PROJECT PHASE II REPORT

ON

CAREWAVE

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to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the degree

of

Bachelor of Technology

in

Computer Science and Engineering

Department of Computer Science and Engineering

St. Joseph's College of Engineering and Technology, Palai

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Declaration

We undersigned hereby declare that the project report on **" CareWave"**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala, is a bonafide work done by us under supervision of **Prof. Dona Mary Cherian**. This submission represents our ideas in our own words and where ideas or words of others have been included, We have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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CERTIFICATE

This is to certify that the report entitled "**CAREWAVE**" submitted by **EMY JOSHY (SJC20CS055), GEORLIT GEORGE (SJC20CS061),MEENU SUSAN MONY (SJC20CS088), SWATHILEKSHMI S.(SJC20CS116)** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering is a bonafide record of the project work carried out by them under my guidance and supervision.

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Abstract

In an increasingly aging population, the need for personalized and efficient healthcare solutions has become paramount. This abstract presents an innovative concept: a health monitoring system that leverages sensors and artificial intelligence (AI) for proactive wellness management. The system utilizes sensors to capture real-time vital signs, including heartbeat, blood pressure, and blood oxygen saturation (SpO2). An AI model continuously analyses this data, identifying anomalies that deviate from the user's established baseline. When the AI detects fluctuations outside the user's normal parameters, a multi-tiered alert system is activated. Initially, the user receives a notification on their health status. If no response is received within If no response is received within a set timeframe, the system escalates the situation by notifying pre-designated emergency contacts and nearby healthcare institutions. Critically, the system also transmits the user's real-time location, enabling a swift and targeted response. Additionally, the system offers medication reminders, promoting adherence to prescribed medication schedules. A companion mobile application acts as a user interface, displaying vital sign data, medication schedules, and any triggered alerts. This comprehensive approach empowers individuals to actively manage their health while providing an extra layer of security through AI-powered anomaly detection, location-aware emergency response, and improved medication adherence.

Contents

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List of Abbreviations

AI	-	Artificial Intelligence
API	-	Apllication Program Interface
EHR	-	Electronic Health Record
GPIO	-	General Purpose Input/Output
GSM	-	Global System for Mobile Communication
I/O	-	Input/Output
I2C	-	Inter-Integrated Circuit
IDE	-	Integrated Development Environment
IoT	-	Internet of Things
JVM	-	Java Virtual Machine
LED	-	Light-emitting diode
SDK	-	Software Development Kit
SPI	-	Serial Peripheral Interface
SpO2	-	Peripheral capillary oxygen saturation
UART	-	Universal Asynchronous Receiver/Transmitter

Chapter 1

Introduction

In an era characterized by unprecedented advancements in technology and healthcare, a critical disparity remains for the aging population and individuals grappling with health conditions. The existing healthcare systems, though robust in many aspects, are confronted with limitations when it comes to delivering personalized health management and prompt emergency response. This deficiency gives rise to a myriad of challenges, including delayed interventions and insufficient remote monitoring, thereby compromising the overall well-being of this vulnerable demographic.

Recognizing the urgent need to address these gaps, there emerges a compelling call for innovation. The solution lies in the development of a cutting-edge, AI-powered software specifically designed for smartwatches. These ubiquitous wearables have the potential to serve as invaluable companions, offering tailored healthcare solutions that go beyond mere fitness tracking. Through harnessing the power of artificial intelligence, this proposed software aims to revolutionize health management for the elderly and those with health conditions, ensuring not only personalized care but also swift responses in times of emergencies. This report delves into the imperative to bridge these gaps and outlines the key features and benefits of the envisioned AI-powered smartwatch software, positioning it as a transformative tool for enhancing the well-being of a deserving and often overlooked segment of the population.

1.1 Background

The aging population and individuals managing health conditions represent a growing demographic facing unique challenges within contemporary healthcare systems. As life expectancy rises globally and chronic health conditions become more prevalent, the need for targeted and personalized healthcare solutions becomes increasingly apparent. Traditional healthcare systems, although proficient in addressing general health concerns, often fall short when it comes to the nuanced and individualized care required by this specific demographic.

Moreover, the existing infrastructure encounters obstacles in delivering timely interventions and efficient remote monitoring, exacerbating the difficulties faced by individuals seeking comprehensive health management. Delayed responses to health emergencies and a lack of real-time monitoring contribute to a suboptimal quality of life for many, with potential ramifications on overall health outcomes.

The integration of technology into healthcare has witnessed remarkable progress in recent years, with smartwatches emerging as accessible and widely adopted devices for health tracking. However, their current capabilities predominantly focus on basic fitness metrics and fail to address the nuanced needs of the aging population and individuals with specific health conditions.

Against this backdrop, there is a compelling imperative to leverage artificial intelligence (AI) to develop a sophisticated software solution tailored to the capabilities of smartwatches. AI has the potential to revolutionize healthcare by offering personalized insights, predictive analytics, and real-time monitoring, thereby bridging the existing gaps in the care continuum. By delving into the unique challenges faced by the target demographic, this background sets the stage for the subsequent exploration of an innovative AI-powered smartwatch software that aims to redefine healthcare management for the elderly and those with health conditions.

1.2 Objective and Scope

This project endeavors to develop an innovative AI-powered software solution tailored for smartwatches, aiming to fill critical gaps in healthcare for the aging population and individuals managing health conditions. The primary objective is to harness artificial intelligence to provide personalized health management, real-time monitoring, and swift emergency response. The software will analyze individual health data to offer tailored recommendations, monitor vital metrics continuously, and initiate automated emergency protocols when needed. The scope encompasses creating a user-friendly interface, ensuring data security and privacy, optimizing accessibility, and exploring interoperability with existing healthcare systems. By focusing on these objectives and scope elements, the project seeks to redefine healthcare for a vulnerable demographic, offering a comprehensive and transformative solution through the integration of AI into everyday wearable technology.

Chapter 2

Literature Review

2.1 Research Papers

This project endeavors to develop an innovative AI-powered software solution tailored for smartwatches, aiming to fill critical gaps in healthcare for the aging population and individuals managing health conditions. The primary objective is to harness artificial intelligence to provide personalized health management, real-time monitoring, and swift emergency response. The software will analyze individual health data to offer tailored recommendations, monitor vital metrics continuously, and initiate automated emergency protocols when needed. The scope encompasses creating a user-friendly interface, ensuring data security and privacy, optimizing accessibility, and exploring interoperability with existing healthcare systems. By focusing on these objectives and scope elements, the project seeks to redefine healthcare for a vulnerable demographic, offering a comprehensive and transformative solution through the integration of AI into everyday wearable technology.

2.1.1 Real-time artificial intelligence based health monitoring, diagnosing and environmental control system for COVID-19 patients

Authors: Muhammad Zia Ur Rahman

This paper[1] presents a real-time artificial intelligence-based health monitoring,diagnosing, and environmental control system for COVID-19 patients. The system utilizes locally available sensors and IoT technology to track the health parameters of isolated COVID-19 patients in remote areas. It provides live location tracking, GSM messages, and email alerts to doctors during emergency conditions. The system incorporates intelligent neural networks for training and diagnosis, and it can automatically prescribe medication in the absence of a doctor. The implementation results are discussed, including a comparison with existing IoT-based health monitoring systems. The paper concludes by highlighting the benefits of the proposed system in remote patient monitoring and suggesting future work for improvement.

2.1.2 Smart Health Monitoring Using Deep Learning and Artificial Intelligence

Author: Suma K G

The paper[2] discusses the use of deep learning and artificial intelligence in smart health monitoring systems, exploring various applications and techniques for data analysis and prediction in healthcare. The document explores the applications of smart health monitoring in various healthcare areas, such as intensive care, medication management, and oxygen saturation monitoring. It also addresses the challenges and limitations in smart health monitoring, including power management, data standardization, and data security. Overall, the document provides insights into the potential benefits and challenges of implementing smart health monitoring systems and suggests future directions for research in the field.

2.2 Existing solutions

2.2.1 Vivify Health

Vivify Health [4] is a cloud-based remote care solution that helps businesses in the healthcare industry design personalized care plans and monitor patient status. It enables users

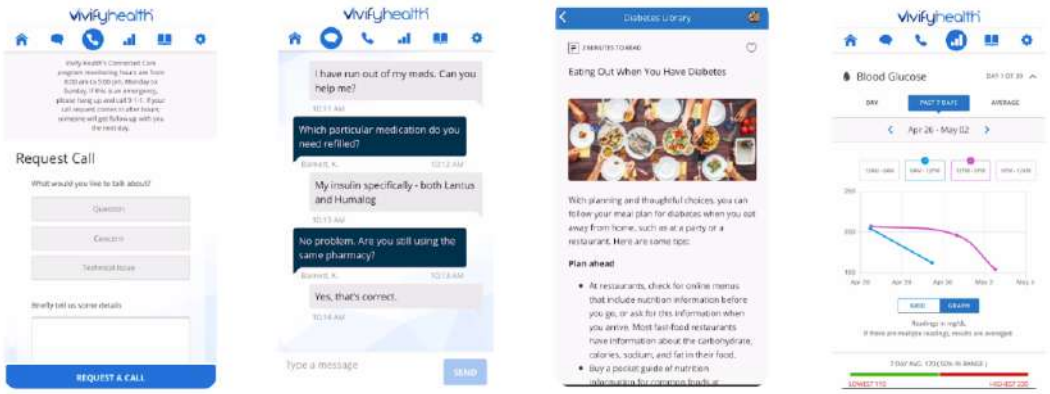

Figure 2.1: Vivify health

to build bundled health programs by analyzing patient data related to pre-op assessments, post-discharge monitoring, compliance documentation and more. Vivify Health facilitates integration with several third-party EHR solutions, ensuring quick access to patient medical records. Mobile applications for Android and iOS devices are also offered, allowing users to remotely manage all activities.

2.2.2 Keva Health

Keva Health's [5] SaaS Respiratory Care Platform for physicians captures the complete patient journey with consistent and accurate capture of remote care data outside the physician's office or hospital. It does this by ensuring that patients follow physician provided action plans, improve their adherence, and also provide just-in-time education when they are at home. The platform provides automated virtual check-ins and the ability to review remote patient monitoring (RPM) reports. Hospitals and clinics can get

reimbursed for services provided through use of KEVA platform virtually with very little overhead. This leads to better patient outcomes and lower costs for chronic diseases.

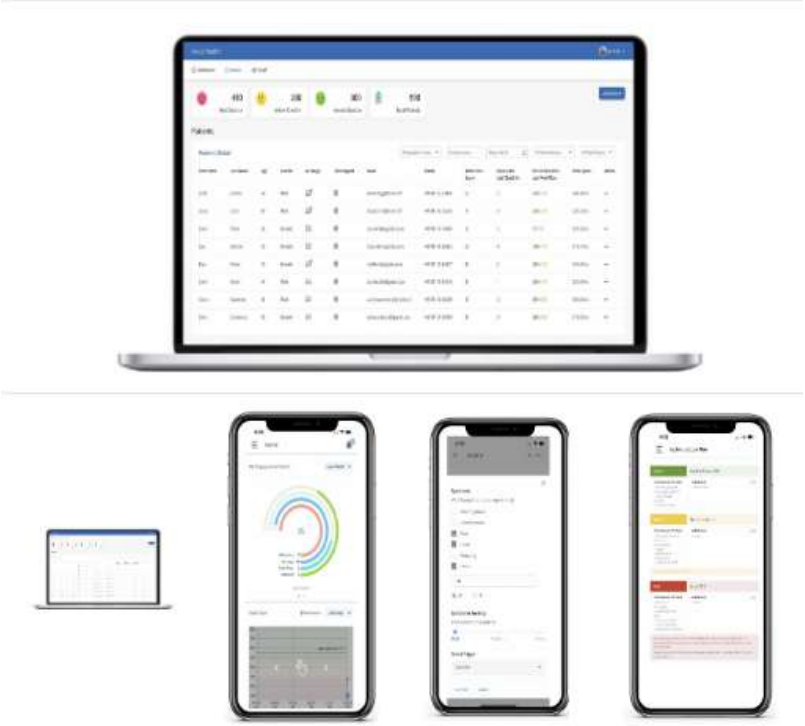

Figure 2.2: Keva health

2.2.3 Hale

Hale[6] is a remote patient monitoring platform, enabling clinical teams and health care practices to gain real-time health data without the need for on-site consultations. The platform enables patient medical records to be updated with data collected from the patient mobile app, while medical practitioners can upload media and data from appoint-

ments, test results, and care plans. This provides up-to-date information on patients' health status for making informed diagnoses and care plans. With Hale automated messages and reminders, patients can be reminded of upcoming appointments, as well as notified of any changes or amendments.

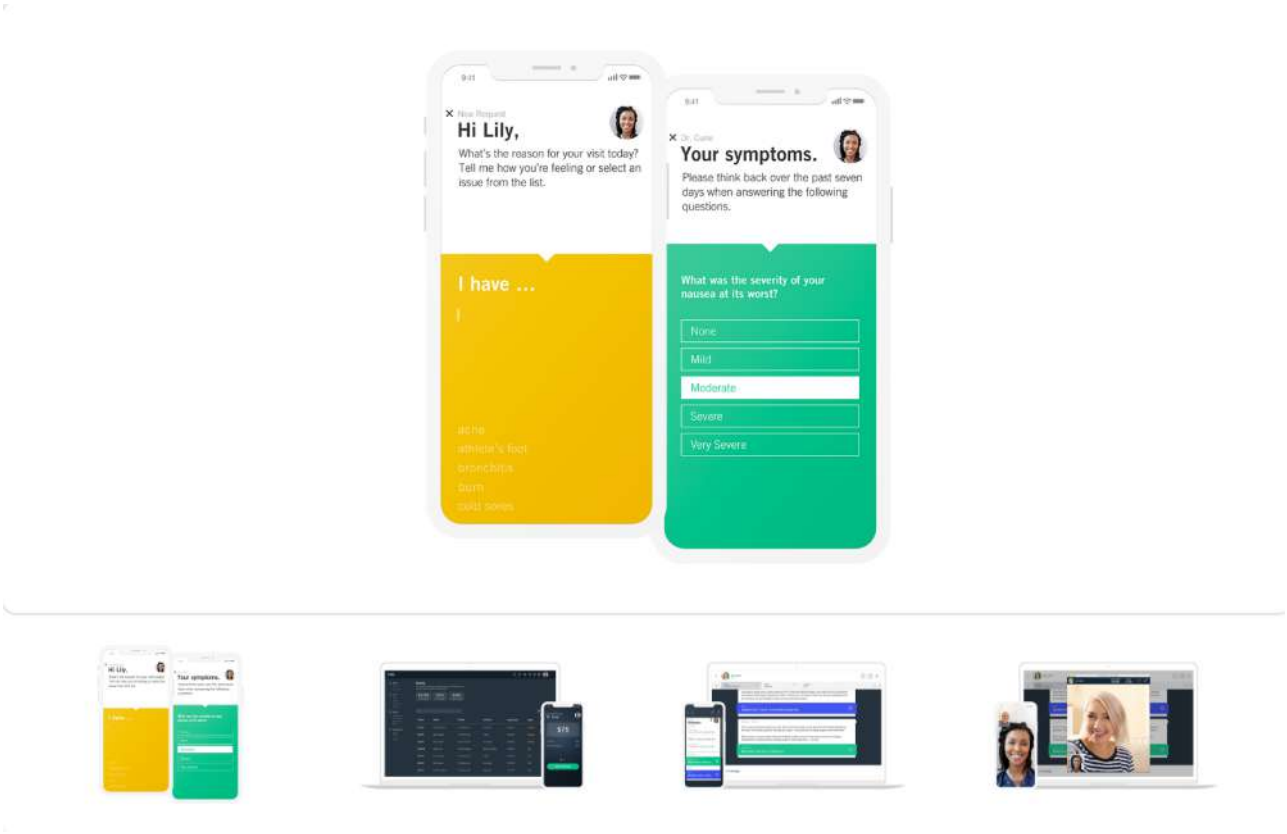

Figure 2.3: Hale software

Chapter 3

Methodology

3.1 Proposed System

Introducing "CareWave," a pioneering initiative aimed at revolutionizing individual healthcare monitoring and medication adherence. At its core, this project combines advanced hardware and software solutions to ensure users' health is monitored effectively. By utilizing ESP32 microcontrollers alongside MAX30102 sensors, CareWave gathers precise real-time data on the user's heart rate and oxygen saturation levels, providing a comprehensive insight into their physiological state with unmatched precision.

