Medical device to detect heart attack

Jasmeet Singh Matta
Electronics Engineering (Interactive System Engineering)
Lippstadt, Germany
jasmeet-singh-ajit-singh.matta@stud.hshl.de

I. Introduction

A. Context

In this paper, I will design and specify the Requirement, UI and Hardware of the device I am making virtually/Imaginary it doesn't exist it is just for prototyping and showcase of my knowledge in Interactive System Design. I am designing a medical device that is used for detecting heart attack before it happens with the help of a patch sensor that detects Cardiac Bookmakers, heartbeat, Oxygen Level and change of electric impulse in the heart

B. Problem

Since the user is free to travel and used modern-day technologies it can be difficult to call the emergency hot-line just using normal connectivity of modern-day life such as Bluetooth and WiFi as Bluetooth can be used by headphones or speakers etc.. and WiFi can be unavailable due to any reason. For the patch, it is made of Polyaniline Coated Filter Paper and it is based on Impedance Spectroscopy-Based Detection

C. Motivation

I would like to thanks all my colleagues for giving feedback which helped me increase the level of writing,diagram and understanding

II. Concept

A. Image of Medical Device and Use Case

In the Fig. 1. there is a sensor substrate that will be attach to user body and it will be attached to wearable device from which the data transmission to the cloud and if required call to emergency service will take place.

III. Designing and Concept

A. Requirements

1) Design:

- It should be under specific weight as it is needed to be carried by user.
- It should be design right as it will be carried by user
- It should also satisfy all the system requirements

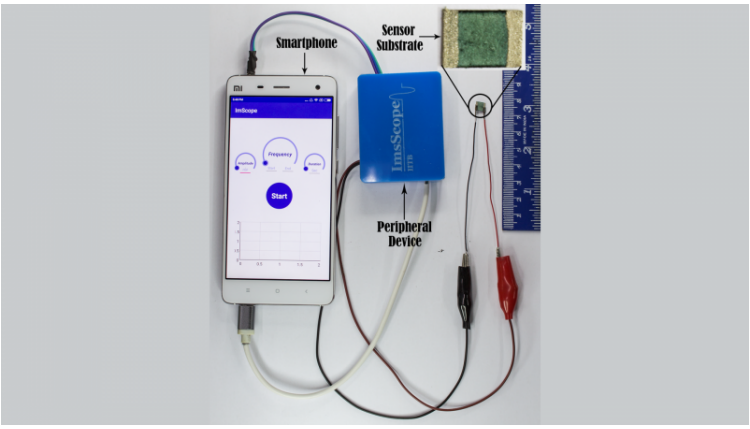


Fig. 1. [2]

2) System:

- It should be able to communicate with other devices/Networks
- It should be able to send SOS Alert when needed
- It should be refined from the Government policies on medical device
- It should have a User Interface which is easy to use

B. Hardware

1) Connectivity:

- GSM - OPTIGA™ Connect Consumer OC1120 - eSIM solution
- Wifi Bluetooth - WL1835MOD

2) Others:

- Medical Sensor (Sensor for detecting change in heart rate, cardiac biomarkers)

  The Sensor designed by D.Mondal and his team in [1] is being used in this project.
- 66AK2G12 Processor Texas Instruments

  The use of this processor because it is designed for networking and also for security which satisfy the need of product being both secure and safe. Processor is integrated with high-speed peripheral and memory interfaces, hardware acceleration for network and cryptography functions.
- 1 GB memory
- Buzzer

It is needed for vibrating the device to let the user know to check their status or in case of failure of system.

- LED (Green, Orange , Red , Yellow)

  It is used as indicator to let user know their health status it is also used for indicating system failure, low battery.
- Speaker

