HEALTH CARE BOT
System Requirements

Project: Project Integration

Company: Saxion University Of Applied Science

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Drawn up by:	Hong Trinh	438443
	Phuc Le	456061
	Shyam Shiwakoti	426021
	Minh Thanh Nguyen	444856
	Minh Le	467475
	Van Nguyen	444878
Supervisors:	Ramazan Kirmali	
	Umit Guler	
Client:	Johan Stokkink	

Abbreviations

Abbreviation	Description
FR	Functional Requirement
IQ	Installation Qualification
NA	Not Applicable
OQ	Operational Qualification
PQ	Performance Qualification
SR	System Requirements
TR	Technical Requirement
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair

Glossary

Term	Definition
Functional Requirement	Requirement related to the system functions (‘what?’)
Technical Requirement	Requirement related to the system design (‘How?’)

References

Number	Author(s)	Title
[1]	J.W van Dijk	Methodological Design

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1. Background

In this project, the final product is building a smart healthcare bot. The project is conducted by group including EIE (Electrical Engineering) students and ACS (Apply Computer Science) students. The purpose of this project is gaining more knowledge about Echo Dot in independent hardware and how to implementation and use wireless radio system with the ESP32 as well as realizing data acquisition by sensors and graphical the user interface. The connective between hardware and software is important in this project. After the concept decision, the project continue with the first phase. System requirements of this project will be described in this document.

2. Functional description and requirements

2.1 Functional description

2.1.1 Use Scenarios

A patient will be connected to a heartbeat monitor, then the doctor/nurse/patient will give command to the Alexa to measure the heartbeat. In case of emergency doctor/nurse will get notification on apps on mobile.If the doctor/nurse/patient wants to see the heart-rate of the patient later then it's possible to get the data from a storage devices that save the data of the patient.

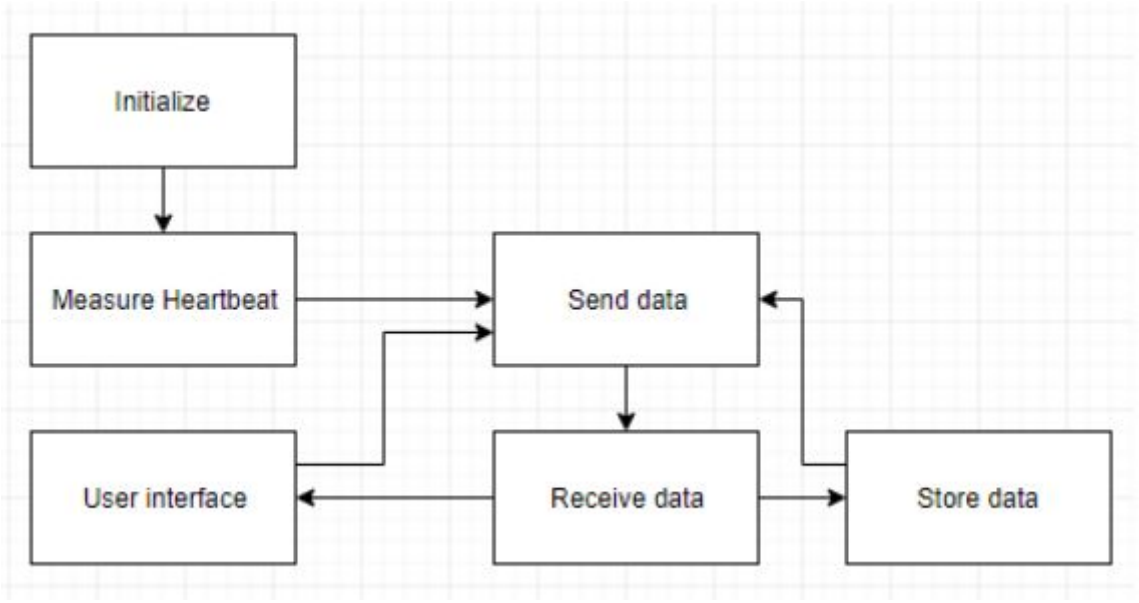
2.1.2 User Requirements

Connecting the patient will require a system that is easy to use. For live monitoring it will need a screen to display the heart rate on. Wearing the monitor 24 hours means we need a battery to sustain the 24 hours and a way to store the recorded data locally.Attaching and Detaching the patient with system, again should be easy and should not take long . Data access at a later time means, we have to store the data and we need log in system.

