected to the internet. It will run on Windows versions from 7 on-wards.

## 2.5 Design and Implementation Constraints

The software will be developed on Windows 10 operating system. Medical diagnostic Data from the Mulago Hospital will be used to train and test the software.

## 2.6 User Documentation

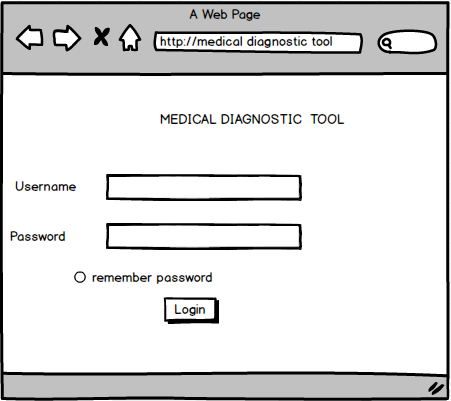
The system will be accompanied with deliverables that will guide all the stakeholders of the project i.e. end-users, system developers, system testers and project supervisors. Different types of documentations will be provided to suit the different roles. They include;

delivered with user manuals, on-line help, and tutorials that will help the users to quickly learn how to operate it.

# 3. External Interface Requirements

## 3.1 User Interfaces

The system will have a login page that will prompt the user to enter their Username and Password, and provide a provision of remembering the password in case a user forgets.



#### Figure 3. 1 The Login Page of the Intelligent Medical Diagnosis Tool

On logging in, the user will be directed to a “Register Patient” page that will contain a form that requires the details of the patient.

## 

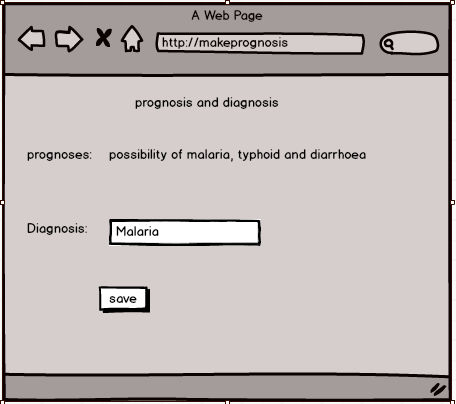
#### Figure 3. 2 The Register Patient Interface of the Intelligent Medical Diagnostic Tool

After registering the patient, the user will be taken to a page where he enters the patient condition and symptoms.

## 

#### Figure 3. 3 The “Capture Patient Condition” page of the Intelligent Medical Diagnosis Tool

Once the patient condition has been captured and saved, the system will make a Prognosis of what the patient could be suffering from.



#### Figure 3. 4 The Prognosis page of the Intelligent Medical Diagnosis Tool

## 3.2 Hardware Interfaces

The system will have no hardware interfaces.

## 3.3 Software Interfaces

The system’s user interface will be integrated with a web browser. The client makes requests to be performed on the data uploaded through select input tabs via an interface.

The server-side system analyses the information input by the user from the UI, verifies it and performs the different functionalities as requested by the user.

## 3.4 Communication Interfaces

The system will require http to communicate with the server. The system can be configured to be accessed via any available port.

The web-based UI will be the means of communication between the user and the system. The system is accessible through all popular well browsers that interact with HTML pages.

# 4. System Features

## 4.1. Capturing Patient Details

### **4.1.1 Description and policy**

This feature lets the doctors enter the details of the patient.

### **4.1.2 Stimulus and Response sequences**

On logging in, the doctors will be led to a page where they have to enter the patients’ details e.g. Name, Age, Medical History, etc. They will be required to fill in the form before proceeding to any other page.

### **4.1.3 Functional requirement**

**REQ 1**

**NAME:** The System shall capture the details of the patient.

## 4.2. Capturing Patient Condition and Symptoms

### **4.2.1 Description and policy**

This feature lets the doctors enter the condition and symptoms of the patient after registering the patient.