However, CareWave goes beyond mere data collection; it's designed to empower users in taking proactive control of their well-being. Through its sophisticated software component, CareWave not only visualizes the gathered data but also employs intelligent algorithms to analyze trends in vital signs. Additionally, CareWave incorporates medication reminder functionalities, issuing timely alerts aligned with users' medication schedules to prevent missed doses.

The significance of medication reminders cannot be overstated. Timely administration of medication is crucial for managing chronic conditions effectively and preventing complications. By sending alerts at the correct time, CareWave ensures that users adhere

to their prescribed medication regimen consistently. This feature not only enhances treatment efficacy but also reduces the risk of medication errors and missed doses, ultimately improving overall health outcomes.

To facilitate seamless data management and accessibility, CareWave integrates Firebase, a robust backend platform developed by Google. Firebase serves as a secure central repository for storing all vital signs data in the cloud, ensuring users can access their health records conveniently from anywhere. Furthermore, Firebase enables real-time synchronization across multiple devices, ensuring both users and healthcare providers have access to the latest information.

CareWave represents a comprehensive approach to personal health monitoring and medication management, bringing together state-of-the-art hardware, intelligent software, and a resilient backend infrastructure. With its focus on delivering real-time insights, medication reminders, and ensuring adherence to prescribed treatment regimens, CareWave aims to promote proactive healthcare practices and enhance overall well-being. Whether it's monitoring vital signs or managing medication adherence, CareWave stands as a reliable companion on the journey to better health.

3.2 Working

We incorporate the technologies of ESP32 and MAX30102 Pulse Oxymeter Heart Rate sensors to access the user's heart rate and oxygen saturation levels. As the user is in contact with the sensor, it starts reading the values to ensure the user's health.The Caregiver can manage access to the user's profile and data.The Caregiver can schedule medication reminders for the user, specifying the medication name, dosage, and timing. This ensures that the user receives timely alerts on their respective mobile phones reminding them to take their prescribed medication. These reminders eliminate the risk of missed or forgotten medications. He/She can also set medication refill reminders for the user. The user will receive an alert on their mobile when it is time to refill their medication. The

user can use the Emergency SOS feature to send an alert to their caregiver in case of an emergency.The CareWave Software utilizes data collected from the user's body and analyzes it using AI algorithms to provide valuable insights and alerts. The caregiver can receive emergency alerts from the system. These alerts inform the caregiver about critical situations or emergencies concerning the user.

3.3 Modules

The system is divided into four modules :
(1) User
(2) Data
(3) Notification
(4) Hardware

3.3.1 User

To ensure a seamless user on boarding experience, the user module incorporates Google Sign-In, allowing users to effortlessly establish their accounts using their existing Google credentials. This eliminates the need for manual registration and password creation, enhancing user convenience and satisfaction. The module further encompasses the collection of basic details, encompassing essential information such as the user's name, email address, and phone number. This data serves as the foundation for user identification and communication. To ensure the well-being of users, the module also gathers details regarding caregivers, including their names and contact numbers. This information is crucial for emergency situations and facilitates effective communication between healthcare providers and family members. Additionally, the module meticulously collects medication details, including the name of each medication, dosage, and frequency of administration. This comprehensive data enables healthcare providers to make informed decisions regarding patient care and medication management.

In essence, the user module streamlines account setup, gathers essential user information, and prioritizes patient well-being by collecting caregiver and medication details, fostering a comprehensive and user-centric approach to healthcare management.When registering to the software, basic details like name and contact details have to be given.Details like medications,doses and time should also be given.

3.3.2 Data

The data monitoring module facilitates seamless health monitoring by continuously collecting vital signs data from smartwatches. This data encompasses a range of parameters, including heart rate and oxygen saturation levels. The module meticulously monitors variations in these vital signs, enabling early detection of potential health concerns. All collected data is securely stored for future reference and analysis. This data serves as a valuable resource for healthcare providers, allowing them to track patient progress, identify trends, and make informed treatment decisions. To ensure the accuracy and reliability of the collected data, the module incorporates predefined maximum and minimum limits for each vital value.These limits serve as reference points, enabling the system to flag any anomalies or deviations from normal ranges, prompting further investigation and intervention if necessary. In essence, the data monitoring module empowers individuals to proactively manage their health by providing a comprehensive and user-friendly platform for continuous vital signs monitoring, data storage, and analysis.

3.3.3 Notification

The alert module plays a pivotal role in promoting medication adherence and ensuring prompt assistance in emergency situations. It functions by generating timely medication alerts, complete with the medicine name, dosage. In addition to medication alerts, the module incorporates caregiver details, ensuring that designated individuals are notified in case of any concerns or deviations from the prescribed medication regimen. This feature fosters a collaborative approach to healthcare management, keeping caregivers

informed and engaged in the patient's well-being. To provide comprehensive support, the alert module generates detailed alert messages that include vital information about the patient's condition, such as heart rate and oxygen saturation levels. These real-time updates empower caregivers and healthcare providers to make informed decisions and initiate timely interventions when necessary. In emergency situations, the alert module promptly triggers an SOS call to designated hospitals, ensuring that patients receive immediate medical attention. This feature acts as a lifeline, bridging the gap between patients and emergency services during critical moments.

The alert module, with its multifaceted functionality, serves as an indispensable tool for promoting medication adherence, facilitating timely interventions, and ensuring prompt assistance in emergencies. Its ability to provide timely reminders, detailed updates, and emergency support makes it a cornerstone of comprehensive healthcare management.

3.3.4 Hardware

- **ESP32**
  - The ESP32 is a highly capable microcontroller developed by Espressif Systems, renowned for its versatility and performance in the realm of IoT (Internet of Things). Featuring a dual-core processor architecture, the ESP32 offers robust processing power, making it suitable for a wide range of applications. One of its key features is its built-in Wi-Fi and Bluetooth connectivity, allowing seamless communication with other devices and networks. Additionally, the ESP32 boasts a generous number of GPIO (General Purpose Input/Output) pins, enabling interfacing with various sensors, displays, and peripherals.Its support for multiple communication protocols, including SPI, I2C, and UART, further enhances its flexibility in hardware integration. With its low power consumption and cost-effectiveness, the ESP32 has become a preferred choice for developing connected devices, wearable technology, smart home systems, and industrial automation solutions.

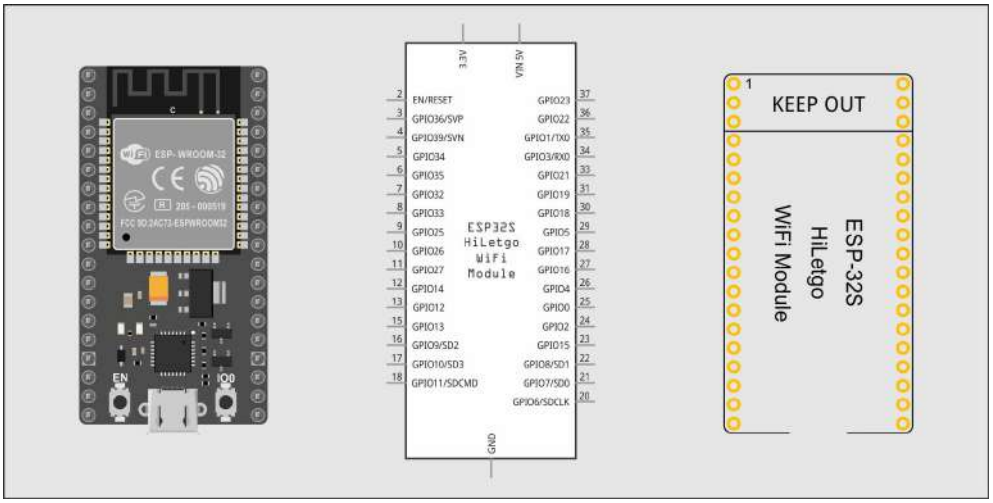

Figure 3.1: ESP 32 diagram

- **MAX30102**
  - The MAX30102 is an integrated pulse oximetry and heart-rate monitor biosensor module. It includes internal LEDs, photodetectors, optical elements, and low-noise electronics with ambient light rejection. The MAX30102 provides a complete system solution to ease the design-in process for mobile and wearable devices.It operates on a single 1.8V power supply and a separate 3.3V power supply for the internal LEDs.Communication is through a standard I2C-compatible interface.The module can be shut down through software with zero standby current, allowing the power rails to remain powered at all times.

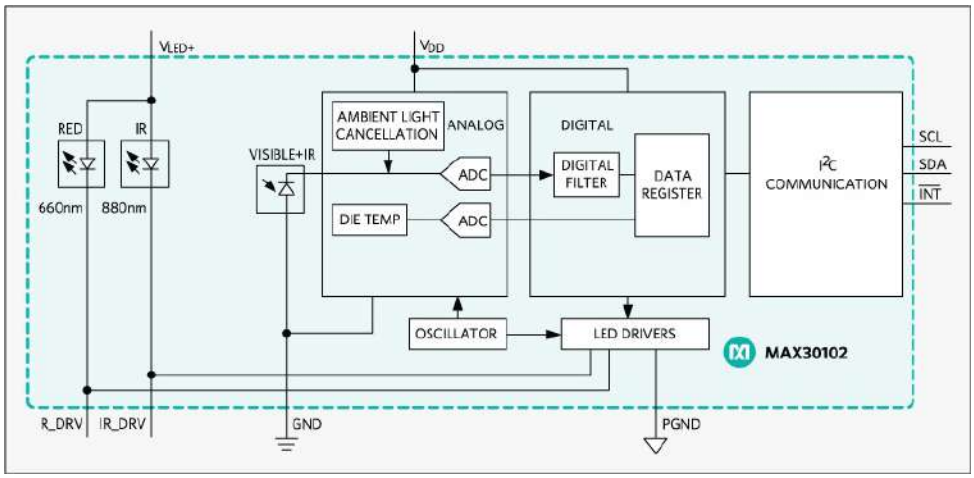

Figure 3.2: Max30102

Chapter 4

System Requirement Specifications

4.1 Functional Requirements

- **Vital sign monitoring:** Vital sign monitoring is a critical feature of smartwatch technology, enabling individuals to track their health metrics and identify potential health concerns. Smartwatches equipped with sensors can measure key vital signs such as heart rate, blood pressure, blood oxygen saturation. This data is then stored and displayed in a mobile app, allowing users to track changes over time and identify any irregularities. Monitoring heart rate is particularly important for individuals with heart conditions or those who regularly exercise. Blood pressure monitoring is also crucial for individuals with hypertension or other cardiovascular conditions. Blood oxygen saturation is another vital sign that can be measured by smartwatches. Smartwatches can be a valuable tool for health monitoring, but it is important to remember that they are not a substitute for medical care.

- **Medication reminders:** Medication adherence, the act of taking medications as prescribed, is crucial for managing chronic conditions and preventing adverse health outcomes. This can lead to uncontrolled symptoms, hospitalizations, etc. They serve as a prompt for users to take their medications at the correct time and can help to overcome forgetfulness, busy schedules, and complex medication regimens.

Medication reminders ensure that medications are taken as prescribed. Overall, medication reminders are an essential tool for promoting medication adherence and improving patient outcomes.

- **Alert notifications:** Timely alert messages to caregivers are crucial for ensuring the well-being of individuals who require assistance, particularly those with chronic conditions, disabilities, or age-related limitations. These alerts serve as a lifeline, providing caregivers with immediate notification of potential health concerns, emergencies, or deviations from routine. By receiving timely alerts, caregivers can promptly intervene, provide necessary care, potentially preventing adverse health outcomes.Timely alert messages empower caregivers to play an active and informed role in their loved ones' healthcare, fostering proactive care and enhancing overall patient well-being.

4.2 Non-Functional Requirements

- **Compatibility:** It refers to the ability of two or more things to work together harmoniously. In the context of technology, compatibility ensures that different hardware and software components can interact seamlessly, enabling users to experience a smooth and consistent operation. It also plays a crucial role in healthcare, where compatibility between medical devices and patient records is essential for accurate diagnosis, treatment, and monitoring. Compatibility extends to various aspects of life, from the ability of different personality types to coexist to the suitability of different products for specific purposes.

- **Performance:** Application performance refers to how effectively an application functions and meets the needs of its users. It encompasses various aspects, including responsiveness, scalability, and stability. Responsive applications quickly respond to user requests, providing a seamless experience. Scalable applications can handle increasing workloads without experiencing significant performance degradation. Stable applications maintain consistent performance over time, minimizing downtime and ensuring reliability.

- **Security:** Data security of an application is crucial for protecting sensitive information from unauthorized access, modification, or destruction. By prioritizing data security, organizations can minimize the risk of data breaches, maintain user trust, and ensure compliance with regulatory requirements.

- **Usability:** Usability is a crucial aspect of any application, determining how effectively and easily users can achieve their desired goals. It encompasses three key attributes:

  Effectiveness: The ability of users to complete tasks successfully using the application. Efficiency: The amount of time and effort required for users to complete tasks. Satisfaction: The overall user experience, including feelings of ease of use, pleasantness,and control. A usable application should be intuitive, consistent, and predictable, allowing users to navigate seamlessly and accomplish their objectives without frustration or confusion.

