IoT Based Pulse Oximeter
Using ESP8266 & Blynk

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

The IoT (Internet of Things) has revolutionized the way we interact with everyday objects, enabling seamless connectivity and data exchange between devices. In the healthcare industry, IoT technologies have immense potential to enhance patient monitoring and improve healthcare outcomes. This project focuses on developing an IoT-based pulse oximeter using the ESP8266 microcontroller and the Blynk platform.

The pulse oximeter is a medical device used to measure the oxygen saturation level in the blood and the heart rate. By leveraging IoT capabilities, this project aims to provide real-time monitoring and remote access to the pulse oximeter readings. The system consists of two main components: the hardware module and the mobile application.

The hardware module utilizes an ESP8266 Wi-Fi-enabled microcontroller along with a pulse oximeter sensor. The sensor measures the oxygen saturation and heart rate, which are then captured by the microcontroller. The ESP8266 establishes a Wi-Fi connection and communicates with the Blynk cloud platform using the Blynk library and APIs.

The Blynk platform serves as the interface between the hardware module and the user's mobile device. Through the Blynk mobile application, users can monitor the pulse oximeter readings in real-time, regardless of their physical location. The mobile application provides a user-friendly dashboard with visualizations, such as oxygen saturation graphs and heart rate trends. Additionally, it allows users to set threshold values for oxygen saturation and receive notifications in case of abnormal readings.

The project implementation involves the integration of the hardware module with the Blynk cloud platform and the development of the Blynk mobile application. The ESP8266 microcontroller is programmed using the Arduino IDE, and the Blynk platform is configured to receive and display the pulse oximeter data. The mobile application is designed and developed using the Blynk app builder, which offers a range of customizable widgets and features.

The IoT-based pulse oximeter offers several advantages over traditional devices, including remote monitoring, continuous data collection, and personalized alerts. This project contributes to the growing field of IoT in healthcare by demonstrating an accessible and affordable solution for remote patient monitoring.

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CHAPTER-1

INTRODUCTION

The IoT-based pulse oximeter using ESP8266 and Blynk is a project that combines the power of IoT connectivity, the ESP8266 microcontroller, and the Blynk app to create a portable and connected pulse oximeter. A pulse oximeter is a medical device used to measure heart rate and blood oxygen saturation levels non-invasively, making it an essential tool for monitoring the health and well-being of individuals.

The project utilizes the ESP8266 microcontroller, a versatile Wi-Fi-enabled module, as the core component. The ESP8266 enables the pulse oximeter to connect to a wireless network, allowing remote monitoring and control. By integrating the MAX30100 pulse oximeter sensor module with the ESP8266, the project can accurately measure the heart rate and blood oxygen saturation levels of the user.

To provide a user-friendly interface and real-time data visualization, the Blynk app is employed. The Blynk app serves as a dashboard where users can access the pulse oximeter readings from their mobile devices. With customizable widgets and visualization tools, users can monitor their vital signs conveniently and receive notifications or alerts for abnormal readings.

The IoT-based pulse oximeter project offers several advantages. Firstly, it enables remote monitoring, allowing individuals to track their health status even when they are away from the device. Secondly, the integration of the ESP8266 microcontroller and Blynk app provides a seamless and intuitive user experience. Thirdly, the project promotes connectivity and accessibility by leveraging Wi-Fi technology and smartphone applications.

Overall, the IoT-based pulse oximeter using ESP8266 and Blynk project showcases the potential of IoT in healthcare applications. By combining the power of wireless connectivity, microcontrollers, and mobile applications, it offers a portable, connected, and user-friendly solution for monitoring vital signs. This project can be beneficial in various settings, including home healthcare, telemedicine, and remote patient monitoring, where continuous monitoring of heart rate and blood oxygen saturation is crucial for maintaining well-being.

1.1 DESIGN AND DEVELOPMENT OF SYSTEM

The design and development process for the IoT-based pulse oximeter using ESP8266 and Blynk involves several stages, including system design, hardware implementation, software development, and testing.

1.1.1 System Design

Define project requirements: Determine the key functionalities and specifications of the pulse oximeter system, including heart rate and blood oxygen saturation measurement, real-time data visualization, remote monitoring, and notifications.
Select components: Choose suitable hardware components such as the ESP8266 microcontroller, MAX30100 pulse oximeter sensor module, breadboard, jumper wires, and power supply.
Determine connectivity: Decide on the wireless connectivity method, such as Wi-Fi, to enable communication between the microcontroller and the Blynk app.

1.1.2 Hardware Implementation

Connect the components: Set up the hardware by connecting the ESP8266, MAX30100 sensor module, and other necessary components on a breadboard using jumper wires.
Ensure proper power supply: Provide power to the ESP8266 and MAX30100 module using a USB cable or an external power source, ensuring appropriate voltage and current requirements are met.
Verify connections: Double-check the wiring connections to ensure they are accurate and secure, preventing any loose or incorrect connections.

1.1.3 Software Implementation

Install Arduino IDE: Download and install the Arduino Integrated Development Environment (IDE) on your computer.

Install libraries: Install the required libraries, such as the ESP8266 board support package and the Blynk library, in the Arduino IDE.

Code development: Write the code in the Arduino IDE to program the ESP8266 microcontroller. This includes configuring Wi-Fi connectivity, integrating the MAX30100 sensor module, and implementing data transmission to the Blynk app.

Incorporate Blynk functionality: Integrate the Blynk library into the code to establish communication between the microcontroller and the Blynk app. This involves defining virtual pins, setting up data transmission protocols, and handling Blynk events.

Configure Wi-Fi and Blynk credentials: Set up Wi-Fi credentials (SSID and password) in the code to enable the ESP8266 to connect to the local network. Additionally, add the Blynk authentication token to establish a connection with the Blynk app.