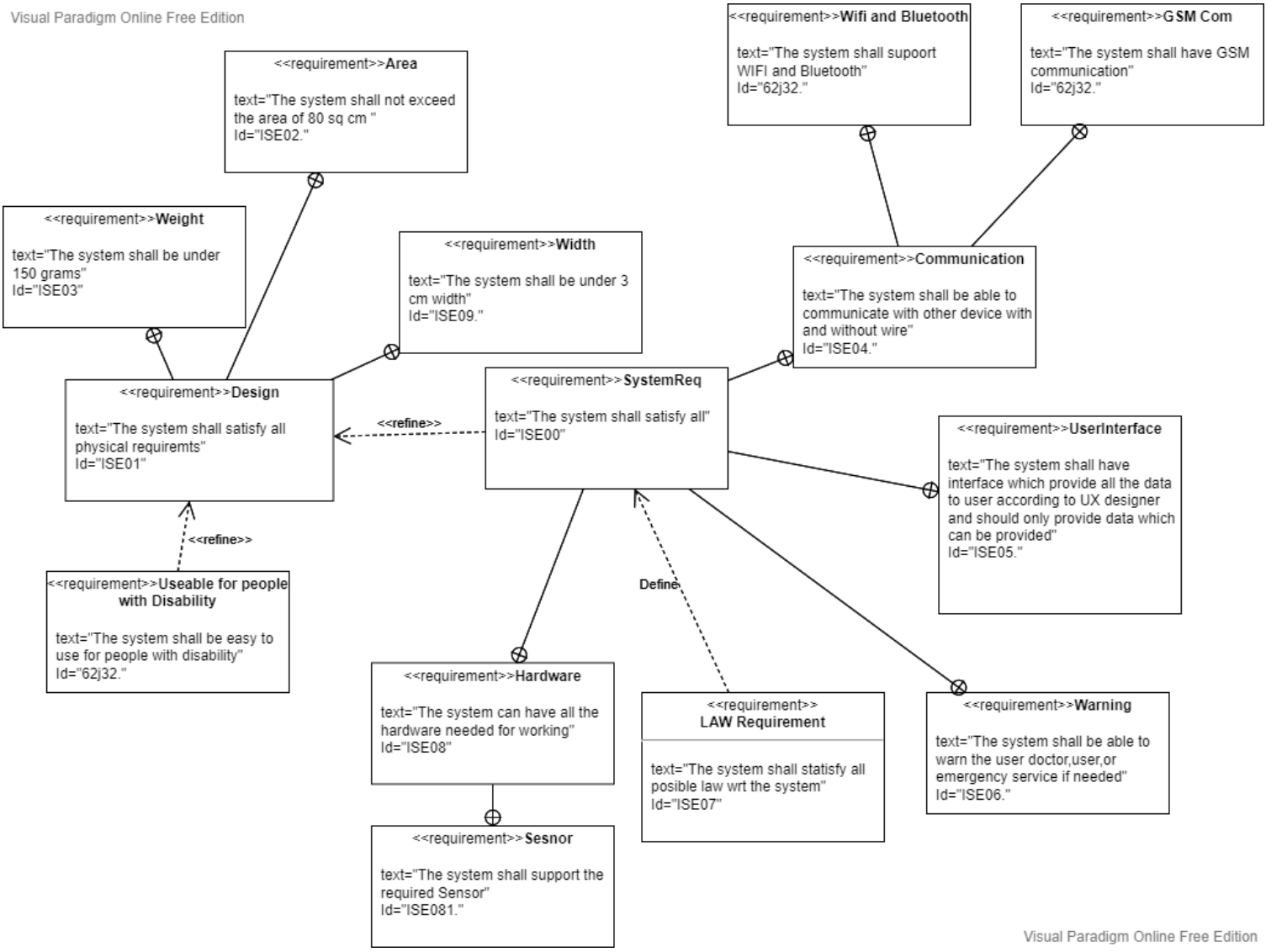
  It is used to let user know their status or device status through auditory perception
- Button

  It is needed to turn on or off the device and also to activate the speaker for that instance.