- **Reliability:** The reliability of an application refers to its ability to perform consistently and accurately according to its specifications. A reliable application should be able to withstand unexpected events, such as hardware failures or software bugs, and continue to operate without interruption. In addition, a reliable application should be easy to use and maintain, and it should have a low incidence of errors.When an application is reliable, users can trust that it will work as expected and that their data will be safe. This can lead to increased user satisfaction and productivity.

4.3 Hardware Requirements

The hardware for an ESP32 and MAX30102 sensor project is basic: an ESP32 board, the MAX30102 sensor itself, and jumper wires for connection. A breadboard and resistors might be helpful for prototyping, and a power supply is needed.

(1) ESP32

(2) Max30102 Pulse Oxymeter Heart Rate Sensor

4.3.1 ESP32

The ESP32, developed by Espressif Systems, is a powerful microcontroller for IoT. It features dual-core processing, built-in Wi-Fi and Bluetooth, and ample GPIO pins for sensor and peripheral integration. Its support for SPI, I2C, and UART enhances hardware flexibility. With low power consumption and cost-effectiveness, it's ideal for connected devices, wearables, smart homes, and industrial automation.

Figure 4.1: ESP32 micro controller

4.3.2 Max30102 Pulse Oxymeter Heart Rate Sensor

The MAX30102 is an integrated pulse oximetry and heart-rate monitor biosensor module. It includes internal LEDs, photodetectors, optical elements, and low-noise electronics with ambient light rejection. The MAX30102 provides a complete system solution to ease the design-in process for mobile and wearable devices.It operates on a single 1.8V power supply and a separate 3.3V power supply for the internal LEDs.Communication is through

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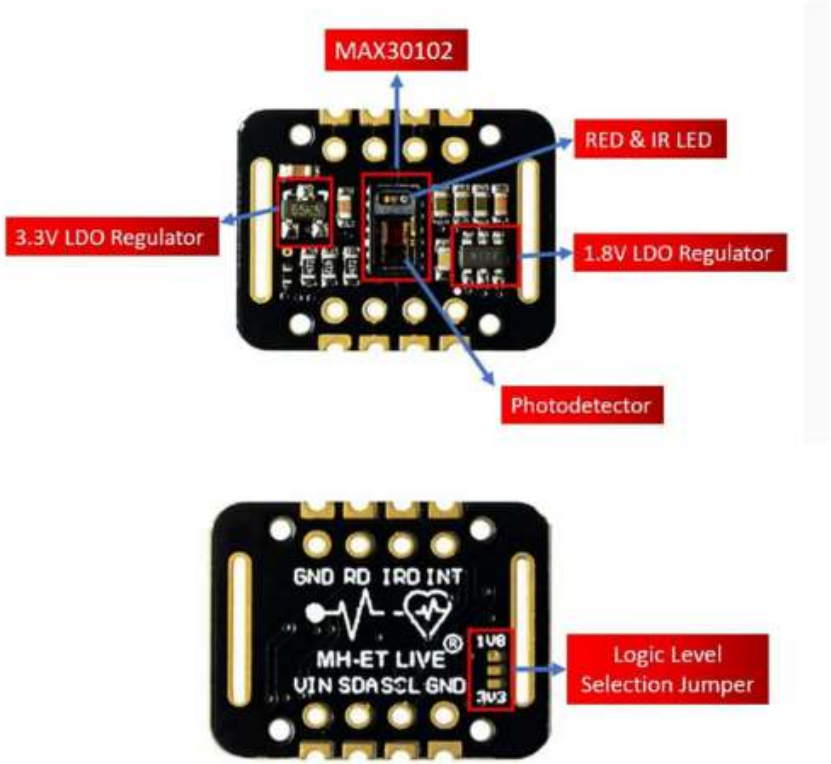

Figure 4.2: Max30102 Pulse Oxymeter Heart Rate Sensor

4.3.3 Workflow

We incorporate the technologies of ESP32 and MAX30102 Pulse Oxymeter Heart Rate sensors to access the user's heart rate and oxygen saturation levels. As the user is in contact with the sensor, it starts reading the values to ensure the user's health.The Caregiver can manage access to the user's profile and data.The Caregiver can schedule medication reminders for the user, specifying the medication name, dosage, and timing. This ensures that the user receives timely alerts on their respective mobile phones reminding them to take their prescribed medication. These reminders eliminate the risk of missed or forgotten medications. He/She can also set medication refill reminders for the user. The

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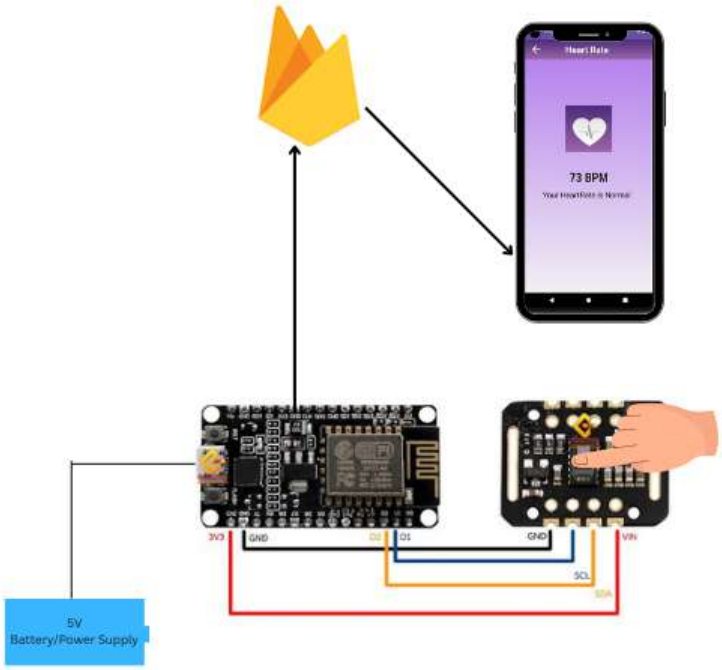

Figure 4.3: ESP32 micro controller

4.4 Software Requirements

4.4.1 Kotlin

Kotlin is a modern, statically-typed programming language that runs on the Java Virtual Machine (JVM) and can also compile to JavaScript or native code. Developed by JetBrains, it's designed to be concise, expressive, and interoperable with existing Java code.

Kotlin offers features like null safety, extension functions, and coroutines, making it a preferred choice for Android app development, server-side applications, and multi-platform development.

4.4.2 Firebase

Firebase is a backend-as-a-service (BaaS) platform that helps you build, improve, and grow your app. It offers a suite of features that can help you develop and manage your mobile and web applications. These features include authentication, database, storage, functions, hosting, remote config, app distribution, analytics, performance monitoring, crashlytics, and testing lab. With Firebase, you can focus on building your app and let Firebase handle the rest. Firebase is a great platform for developers of all levels of experience, and it can help you build high-quality apps that are scalable, reliable, and secure.

4.4.3 Tensorflow

TensorFlow is an open-source software library for numeric computation using data flow graphs. It is a powerful platform for developing and deploying machine learning and deep learning models. TensorFlow's core abstraction is the tensor, which is a multidimensional array of data. Tensors can be used to represent a variety of data types, such as images, text, and audio. TensorFlow provides a comprehensive set of operations for manipulating and transforming tensors, as well as for building and training machine learning models. TensorFlow is used by a wide range of organizations, including Google, Facebook, and Microsoft, to develop a variety of machine learning applications, such as image recognition, natural language processing, and recommending systems.

4.4.4 Python

Python is a widely-used programming language renowned for its simplicity and versatility in AI development. With libraries like TensorFlow, PyTorch, and scikit-learn, Python provides powerful tools for building AI models. Its clear syntax and extensive community support make it an excellent choice for creating various types of AI, from machine learning algorithms to neural networks.

4.4.5 Arduino IDE

The Arduino IDE is a user-friendly software platform for programming microcontrollers and interfacing with sensors. It offers a simple yet powerful environment for writing, compiling, and uploading code to Arduino boards. With its extensive library support and intuitive interface, the Arduino IDE is widely used by beginners and experts alike for prototyping and developing various electronic projects.

Chapter 5

System Design

5.1 Use Case Diagram

The use case diagram , given in figure 4.1 , shows the interactions between a Care Giver and a User using the CareWave Software. The CareGiver can create a profile for the user, set medication reminders, and monitor the user's health data. The Care Giver creates a profile for the user.The Care Giver can manage access to the user's profile and data.The Care Giver can schedule medication reminders for the user, specifying the medication name, dosage, and timing. This ensures that the user receives timely alerts on their smartwatch reminding them to take their prescribed medication. These reminders eliminate the risk of missed or forgotten medications. He can also set medication refill reminders for the user. The user will receive an alert on their smartwatch when it is time to refill their medication. The user can use the Emergency SOS feature to send an alert to their Care Giver in case of an emergency.The CareWave Software utilizes data collected from the user's smartwatch and analyzes it using AI algorithms to provide valuable insights and alerts. The Care Giver can receive emergency alerts from the system. These alerts inform the Care Giver about critical situations or emergencies concerning the user.

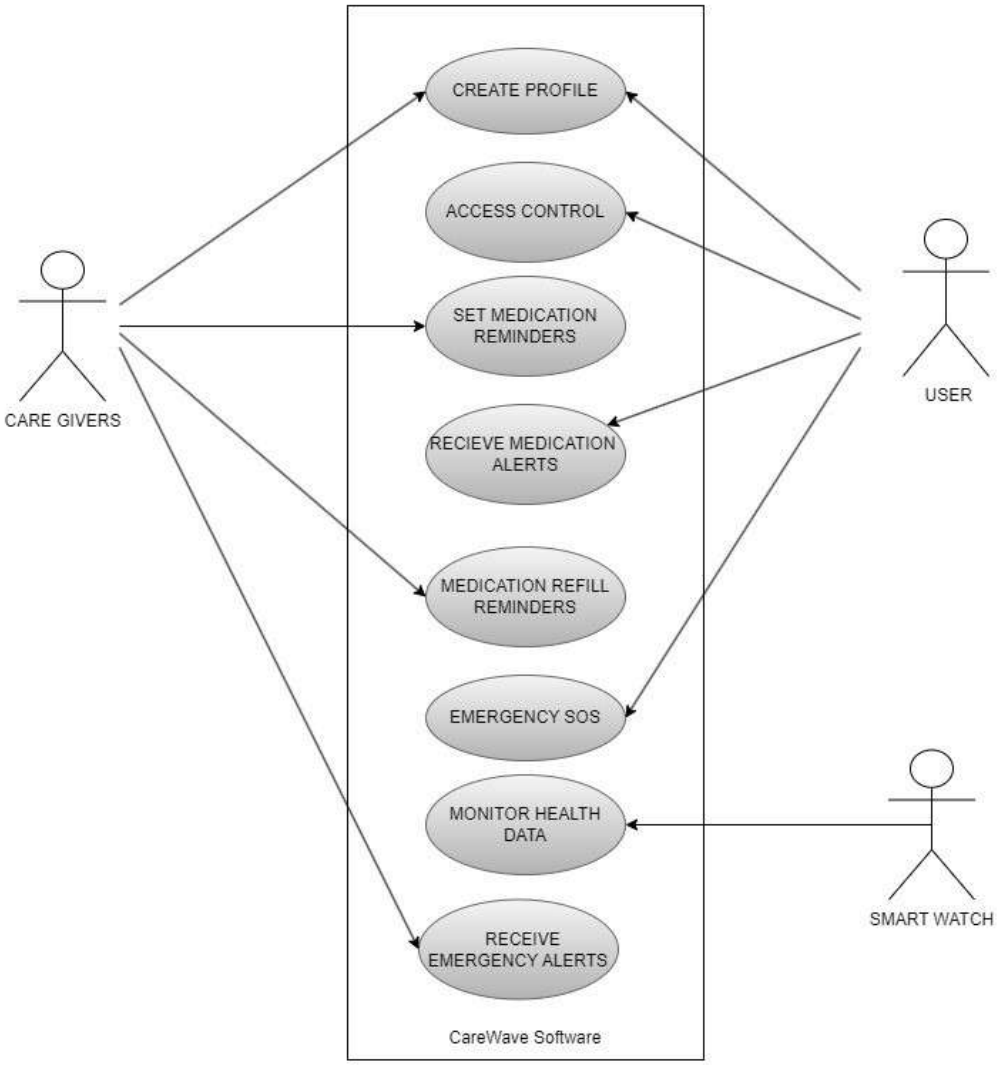

Figure 5.1: Use case diagram of CareWave

5.2 Activity Diagram

Activity diagram for the health monitoring app is given in figure 4.2 is depicted below. The Caregiver could create an account and login with the appropriate credentials. Caregivers set medication refill reminders, preventing medication shortages and ensuring continuous adherence to prescribed treatment plans. They could schedule timely medication reminders, prompting patients to take their medications as prescribed, minimizing missed doses and optimizing treatment effectiveness. The User would get reminder alerts

according to the medication alerts set by the Caregiver. Vital signs have been analysed and continously monitored and this real-time monitoring provides caregivers with a comprehensive picture of the patient's health status, enabling early detection of potential health concerns.The system promptly alerts caregivers of any abnormalities in patient vital signs, enabling timely intervention and addressing potential health concerns.