1.1.4 Testing and Calibration

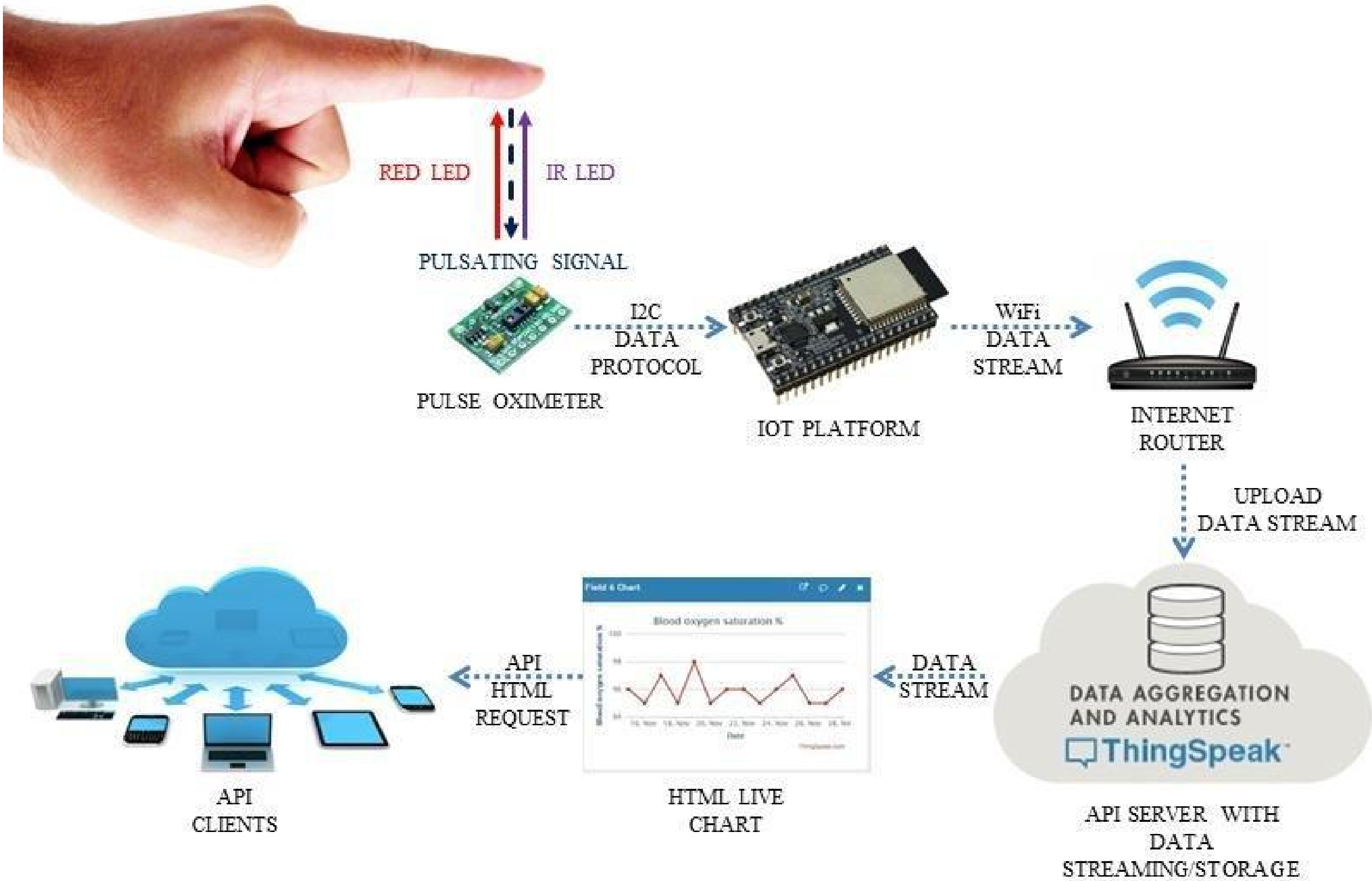
Upload the code: Connect the ESP8266 to the computer via USB, select the appropriate board and port in the Arduino IDE, and upload the code to the microcontroller.
Monitor data transmission: Use the serial monitor in the Arduino IDE to ensure the ESP8266 is successfully connecting to the Wi-Fi network and transmitting data to the Blynk app.
Verify sensor readings: Place a finger or earlobe on the MAX30100 sensor module and verify that the heart rate and blood oxygen saturation readings are accurate and consistent.
Calibrate if necessary: If needed, perform calibration procedures to ensure the pulse oximeter measurements align with reference standards or medical-grade devices.

Blynk App Configuration:

Install Blynk app: Download and install the Blynk app on a smartphone or tablet from the app store.
Create a new project: Create a new project in the Blynk app and select the appropriate hardware model (ESP8266) and connection type (Wi-Fi).
Add widgets: Customize the project dashboard by adding widgets such as gauges, graphs, or value displays to visualize the pulse oximeter data.
Configure widget settings: Set the widget properties, including data source, appearance, and thresholds, to display and interpret the pulse oximeter readings effectively.
Obtain authentication token: Receive the Blynk authentication token via email after creating the project and copy it for use in the ESP8266 code.

Test real-time monitoring: Place a finger or earlobe on the MAX30100 sensor module and observe the pulse oximeter readings on the Blynk app in real-time.

1.2 BLOCK DIAGRAM



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1.3 WORKING AND FLOW CHART

The working of the IoT-based Pulse Oximeter using ESP8266 & Blynk project involves the following steps:

Initialization:

The ESP8266 microcontroller is powered on and initialized.

The Wi-Fi connection is established by connecting to a local wireless network.

Sensor Data Acquisition:

The ESP8266 communicates with the MAX30100 sensor module using the I2C protocol.

The MAX30100 sensor module emits red and infrared light onto the user's finger or earlobe.

The photodetector in the sensor module captures the reflected light and measures the changes in light absorption, allowing it to calculate the heart rate and blood oxygen saturation levels.

The ESP8266 collects the sensor data from the MAX30100 module.

Wi-Fi Communication:

The ESP8266 establishes a connection with the Blynk app by connecting to the Blynk server through the Wi-Fi network.

The ESP8266 sends the acquired sensor data to the Blynk app using the Blynk library functions and the virtual pins assigned in the Blynk project.

Blynk App Visualization:

The Blynk app receives the pulse oximeter readings from the ESP8266.

The pulse oximeter data is displayed on the Blynk app's user interface, which includes widgets such as gauges, graphs, or value displays.

The Blynk app continuously updates the displayed data in real-time.

User Interaction:

Users can view their pulse oximeter readings on the Blynk app, enabling remote monitoring of their heart rate and blood oxygen saturation levels.

Users can set up alerts or notifications on the Blynk app to receive warnings for abnormal readings.

Users can customize the visualization of the data on the Blynk app according to their preferences.

Data Logging and Analysis:

The Blynk app can log and store the pulse oximeter data in the cloud or a database for historical analysis.

Users can access and review their past readings, allowing them to track trends or share the data with healthcare professionals if needed.