2.1.3 Functions

Function	Normal Operation	Faulty operation
Initialize	Startup the mobile device by Alexa(voice recognize)	Alexa cannot identify the mobile device
Measure heartbeat	A sensor is measuring	
User Interface	Display graphical data on PC and numerical data on the mobile device	A screen doesn't display the graphical data on the mobile device.
Send data	The heartbeat data is sent to a local server/internal memory when connect to Wifi.	The device cannot connect to the Wifi.
Store data	Data will be stored in a database/sd card.	The heartbeat data is stored inside the internal memory (ROM/RAM) of the device.
Receive data	Receive data without problem.	Receive a unexpected data from other mobile device.

2.1.4 Functional architecture



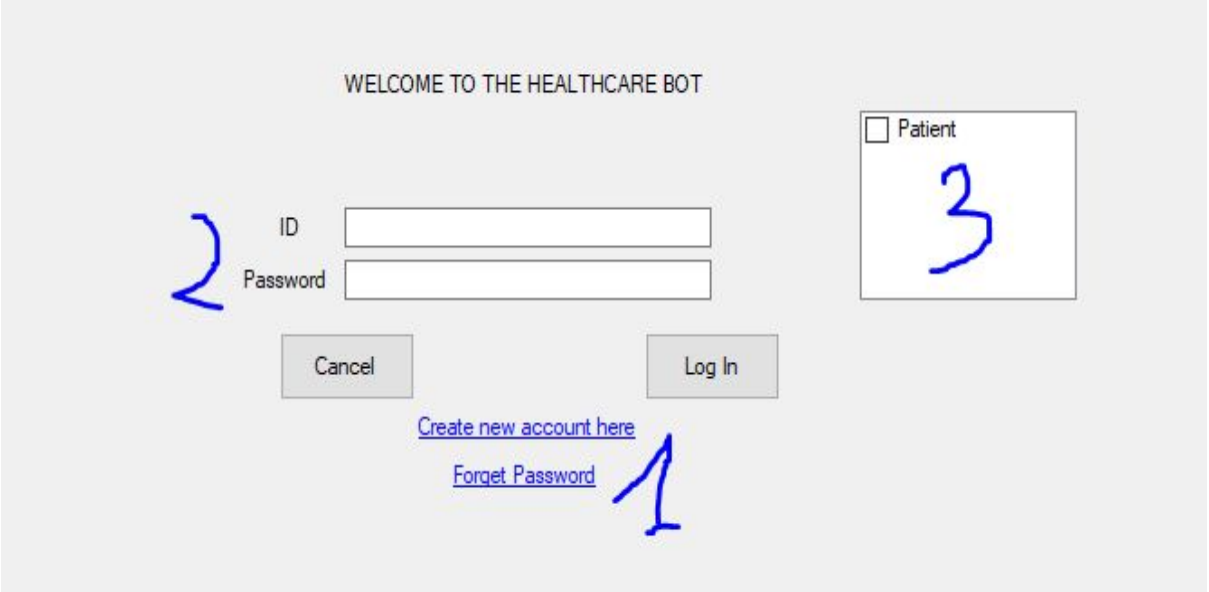
The diagram depicts the function architecture of the product.
- At the first step, the customer can initialize the mobile part by Alexa (voice recognize). After that, the measurement can be performed and all the data will be displayed graphically and numerically on the PC/Smartphone. Beside, on the mobile part, there is a screen for patient to keep track easily.
- With the internet connection, the data can be upload to the database or cloud so a doctor can check it regularly. In case there isn't a internet connection, the data can be (stored in the sd card and) displaying on the mobile part screen.
- In Addition, if there is no power supply (5V from micro usb port), the system will use the battery as a replacement.

2.2 Functional requirements

As the requirements of the client, the project result that will give out a mobility heartbeat measuring device. To keep track user's health, a desktop user interface will be made for user include patients; specialist, who are doctors, nurses,... medical staffs in general, use in healthcare activities and contain two main parts: Login screen and main interface. Through the interface, user and medical staffs are able to access and see the result of the done measuring processes which should be saved and visible for users. Therefore, the user interface should contain these following functions which this chapter is going to describe about.