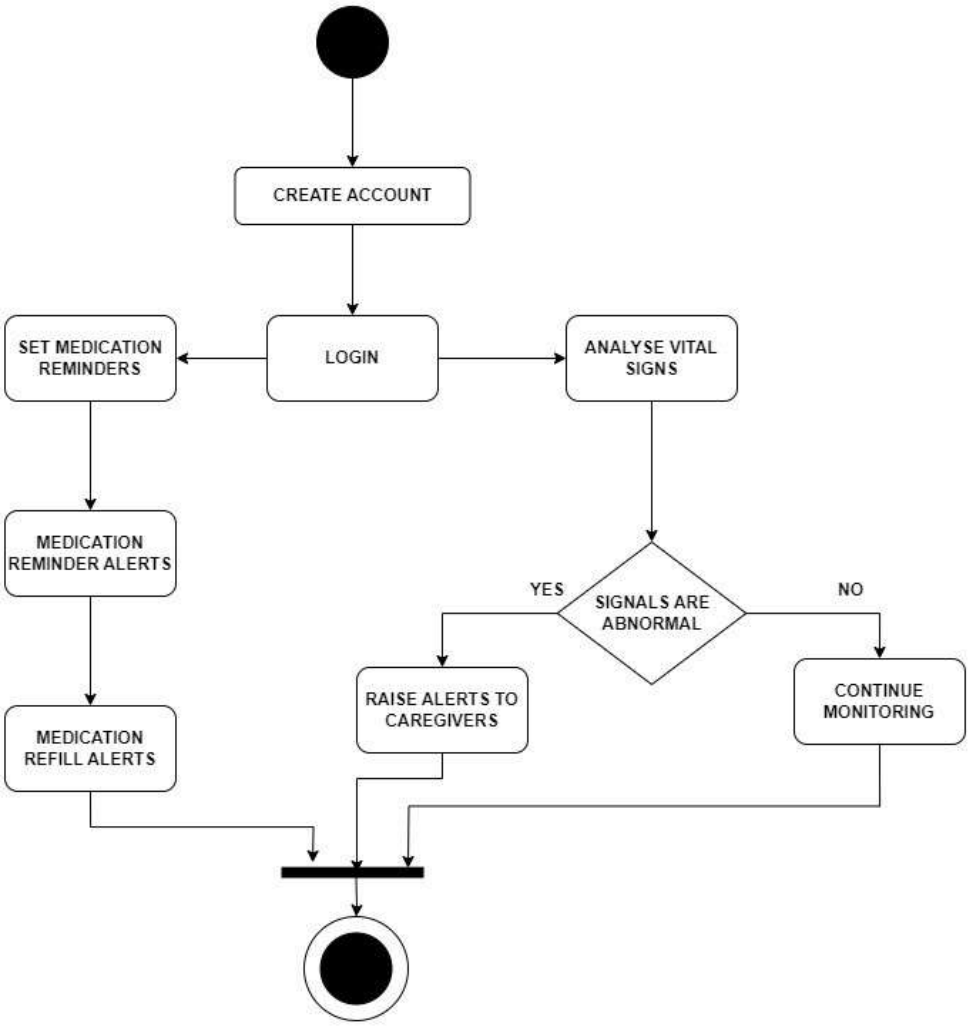

Figure 5.2: Software Activity diagram of CareWave

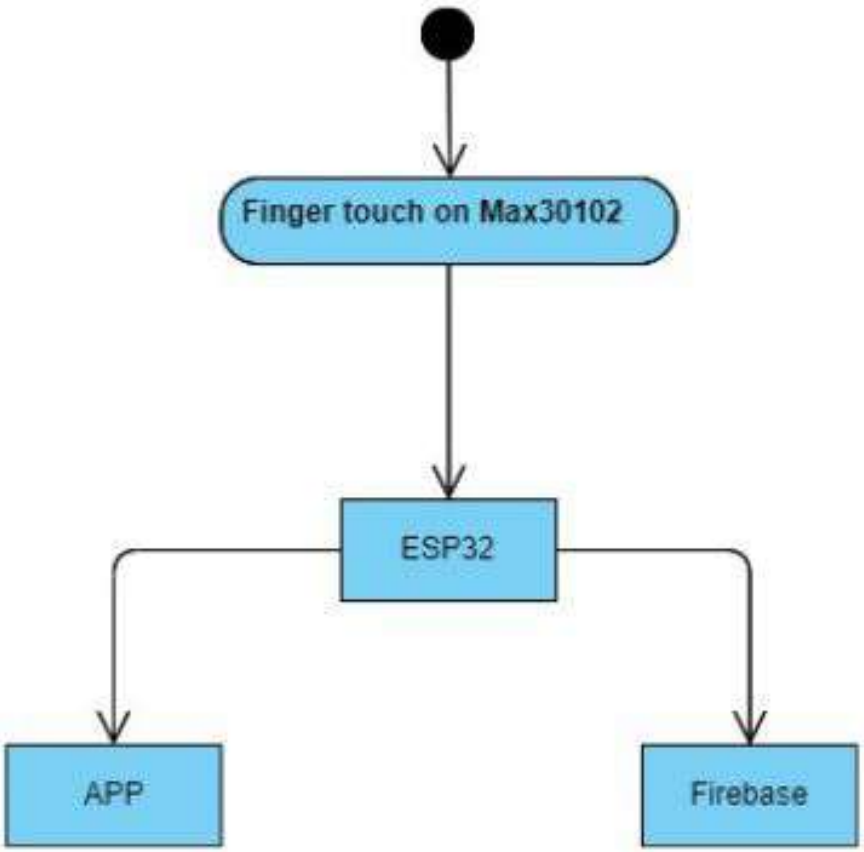

Figure 5.3: Hardware Activity diagram of CareWave

5.3 Schema Diagram

Schema Diagram depicts the basic structure of the database we use in our system. The Schema Diagram for our proposed system is given in figure 4.3 which shows the relationship between the entities of our system. We have five entities in our system which are profile,health data, smart watch, alert messages and medication reminder. The database comprises interconnected entities managing caregiver and patient information, medication schedules, vital signs monitoring, and alert notifications. Profile stores information about user profiles, including their name,email,password , health information etc.It has a unique id. Medication Reminder stores information about medication reminders, including the medicine name, dosage and scheduled reminder time.It has a unique medication id. Health data stores the health information such as heart rate,oxygen saturation,variations in health conditions and the given health information.It has unique user id.Smart watch has unique watch id. Alert messages has the messages with the vital signs and it has the unique alert id.

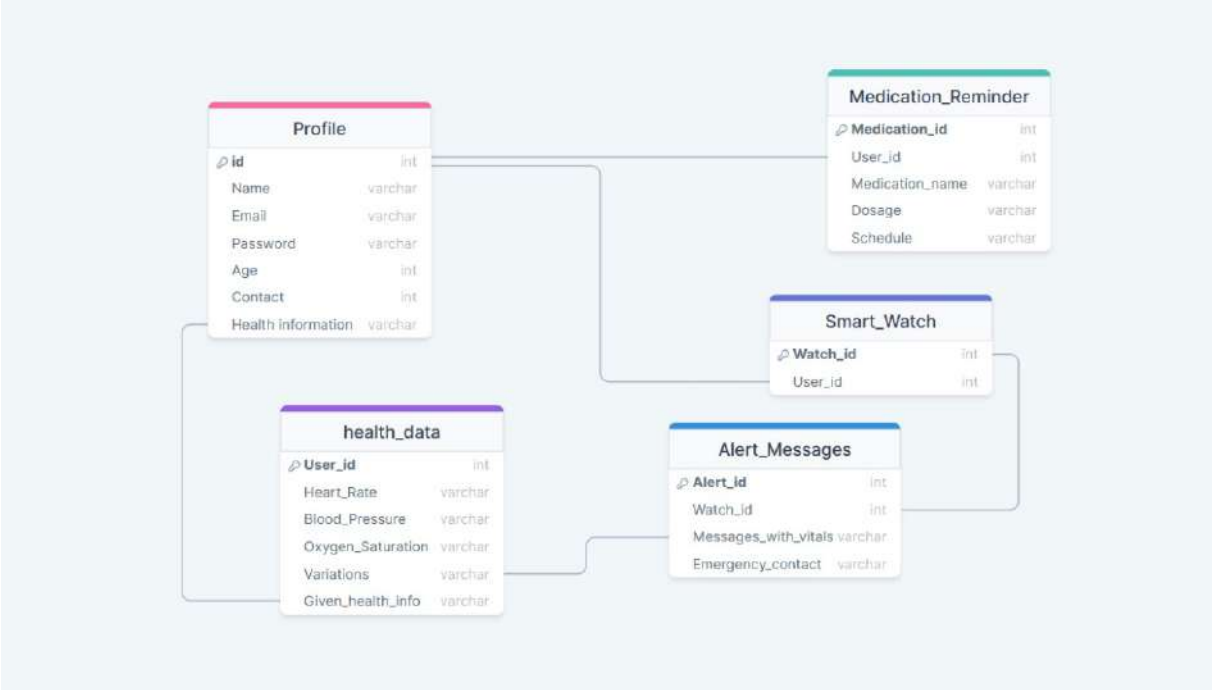

Figure 5.4: Schema Diagram of CareWave

Chapter 6

System Implementation

6.1 Hardware Setup

6.1.1 ESP32

The ESP32 serves as the fundamental microcontroller for this project, providing the computational backbone for data processing and communication tasks. Leveraging its versatility and capabilities, the ESP32 interfaces with the MAX30102 sensor, a vital component in this setup, to gather essential physiological data. As a highly integrated system-on-chip (SoC), the ESP32 offers robust features such as built-in Wi-Fi and Bluetooth connectivity, ample processing power, and a wide range of I/O interfaces. These capabilities enable seamless integration with the MAX30102 sensor, facilitating the acquisition of critical health metrics such as heart rate and blood oxygen levels.

6.1.2 Max30102 Pulse Oxymeter Heart Rate Sensor

The MAX30102 sensor functions as a pivotal component within this project, responsible for capturing vital physiological data essential for health monitoring and diagnostics. Uti-

lizing its advanced optical sensing technology, the MAX30102 sensor detects changes in light absorption caused by variations in blood flow, enabling the accurate measurement of parameters such as heart rate and blood oxygen saturation levels. Integrated into wearable devices or medical instruments, the sensor emits light into the skin and measures the reflected or transmitted light to extract valuable health information. Through its precise and non-invasive measurement capabilities, the MAX30102 sensor empowers applications across various domains, including fitness tracking, sleep monitoring, and medical diagnostics, contributing significantly to enhancing individuals' well-being and quality of life.

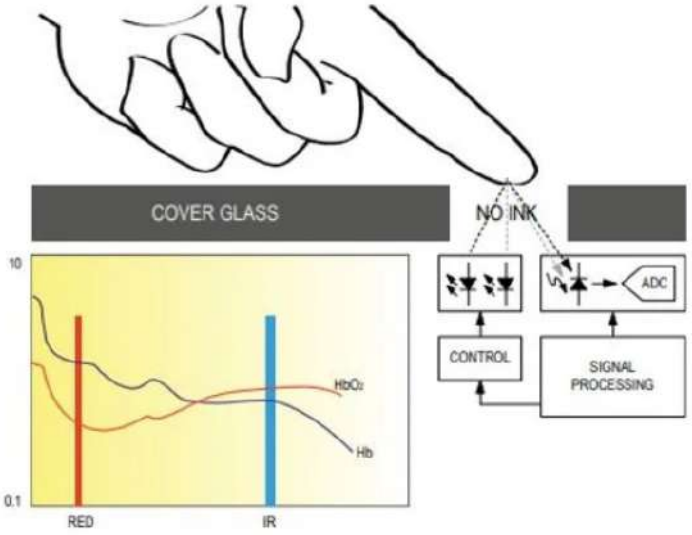

Figure 6.1: Photodetector of Max30102

6.2 Software Setup

6.2.1 Data Management

In this project, the ESP32 microcontroller acts as the central hub for collecting data from the MAX30102 sensor and transmitting it to the Firebase Realtime Database. Initially, the ESP32 establishes a communication link with the MAX30102 sensor, leveraging its I2C interface to retrieve vital physiological information such as heart rate and blood oxygen levels. Once acquired, the sensor data is processed and formatted by the ESP32,

ensuring compatibility with the Firebase database structure. Through its built-in Wi-Fi capabilities, the ESP32 then establishes a secure connection to the Firebase backend, enabling seamless data transmission in real-time.

Upon successful transmission, the data from the MAX30102 sensor is stored in the Firebase Realtime Database, where it becomes instantly accessible to authorized users and applications. Leveraging Firebase's robust and scalable infrastructure, the sensor data is efficiently organized and stored, ensuring reliability and accessibility across various platforms. With Firebase's real-time synchronization feature, any updates or changes to the sensor data are immediately reflected in the database, enabling timely and accurate monitoring of vital health metrics.

In the accompanying mobile application, dedicated pages are designed to visualize and display the sensor data retrieved from the Firebase Realtime Database. Using Firebase SDKs and APIs, the app retrieves the sensor data in real-time, presenting it to users in an intuitive and user-friendly interface. These dedicated pages provide comprehensive insights into the individual's health status, allowing users to track their vital signs over time and make informed decisions about their well-being. Through seamless integration with Firebase, the app ensures that users have access to up-to-date and accurate sensor data, empowering them to take proactive measures towards maintaining optimal health and wellness.