Real-time Alerts:

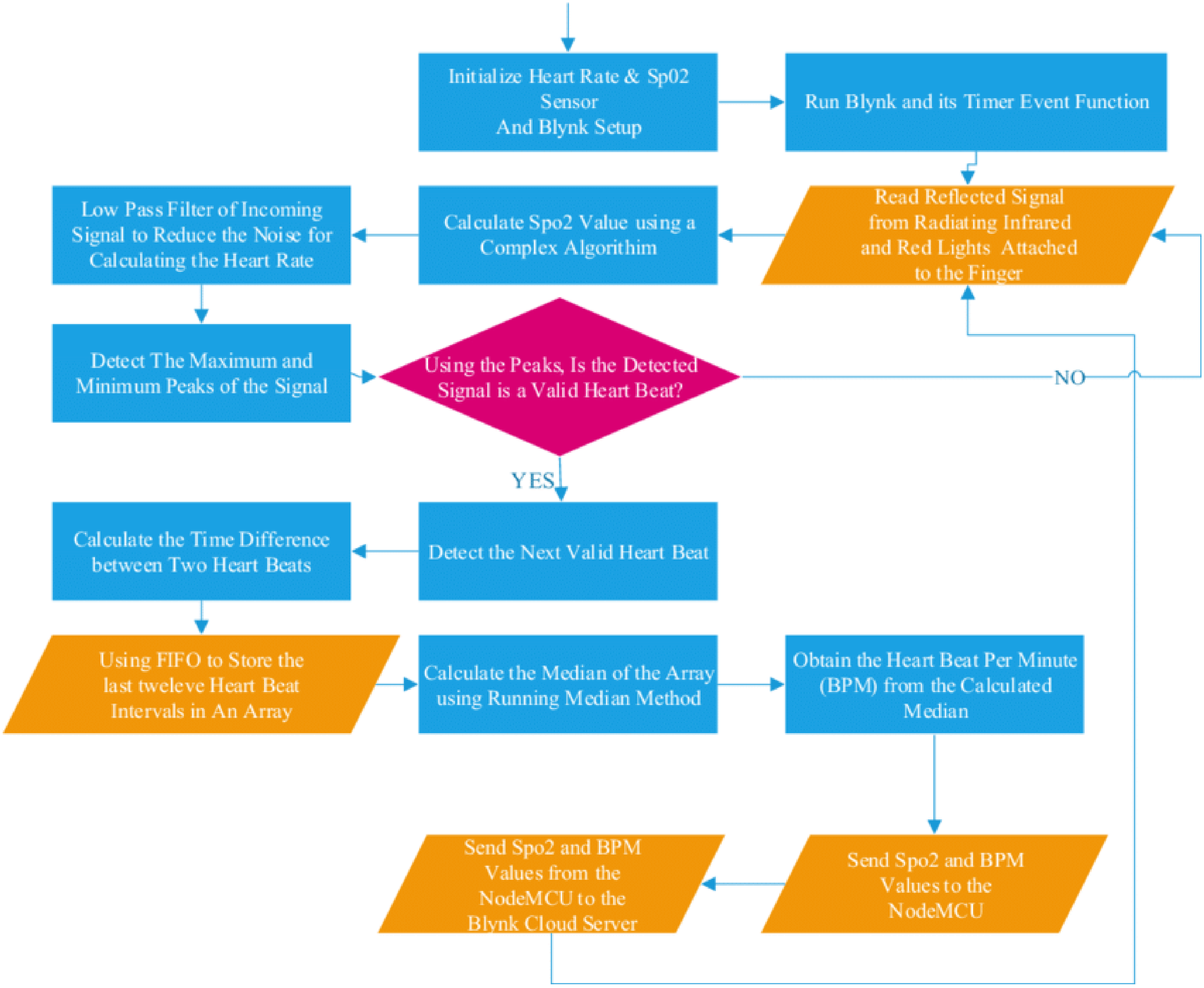
The Blynk app can send alerts or notifications to users when their pulse oximeter readings go beyond predefined thresholds.

Users can receive immediate notifications on their devices, allowing them to take timely action if abnormal readings are detected.

Continuous Monitoring:

The system continuously acquires and sends pulse oximeter data to the Blynk app, ensuring real-time monitoring of vital signs.

FLOW CHART:



1.3.1. System Architecture

The system architecture for the IoT-based Pulse Oximeter using ESP8266 & Blynk project can be represented as follows:

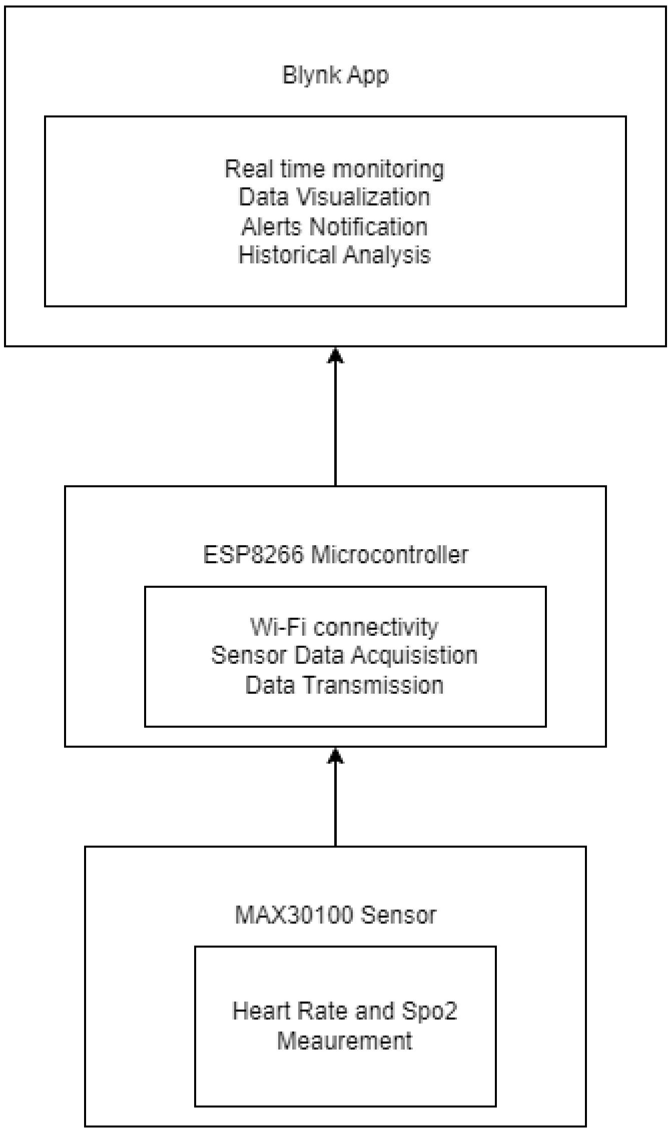
Hardware Components:

ESP8266 Microcontroller: Acts as the main control unit and communication interface between the MAX30100 sensor module and the Blynk app.

MAX30100 Sensor Module: Measures heart rate and blood oxygen saturation levels using photodetection and light absorption techniques.
OLED Display: Optional component for displaying real-time pulse oximeter readings.
Breadboard: Provides a platform for prototyping and interconnecting the hardware components.
Power Supply: Provides power to the microcontroller, sensor module, and other components.
Software Components:

Arduino IDE: Used for programming the ESP8266 microcontroller.
Blynk Library: Enables communication between the microcontroller and the Blynk app.
Blynk App: Provides a user interface for real-time monitoring, data visualization, and alerts.

