Software Requirements Specification

For

CareAI : An IoT based eHealthcare Advisor

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Prepared by

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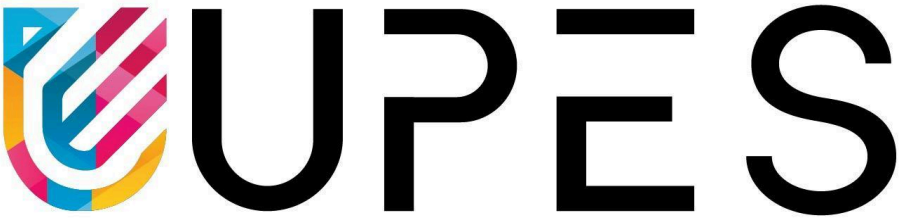

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1. INTRODUCTION

The Medical Services of a nation assume a significant part in characterizing a nation's turn of events. It is the consumption, quality, and openness of well-being administrations that oversee the nature of medical services. This expects to foster an IoT-based medical care unit that is a compact, minimal expense, lightweight, and low-power electronic medical services framework. It will record and screen well-being boundaries like temperature, pulse, circulatory, and so forth giving essential patient observation and care help to reinforce our country's medical services framework from rustic to metropolitan areas[1]. The unit is available every minute of every day as constant information can be put away and brought from the cloud whenever and anyplace. A huge issue in rural India is the 1:10,000 proportion of doctors to patients,which is currently settled by this pack since doctors all over India can now get the information on their course of events.

The medical services industry assumes a fundamental part not just in the actual soundness of individuals yet additionally in the economy all in all. While the medical services area is continually improving, a country like India with its developing populace generally falls short of sufficient offices. India has a general medical care model that is generally directed at the state level rather than the government level, with each state having its own openly financed medical services. The Public Wellbeing[2] Strategy centers around the development of the powerful medical care industry. By and by, notwithstanding, the confidential medical services area is answerable for the greater part of medical services in India. Significant clinical experts are in metropolitan regions which simply cover a few pieces of India. The need for openness to country regions builds the dangers and decreases personal satisfaction. What's more, the expense of clinical treatment is high. Ordinary body tests, forward and backward clinics, and pre-and-post-hospitalization clinical costs all amount to a powerful sum that individuals can't bear. To change this multitude of negative marks, the full advantage of altering IoT in medical care is thought of. The Web of Things has made objects brilliant with next to no manual intercession. It lays out a stage that opens doors for individuals to interface gadgets and controls them with enormous information innovation. It is an ideal mixture of continuous investigation, remote organization sensors, and installed frameworks.

There are endless benefits of IoT in medical services fields like using time productively, less use, and better and precise outcomes. Along these lines, every one of the shortcomings in the well-being area will diminish. With arising advances, information the executives likewise turn into a significant piece of the medical services framework. A great many information must be put away and this causes space intricacy in data sets.

1.1 Purpose of the Project

The idea of this project originated to give good medical care and reduce the need for patients to visit the doctor for a regular health checkup. This Healthcare Kit[3] facilitates cost and time savings for both patients and doctors and it also allows doctors to give more time for emergency cases. An IoT-based solution has been developed that can monitor the medical issues based on the output of a hardware system composed of various sensors such as Temperature Sensor (LM35) & Pulse Sensor(MAX30100). Further, Email alerts are being generated to the patient considering the average rate of the reading by the health monitoring sensors. The data and other personal details of the patient are stored in the MongoDb cloud which can be used for the Authentication & authorization.

1.2 Target Beneficiary

The target beneficiaries of the proposed methodology are the old people & rural population who live without their caretakers. They are not able to call their caretakers at the last moment. Healthcare authorities are the main beneficiaries because they are able to remotely monitor the patients.

1.3 Project Scope

The scope of our project is to monitor the basic medical vital analysis of the patient remotely with the use of cloud computing and IoT. The triggers are generated to the patients when there is an abnormal behavior captured by the sensors. The pulse sensor & temperature sensor is used to capture the Heart Rate & temperature which is interfaced with the microcontroller to store the data. This methodology is very useful for the healthcare professionals in order to monitor and detect the medical issues of the patient.

1.4 References

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[4] M. U. Ahmed, M. Björkman, A. Čaušević H. Fotouhi, and M. Lindén, *"An overview on the internet of things for Health Monitoring Systems,"* SpringerLink, 01-Jan-1970. Available: https://link.springer.com/chapter/10.1007/978-3-319-47063-4_44.

2. PROJECT DESCRIPTION

2.1 SWOT Analysis

Strength: The utmost strength of our project is that it is a real-time monitoring system and can help in detecting medical problems at an early stage. Further our all details will be uploaded on cloud for the future reference of patient medical history.