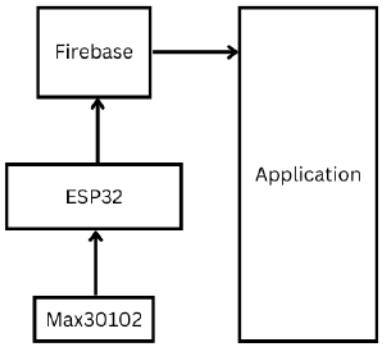

Figure 6.2: Dataflow

6.2.2 Application Interface

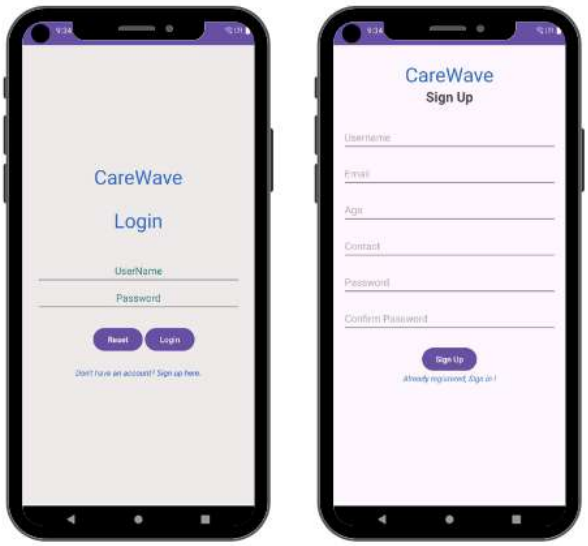

Figure 6.3: Login & sign up pages

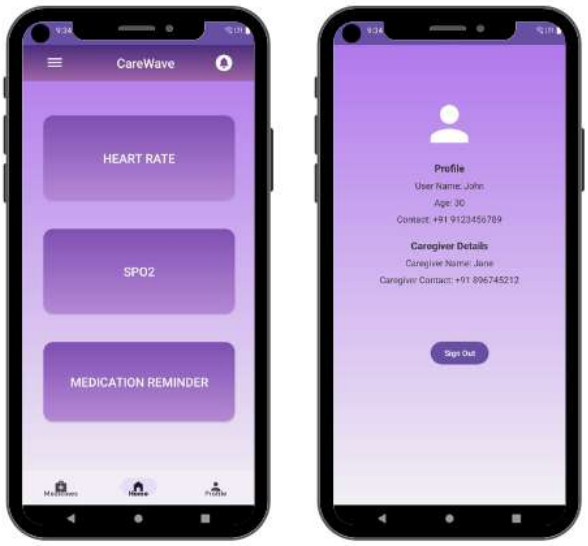

Figure 6.4: Home Page and Dashboard

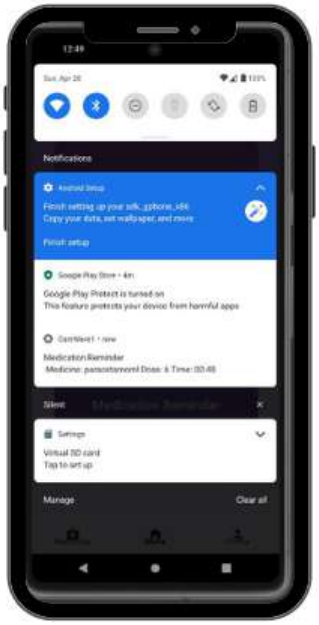

Figure 6.5: Notifications

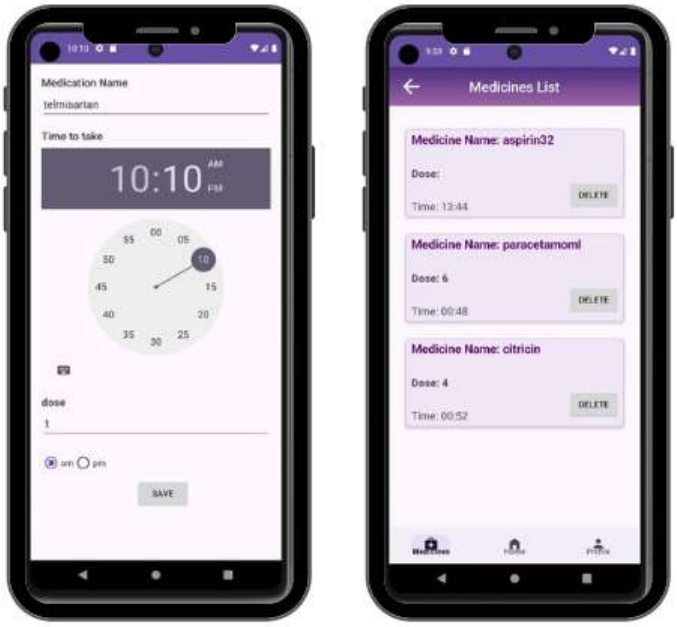

Figure 6.6: Medication reminder

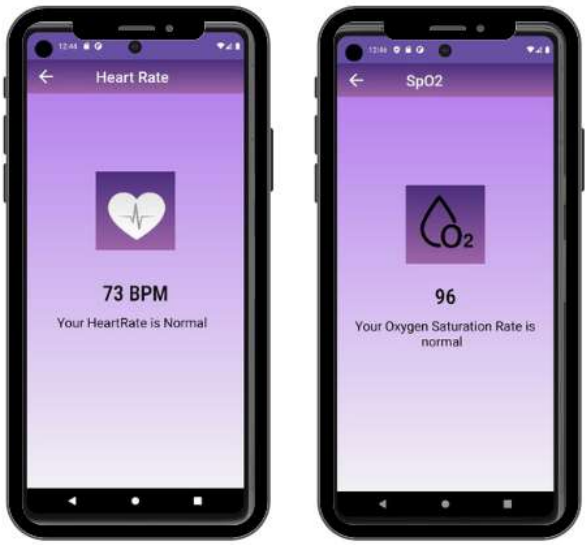

Figure 6.7: Vitals monitoring

6.3 Technology Stack

The following are the technical tools we've used for this project:

- Android Studio
- Firebase
- Arduino IDE
- Internet of Things
- Python
- Kotlin
- TensorFlow

6.3.1 Android Studio

Android Studio is the primary integrated development environment (IDE) utilized for crafting this Kotlin-based Android application, offering us,developers a comprehensive suite of tools and features tailored to streamline the app development process. As the official IDE for Android development, Android Studio provides an intuitive and user-friendly interface, empowering developers to create rich and immersive applications for a wide range of Android devices. With robust support for Kotlin, a modern and expressive programming language endorsed by Google for Android development, Android Studio facilitates efficient code writing, debugging, and testing workflows, enhancing developer productivity and code quality. Additionally, Android Studio offers a plethora of built-in templates, wizards, and libraries, accelerating app development by simplifying common tasks such as layout design, resource management, and dependency management.Overall, Android Studio serves as an indispensable tool for crafting innovative and feature-rich Kotlin apps, empowering developers to bring their creative visions to life on the Android platform with ease and efficiency.

6.3.2 Firebase

Firebase is a reliable tool for storing and getting important data like heart rate, SpO2, medications, and user details. It helps keep this information safe and accessible across different devices. With Firebase, users can securely log in, and developers can add custom features and automate tasks to make healthcare apps more useful and scalable. By using Firebase, developers can create user-friendly healthcare apps that allow users to track their health easily and confidently.

6.3.3 Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.The Arduino Integrated Devel-

opment Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

6.3.4 Internet of Things

Internet of Things refers to the rapidly growing network of connected objects that are able to collect and exchange data in real time using embedded sensors.The Internet of 16 ICU-Managment System Things (IoT) describes the network of physical objects things that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

6.3.5 Python

Python is a widely-used programming language renowned for its simplicity and versatility in AI development. With libraries like TensorFlow, PyTorch, and scikit-learn, Python provides powerful tools for building AI models. Its clear syntax and extensive community support make it an excellent choice for creating various types of AI, from machine learning algorithms to neural networks

6.3.6 Kotlin

Kotlin is a modern, statically-typed programming language that runs on the Java Virtual Machine (JVM) and can also compile to JavaScript or native code. Developed by Jet-Brains, it's designed to be concise, expressive, and interoperable with existing Java code.Kotlin offers features like null safety, extension functions, and co-routines, making it a preferred choice for Android app development, server-side applications, and multi-platform development.

6.3.7 TensorFlow

TensorFlow is an open-source software library for numeric computation using data flow graphs. It is a powerful platform for developing and deploying machine learning and deep learning models. TensorFlow's core abstraction is the tensor, which is a multidimensional array of data. Tensors can be used to represent a variety of data types, such as images, text, and audio. TensorFlow provides a comprehensive set of operations for manipulating and transforming tensors, as well as for building and training machine learning models. TensorFlow is used by a wide range of organizations, including Google, Facebook, and Microsoft, to develop a variety of machine learning applications, such as image recognition, natural language processing, and recommending systems.

Chapter 7

Experimental Results

7.1 Login & Sign up pages

When accessing the app for the first time, users are greeted with a straightforward signup process. They're prompted to create an account by providing key information such as their name, email address, age, and selecting a password. This signup step ensures that users have a personalized experience within the app and enables the system to securely store their details for future access.After submitting their information, users are immediately registered and can proceed to log in using their provided email and password. There's no additional verification step required via email. Once the signup is complete, users can seamlessly access the app's features without further login procedures. Upon entering their registered email and password, users are directed straight to the app's main interface, enabling them to explore its functionalities without delay. This streamlined process ensures a hassle-free experience for users, allowing them to engage with the app's content and services promptly.

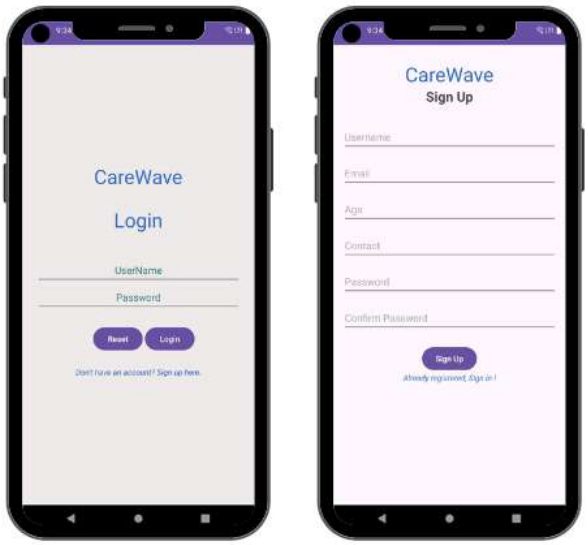

Figure 7.1: Login & sign up pages

7.2 Home Page and Dashboard

Upon logging in, users are greeted with a welcoming dashboard that serves as the central hub for their health monitoring journey. The dashboard prominently features a vital signs monitoring panel, providing real-time data on crucial metrics such as heart rate and blood oxygen saturation (SpO2). This comprehensive display empowers users to stay informed about their physiological well-being at a glance. Additionally, the dashboard offers a streamlined setup for medication reminders, enhancing user adherence to treatment regimens effortlessly. With intuitive controls and clear prompts, managing medication schedules becomes a hassle-free experience, ensuring users never miss a dose.

At the bottom panel of the dashboard houses convenient links to other key sections of the app. Here, users can easily access their medicine list, navigate back to the home page, or explore their profile settings for personalized adjustments. This intuitive navigation system enhances user accessibility and ensures a seamless browsing experience throughout the app. By providing quick access to essential features and pages, the bottom panel enhances user convenience and promotes efficient engagement with the app's

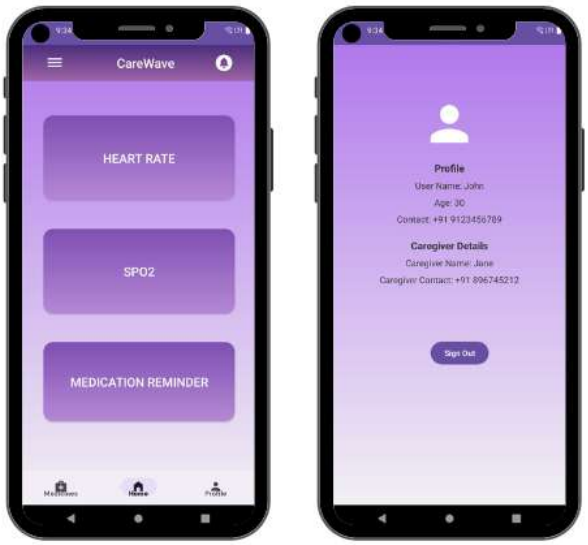

Figure 7.2: Home Page and Dashboard

functionalities.

Upon entering the profile page, users encounter a comprehensive overview of their account details and preferences. Here, they can review and update personal information such as age, email address, and other relevant details. Additionally, the profile page offers insights into caregiver information, facilitating seamless communication and coordination with healthcare providers or family members. Moreover, users have the option to sign out of the app, ensuring privacy and security when accessing sensitive health data. This robust profile management system empowers users to personalize their app experience while maintaining control over their privacy and security settings.

7.3 Notifications

Medication reminder notifications represent a critical component in modern healthcare management systems, profoundly impacting users' adherence to prescribed medications and, consequently, their overall health outcomes. These notifications serve as gentle yet

persistent reminders, ensuring that users stay on track with their medication regimens amidst the hustle and bustle of daily life. The inclusion of detailed information such as the medicine name, prescribed dosage, and scheduled administration time adds a layer of precision and clarity, empowering users to take their medications with confidence and accuracy. This level of specificity not only minimizes the risk of missed doses but also helps users avoid inadvertent errors in dosage or timing, which could otherwise compromise treatment efficacy and safety.

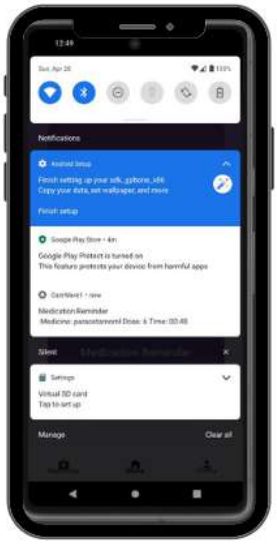

Figure 7.3: Notifications

Moreover, medication reminder notifications play a pivotal role in fostering a sense of accountability and responsibility in users regarding their healthcare management. By receiving regular prompts on their smartphones or devices, users are prompted to prioritize their health and adhere to their prescribed treatment plans diligently. These notifications serve as gentle nudges, reminding users of the importance of staying compliant with their medications to manage chronic conditions effectively and prevent disease progression.

7.4 Medication reminder

Setting a medication reminder with detailed information such as the medicine name, dosage, and scheduled administration time is a straightforward and user-friendly process designed to streamline healthcare management. Users can effortlessly input essential medication details into the app, including the name of the medication, the prescribed dosage, and the designated time for administration. With intuitive interface design and clear prompts, users can navigate through the app's medication reminder feature with ease, ensuring that all necessary information is accurately recorded. Additionally, users have the flexibility to customize their medication reminders based on their unique treatment regimens, enabling them to tailor the reminders to their individual needs and preferences.

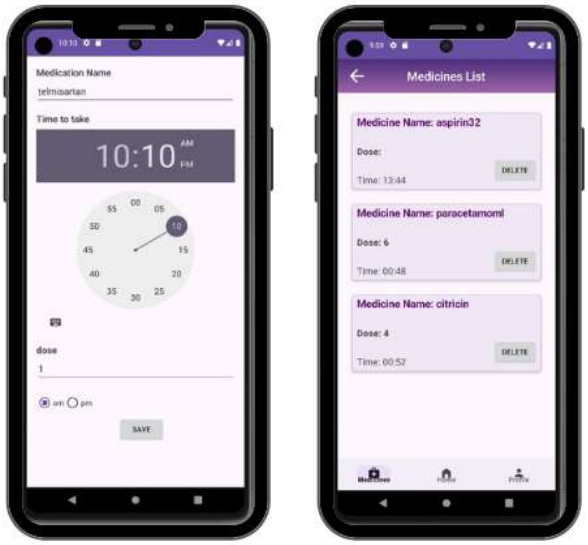

Figure 7.4: Medication reminder

Once the medication reminder is set, users can rest assured that timely notifications will be delivered to their smartphones or devices at the specified times. These notifications serve as gentle yet effective reminders, prompting users to take their medications as prescribed without the need for manual intervention. By receiving notifications with detailed information about the medication name, dosage, and scheduled time for administration, users can stay informed and organized, ensuring that they never miss a dose.

This seamless integration of medication reminder notifications into users' daily routines enhances medication adherence rates and promotes better health outcomes, ultimately empowering individuals to take proactive steps towards managing their health effectively.