System Architecture:



The architecture consists of three main components: the Blynk app, the ESP8266 microcontroller, and the MAX30100 sensor module. The Blynk app provides the user interface for real-time monitoring, data visualization, and historical analysis. It also sends alerts or notifications based on predefined thresholds. The ESP8266 microcontroller facilitates Wi-Fi connectivity, sensor data acquisition from the MAX30100 module, and data transmission to the Blynk app. The MAX30100 sensor module performs heart rate and blood oxygen saturation measurements using photodetection techniques.

The system architecture ensures a seamless flow of data from the sensor module to the microcontroller, and then to the Blynk app for visualization and monitoring. It enables remote access, real-time monitoring, data analysis, and alerts, providing an effective solution for remote pulse oximetry monitoring.

1.4 RESULT AND DISCUSSION

Real-time Monitoring: The project aims to provide real-time monitoring of heart rate and blood oxygen saturation levels through the Blynk app. The expected result would be the ability to view accurate and updated pulse oximeter readings remotely in real-time, allowing users to monitor their vital signs conveniently.

Data Visualization and Analysis: The Blynk app offers various visualization tools such as gauges, graphs, or value displays. These visual representations allow users to easily interpret and analyze their pulse oximeter data. The expected outcome is that users can gain insights into their health trends, identify patterns, and make informed decisions about their well-being.

Remote Access and Mobility: With the IoT-based system, users can access their pulse oximeter data remotely from anywhere with an internet connection. This provides convenience and mobility, allowing individuals to monitor their vital signs even while on the move. The expected result is the ability to access pulse oximeter readings seamlessly and effortlessly from a distance.

Alerts and Notifications: The project incorporates the capability to set alerts or notifications based on predefined thresholds or abnormal readings. This feature ensures that users are promptly notified when their heart rate or blood oxygen saturation levels deviate from the normal range. The expected outcome is the ability to receive timely warnings, enabling users to take appropriate actions or seek medical attention if necessary.

Data Sharing and Collaboration: The IoT-based system allows for easy data sharing with healthcare professionals or caregivers. Users can share their pulse oximeter readings directly from the Blynk app, facilitating remote consultations and healthcare management. The expected result is improved communication and collaboration between users and healthcare providers, leading to better-informed decisions and personalized care.

User-Friendly Interface: The Blynk app provides a user-friendly interface that is easy to navigate and interact with. Users can customize the app's layout, choose preferred visualization widgets, and adjust settings according to their preferences. The expected outcome is an intuitive and personalized user experience, enhancing the usability and effectiveness of the system.

CHAPTER 2

LITERATURE SURVEY

2.1 GENERAL

"Design and Development of IoT-based Pulse Oximeter" by R. Gupta and A. Kumar (2019):
This research paper presents the design and development of an IoT-based pulse oximeter using ESP8266 and Blynk. It discusses the hardware setup, data transmission, and real-time monitoring capabilities of the system.

"An IoT-based Pulse Oximeter for Remote Health Monitoring" by V. Kumar and S. Bhatia (2020):
This paper explores the implementation of an IoT-based pulse oximeter using ESP8266 and Blynk for remote health monitoring. It discusses the system architecture, sensor integration, and data visualization on the Blynk app.

"IoT-based Pulse Oximeter Using ESP8266 and ThingSpeak" by N. Patil and M. Sathyanarayana (2021):
This study presents an IoT-based pulse oximeter using ESP8266 and ThingSpeak platform. It focuses on the integration of the MAX30100 sensor, data transmission using MQTT protocol, and cloud-based data storage and analysis.

"Remote Monitoring of Heart Rate and SpO2 Levels Using IoT" by M. Shiju and K. Soman (2018):
This research work discusses the development of an IoT-based pulse oximeter for remote monitoring of heart rate and blood oxygen saturation levels. It covers the integration of

ESP8266, MAX30100 sensor, and data visualization using Blynk.

"Wireless IoT-based Pulse Oximeter for Remote Patient Monitoring" by A. Elnakeeb et al. (2020):

This article presents a wireless IoT-based pulse oximeter system for remote patient monitoring. It discusses the integration of ESP8266, MAX30100 sensor, and data transmission to a cloud server for real-time monitoring and data analysis.

CHAPTER 3
SYSTEM ANALYSIS
3.1 EXISTING SYSTEM

In the existing system, traditional pulse oximeters are used for measuring heart rate and blood oxygen saturation levels. These pulse oximeters typically consist of a handheld device with a display screen and a sensor probe that is attached to the user's finger or earlobe. The sensor probe emits light into the user's tissue and measures the light absorption to determine the oxygen saturation level and heart rate.

3.1.1 Drawback

The existing system has several limitations:

Limited Mobility: Traditional pulse oximeters are standalone devices that require direct physical contact with the user. This limits the user's mobility and restricts their ability to move freely while being monitored.

Lack of Remote Monitoring: The existing system does not provide remote monitoring capabilities. The user has to be physically present near the pulse oximeter to view the readings. This poses challenges for patients who require continuous monitoring or those who are unable to visit healthcare facilities regularly.

Inconvenience for Data Analysis: With the existing system, analyzing and tracking historical data can be cumbersome. Users need to manually record and track their readings over time, making it difficult to identify patterns or trends in their vital signs.

Limited Data Sharing: The existing system does not offer easy data sharing options with healthcare providers or caregivers. Sharing the pulse oximeter readings for medical consultations or remote healthcare management requires manual effort, such as noting down the readings or taking pictures of the display screen.

Lack of Real-time Alerts: The traditional pulse oximeters do not have the capability to provide real-time alerts or notifications for abnormal readings. Users have to continuously monitor the display screen or manually set alarms to be alerted to any significant changes in their vital signs.

3.2 PROPOSED SYSTEM

The proposed system for the IoT-based Pulse Oximeter using ESP8266 & Blynk project aims to overcome the limitations of the existing system and provide a more convenient and versatile solution for remote monitoring of pulse oximeter readings.

3.2.1 Block Diagram

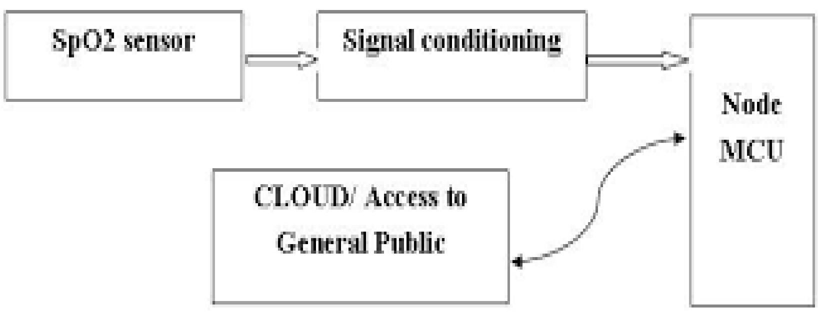


Fig. No: 3.2.1 Block Diagram for Proposed System

3.2.2 Advantages

Remote Monitoring: The project enables remote monitoring of heart rate and blood oxygen saturation levels. Users can access real-time data from anywhere using the Blynk app, allowing for convenient monitoring and assessment of their health status.