Weakness: The only weakness of our project is the hardware connected components in IOT devices. Because the components used are suitable for low level usage, though we can still integrate high level components for the same project.

Opportunities: It can have a wide range of valid possibilities that this project can evolve into some bigger medical project or maybe subsumed under some higher application. This project can also be used for educational purposes, say, for demonstration of working of IOT devices used for medical services. An enhanced version of a health bot can be developed to solve complicated issues and provide more options for consultation. We will add advanced machine learning to increase the efficiency of the health bot.

Threats: Our IOT-based project is susceptible to AI-based attacks. These AI attacks have been around since 2007, the threats they present within IoT are becoming increasingly more prominent. Hackers now can build AI-powered tools that are faster, easier to scale, and more efficient than humans, to carry out their attacks. This poses a serious threat within the IoT ecosystem.
The availability of the sensors required is necessary. In case the sensors are not available, we cannot collect the data of the system.

2.2 Project Features

This model is well equipped where a doctor can examine his patient from anywhere and anytime. Our web application can contribute to ease of accessibility to the masses as it can be used by rural people through mobile phones. We aim to provide virtual assistance to patients, and workers to build better and well-connected healthcare for society. This results in a better understanding of the medical terminologies and provides a customized service to the patients via our Healthbot.

2.3 Design and Implementation Constraints

- Networking issues
- Storage restrictions
- Complexity in integrating different sensors.

2.4 Design diagram

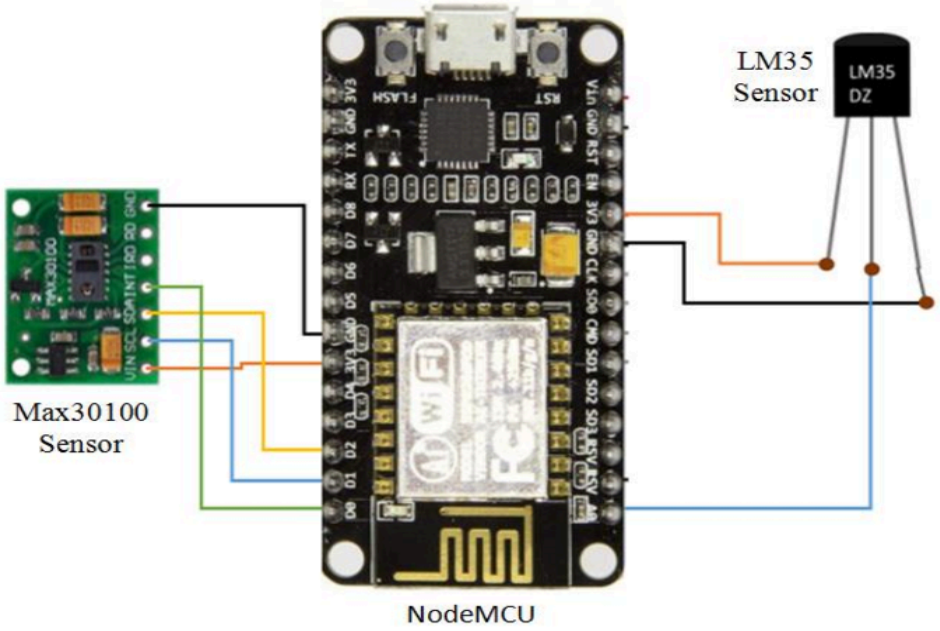

Fig. 1- Interfacing NodeMCU with MAX30100 & LM35 (Heart Rate/Pulse rate Sensor & Temperature Sensor)