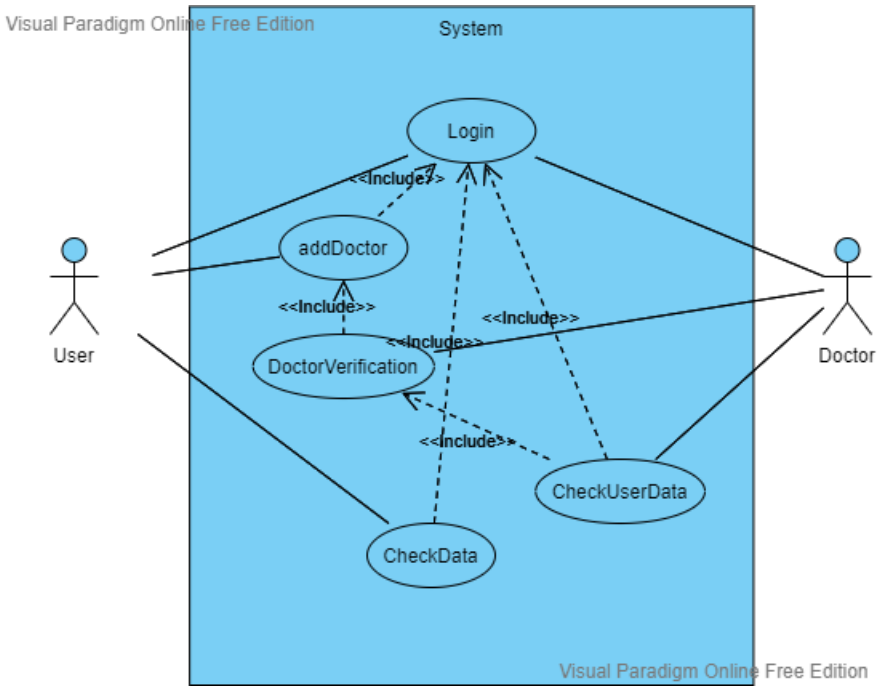
C. Redundancy

For Redundancy the system will always check the condition of software,will also store data from the sensor two time and in case of failure it will try to self boot in safe mode and alert the user. For Sensor Two sensor are used with each subdivided in two part giving us the total 2^n values. For better accuracy we use Advanced Evidence Theory or Demspter Shafer Theory for combining the data from sensor To know when the Sensor is not working we use Divergence Measure to Measure the conflict in data from the sensor We Store this Conflict and calculate error rate over time and once the time period is over we notify the user that need of servicing of sensor is needed