### **4.2.2 Stimulus and Response sequences**

After registering the patient, the doctors will be led to a page with another form where they can enter the condition and symptoms of the patient.

### **4.2.3 Functional requirement**

**REQ 2**

**NAME:** The System shall capture the condition and symptoms of the patient.

## 4.3. Perform Prognosis

### **4.3.1 Description and policy**

This feature prompts the most important functionality of the Intelligent Medical Diagnosis Tool i.e. performing the prognosis of a patient based on the condition and symptoms exhausted by the doctor.

### **4.3.2 Stimulus and Response sequences**

Once the patient condition has been captured and saved, the system will make a Prognosis of what the patient could be suffering from.

### **4.3.3 Functional requirement**

**REQ 3**

**NAME:** The System shall perform a prognosis from the patient circumstances entered.

# 5. Other Non-functional Requirements

## 5.1 Performance Requirements

* The response time is expected to be fast to increase efficiency, with a maximum waiting time of thirty seconds. This prevents the user from assuming that the system is down.
* The system shall allow a maximum number of a hundred users at a time.
* The system shall have a low power consumption.
* The system shall perform failure handling that is to say the system components will fail independently of others. The system components must be built so they can handle the failure of other components they depend on.

## 5.2 Safety Requirements

The system will be integrated with Data Integrity Gateway tools to perform data cleaning to detect, eliminate and correct all errors and inconsistencies.

## 5.3 Security Requirements

The system will be designed with authentication and authorization points of password and email login to protect against disclosure of sensitive data to unauthorized individuals.

## 5.4 Software Quality Attributes

**Portability**

The system shall support new versions of the related browsers and computer operating systems without requiring major rework. The administrative and server technologies shall be standard and supported by most platforms.

**Maintainability**

The system shall be well documented to enable proper understandability, reparation, and enhancement. In cases of further system developments and change of team members, they can still follow up by reviewing the system documentation.

**Reliability**

The system shall work reliably, with automatic backup and recovery features. In case of unexpected termination of a session, the unsaved data shall be recovered without loss and displayed to the respective users.

**Availability**

The entire system shall be available round the year, except for a periodic maintenance. The maintenance period should be pre-scheduled and short. The users should be reminded of the unavailability period, well in advance.

**Testability**

The system shall be tested with the data sets created by the system developers of the Intelligent Medical Diagnosis tool, from the data collected during the process of data collection. The system will also be tested for syntax and semantic errors using all necessary testing techniques like Control Flow Testing, Data Flow Testing and the like, to increase efficiency.

## 5.5 Business Rules

The following are some of the constraints that are to be considered while designing the system.

* A user(doctor) must have a unique password and username combination that will uniquely let them access the system.
* A patient seeking medical attention must provide an extensive description of how they feel before getting a prognosis from the system.
* Updates to the system will only be made by the software developers of this project.

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# 6. Appendix: Glossary

***Term/ Acronym Description/ Meaning***

**AI:** Artificial Intelligence

**ANN:** Artificial Neural Network

**CNN:** Convolutional Neural Network

**Control Flow Testing:** This is a structural testing strategy that uses the program’s control flow as a model.

**Data Flow Testing:** This is a family of test strategies based on selecting paths through a program’s control flow in order to explore sequences of events related to the status of variables or data objects.

**Data Integrity Gateway tools:** These are tools that are used to ensure the integrity of data. They are used during installations, upgrades, and system configuration

**Deep-Learning:** It is a subset of machine learning in AI that has networks capable of learning unsupervised from data that is unstructured or unlabeled.

**DESC:** Description

**Diagnosis:** This is a process of determining which disease or condition explains a person’s symptoms and signs

**IEEE:** Institution of Electrical and Electronics Engineers

**Interface:** Outlook (Physical Appearance) of the system that users interact with to manipulate the system.

**Prognosis:** An opinion based on medical experience, of the likely course of a medical condition.

**REQ:** Requirement