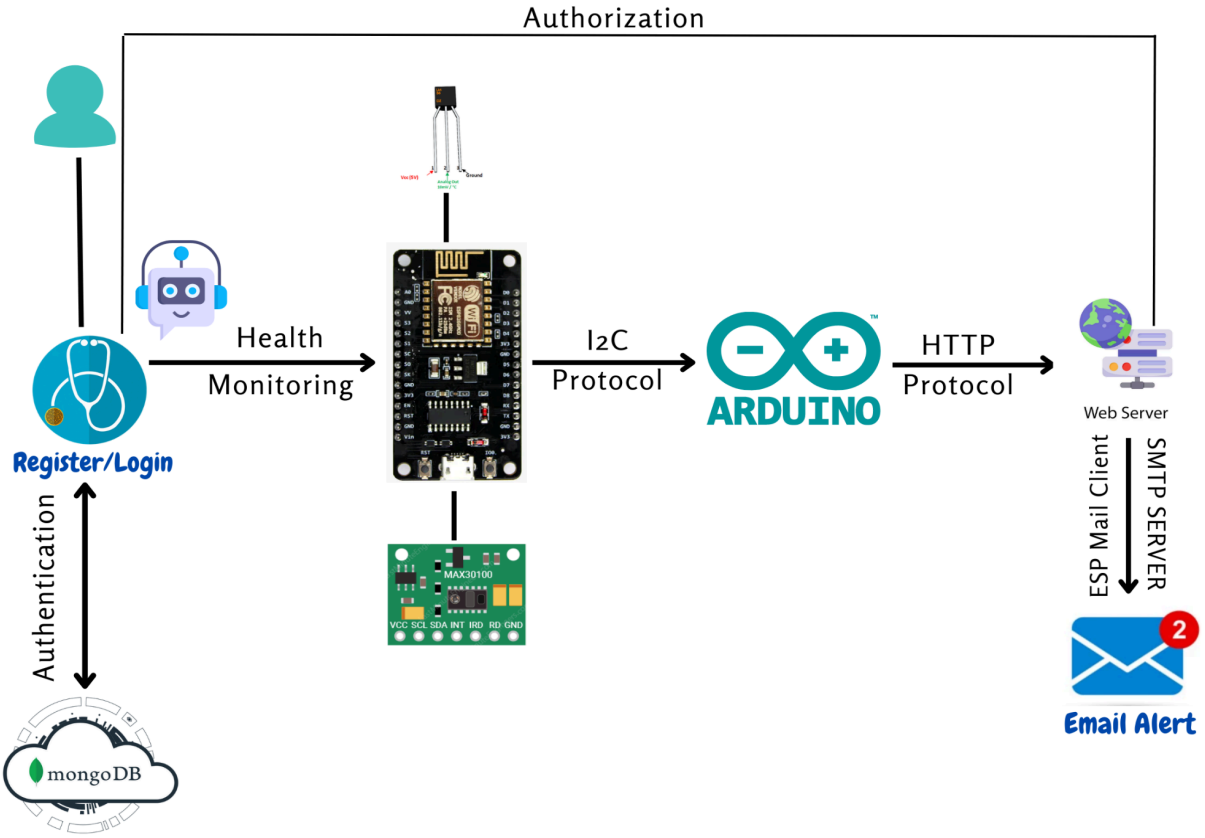

Fig. 2- Working diagram of the project

3. SYSTEM REQUIREMENTS

3.1 User Interface

Our project requires a user interface so that it is easier for the users to get their respective data. For this, we have used HTML, CSS, JS & NodeJs to design our frontend which will allow the users to see analysis of their medical issues at a particular time and monitor accordingly. Generation of triggers will help the user to take precautions and medication. As we are using an IoT device to sense the temperature, pulse rate and send it to the backend where it will be accessed by the database.

Design and implementation of the User Interface: Visual Studio Code.
Sensor connection: Arduino IDE
Database Storage: MongoDB Cloud

3.2 Protocols

- **HTTP (Hypertext Transfer Protocol)** is an application-layer protocol used for communication on the World Wide Web. It is the foundation of data communication for the World Wide Web, and it enables communication between clients and servers. HTTP was designed to be a stateless protocol, meaning that it does not keep track of previous interactions between the client and server. It is used to transmit text, images, videos, and other types of data over the Internet. It works by using a client-server model, where the client sends a request to the server, and the server responds with the requested information.

- **I2C (Inter-Integrated Circuit)** protocol is a synchronous, multi-master, multi-slave communication protocol used to interface low-speed peripherals with microcontrollers, microprocessors, and other electronic devices. It was developed by Philips Semiconductor (now NXP Semiconductors) in the 1980s to enable communication between components on a circuit board with a minimum number of wires.
  The I2C protocol uses two bidirectional lines for communication: SDA (Serial Data) and SCL (Serial Clock). SDA is used to transmit data between devices, and SCL is used to synchronize the data transfer between devices. Devices on the bus

4. NON-FUNCTIONAL REQUIREMENTS

4.1 Performance requirements

The following are the four basic requirements needed:

- Provisioning and Authentication
- Configuration and Control
- Monitoring and Diagnostics
- Software Updates and Maintenance

4.2 Security requirements

- In this system, real-time health monitoring will be done by using IoT. The proposed design is advantageous to patients of different age groups & people living in rural areas. It also provides security and privacy to the data of the patient.

- Authentication and Authorization helps users to identify and to decide which user is given the access. We have used MongoDB Cloud for this purpose.

4.3 Software Quality Attributes

Accessibility: Our project's accessibility is reliant on the accessibility of each individual service we use.

Portability: We used IoT devices that are easily portable for our project.

Usability: It is the ease with which things, such as software and web apps, may be utilized to accomplish necessary tasks effectively and efficiently. Usability evaluates how challenging a user interface is to use. In order to make our product as user-friendly as possible, we created a simple and friendly web user interface.

Testability: Depending on the services and devices used, our project can be easily divided into smaller components. It is possible to test and confirm the usability of any specific device service.