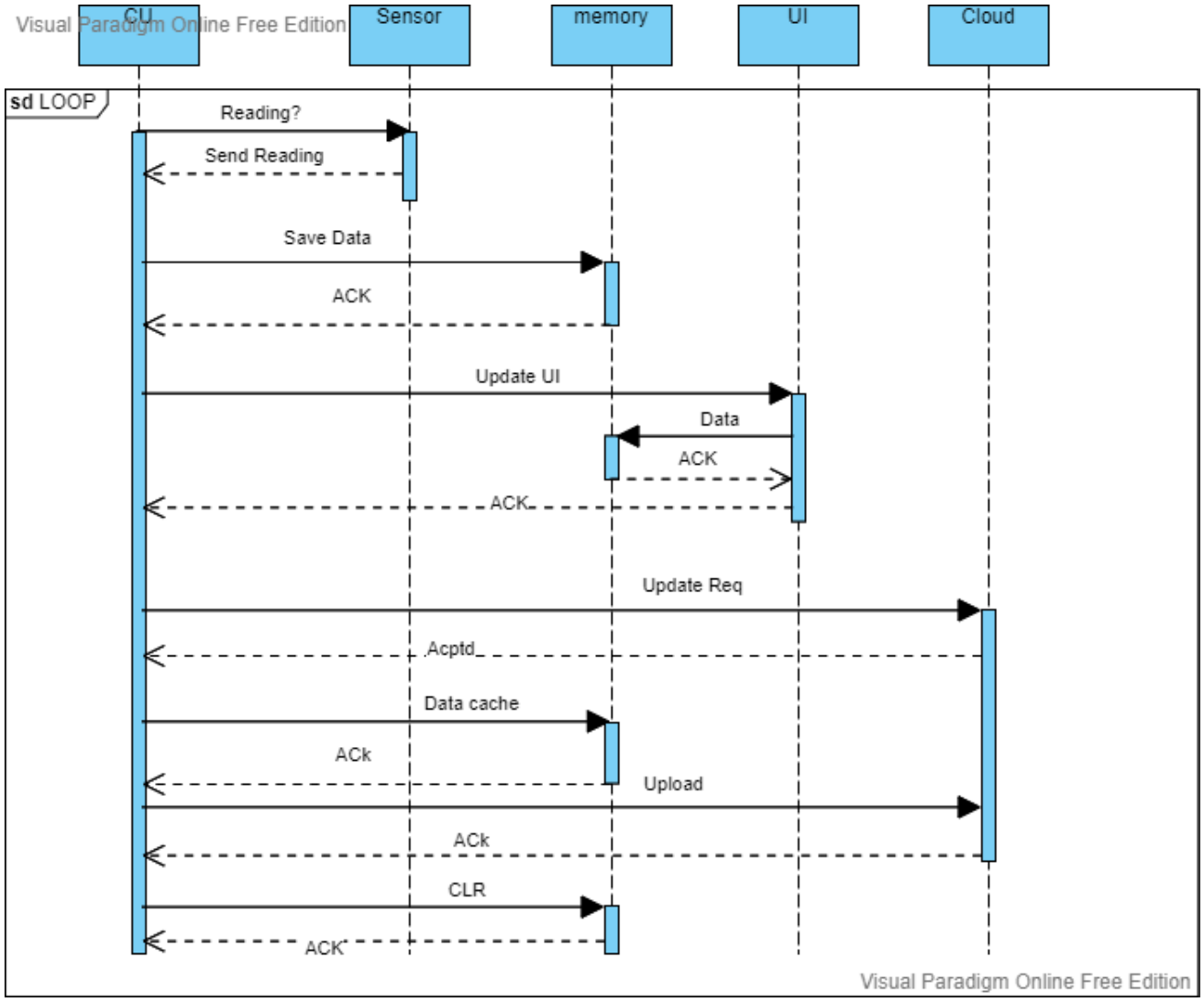
D. Models



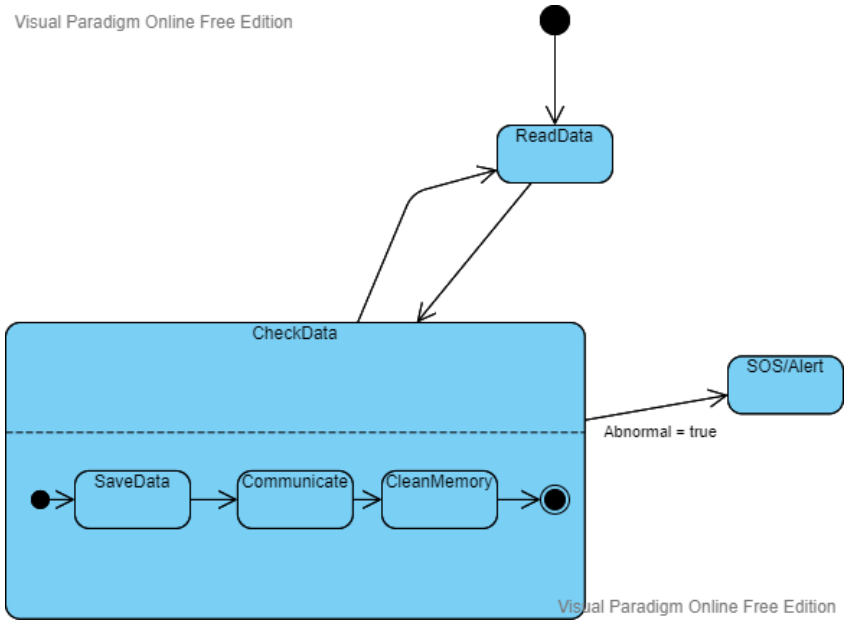
Requirements



UseCase

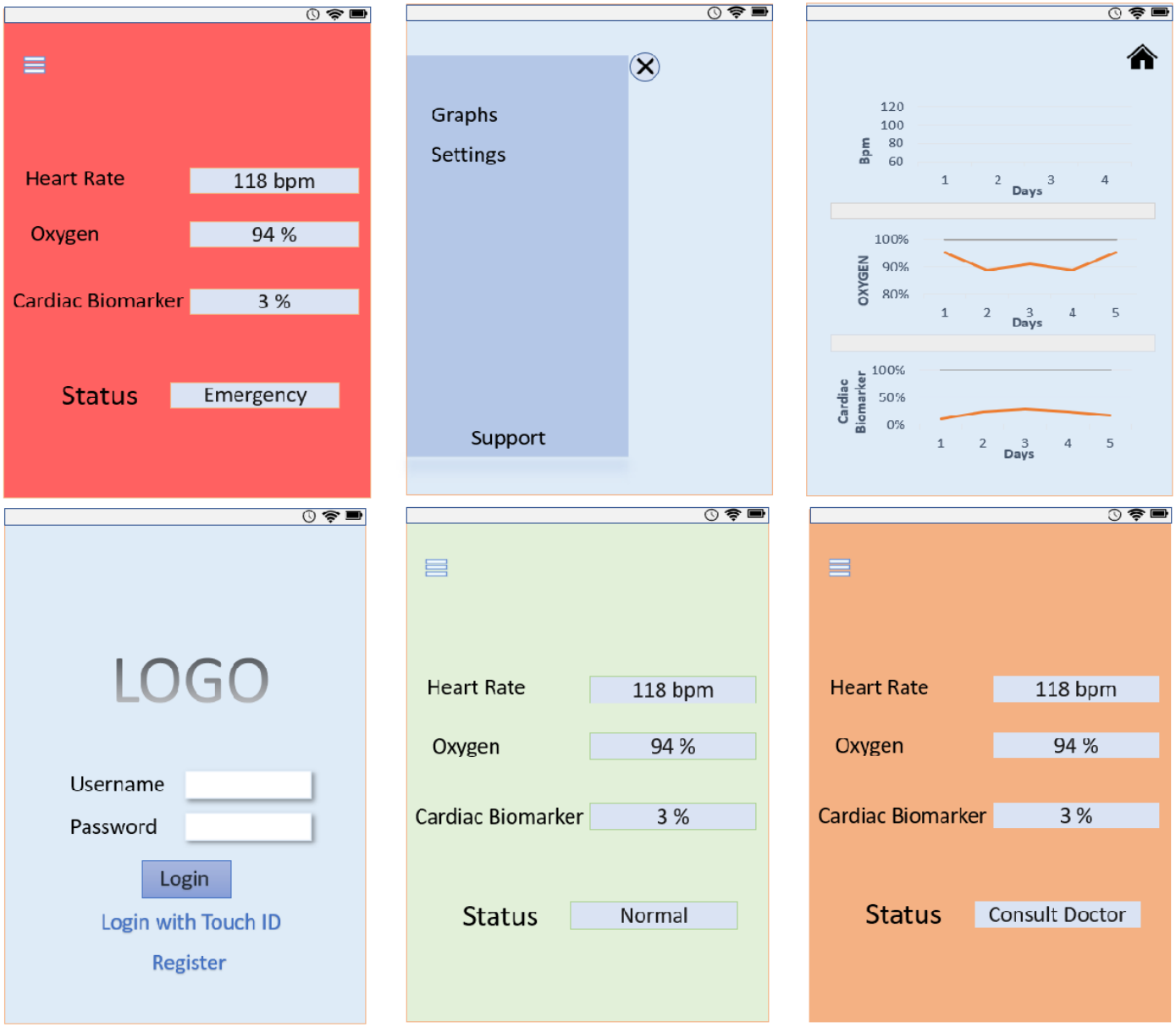


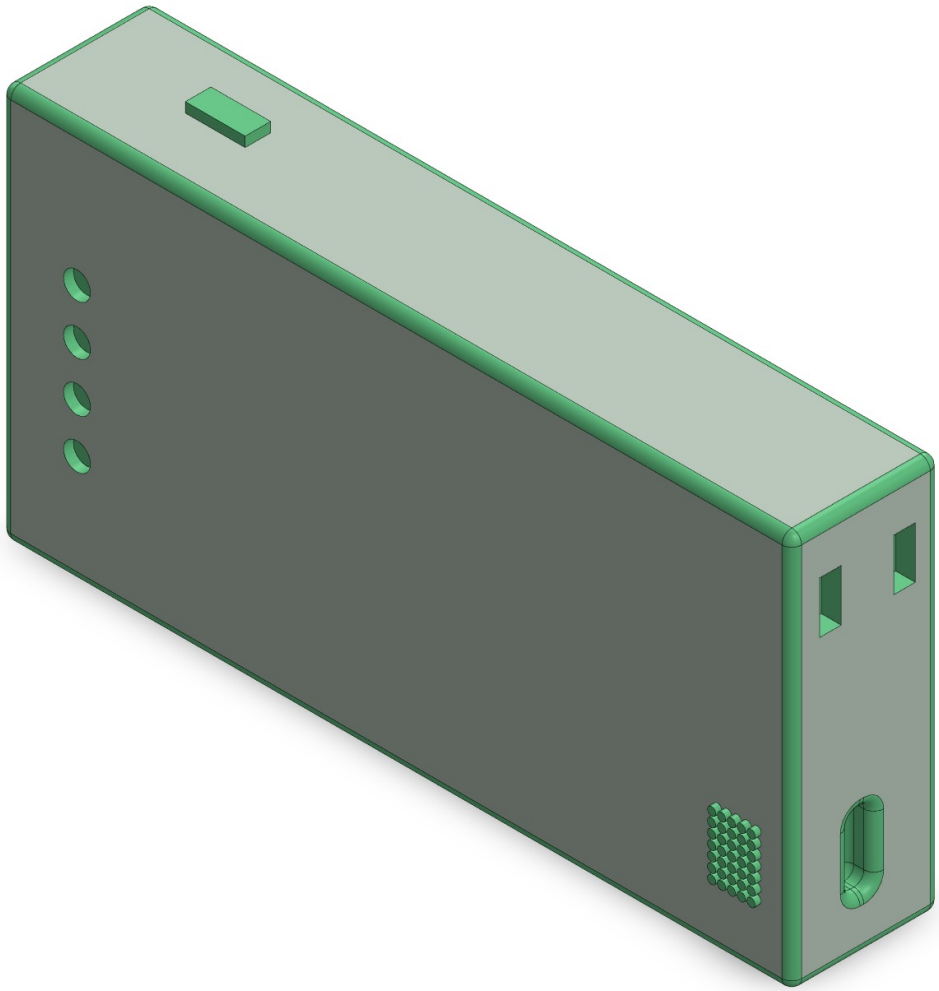
Activity



StateMachine

E. User Interface





IV. Discussion

A. Concept

My concept was to convert the prototype into state of the art device easy to use by people of all ages and also for people with disability. My task was also to get rid of connection to power and audio on the Mobile phone as displayed in fig 1. It was also to make a emergency request with Location of user in case of emergency without relaying on WiFi and Bluetooth which may be unavailable to us due to any circumstances.

B. Initial Problem

Not only does it solve the initial problem of having peripheral device connected to your cell phone via wire it also efficiently increase the readiness for user to get medical feedback via doctor or emergency service making user more safe.

C. Improvement