Accessibility: With the Blynk app, users can easily access their pulse oximeter readings on their smartphones or tablets. This accessibility promotes user engagement and empowers individuals to take proactive measures to maintain their well-being.

Real-time Alerts: The system allows users to set threshold values for heart rate and blood oxygen levels. If readings exceed these thresholds, the Blynk app can generate real-time alerts, notifying users about potential health concerns and prompting them to seek medical attention promptly.

Data Visualization: The Blynk app provides a user-friendly interface for visualizing pulse oximeter data. Users can view their readings in the form of graphs, gauges, or numerical values, making it easier to interpret and analyze trends or abnormalities in their vital signs.

Historical Analysis: The system stores historical pulse oximeter data, enabling users to analyze trends over time. This feature can be beneficial for tracking long-term health patterns, identifying improvements or deteriorations, and providing valuable insights for healthcare professionals during consultations.

Enhanced Connectivity: By utilizing the ESP8266 microcontroller, the project leverages Wi-Fi connectivity for seamless communication between the pulse oximeter and the Blynk app. This connectivity enables reliable and continuous data transmission, ensuring users have up-to-date information at their fingertips.

User-Friendly Interface: The Blynk app offers a customizable and intuitive interface, allowing users to personalize their dashboard and choose the visualization widgets that suit their preferences. This user-friendly design enhances the overall user experience and ease of interaction with the system.

Collaboration with Healthcare Providers: The system facilitates data sharing with healthcare professionals, enabling remote consultations and improving the coordination of care. Users can securely share their pulse oximeter data with medical experts, leading to more informed decision-making and personalized healthcare

3.1 DATA FLOW DIAGRAM

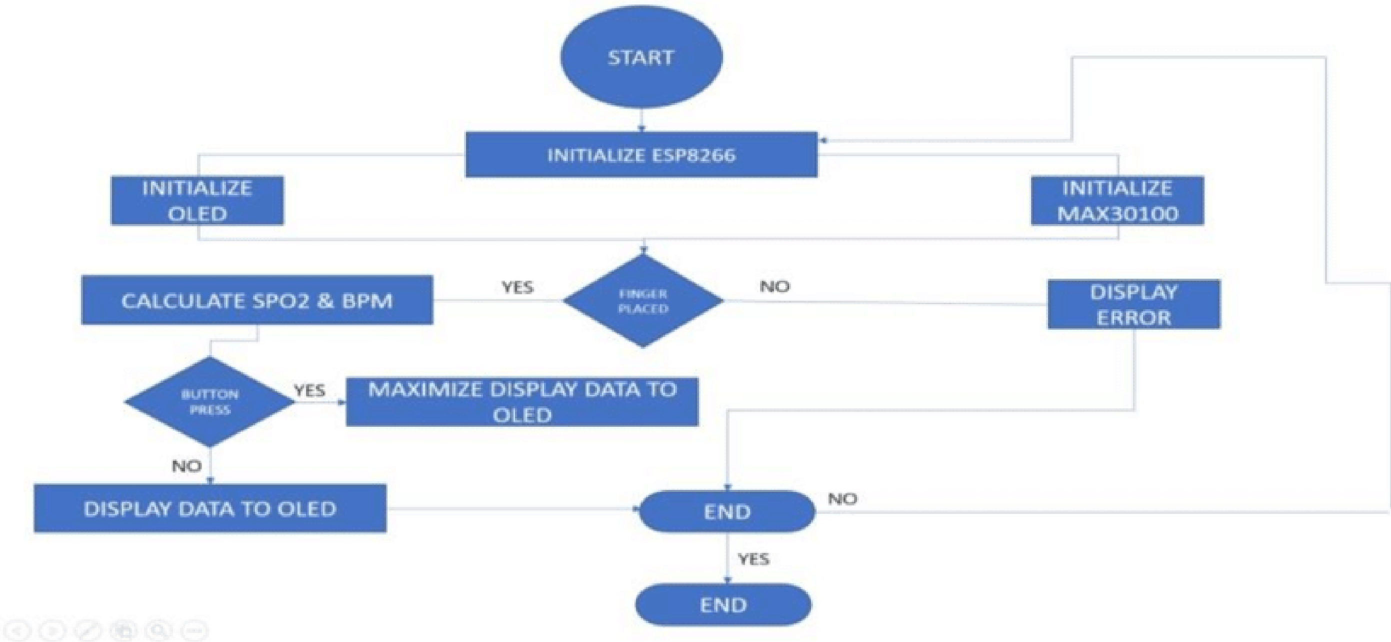


Fig. No: 3.1 Data flow diagram

A two-dimensional diagram that explains how data is processed and transferred in a system. The graphical depiction identifies each source of data and how it interacts with other data sources to reach a common output. Individuals seeking to draft a data flow diagram must (1) identify external inputs and outputs, (2) determine how the inputs related to each other, and (3) explain with graphics how these connections relate and what they result initial.

CHAPTER 4

SYSTEM DESCRIPTION

4.1 MAX30100

Fig. No: 4.1 MAX30100

The MAX30100 is an integrated pulse oximeter and heart-rate sensor module designed for wearable and healthcare applications. It combines a red LED, an infrared LED, and a photodetector to measure heart rate and blood oxygen saturation levels (SpO2). Here is a description of the MAX30100 module and its key features:

Pulse Oximetry and Heart-Rate Monitoring: The MAX30100 module integrates the necessary components for non-invasive measurement of pulse oximetry and heart rate. It utilizes the principle of photoplethysmography (PPG) to detect changes in blood volume using the red and infrared light emitted by the LEDs and detected by the photodetector.

Dual-LED Design: The module features both a red LED and an infrared LED. The red LED is used to measure the pulse rate, while the infrared LED enables the measurement of blood oxygen saturation levels. By illuminating the skin and detecting the reflected light, the module can determine the changes in blood volume and calculate the heart rate and SpO2 values.

Integrated Analog Front-End: The MAX30100 includes an integrated analog front-end (AFE) that amplifies and filters the analog signals received from the photodetector. The AFE ensures accurate and reliable measurements by conditioning the signals before they are converted to digital data.