APPENDIX A: GLOSSARY

- I2C Protocol- It is a communication protocol that is commonly used to connect microcontrollers and other integrated circuits on a circuit board. It was developed by Philips Semiconductors (now NXP Semiconductors) and is widely used in the electronics industry. The IC2 protocol uses a master-slave architecture, where one device acts as the master and initiates the communication, while one or more devices act as slaves and respond to the master's requests. The master generates clock signals, and the slaves use these signals to synchronize their data transfer. The communication in IC2 protocol takes place using two lines - SDA (Serial Data) and SCL (Serial Clock). The SDA line carries the actual data being transmitted, while the SCL line carries the clock signals that synchronize the data transfer.
  IC2 protocol supports both 7-bit and 10-bit addressing modes, which allows up to 128 or 1024 devices to be connected on the same bus. It also supports multiple data transfer modes, including byte-by-byte transfer and block transfer modes.
  IC2 protocol is widely used in various applications, such as sensors, LCD displays, EEPROMs, and many other devices that require communication between microcontrollers or integrated circuits.

- SMTP Server- SMTP (Simple Mail Transfer Protocol) is a protocol used for sending and receiving emails over the Internet. An SMTP server is a software application or program that runs on a server and facilitates the transfer of emails between email clients or servers.
  SMTP servers work by using a set of commands and responses to communicate with other email servers or clients. When an email is sent, the sender's email client or server sends the message to the SMTP server, which then forwards the message to the recipient's email server or client. The recipient's email server or client then retrieves

the email from the server and delivers it to the recipient. SMTP servers use TCP (Transmission Control Protocol) to ensure reliable communication between email clients or servers. The default port for SMTP is 25, but many email servers also support alternate ports such as 587, which is often used for secure communication using TLS (Transport Layer Security) encryption. SMTP servers are essential for sending and receiving emails, and they are used by both individuals and organizations.

- HTTP Protocol- HTTP (Hypertext Transfer Protocol) is an application-layer protocol used for communication on the World Wide Web. It is the foundation of data communication for the World Wide Web, and it enables communication between clients and servers. HTTP was designed to be a stateless protocol, meaning that it does not keep track of previous interactions between the client and server. It is used to transmit text, images, videos, and other types of data over the Internet. It works by using a client-server model, where the client sends a request to the server, and the server responds with the requested information. HTTP requests are made using a uniform resource locator (URL), which identifies the resource being requested, and a set of headers, which provide additional information about the request, such as the client's preferred language or the type of data it can accept. The HTTP response contains a status code, which indicates whether the request was successful or not, and the requested data.

- LM35- It is a temperature sensor integrated circuit (IC) that is used to measure temperature with a high degree of accuracy. It is a popular temperature sensor among electronic enthusiasts and professionals because it provides a voltage output that is linearly proportional to the Celsius temperature.The LM35 IC works by converting the analog output voltage oF the temperature sensor to a digital value using an analog-to-digital converter (ADC). The ADC can be built into the microcontroller or processor, or it can be a separate component. The LM35 has a number of advantages over other temperature sensors. One of the main advantages is its accuracy, with an accuracy of around ±0.5°C at room temperature. It is also easy to use, as it requires only a single power supply and no external calibration. Additionally, it has a wide temperature range, typically from -55°C to 150°C.

- MAX30100- The MAX30100 is a pulse oximetry and heart-rate sensor module that can be used to monitor blood oxygen saturation levels and heart rate in real-time. It is a compact and low-power sensor module that integrates red and infrared LED emitters, photodetectors, and low-noise electronics into a single small package.The MAX30100 operates by shining red and infrared light through the skin and measuring the amount of light that is absorbed by the blood. The sensor then calculates the oxygen saturation and heart rate based on the changes in light absorption. This sensor can be used in various applications such as fitness trackers, wearable devices, medical monitoring equipment, and other health-related applications.

- NodeMCU- NodeMCU is an open-source firmware and development kit based on the ESP8266 Wi-Fi chip. The ESP8266 chip is a low-cost, low-power, and highly-integrated system-on-a-chip (SoC) that is widely used in IoT (Internet of Things) applications. NodeMCU provides a Lua-based firmware for the ESP8266 chip, which allows developers to easily program and interact with the chip using a high-level scripting language. It also includes a built-in Wi-Fi module, which enables the ESP8266 chip to connect to the internet and communicate with other devices. NodeMCU development boards are widely available and come with various built-in features such as USB-to-serial interface, voltage regulators, and GPIO (general-purpose input/output) pins. This makes it easy for developers to prototype and build IoT projects without requiring additional components. NodeMCU has a large and active community of developers and users, who have contributed to the development of various libraries and tools for the platform. This has made it a popular choice for IoT projects, particularly those involving Wi-Fi connectivity and web-based interfaces.