7.5 Vitals monitoring

Monitoring heart rate and blood oxygen saturation (SpO2) in real-time is a pivotal aspect of modern healthcare management, and dedicating specific pages within the app to display these vital signs ensures that users have access to accurate and up-to-date information about their physiological status. The integration of sensors such as the MAX30102 pulse oximeter and heart rate monitor with the app allows for continuous monitoring of these vital signs, providing users with real-time feedback on their cardiovascular health. By accessing dedicated pages within the app dedicated to heart rate and SpO2 monitoring, users can observe fluctuations in these vital signs over time, allowing for early detection of potential health issues or abnormalities. On the heart rate monitoring page, users can

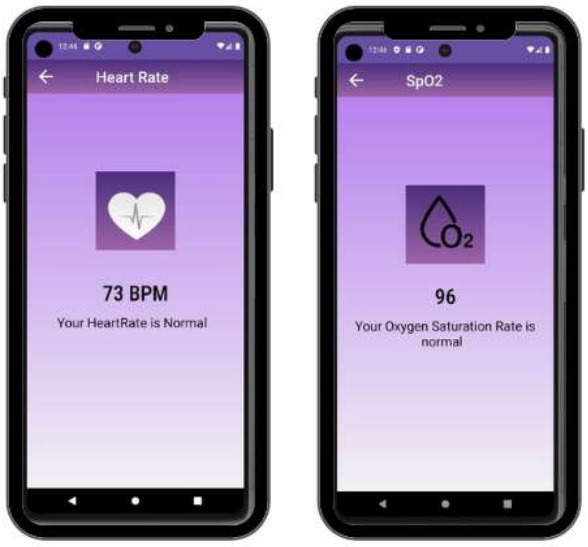

Figure 7.5: Vitals monitoring

view their heart rate data presented in a clear and intuitive format, such as a real-time

graph or numerical display. This allows users to track their heart rate trends over time and identify any irregularities or patterns that may warrant further attention. Similarly, the SpO2 monitoring page provides users with real-time insights into their blood oxygen saturation levels, allowing for continuous monitoring of respiratory health. By displaying SpO2 data in a user-friendly format, such as a color-coded gauge or numerical value, users can easily assess their oxygen saturation levels and take appropriate actions if necessary, such as seeking medical attention in the event of low oxygen saturation levels. Overall, dedicating specific pages within the app to display real-time heart rate and SpO2 data empowers users to take an active role in monitoring their cardiovascular and respiratory health, promoting early detection of potential issues and facilitating timely interventions.

7.6 Hardware

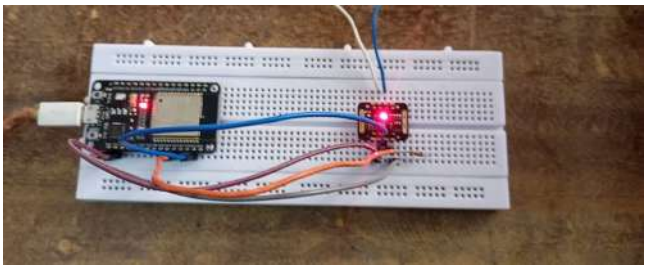

Figure 7.6: Hardware connections

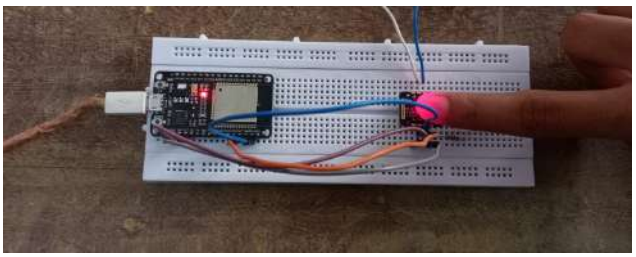

Figure 7.7: Hardware connection checking

We incorporate the technologies of ESP32 and MAX30102 Pulse Oxymeter Heart Rate sensors to access the user's heart rate and oxygen saturation levels. As the user is in contact with the sensor, it starts reading the values to ensure the user's health.The Caregiver can manage access to the user's profile and data.The Caregiver can schedule medication

reminders for the user, specifying the medication name, dosage, and timing. This ensures that the user receives timely alerts on their respective mobile phones reminding them to take their prescribed medication. These reminders eliminate the risk of missed or forgotten medications. He/She can also set medication refill reminders for the user.The user will receive an alert on their mobile when it is time to refill their medication. The user can use the Emergency SOS feature to send an alert to their caregiver in case of an emergency.The CareWave Software utilizes data collected from the user's body and analyzes it using AI algorithms to provide valuable insights and alerts. The caregiver can receive emergency alerts from the system. These alerts inform the caregiver about critical situations or emergencies concerning the user.

Chapter 8

Conclusion

CareWave, an artificial intelligence health monitoring software for watches, has the potential to revolutionize the way individuals approach their health and well-being. Its ability to provide real-time heart rate monitoring, personalized insights, and timely medication reminders empowers users to take control of their health and make informed decisions. By leveraging AI capabilities, CareWave can identify potential health risks early on, enabling users to seek preventive care and intervention when necessary. The integration of medication reminders and alerts further enhances the application's effectiveness, ensuring that users adhere to their prescribed treatment plans and optimize their health outcomes. With its comprehensive features and user-friendly interface, CareWave has the potential to become an indispensable tool for individuals seeking to lead healthier, more fulfilling lives.

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ANNEXURE-A

ST. JOSEPH'S
COLLEGE OF ENGINEERING
AND TECHNOLOGY,
- PALAI -

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CSD 415 PROJECT PHASE II

Final Review

02-05-2024

CAREWAVE

HEALTH MONITORING SYSTEM

TEAM GUIDE:
PROF. DONA MARY CHERIAN

TEAM MEMBERS:

EMY JOSHY
GEORLIT GEORGE
MEENU SUSAN MONY
SWATHILEKSHMI S

COURSE OUTCOMES

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

CONTENT

ABSTRACT

- The system utilizes sensors to capture realtime vital signs, including heartbeat and blood oxygen saturation (SpO2). An AI model continuously analyses this data, identifying anomalies that deviate from the user's established baseline.

- When the AI detects fluctuations outside the user's normal parameters, a multitiered alert system is activated. Initially, the user receives a notification on their health status.

- The system offers medication reminders, promoting adherence to prescribed medication schedules. A companion mobile application acts as a user interface, displaying vital sign data, medication schedules, and any triggered alerts.

INTRODUCTION

- The existing healthcare systems, though robust in many aspects, are confronted with limitations when it comes to delivering personalized health management and prompt emergency response.

- Carewave revolutionizes health management by seamlessly integrating hardware and software to provide real-time vital sign monitoring and medication alerts

- With its proactive alert system and customizable interface, users can stay ahead of their health, receiving timely notifications and taking proactive measures to maintain their well-being

PROBLEM STATEMENT

- The aging population and individuals with health conditions lack a comprehensive healthcare solution tailored to their needs.
- Existing systems fall short in providing personalized health management and swift emergency response.
- This gap results in challenges such as delayed interventions and insufficient remote monitoring.
- The problem statement calls for the development of an innovative AI-powered software to bridge these gaps and improve the well-being of this vulnerable population.

LITERATURE SURVEY

RESEARCH PAPER

- Title: Real-time artificial intelligence based health monitoring, diagnosing and environmental control system for COVID-19 patients.
  Author: Muhammad Zia Ur Rahman
  Summary: This paper presents a real-time artificial intelligence-based health monitoring, diagnosing, and environmental control system for COVID-19 patients.

- Title: Smart Health Monitoring Using Deep Learning and Artificial Intelligence
  Author: Suma K G Journal: Revue d'Intelligence Artificielle Date: May 2023
  Summary: The paper discusses the use of deep learning and artificial intelligence in smart health monitoring systems.

EXISTING SOLUTIONS

- Vivify Health : Vivify Health is a cloud-based remote care solution that helps businesses in the healthcare industry design personalized care plans and monitor patient status.
- Keva Health : Keva Health's SaaS Respiratory Care Platform for physicians captures the complete patient journey with consistent and accurate capture of remote care data outside the physician's office or hospital.
- Hale : Hale is a remote patient monitoring platform, enabling clinical teams and health care practices to gain real-time health data without the need for on-site consultations.

PROPOSED SYSTEM

- Introducing CareWave, leveraging ESP32 and MAX30102 sensors for real-time heart rate and oxygen saturation monitoring.
- Caregivers manage user profiles and schedule medication reminders, ensuring timely dosage and refill alerts.
- The Emergency SOS feature enables users to alert caregivers in emergencies.
- AI algorithms analyze user data for valuable insights, with caregivers receiving emergency alerts for critical situations.

SOFTWARE REQUIREMENT SPECIFICATION

FUNCTIONAL REQUIREMENTS

- **Vital sign monitoring**

Vital signs like heart rate and spo2 of the user is monitored to know about the health status.

- **Medication reminders**

Medication adherence, the act of taking medications as prescribed, is crucial for managing chronic conditions and preventing adverse health outcomes.

- **Alert notifications**

Timely alert messages to caregivers are crucial for ensuring the well-being of individuals who require assistance, particularly those with chronic conditions, disabilities, or age-related limitations.

NON-FUNCTIONAL REQUIREMENTS

- **Compatibility** : It refers to the ability of two or more things to work together harmoniously.
- **Performance** : Application performance refers to how effectively an application functions and meets the needs of its users.
- **Security** : Data security of an application is crucial for protecting sensitive information from unauthorized access, modification, or destruction.
- **Usability** : Usability is a crucial aspect of any application, determining how effectively and easily users can achieve their desired goals.
- **Reliability** : The reliability of an application refers to its ability to perform consistently and accurately according to its specifications.

TECHNOLOGY STACK

The following are the technical tools we've used for this project:

- Android Studio: An integrated development environment (IDE) for building Android applications.
- Firebase: A platform offering various tools and services for mobile and web app development, including authentication, real-time databases, and cloud messaging.
- Arduino IDE: A software environment used to develop code for Arduino microcontroller boards.

TECHNOLOGY STACK

- Internet of Things (IoT): A network of interconnected devices that communicate and exchange data, enabling smart functionalities and automation.
- Python: A versatile programming language known for its simplicity and readability, widely used in web development, data analysis, and artificial intelligence.
- Kotlin: A modern programming language for developing Android applications, officially supported by Google as an alternative to Java.
- TensorFlow: An open-source machine learning framework developed by Google for building and training neural network models.

MODULE DESCRIPTION

- **USER**
- Sign in using google
- Basic details
- Medication details

- **DATA**
- Vitals collection
- Monitoring
- Save data
- Values to verify(max and min limits)

- **ALERT**
- Medication alerts with medicine name and dose.
- Timely alerts for fluctuation of vital signs

- **HARDWARE**
- For collecting the vital signs
- Sending data to database and application

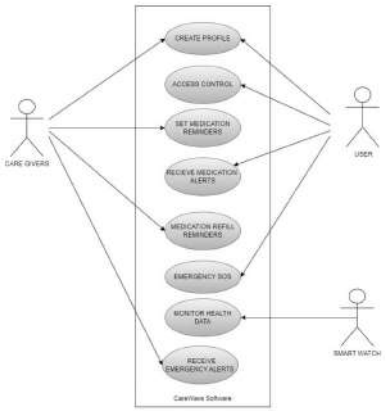
UML DIAGRAMS

1.Use case diagram

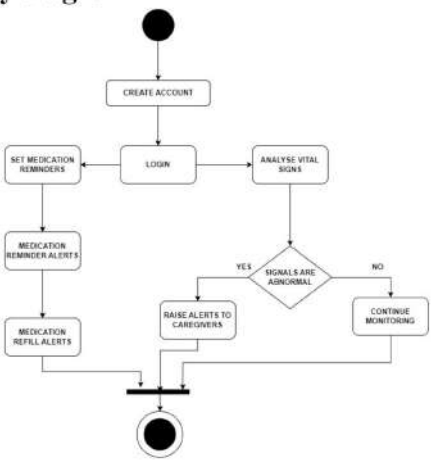
2.Activity diagram

3.Schema Diagram

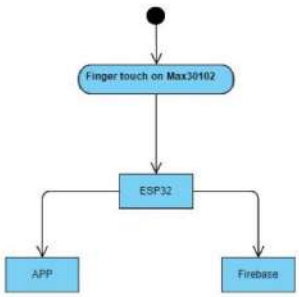
1.Use case diagram



2.Activity diagram

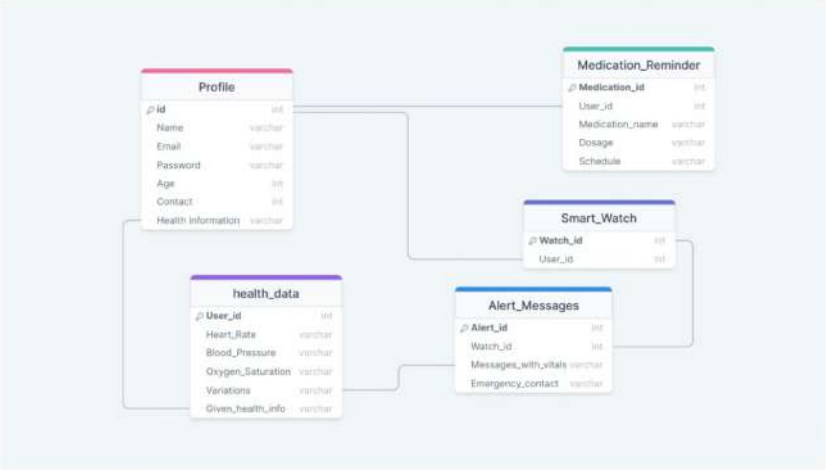


Activity diagram for software



Activity diagram for hardware

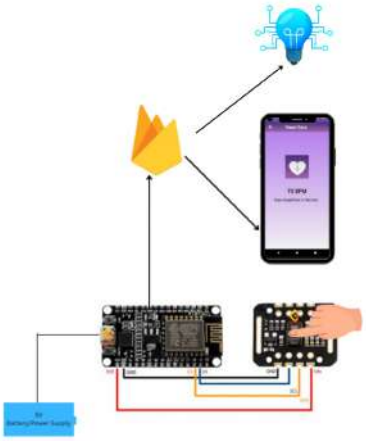
3.Schema Diagram



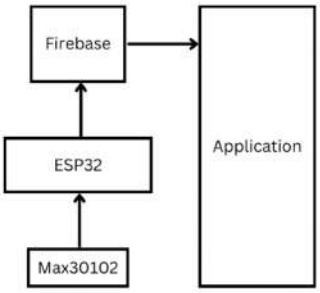
SYSTEM IMPLEMENTATION

- A user comes in contact with the Max30102 sensor so that, his/her ‘s Heart Rate and Blood Oxygen Saturation Levels are calculated and is taken to the database.
- This data is transferred to the application and the incorporated AI model so that the model verifies the values.
- After the verification, alert messages are sent if necessary.
- The option to add medications will help improvise the timely intake of medicines by the user.