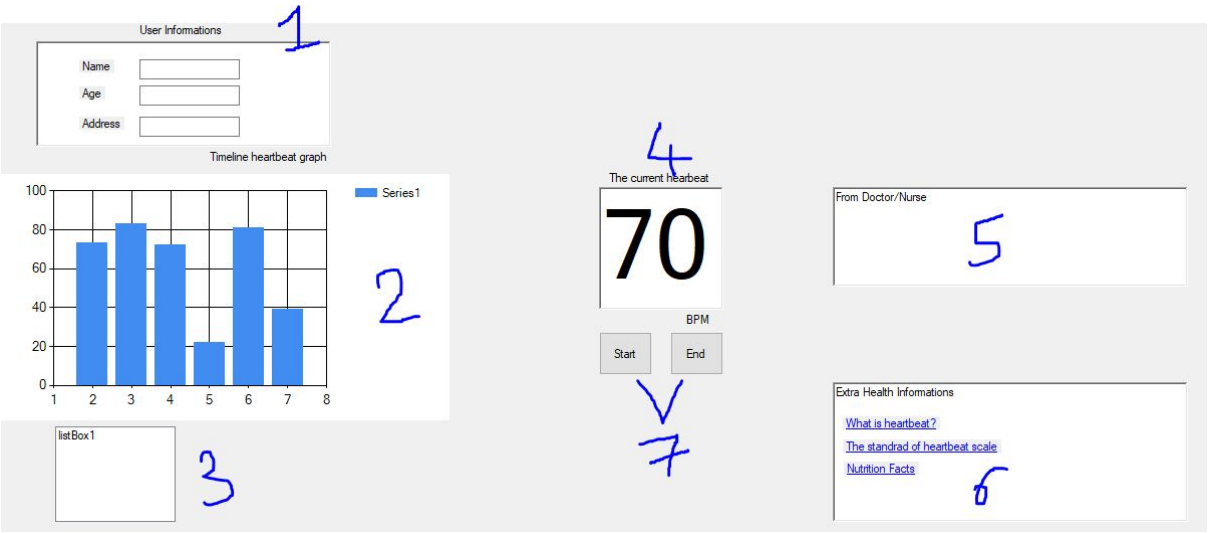
2.2.1 Function 1: User interface

Login screen



Components	Functions	Objects	Descriptions	Input	Output
FR01	1.Registering	Patient & medical staff	Patient can register for this application by using their patient ID number as ID and create their own password to make an account to use the app. Meanwhile, medical staff just use their staff ID as login ID and also create their own password. All of these account will be store in database.	New ID and password of login credentials	New login account
FR02	2.Logging in	Patient & medical staff	By using their account to as login credentials to fill in and access the app.	User's created account	Main interface of application
FR03	3.Logging version	Patient & medical staff	By selecting a suitable category in a list which fit with the roles of users (2 main categories are patient and medical staff)	Database of users (by registering and sort by categories)	Suitable list of categories for user

Main interface



Components	Functions	Objects	Descriptions	Input	Output
FR04	1.User interface	Patient & medical staff	Display information of logged user	Database of users (by registering and sort by categories)	User's information are displayed
FR05	2.Timeline heartbeat graph	Patient & medical staff	Will be mainly used by medical staff as tracking patient health through the timeline heartbeat graph. This graph can visible the data of measurement of last recent time. Also, user can use this function as their own curious to see their heartbeat process.	Measuring heartbeat's data which is stored in database	Visible graph for user

FR06	3.Timeline selection	Patient & medical staff	This small function allow user to choose which timeline should be shown in the graph by listing a small list of timeline: a day, 3 days, a week, 2 weeks, a month... This is a small function to support the timeline graph function become more convenient.	Heartbeat measuring data which is stored in database	List of timeline for user choosing
FR07	4.The current heartbeat	Patient & medical staff	Patient and medical staff can easily witness the current heartbeat during the measuring procedure at that moment through a small heartbeat graph	Measuring heartbeat with online data transfer to database to be stored	Visible graph for user/Specific result at the moment when measuring procedure finished
FR08	5.Noting	Medical staff	This function allow medical staff give advices to their patients by noting to a small text box. By that way, patient when logging in to the app as a patient, the can receive the notification that come from medical staff's message	From keyboard of computer, string text from medical staffs	String text for patient which content from medical staffs that show as a short text