During lecture via the feedback of my colleague i was able to identify a clause in my requirement which i later on not only corrected but also improved it. For Hardware i was using quite a high amount of memory given today memory is comparatively cheap but i reduce the amount of memory needed saving us from money in development.

V. Conclusion and Future Direction

A. Overview

- In this project i have designed a device which can be used by people easily as it is also made for people with

disability and people who doesn't like or cant to use mobile phone.

- It is also made possible for doctor to read your daily Heart rate,oxygen and Cardiac Bio-maker value so that if needed he can consult the user.
- It is also made possible to contact the emergency service with the location of user with the error of up to 30 cm without the use WiFi and Bluetooth to make it more reliable, available to user.
- With keeping the regulation of government on medical device in the requirement it is also safe for user
- With current up to art technologies in the field of I.O.T and connection it is to be said that the device is also secure for user

B. Future Direction

- I believe for future we can also add communication via satellite to make the device more reliable for its emergency service as connection using satellite consume more power one need to work on it.
- There can also be addition of new sensor to same device for multi functionality keeping it small and easy to carry.

REFERENCES

[1] D. Mondal, D. Paul and S. Mukherji, "Impedance Spectroscopy-Based Detection of Cardiac Biomarkers on Polyaniline Coated Filter Paper," in IEEE Sensors Journal, vol. 17, no. 16, pp. 5021-5029, 15 Aug.15, 2017, doi: 10.1109/JSEN.2017.2717701.

[2] "Now, Your Smartphone Can Help You Detect A Heart Attack" IIT Bombay. 2018 [Online] Available https://www.iitb.ac.in/en/research-highlight/now-your-smartphone-can-help-you-detect-heart-attack

Fig. 2. Author - Jasmeet Singh Matta