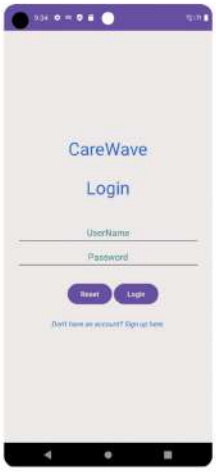
WORKFLOW

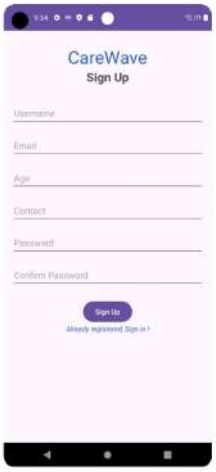


BLOCK DIAGRAM



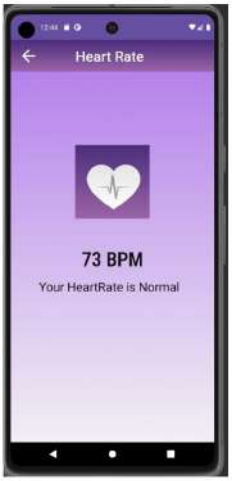
EXPERIMENTAL RESULTS



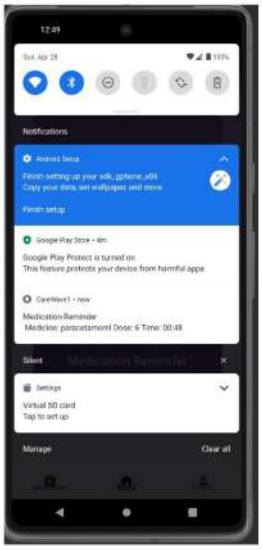



CareWave
HEART RATE
SPO2
MEDICATION REMINDER

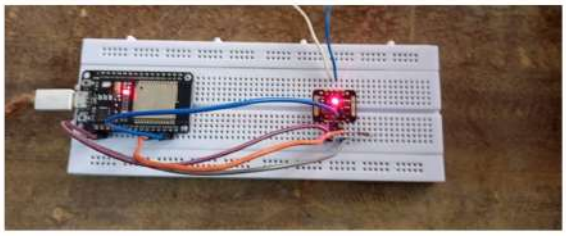

SpO2
96
Your Oxygen Saturation Rate is normal

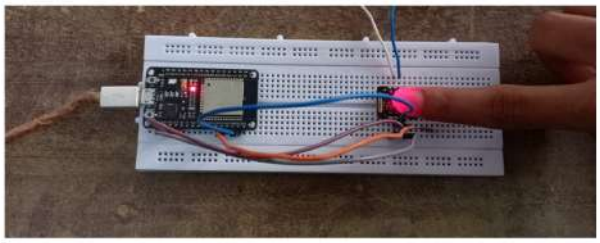

Heart Rate
73 BPM
Your HeartRate is Normal


Medication Name
telmisartan
Time to take
10:10
AM
PM
dose
1
am
pm
SAVE

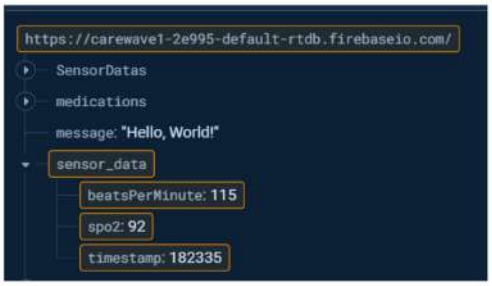

Notifications
Clear all

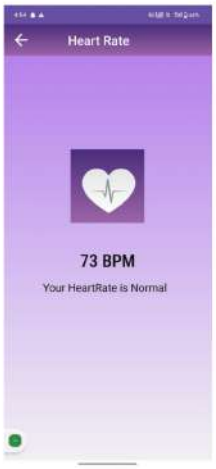

Medicines List
Medicine Name: aspirin32
Dose:
Time: 13:44
DELETE
Medicine Name: paracetamoml
Dose: 6
Time: 00:48
DELETE
Medicine Name: citricin
Dose: 4
Time: 00:52
DELETE





```
12:40:16.725 -> IR=66314, BPM=115.16, Avg BPM=88
12:40:16.725 -> IR=66286, BPM=115.16, Avg BPM=88
12:40:16.771 -> IR=66270, BPM=115.16, Avg BPM=88
12:40:16.771 -> IR=66247, BPM=115.16, Avg BPM=88
12:40:16.807 -> IR=66235, BPM=115.16, Avg BPM=88
12:40:16.807 -> IR=66207, BPM=115.16, Avg BPM=88
12:40:16.849 -> IR=66170, BPM=115.16, Avg BPM=88
12:40:16.849 -> IR=66146, BPM=115.16, Avg BPM=88
12:40:16.891 -> IR=66142, BPM=115.16, Avg BPM=88
12:40:16.891 -> IR=66142, BPM=115.16, Avg BPM=88
12:40:16.925 -> IR=66154, BPM=115.16, Avg BPM=88
12:40:16.925 -> IR=66159, BPM=115.16, Avg BPM=88
12:40:16.965 -> IR=66175, BPM=115.16, Avg BPM=88
12:40:16.965 -> IR=66220, BPM=115.16, Avg BPM=88
12:40:17.002 -> IR=66287, BPM=115.16, Avg BPM=88
12:40:17.002 -> IR=66354, BPM=115.16, Avg BPM=88
12:40:17.033 -> IR=66455, BPM=115.16, Avg BPM=88
12:40:17.071 -> IR=66617, BPM=115.16, Avg BPM=88
12:40:17.071 -> IR=66765, BPM=115.16, Avg BPM=88
12:40:17.108 -> IR=66947, BPM=115.16, Avg BPM=88
12:40:17.108 -> IR=67165, BPM=115.16, Avg BPM=88
12:40:17.143 -> IR=67397, BPM=115.16, Avg BPM=88
12:40:17.143 -> IR=67654, BPM=115.16, Avg BPM=88
12:40:17.683 -> Data sent to Firebase Realtime Database successfully
12:40:17.683 -> IR=67945, BPM=115.16, Avg BPM=88
12:40:17.683 -> IR=67786, BPM=115.16, Avg BPM=88
12:40:17.716 -> IR=67609, BPM=115.16, Avg BPM=88
12:40:17.716 -> IR=67488, BPM=115.16, Avg BPM=88
12:40:17.753 -> IR=67401, BPM=115.16, Avg BPM=88
```





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Thank You

OPEN FOR QUESTIONS

ANNEXURE-B

CHRIST COLLEGE OF ENGINEERING, IRINJALAKUDA

TECHLETICS '24

INTERNATIONAL CONFERENCE ON ADVANCE IN COMPTING COMMUNICATION AND DATA SCIENCE

CERTIFICATE

THIS CERIFICATE IS PRESENTED TO

Emy Joshy

from **St. Joseph College of Engineering and Technology**

for his/her active participation in Paper Presentation Event on topic **Carewave : An Advanced Health Monitoring Software** conducted by Department of Computer Science and Engineering in association with Techletics'24 , held at Christ College of Engineering , Irinjalakuda on 28th February ,2024

Dr. VINCE PAUL	Dr. SAJEEV JOHN	Fr.JOHN PALIAKARA
HOD,CSE	PRINCIPAL	EXECUTIVE DIRECTOR

CHRIST COLLEGE OF ENGINEERING, IRINJALAKUDA

TECHLETICS '24

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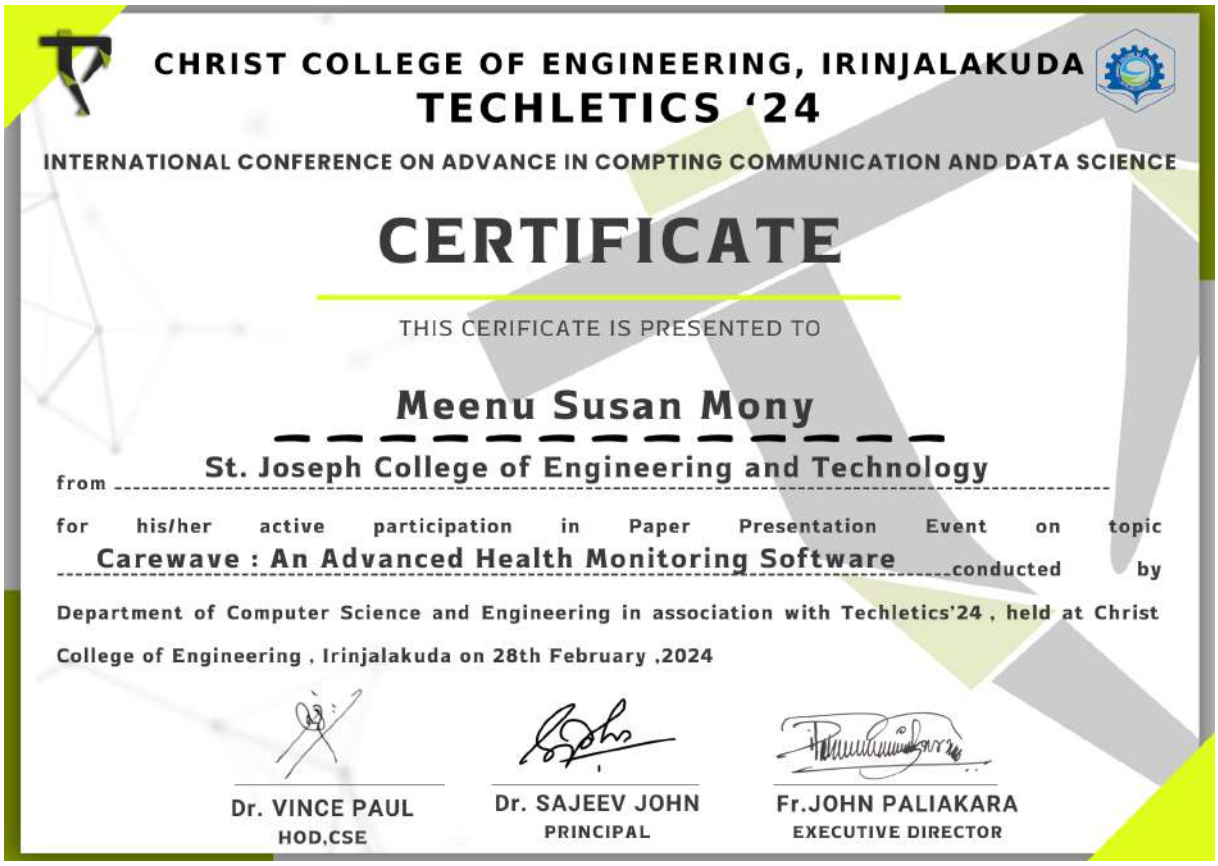
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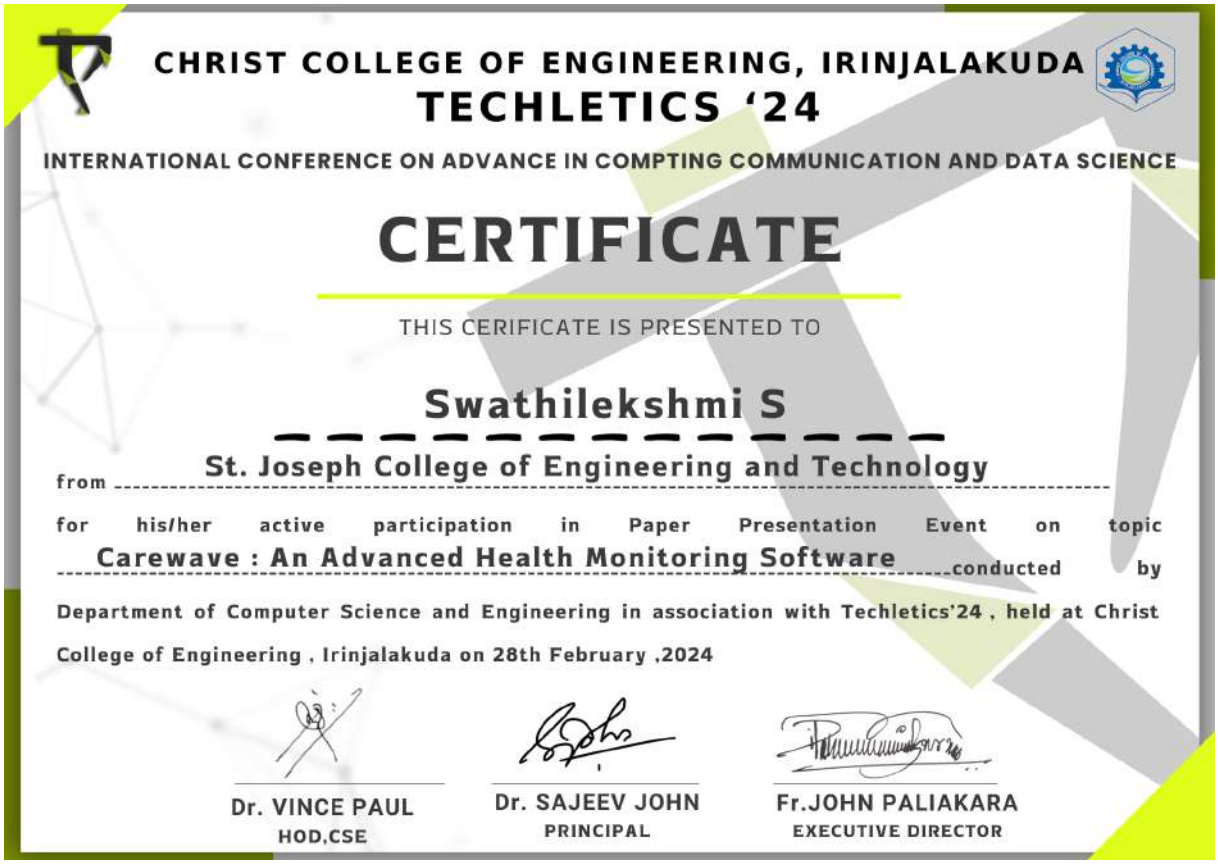
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Carewave : An Advanced Health Monitoring Software

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***Abstract*—In the midst of a population that is progressively aging, the need for healthcare solutions that are precisely tailored and efficient has become increasingly critical. Our inventive proposal centers around an AI-powered health monitoring and emergency assistance software. This software is strategically positioned to redefine the dynamics of health management and emergency response, all while prioritizing fundamental principles of user privacy and comfort.Specifically crafted for easy installation on smartwatches, this versatile software boasts a rich array of features, meticulously curated to address the unique and evolving needs of its user base. At its core, the software employs real-time AI algorithms that meticulously examine health data, enabling prompt alerts to be sent to designated caregivers or emergency contacts at the first sign of abnormal vital signs. To further streamline healthcare management, the software seamlessly integrates medication reminders, offering a comprehensive approach to enhancing user well-being.By harnessing the capabilities of AI-driven health monitoring and emergency assistance, this software becomes a catalyst for tangible improvements in user well-being. It not only provides an intricate web of real-time health monitoring capabilities but also serves as a testament to the harmonious integration of cutting-edge technology with a profoundly personalized approach to care.This fusion of sophistication and individualized attention extends beyond traditional healthcare models, promising a paradigm shift in how we perceive and address the well-being of the elderly. In essence, this innovative solution signifies a pivotal step towards cultivating a lifestyle characterized by enhanced safety, security, and an overall improved quality of life for our aging population.**

***Index Terms*—Health Monitoring System,AI-driven health monitoring, Smart Watch**

I. Introduction

In an era marked by extraordinary advancements in technology and healthcare, a glaring disparity persists for the aging population and individuals grappling with health conditions. Despite the robust nature of existing healthcare systems in various aspects, they encounter limitations in delivering personalized health management and prompt emergency response. This deficiency gives rise to an array of challenges, including delayed interventions and inadequate remote monitoring, thereby jeopardizing the overall well-being of this vulnerable demographic.