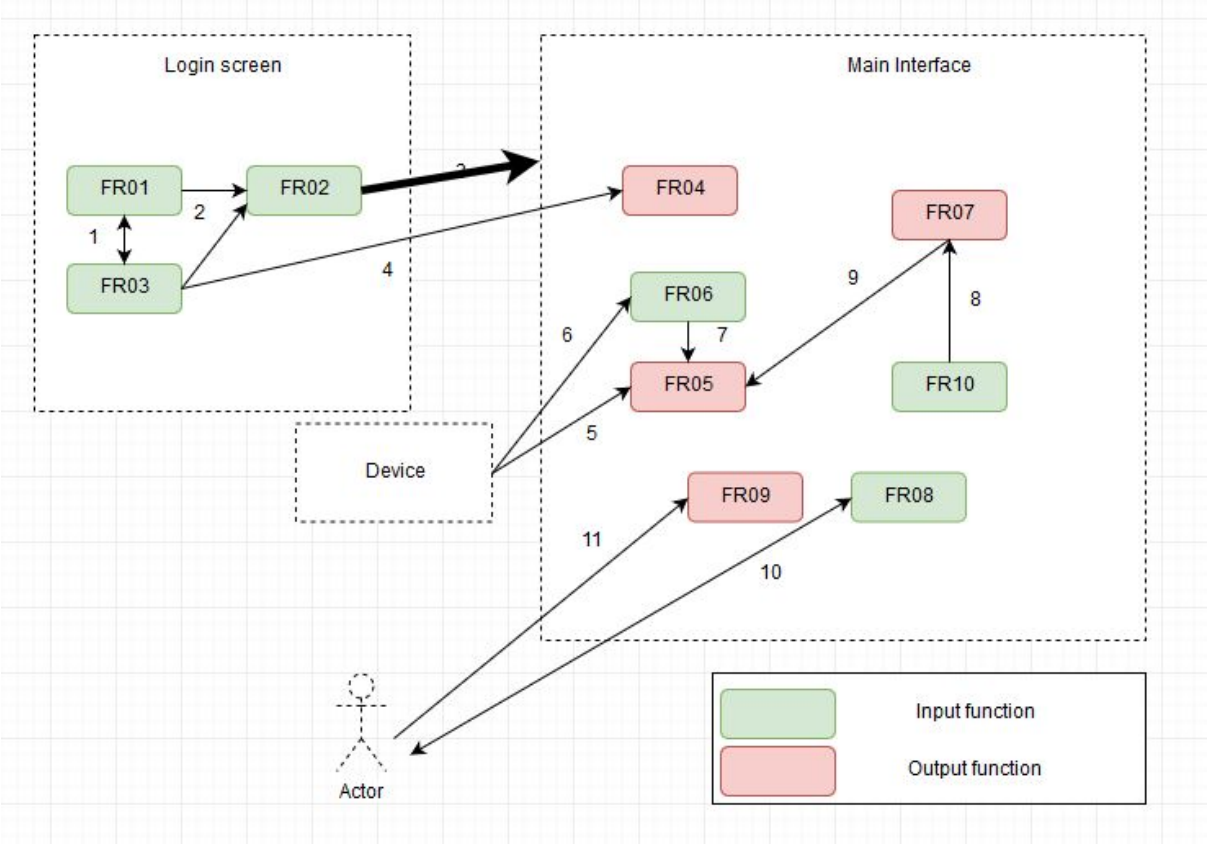
FR09	6.Extra information	Patient	For those patients who have less or no idea about the scale of heartbeat, this function can help them as the extra information about heartbeat, what is good range? What is not good for health ?... whatever that related to health for patients, it can be found in this function and specially for patient's uses	Built-in application linkable to source of information (websites,..)	Accessible link for user to look up health information
FR10	7.Start/End measuring	Patient & medical staff	Patients or medical staff can use this function for getting heartbeat data	Button to start measuring procedure of device	Starting a procedure and end a procedure

Basically, there are total ten functions for the GUI which can be seen that these function could be separated into 2 main groups : The input function that receive the input data and actions for output functions do its work as it was designed

Input Functions	Output Functions
FR01, FR02, FR03, FR06, FR08, FR10	FR05, FR07, FR09

2.2.2 Function 2: Control Functions

According to the user interface, there are input and output functions which have relationships and support each other to make a good application for user which can be illustrated as the flowchart below



FR01	Registering function
FR02	Logging in function
FR03	Logging in version function
FR04	User interface function
FR05	Timeline heartbeat graph function
FR06	Timeline selection
FR07	Current heartbeat function
FR08	Noting function
FR09	Extra information function
FR10	Start/End measuring

In general, the login screen is the input for the main interface.

(1) Registering and logging version functions are the input to each other. Base on each user, the logging version must be picked correctly, then the registering will give out the account of that logging version. For instance, if user is a doctor, logging version will be selected as a doctor, then the created account will only work in the doctor version.
(2) The Logging in function take the input data from (2). In this case, account is created as the user version, all user have to do is fill in and press log in.
(3) Thank to logging in function, the GUI now change to the main interface where all main functions locate in.
(4) Where to display the user information. This function is as an output from the choosing logging version. For example, a patient logged in, so the information over there are belonged to that patient.
(5) The timeline graph is the output of all recent measuring process which performed by the device. The timeline selection is the one that decide the timeline graph (7). It also bases on the device (6) to know all finished measurements that it can possibly list out for user to choose to be displayed in the graph. Moreover, this graph can also display the current measuring process of the device. However, to receive those data, the start/end measuring process function will decide when the process start. When it start, the data can be shown as a specific number of heartbeat (8). Of course, the runtime data is also become input for the timeline graph (9).
Actor (medical staffs) can leave a message or a notification to patient by typing something on the given textbox (10).
(11) Actor (as patient) can get access to the given external information resource about health by actor (doctor/nurses...).