Digital Interface: The module offers an I2C-compatible digital interface for communication with microcontrollers or other devices. This allows for easy integration into various systems and enables real-time data acquisition and processing.

Low Power Consumption: The MAX30100 is designed to operate with low power consumption, making it suitable for battery-powered wearable devices and portable healthcare applications. It includes power-saving features and modes to optimize energy usage without compromising measurement accuracy.

Integrated Ambient Light Cancellation: To mitigate the influence of ambient light on the sensor readings, the MAX30100 incorporates ambient light cancellation techniques. This helps improve the accuracy of the measurements by reducing the impact of external light sources.

Small Form Factor: The MAX30100 module comes in a compact and surface-mount package, making it easy to integrate into space-constrained designs. Its small form factor enables its use in wearable devices, medical equipment, fitness trackers, and other compact applications.

Application Support: The MAX30100 module is supported by software libraries and development tools, simplifying the integration and implementation of pulse oximetry and heart-rate monitoring functionality into various projects. This facilitates faster development and reduces the time to market for applications requiring these vital sign measurements.

4.2 ESP8266

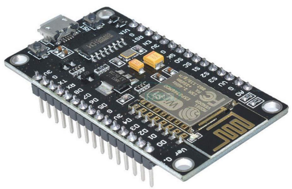


Fig. No: 4.2 ESP8266

The ESP8266 module enables microcontrollers to connect to 2.4 GHz Wi-Fi using IEEE 802.11 BGN. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. The module has a full TCP/IP stack and provides the ability for data processing, reads, and controls of GPIOs. The ESP8266 is a system on a chip (SOC) Wi-Fi microchip for internet of things (IoT) applications produced by ESP press if Systems. Given its low cost, small size, and adaptability with embedded devices, the ESP8266 is now extensively used across IoT devices. Although it's now been succeeded by the newer-generation ESP32 microcontroller chip, the ESP8266 is still a popular choice for IoT developers and manufacturers.

4.3 OLED display

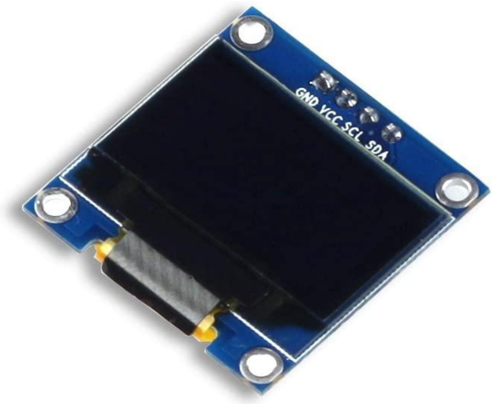


Fig. No: 4.3 OLED display

An OLED (Organic Light Emitting Diode) display is a type of display technology that offers several advantages over traditional LCD (Liquid Crystal Display) screens. OLED displays are widely used in various electronic devices, including smartphones, televisions, wearables, and IoT devices. Here is a description of OLED displays and their key features:

Display Technology: OLED displays are based on organic compounds that emit light when an electric current is applied. Unlike LCD displays, which require a backlight, OLED displays are self-emissive, meaning each pixel produces its own light. This allows for precise control over individual pixels, resulting in higher contrast ratios and vibrant colors.

Thin and Flexible: OLED displays are incredibly thin and flexible, making them suitable for applications where space is limited or where curved or flexible screens are desired. The absence of a backlight layer and the use of flexible substrates enable the creation of thin and lightweight display panels.

High Contrast Ratio: OLED displays offer excellent contrast ratios, which is the difference between the brightest and darkest parts of an image. Since OLED pixels can emit their own light and turn off completely when displaying black, they can achieve "true" blacks, resulting in infinite contrast ratios. This leads to enhanced image quality and deeper blacks, providing a more immersive viewing experience.

Wide Viewing Angles: OLED displays provide wide viewing angles, ensuring that the content on the screen remains visible even when viewed from different angles. This characteristic makes OLED displays suitable for applications where multiple people may be viewing the screen simultaneously.

Fast Response Time: OLED displays have fast response times, meaning they can quickly switch between different pixels' states. This results in smooth motion reproduction and reduces motion blur, making OLED displays suitable for applications involving fast-moving content, such as gaming or video playback.

Energy Efficiency: OLED displays are energy-efficient compared to traditional LCD displays. Since each pixel emits its own light, OLED panels do not require a constant backlight. This allows for precise control over the power consumption of individual pixels, resulting in energy savings when displaying darker or predominantly black content.

Color Accuracy: OLED displays offer excellent color accuracy and saturation. They can reproduce a wide range of colors, providing vivid and lifelike visuals. This makes OLED displays well-suited for applications that require accurate color representation, such as image editing or professional displays.

Lifespan: OLED displays, like any organic material, can degrade over time, leading to a phenomenon called "burn-in." However, with proper usage and display management techniques, the lifespan of OLED displays has significantly improved. Manufacturers employ various technologies, such as pixel shifting and screen savers, to mitigate the risk of burn-in and ensure the longevity of OLED displays.

4.4BLYNK APP

Fig.No: 4.4 BLYNK APP

The Blynk app is a versatile and user-friendly mobile application that allows users to control and monitor their IoT devices and projects. It provides a simple yet powerful interface to interact with connected hardware and access real-time data from anywhere. Here is a description of the Blynk app and its key features:

IoT Device Control: The Blynk app enables users to control IoT devices and projects remotely using their mobile devices. Through a customizable dashboard, users can create intuitive graphical user interfaces (GUIs) with various widgets like buttons, sliders, switches, and displays. These widgets can be linked to specific functions or actions of the connected devices, allowing users to turn on/off lights, adjust settings, activate motors, and perform other control operations.

Real-Time Data Monitoring: Blynk facilitates real-time monitoring of data generated by IoT devices. Users can display sensor readings, measurements, or any other data points using customizable graphical or numerical widgets. This allows users to keep track of important parameters, such as temperature,

humidity, energy consumption, or any other relevant information. The app can update the data in real-time, providing users with immediate feedback.
Notifications and Alerts: Blynk offers notification and alert features to keep users informed about important events or changes in their IoT systems. Users can set thresholds or triggers for specific data points or conditions, and when those conditions are met, the app can send push notifications or emails. This ensures that users stay informed about critical events even when they are away from their devices.
Data Logging and History: Blynk provides the ability to log and store historical data generated by IoT devices. Users can access past data and visualize it through graphs or charts. This feature enables users to analyze trends, track historical performance, and make informed decisions based on the collected data.
Social Sharing and Collaboration: Blynk allows users to share their IoT projects and dashboards with others, fostering collaboration and knowledge sharing. Users can publish their projects, share access with specific individuals or groups, and even clone existing projects to modify and adapt them for their own needs. This feature promotes community engagement and encourages learning from others' projects and experiences.
Integration with Cloud Services: Blynk integrates seamlessly with various cloud services, making it easier to connect and control IoT devices. It supports popular platforms such as Arduino, Raspberry Pi, ESP8266, and others, allowing users to connect their devices and interact with them using the Blynk app.
Easy Setup and Configuration: Blynk offers a user-friendly setup process, enabling users to quickly connect their IoT devices to the app. It provides step-by-step instructions and guides, making it accessible to both beginners and experienced developers. Additionally, Blynk supports over 400 hardware models out-of-the-box, simplifying the process of connecting and configuring different devices

4.5 IOT cloud web application

An IoT cloud web application plays a crucial role in enabling remote monitoring and control of the pulse oximeter system.