In response to the pressing need to address these gaps, there arises a compelling call for innovation. The remedy lies in the creation of state-of-the-art, AI-powered software specifically tailored for integration into smartwatches. These omnipresent wearables possess the potential to act as invaluable companions, providing tailored healthcare solutions that extend beyond mere fitness tracking. By leveraging the capabilities of artificial intelligence, the proposed software aspires to revolutionize health management for the elderly and those with health conditions, ensuring not only personalized care but also swift responses during emergencies. This comprehensive report delves deep into the imperative to bridge these existing gaps and meticulously outlines the key features and benefits of the envisaged AI-powered smartwatch software, positioning it as an unequivocally transformative tool poised to enhance the well-being of a deserving and often overlooked segment of the population.

II. Literature Review

This project endeavors to develop an innovative AI-powered software solution tailored for smartwatches, aiming to fill critical gaps in healthcare for the aging population and individuals managing health conditions. The primary objective is to harness artificial intelligence to provide personalized health management, real-time monitoring, and swift emergency response. The literature review encompasses a multifaceted exploration of advanced healthcare technologies, focusing on AI-driven solutions for health monitoring, diagnosis, and patient care. The first segment introduces research papers. They include A real-time AI-based system for COVID-19 patients by Muhammad Zia Ur Rahman.The system utilizes locally available sensors and IoT technology to track the health parameters of isolated COVID-19 patients in remote areas. [1],Smart Health Monitoring Using Deep Learning and Artificial Intelligence by Jeethu Philip delves into the applications of smart health monitoring in various healthcare areas, such as intensive care, medication management, and oxygen saturation monitoring. It also addresses the challenges and limitations in smart health monitoring, including power management, data standardization, and data security. [2]. The second segment introduces three distinct remote patient monitoring platforms—Vivify Health [3],is a cloud-based remote care solution that helps businesses in the health- care industry design personalized care plans and monitor patient status. It enables users To construct bundled fitness packages via way of means of studying affected person facts associated with pre-op assessments,post-discharge monitoring, compliance documentation and more.Keva Health's SaaS Respiratory Care Platform for physicians Captures the entire affected person adventure with regular and correct seize of faraway care statistics outdoor the physician's workplace or hospital. It does this by ensuring that patients follow the physician supplied motion plans, enhance their adherence, and additionally offer just-in-time education when they are at home. [4], and Hale is a remote patient monitoring platform, enabling clinical teams and health care practices to gain real-time health data without the need for on-site consultations. The Platform allows affected person clinical facts to be up to date with records amassed from the patient mobile app, while medical practitioners can upload media and data from appointments, test results, and care plans. [5]

III. Significance of the Study

The aging population and individuals managing health conditions represent a growing demographic facing unique challenges within contemporary healthcare systems. As life expectancy rises globally and chronic health conditions become more prevalent, the need for targeted and personalized healthcare solutions becomes increasingly apparent. Traditional healthcare systems, although proficient in addressing general health concerns, often fall short when it comes to the nuanced and individualized care required by this specific demographic.

Moreover, the existing infrastructure encounters obstacles in delivering timely interventions and efficient remote monitoring, exacerbating the difficulties faced by individuals seeking comprehensive health management. Delayed responses to health emergencies and a lack of real-time monitoring contribute to a suboptimal quality of life for many, with potential ramifications on overall health outcomes.

The integration of technology into healthcare has witnessed remarkable progress in recent years, with smartwatches emerging as accessible and widely adopted devices for health tracking. However, their current capabilities predominantly focus on basic fitness metrics and fail to address the nuanced needs of the aging population and individuals with specific health conditions.

Against this backdrop, there is a compelling imperative to leverage artificial intelligence (AI) to develop a sophisticated software solution tailored to the capabilities of smartwatches. AI has the potential to revolutionize healthcare by offering personalized insights, predictive analytics, and real-time monitoring, thereby bridging the existing gaps in the care continuum. By delving into the unique challenges faced by the target demographic, this background sets the stage for the subsequent exploration of an innovative AI-powered smartwatch software that aims to redefine healthcare management for the elderly and those with health conditions.

IV. Methodology

The methodology employed for the study has been meticulously designed to delineate every phase involved in constructing this project. It has been shaped with input and recommendations from professionals in the field of Computer Science. Consequently, the methodology guarantees a clear and effective approach to implementing the project with optimal efficiency.The research project is structured into three distinct modules:

A. User Module

The user module focuses on ensuring a seamless user onboarding experience by integrating Google Sign-In functionality, which enables users to conveniently establish their accounts using their existing Google credentials. This eliminates the need for manual registration and password creation, thereby enhancing user convenience and satisfaction. This module also includes the collection of fundamental user details such as name, email address, and phone number, which serve as the basis for user identification and communication. Additionally, it gathers information about caregivers, including their names and contact numbers, to facilitate effective communication during emergencies. Furthermore, the module meticulously collects medication details, including the name, dosage, and frequency of administration, to enable healthcare providers to make informed decisions regarding patient care and medication management. In essence, the user module streamlines account setup, gathers essential user information, and prioritizes patient well-being by collecting caregiver and medication details, fostering a comprehensive and user-centric approach to healthcare management.

B. Data Module

The data monitoring module facilitates seamless health monitoring by continuously collecting vital signs data from smartwatches. This data includes parameters such as heart rate, blood pressure, and oxygen saturation levels. The module monitors variations in these vital signs, enabling early detection of potential health concerns. All collected data is securely stored for future reference and analysis, providing valuable insights for healthcare providers to track patient progress and make informed treatment decisions. To ensure data accuracy and reliability, predefined maximum and minimum limits for each vital value are incorporated, enabling the system to flag anomalies or deviations from normal ranges for further investigation and intervention if necessary. In essence, the data monitoring module empowers individuals to proactively manage their health by providing a comprehensive platform for continuous vital signs monitoring, data storage, and analysis.

C. Alert Module

The alert module plays a pivotal role in promoting medication adherence and ensuring prompt assistance in emergency situations. It generates timely medication alerts, complete with medicine names and dosages, and incorporates caregiver details to notify designated individuals of concerns or deviations from prescribed medication regimens. Detailed alert messages include vital information about the patient's condition, such as heart rate, blood pressure, and oxygen saturation levels, empowering caregivers and healthcare providers to make informed decisions and initiate timely interventions when necessary. In emergency situations, the module triggers an SOS call to designated hospitals, ensuring patients receive immediate medical attention. The alert module serves as an indispensable tool for promoting medication adherence, facilitating timely interventions, and ensuring prompt assistance in emergencies, making it a cornerstone of comprehensive healthcare management.

D. Working

The Caregiver can manage access to the user's profile and data.The Caregiver can schedule medication reminders for the user, specifying the medication name, dosage, and timing. This ensures that the user receives timely alerts on their smartwatch reminding them to take their prescribed medication. These reminders eliminate the risk of missed or forgotten medications. He/She can also set medication refill reminders for the user. The user will receive an alert on their smartwatch when it is time to refill their medication. The user can use the Emergency SOS feature to send an alert to their caregiver in case of an emergency.The CareWave Software utilizes data collected from the user's smartwatch and analyzes it using AI algorithms to provide valuable insights and alerts. The Caregiver can receive emergency alerts from the system. These alerts inform the caregiver about critical situations or emergencies concerning the user.

E. Entities

We have five entities in our system which are profile, health data, smartwatch, alert messages, and medication reminders. The database comprises interconnected entities managing caregiver and patient information, medication schedules, vital signs monitoring, and alert notifications. Profile stores information about user profiles, including their name, email, password, health information, etc. It has a unique ID. Medication Reminder stores information about medication reminders, including the medicine name, dosage, and scheduled reminder time. It has a unique medication id. Health data stores health information such as heart rate, oxygen saturation, variations in health conditions, and the given health information. It has a unique user ID. The smartwatch has a unique watch ID. Alert messages have messages with the vital signs and it has a unique alert ID.

F. Technical Stack Setup

The technology stack chosen for the health monitoring software is carefully designed to offer a comprehensive solution for building and deploying the application.

Python, known for its simplicity and versatility, serves as the primary programming language due to its readability and extensive libraries, making it suitable for a wide range of tasks from web development to data science and machine learning.

Flutter, developed by Google, is selected for its ability to create visually appealing and high-performance user interfaces across various platforms. Its unique approach combines declarative programming with a single codebase methodology, enabling developers to efficiently build and deploy applications with consistent user experiences. Firebase, as a backend-as-a-service platform, provides essential features such as authentication, database management, and analytics, freeing developers from managing backend infrastructure and allowing them to focus on core application development.

Lastly, TensorFlow, an open-source library, enhances the software with powerful machine learning and deep learning capabilities, enabling tasks such as image recognition and natural language processing, which are crucial for health monitoring and analysis. Together, these technologies form a robust and scalable foundation for the health monitoring software, ensuring optimal performance and user experience.

V. Findings and Discussions

The findings and discussions section of this research paper delves deeply into the multifaceted landscape of contemporary healthcare, focusing particularly on the challenges faced by the aging population and individuals managing chronic health conditions. With global life expectancy on the rise and chronic illnesses becoming increasingly prevalent, there is a pressing need for healthcare solutions that are tailored to the specific needs of these demographic groups. Traditional healthcare systems, while effective in addressing general health concerns, often fall short when it comes to providing personalized and

timely interventions for individuals with complex health conditions. This limitation is exacerbated by the existing infrastructure, which struggles to deliver efficient remote monitoring and prompt responses to health emergencies, leading to suboptimal health outcomes and reduced quality of life for many patients.

The literature review conducted for this research sheds light on the evolving landscape of healthcare technology, particularly highlighting the role of artificial intelligence (AI) in addressing the existing gaps in healthcare delivery. While smartwatches have emerged as accessible devices for health tracking, their current capabilities are largely focused on basic fitness metrics and do not fully meet the nuanced needs of the aging population and individuals managing chronic health conditions. Thus, there is a compelling imperative to harness the potential of AI to develop sophisticated software solutions that can leverage the capabilities of smartwatches to provide personalized health management, real-time monitoring, and swift emergency response.

The reviewed literature presents a wealth of insights into the applications of AI-driven solutions in healthcare, ranging from remote patient monitoring to predictive analytics and disease management. For instance, studies such as "A real-time AI-based system for COVID-19 patients" by Muhammad Zia Ur Rahman highlight the potential of locally available sensors and IoT technology in tracking the health parameters of isolated COVID-19 patients in remote areas. Similarly, "Smart Health Monitoring Using Deep Learning and Artificial Intelligence" by Jeethu Philip explores the applications of smart health monitoring in intensive care, medication management, and oxygen saturation monitoring, while also addressing the challenges and limitations in data standardization and security.

Moreover, the literature review introduces three distinct remote patient monitoring platforms—Vivify Health, Keva Health's SaaS Respiratory Care Platform, and Hale—that demonstrate the diverse capabilities and functionalities offered by AI-driven healthcare solutions. These platforms enable healthcare providers to design personalized care plans, capture remote care data, and gain real-time insights into patient health status without the need for on-site consultations.

In summary, the findings and discussions section synthesizes the insights gleaned from the literature review, highlighting the potential of AI-driven solutions in revolutionizing healthcare delivery for the aging population and individuals managing chronic health conditions. By leveraging the capabilities of smartwatches and advanced AI algorithms, healthcare providers can offer personalized care, improve patient outcomes, and enhance overall quality of life for individuals with complex health needs. However, further research and development are necessary to address the challenges and limitations associated with the implementation of AI-driven healthcare solutions and realize their full potential in transforming the healthcare landscape.

VI. Conclusion and Future Scope

In conclusion, the study underscores the formidable challenges faced by the aging population and individuals managing chronic health conditions within contemporary healthcare systems. As life expectancy rises globally and chronic health conditions become increasingly prevalent, the demand for targeted and personalized healthcare solutions becomes more evident. While traditional healthcare systems excel in addressing general health concerns, they often falter when it comes to providing the nuanced and individualized care required by this specific demographic. The existing infrastructure encounters obstacles in delivering timely interventions and efficient remote monitoring, exacerbating the difficulties faced by individuals seeking comprehensive health management. Delayed responses to health emergencies and a lack of real-time monitoring contribute to a suboptimal quality of life for many, with potential ramifications on overall health outcomes.

The integration of technology, particularly smartwatches, has showcased remarkable progress in recent years as accessible and widely adopted devices for health tracking. However, their current capabilities predominantly focus on basic fitness metrics and fail to address the nuanced needs of the aging population and individuals with specific health conditions. Against this backdrop, there is a compelling imperative to leverage artificial intelligence (AI) to develop a sophisticated software solution tailored to the capabilities of smartwatches. AI holds the potential to revolutionize healthcare by offering personalized insights, predictive analytics, and real-time monitoring, thereby bridging existing gaps in the care continuum. By delving into the unique challenges faced by the target demographic, this background sets the stage for the subsequent exploration of an innovative AI-powered smartwatch software that aims to redefine healthcare management for the elderly and those with health conditions.

The envisioned project endeavors to develop an innovative AI-powered software solution tailored for smartwatches, aiming to fill critical gaps in healthcare for the aging population and individuals managing health conditions. The primary objective is to harness artificial intelligence to provide personalized health management, real-time monitoring, and swift emergency response. The literature review conducted as part of this research encompasses a multifaceted exploration of advanced healthcare technologies, focusing on AI-driven solutions for health monitoring, diagnosis, and patient care. The review introduces research papers and distinct remote patient monitoring platforms, shedding light on the transformative potential of AI-driven solutions in revolutionizing healthcare management.

Looking ahead, the future scope of research and development in AI-driven healthcare solutions is vast and promising. Further exploration and refinement of AI algorithms, coupled with advancements in sensor technology and data analytics, hold the potential to unlock new frontiers in personalized healthcare delivery. Interdisciplinary collaborations between healthcare professionals, technologists, and researchers will be

pivotal in driving innovation and translating research findings into practical solutions. Moreover, addressing scalability and accessibility issues will be essential to ensure equitable access to quality care for all individuals, regardless of geographic location or socioeconomic status. By embracing emerging technologies and fostering collaborative partnerships, the healthcare industry can usher in a new era of patient-centered care, marked by personalized interventions, improved outcomes, and enhanced quality of life for individuals managing chronic health conditions.

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