3. Design architecture and requirements

This chapter holds a small description of the system design technical requirements, “white box “method is used since the internal structure/design/implementation to be used is clear to the engineers.
Some of the technical requirements are about an interpretation of the functional requirements, while others are generated independently.

3.1 Technical requirements

3.1.1 Safety

- Safety is one of the most important feature that need to be insured in the project. The systems will be built with the EMC requirements, using CE safety medical standards. There will be the emergency alarm in the wristband, which will be buzzed when there is a problem with User’s heartbeat, it also have the fuse in order to disconnect the system whenever the trouble appears. The wristband will have the wood case to cover the electronic components inside and use the DC power supply, which is safe for human.
- In case the user need the tutorial about the system, there is the User’s manual that can give them the information in order to use the product.

Number	Requirement	Relation	Value	Unit
TR0101	EMC requirement	=	CE medical standards	-
TR0102	Emergency Alarm	-	-	-
TR0103	Fuse	-	-	-
TR0104	Wristband case	=	Wood	-
TR0105	Power supply	=	DC	-
TR0106	User Manual	-	-	-

3.1.2 Cost

- The cost is divided into 2 parts: Components and labour.
- For the components parts, there are some components that need to be supplied: Micro Controller, Display, Heartbeat sensor, Alarm, Echo Dot, Battery, Micro Controller USB.... There also have some components that the group need to be design: Input Amplifier, Micro controller USB, the wristband case...

- For the labour parts, each member in the group need the time in order to research the system, design PCB, build PCB, testing prototype, gathering information, programing, build wristband case

Number	Requirement	Relation	Value	Unit
TR0201	Micro Controller	=	Supplied	-
TR0202	Display	=	Supplied	-
TR0203	Sensor	=	Supplied	-
TR0204	Alarm	=	Supplied	-
TR0205	Battery	=	Supplied	-
TR0206	Echo DOt	=	Supplied	-
TR0207	Input Amplifier	=	Made	-
TR0208	Micro controller PCB	=	Made	-
TR0209	PCB design	~	20	Hours
TR0210	PCB build	~	7	Hours
TR0211	System research	~	60	Hours
TR0212	Gathering information	~	6	Hours
TR0213	Programing	~	30	Hours
TR0214	Build wristband case	~	5	Hours
TR0215	Testing	~	20	Hours

3.1.3 Physical properties

- For the maximum dimensions, The wristband's maximum dimensions is about 6-7cm in length and 3.5-4cm in width. The Alexa's dimensions is 3.8 x 8.3 x 8.3 cm.

- For the maximum mass, the wristband weight's around 0.5 kg, so it will not annoy the user because of their weight. The Alexa's weights around 0.2kg

Number	Requirement	Relation	Value	Unit
TR0301	Wristband dimensions	~	7 x 4	Cm
TR0302	Alexa dimensions	=	3.8 x 8.3 x 8.3	Cm

TR0303	Wristband mass	~	0.5	Kg
TR0304	Alexa's weight	~	0.2	Kg
TR0305	Wristband mobility	=	True	-
TR0306	Alexa mobility	=	True	-
TR0307	Wristband color	=	Pink	-

3.1.4 Environmental

- The operational and storage temperature for the system will be at 0-85. With this range, all the components in the wristband can work very well without any problems. On The order hand, the operating voltage will be 2.7-3.6V, this is the range for the micro controller can work with its best. Therefore, the power supply voltage can be used in range 3.0-3.3V. The operating current in average is 80mA and the power supply current is 500mA. The humidity for the system need to be lower than 80%.

Number	Requirement	Relation	Value	Unit
TR0401	Operational and Storage temperature range	=	0-85	
TR0402	Operating voltage	=	2.7-3.6	V
TR0403	Operating current	=	80	mA
TR0404	Power supply voltage	=	3.0-3.3	V
TR0405	Power supply current	=	500	mA
TR0406	System's humidity	<	80%	-

3.1.5 Mechanical design (including dynamical and thermal requirements)

- For the Mechanical design, thermal and dynamical requirement have to follow application of principles about physicals , technical, and also materials science in other to analyse , design, construct or maintain machines or mechanical systems.