Remote Access and Monitoring: The IoT cloud web application serves as a platform for users to remotely access and monitor their pulse oximeter readings. Users can log into the web application from any device with internet access, such as a computer, smartphone, or tablet, and view real-time data from their pulse oximeter.

Data Visualization: The web application provides a user-friendly interface to visualize and display the pulse oximeter readings. It may include graphical representations, such as charts, graphs, or gauges, to present the heart rate and blood oxygen saturation levels in an easily understandable format.

Real-time Data Updates: The IoT cloud web application continuously receives and updates the pulse oximeter data in real-time. This ensures that users can view the most recent and accurate readings without any significant delay.

Historical Data Storage: The web application stores the pulse oximeter data in a database, allowing users to access and review historical readings. This feature is particularly useful for tracking trends, analyzing patterns, or sharing data with healthcare professionals.

Alerts and Notifications: The web application can be configured to send alerts or notifications to users based on predefined thresholds or abnormal readings. This functionality helps users stay informed about any significant changes in their pulse oximeter measurements and take appropriate actions if necessary.

User Management: The IoT cloud web application typically includes user management features, enabling users to create accounts, set up personalized profiles, and manage their preferences. This ensures a personalized and secure experience for each user.

Integration with Other Services: The web application may offer integration with other services or platforms, such as email notifications, data export, or data sharing capabilities. This enhances the functionality and usability of the pulse oximeter system, allowing users to leverage the data for additional purposes or collaborate with healthcare professionals.

Security and Privacy: The IoT cloud web application ensures the security and privacy of the user's data. It implements robust authentication mechanisms, encryption protocols, and data access controls to safeguard sensitive information.

4.6 Bread Board

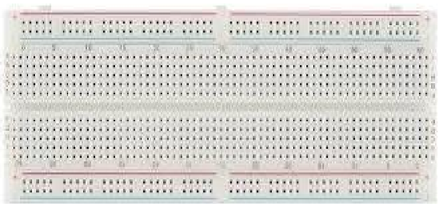


Fig. No: 4.6 Bread Board

The breadboard is a white rectangular board with small embedded holes to insert electronic components. It is commonly used in electronics projects. We can also say that a breadboard is a prototype that acts as a construction base for electronics. A breadboard is derived from the two words bread and board. The word breadboard was initially used to slice the bread pieces. But it was further named electrical connection. A breadboard is also classified as a solderless board. It means that the component does not require any soldering to fit onto the board. Thus, we can say that breadboards can be reused. We can easily fit the components by plugging their end terminals into the board. Hence, a breadboard is often called a plugboard.

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4.7 Introduction of IoT

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifier(UIDs) and the ability to transfer data over a network without requiring human- to- human or human – to – computer interaction . The ‘Thing’ in IoT can be any device with any kind of built- in – sensors with the ability to collect transfer data over a network without manual intervention. The embedded technology in the object helps them to interact with internal states and the external environment, which in turn helps in decision making process.

In a nutshell, IoT is a concept that connects all the devices to the internet and let them communicate with each other over the internet. IoT is a chain network of connected devices- all of which gather and share data about how they are used and environments which they are operated. Interesting improvement to the service quality have found their way with the application of the IoT to the hotel industry.

Similar, it detects temperature by intercepting a portion emitted infrared energy of the object or substance, and sensing its intensity, can be used to measure the temperature of solids and liquids only, not possible to use it on gases because of their transparent nature.

4.10.2 Benefits of IoT

In this current scenario, the Internet of Things technology is playing a vital role in the enterprise for their future business. The technology has a significant impact on both common people and professionals work. The IOT has several benefits and perks which can help enterprise, common people to make their life easy. Some of the benefits are highlighted below:

1. Achieve customer-centricity

For any business or any organization, customer satisfaction is a very critical factor that needs to be always focused. By using advanced IOT technology like mobile card readers or smart trackers which can be used to enhance the customers experience. By using mobile card readers it can help to conduct all transaction on smartphone very smoothly.

2. Gathering rich data

For any type of organization, the data is termed as the most important weapon. The organizations are extensively using the IOT models and methodologies in their businesses for gathering a huge chunk of data about customers and company products.

3. Enhanced security measures

The IOT enables the access control system to provide additional security to the organization and common people. The use of IOT technology in surveillance can help to improve security standards in the organization and also help to track any suspicious activity. In the organization it can be use full to track the activities of an employee can be used to maintain their daily record. And with the help of the internet, it can be controlled from anywhere.

4. Reduction in operational cost

Advancement of IOT technologies can benefits the organization to reduce their operational cost and other costs to earn maximum profit. Every organization tries to reduce their operational cost but only that enterprise become successful which uses maximum use of IOT solutions for their purpose. There is a need for constant connection to the smart device and organization so that operational costs can be reduced for the organization.

4.10.3 Characteristics of IoT

The Internet of Things (IOT) characterised by the following key features:

4.3.3.1 Safety

There is a danger of the sensitive personal details of the users getting compromised when all his/ her devices are connected to the internet. This can cause a loss to the user. Hence, data security is the major challenge. Besides, the equipment involved is huge. IoT network may also be at the risk. Therefore, equipment safety is also critical.

4.10.3.2 Self configuring

This is one of the most important characteristics of IoT. IoT devices are able to upgrade their software in accordance with requirements with a minimum of user participation. Additionally, they can setup the network, allowing for the addition of new devices to on already existing network.

4.10.3.3 Interoperability

IoT devices use standardized protocols and technologies to ensure that they can a communicate with each other and with other systems. Interoperability is one of the key characteristics of the Internet of Things (IoT). It refers to the ability of different IoT devices and systems to communicate and the exchange data with each other, regardless of the underlying technology or manufacturer.

4.10.3.4 Embedded sensors and actuators

Embedded sensors and actuators are critical components of the Internet of Things (IoT). They allow IoT devices to interact with their environment and collect and transmit data. Sensors are devices that can detect changes in the environment, such as temperature, light, sound or movement. In the IoT system, sensors are embedded into devices, allowing them to collect data about the environment.