Number	Requirement	Relation	Value	Unit
TR0601	Effect of humidity on wristband	=	True	
TR0602	Thermal conductivity of the materials	=	None	
TR0603	Electrical conductivity of the materials	=	None	
TR0604	Thermal expansion of material	=	None	
TR0605	Compatibility of the material on human skin	=	None	
TR0606	Stiffness of the wristband	<	49.2	MPa
TR0607	Standardized major or minor components compliance with CE standards	=	True	

3.1.6 Electrical and electronic design

- For electrical and electronic design, PCB design have to follow rule and principle of EMC standard , the schematic should be indicated in detail with all information and statistic in other to achieve the final result of the product.

Number	Requirement	Relation	Value	Unit
TR0701	Apply EMC standard for the design	=	True	
TR0702	Using Ultiboard on Matlab	=	True	
TR0703	Follow instruction when print and solder PCB layout	=	True	
TR0704	DC power supply	=	5	V
TR0705	Minimum Installation Temperature of cable	>	-0	
TR0706	Minimum Operating Temperature once installed of cable	>	-15	
TR0707	Cable size required (5A max)	<	0.5	
TR0708	Conductor temperature	=	85	

3.1.7 Software design requirements

There will be many software requirements for this project.This Table shows the list of software Design requirements

Number	Requirement	Relation	Value	Unit
TR0801	Download Software	=	TRUE	-
TR0802	Login And logout	=	TRUE	-
TR0803	Python Programming Language	=	TRUE	-
TR0804	Java Programming Language	=	TRUE	-
TR0805	C# Programming Language	=	TRUE	-
TR0806	MYSQL	=	TRUE	-
TR0807	Time and Date	=	TRUE	-
TR0808	Recovery Of Data loss	=	FALSE	-
TR0809	Admin Interface	=	FALSE	-
TR0810	Reset/Recovery Of login	=	FALSE	-
TR0811	Code comment	=	TRUE	-
TR0812	Encryption of Memory Card	=	TRUE	-
TR0813	Standard software Development	=	TRUE	-
TR0814	Test Phase	=	TRUE	-
TR0815	Multiple Patient Option	=	TRUE	-
TR0816	Multiple Doctors Option	=	FALSE	-
TR0817	Alternative Backup Of Data	=	TRUE	-

Notes: In case of Data recovery of loss data from both sd card and database we need more backup plans.

3.1.8 Production and assembly

3.1.9 Reliability

Number	Requirement	Relation	Value	Unit
TR01001	Main Time Between Failure (MTBF) of the system	<	2	year

3.1.10 Maintainability

Number	Requirement	Relation	Value	Unit
TR01101	Main Time To Repair (MTTR) of the system	<	1	day

4. Quality assurance Provisions

4.1 Verification definition

The qualification assurance includes activities that determines the procedures and standards for the product. The quality assurance focuses on checklist, process standards, project audits, methodology and procedures for development. The aim of quality requirement is creating an environment to assure the product satisfies the quality requirements.

4.2 Verification setup 1: control

4.2.1 Purpose of test/analysis

The general purpose of testing in both hardware and software is:

- Increase quality of the upgrade
- Reduce risks to the product
- Meet the requirements of the users
- Determine capability of the product
- Define monitoring requirement in production

4.2.2 Test setup/analysis method

Software:

Functional testing:

Unit testing	Shall be designed, implemented and executed to test each individual software components
Integration testing	After successful with unit test. Integrated together to perform specific tasks and activities
System testing	Testing the entire system for errors and bugs by interfacing the hardware and software components. Finally, testing whole system.
Acceptance testing	All the project requirements have been met and user have tested the system to ensure the product operates as expected and satisfies all requirements.

Non-functional testing:

Performance testing	Measuring how the system performs under the increasing load (number of users and data volumes)
Security testing	Test the software for confidentiality, integrity, authentication, availability.
Usability testing	As user aspect for using the software product.
Compatibility testing	The product or application is compatible with specified operating system, hardware platforms, web browsers, mobile devices,...

4.2.3 Test procedure/analysis

The step of testing:

- Analyze the product

  The information of product performs a vital function in testing. The product must to be learned thoroughly before testing it. The demand and expectation of clients and end users need to know clearly.

  Who will use the healthcare bot?_Patient and doctor/nurse

  What is it use for?_hearbeat measurement and alarm in emergency

  How will it work?

  What are software/hardware the product uses? mySQL for database, Micropython for ESP32, C# for GUI

- Design test strategy

  Scope of testing: As the software requirement specs, the project focuses on all functions, the stress or overload of a database, performance.

  Testing type: unit test, integration test, system test

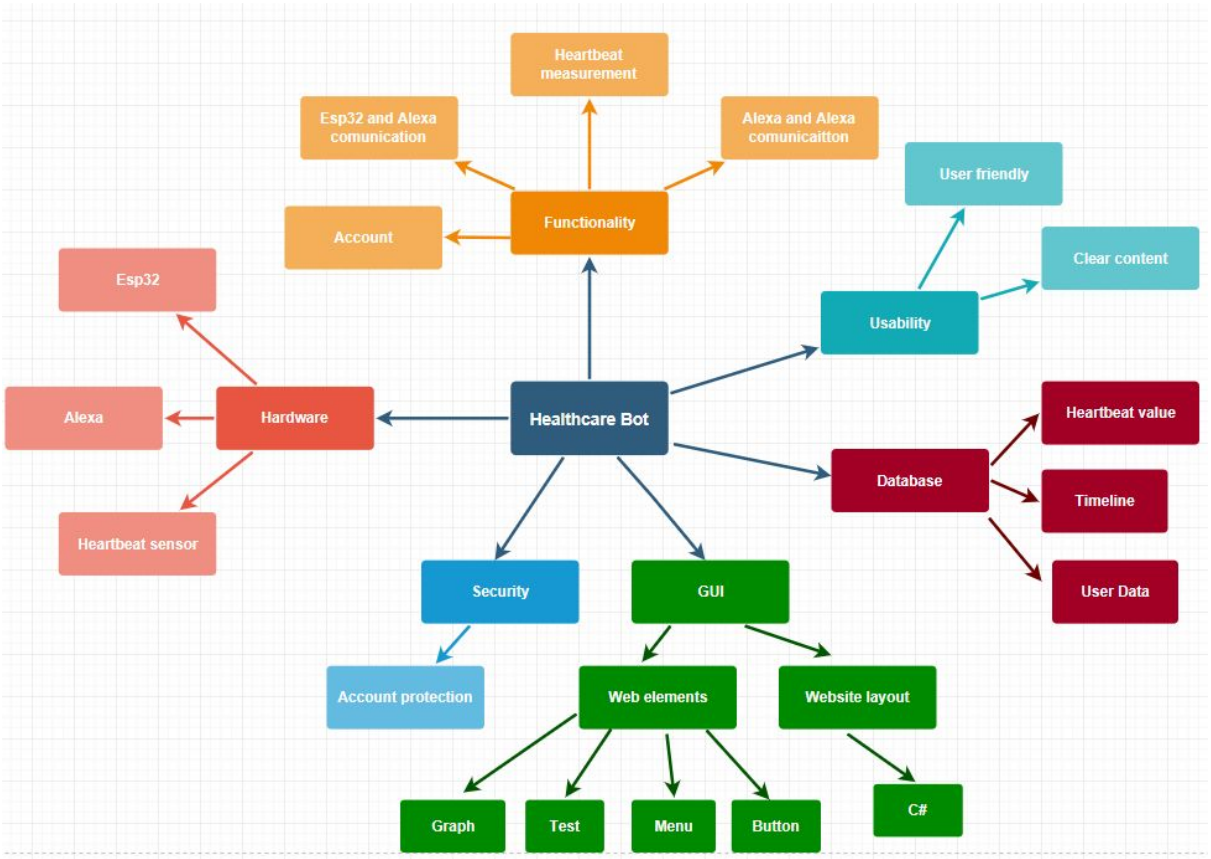
  Risk and Issues:

Risk	**Issue**
Team member lack the required skills for esp32	Research and study how to implement with ESP32
A lack of cooperation in group	Remind team member in their task

  Test logistics

  Each member of the team will involve in testing after finishing

- Define test objectives



- Define test criteria

  Planning the test cases and assure all the test has record and pass.
- Resource planning

  Human resource

Members	**Task**
Test Manager	Define project direction Acquire appropriate resources
Tester	Identifying and describing test techniques, tools,.. Verify and assess the test approach Execute and report the test
Developer in test	Implement the test cases, test program, test suite
QA member	Take in charge of quality assurance

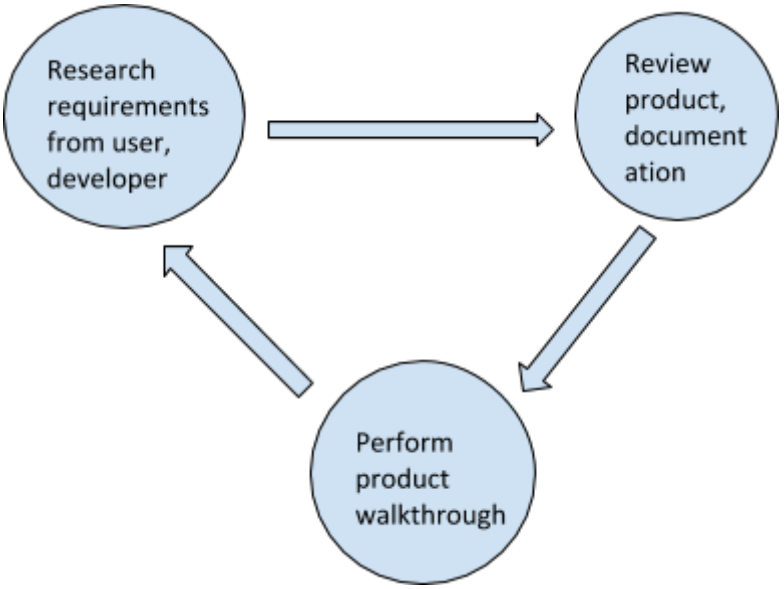
Equipment

Resources	**Descriptions**

Server	Web server, database server and application server
Network	LAN, Wifi, Bluetooth
Computer	Operating system, local server

- Plan test environment

  In each phase, the test environment build by a strong cooperation between test and development:

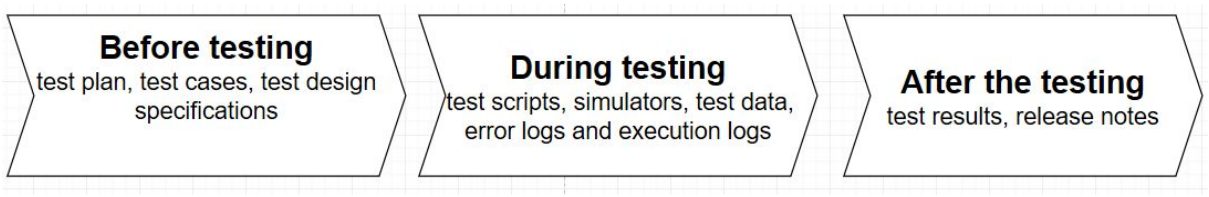


- Schedule and estimation (ACS)

Task	Members	Goals	Time consump (Estimate)
Test esp32 with LEDs	Hong Trinh	Control LEDs with esp32 making sure that esp32 Chip working well	1 days
Test esp32 with serial communication	Phuc Le	Control the esp32 with serial connection for transmitting and receiving data functionality	5 days
Test esp32 with wifi or bluetooth	Shyam	Be able to connect device to network by	5 days

		wifi or bluetooth for controlling from distance	
Test esp32 connecting with Alexa	Shyam, Phuc Le, Hong Trinh	By using Alexa to giving order and check if the esp32 can response to the Alexe command ?	1 week
Test database	Shyam, Phuc Le, Hong Trinh	Is the data too large? The period to store data is right?	4 days
Test web server, GUI	Shyam, Phuc Le, Hong Trinh	Ensure the UI being friendly with user	3 days

Determine test deliverables



4.2.4 Test/analysis data recorded

To make sure testing and analysing procedure work effectively, each of test or analysis should be recorded by a small report. In each report will have the finished test/analysis with detail test script descriptions, test data, simulation description,.. From that point, the goals of the test/analysis are clear enough and the team can decide the result of that test/analysis with the error logs and execution logs which can provide detail result of the test/analysis

- Input data: built-in test function (debug function, built-in function in IDE), components functions (esp32, heartbeat sensor), device functions (measuring heartbeat, display, notification), application function (logging in, display data, notification)
- Output data: functionality of components, device, GUI (work - not work), testing code functions, (pass - fail), executing code (run - error)

4.2.5 Processing and evaluation of results

Basing on the test/analysis data recorded, all tests/analyses will be saved with clear input and output. From that point, the team can be easy to dig deep into the problems of the test or the analysis as well.

During the testing/analysing process, the result can be considered as a success of fail which depend on the result of the project

- Coding: executing, running without error.

- Application: all function of the GUI work and meet requirements of the client: can create new account to log in, easy to use, visible all necessary data, be able to send-receive notification.
- Component functionality: the device can measure the heartbeat, built-in display of device work, be able to send-receive notification to application.