4.10.3.5 Autonomous operation

Autonomous operation refers to the ability of IoT devices and systems to operate independently and make decisions without human intervention. This is a key characteristics of Internet of Things (IoT) and enable a wide range of new applications and services. In IoT systems, devices and systems are equipped with sensors, actuators, and processing power, allowing them to collect and process data about the environment, make decisions based on that data, and take actions accordingly.

4.10.4 Importance of IoT

The importance of the internet of things,it is necessary to understand that technology is really accepted and appreciated by people. All devices that allow to gather information or to interact with other products become popular in a short period of time.

The internet of things reduces human effort for many activities,and provides tons information. When people have data, they feel more in control of every aspect that surrounds them.

These technologies have also become more popular because of product prototype development. If an entrepreneur comes up with a great idea for an IoT product that person can look for a company that makes prototypes, and build it with an affordable budget.

Of course, the IoT device will succeed if there is a market or problem that needs to be solved. The entrepreneur shares his vision, and the prototyping company does the rest with a professional engineering team that builds the machine or product.

Let’s explore more the importance of IoT.

4.10.5 Applications of IoT

1. Agriculture. Agriculture encompasses crop and livestock production,aquaculture, fisheries, and forestry for food and non-food products.
2. Smart home. Home automation, or domestics, is building automation for a home, called a smart home or smart house.
3. Smart city
4. Healthcare
5. Retail
6. Wearable technology
7. Automation
8. Management
9. Supply chain management

4.3 IoT Hardware

IoT hardware includes a wide range of devices, such as devices for routing, bridges, sensors, etc. These IoT devices manage key tasks and functions such as system activation, security, action specifications, communication, and detection of support-specific goals and actions.

IoT Hardware components can vary from low-power boards to single-board processors like the Arduino Uno, which are basically smaller boards that are plugged into mainboards to improve and increase their functionality by bringing out specific functions or features (such as GPS, light and heat sensors, or interactive displays).

4.11.1 a.Building Block of IoT Hardware

Here, we will discuss some Internet of Thingshardware:

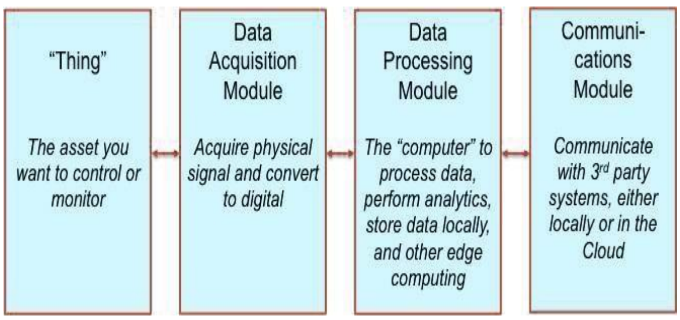

Fig. No:4.11.2 IoT Hardware: Building Block

i Thing

"Thing" in IoT is the asset that you want to control, monitor, or measure, i.e., observe closely. In many IoT products, the "thing" gets fully incorporated into a smart refrigerator or automatic vehicle. These products control and monitor themselves.

There are sometimes many other applications where the thing stands alone as a device and a separate product is connected to ensure it possesses smart capabilities.

ii Data Acquisition Module

The data acquisition module focuses on acquiring physical signals from the thing that is being observed or monitored and converting them into digital signals that can be manipulated or interpreted by a computer.

This is the hardware component of an IoT system that contains all the sensors that help in acquiring real-world signals such as temperature, pressure, and density. motion, light, vibration, etc. The type and number of sensors you need depend on your application.

iii Data Processing Module

The third building block of the IoT device is the data processing module. This is the actual "computer," and the main unit that processes the data performs operations such as local analytics, stores data, and performs some other computing operations.

iv Communication Module

The last building block of IoT hardware is the communications module. This is the part that enables communications with your cloud platform and with third-party systems, either locally or in the cloud.

b. IoT Sensors

The most important IoT hardware might be its sensors. These devices consist of a variety of modules, such as energy modules. RF modules, power management modules, and sensing modules

c. Wearable electronic devices

Wearable electronic devices are small devices that can be worn on the head, neck, arms, or feet

- Current smart wearable devices include:
- Head- Helments, glasses,
- Neck- jewellery, collars
- Arm- Wristwatches, wristbands, rings
- Torso-Clothing Pieces,backpacks
- Feet- Shoes, socks.

d.Basic Devices

The day to day devices that we use such as desktop, cellphones, and tables remain integral parts of IoT system

- The desktop provides the user with a very high level of control over the system and its settings.
- The tablet acts as a remote and provides access to the key features of the system

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- Cellphones allow remote functionality and some essential setting modifications.

- **Other key connected devices include standard network devices like routers and switches.**

4.4 Software Equipment

The set of programs that help you get activities done like the data collection, processing, storage, and evaluating instructions based on the processed data from the IoT software. Operating systems, firmware, applications, middleware are some of the examples that fall into the category.

4.12.1 Data collection:

This step involves the core of the data collection aspects ranging from sensing the data, filtering it, measuring it, aggregating it, and at the end managing the security of the collected data. Data collection can be performed from various sources, and once done is distributed over devices and then to a central data repository.

4.12.2 Device integration:

This ensures that all components within the IoT system are all well integrated. It manages al lthe limitations, protocols, and applications that are handles properly to ensure proper communication amongst the devices

4.12.3 Real-Time Analytics:

Over the collected data and the processing that is done over this data, there can be automated tasks that could run and analyze this data for specific patterns.

4.12.3 Application and process extension:

This ensures that the data collection process can be accentuated to get the most of it, from all possible sources. These are more like the enhancers over the existing data collection infrastructure.

4.12 IOT PLATFORM

The Internet of Things (IoT) strives to connect devices for seamless functioning and ease of operations. An IoT platform bridges the gap between device sensors and data networks. It provides an insight into the data used in the backend application. An IoT platform is a set of components that allows developers to spread out the applications, remotely collect data, secure connectivity and execute sensor management.

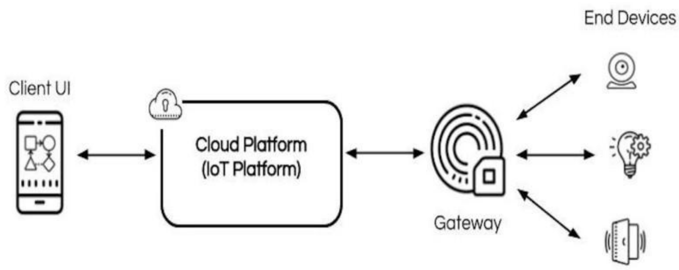

Fig. No: 4.12 IoT platform

CHAPTER 5
CIRCUIT DIAGRAMS

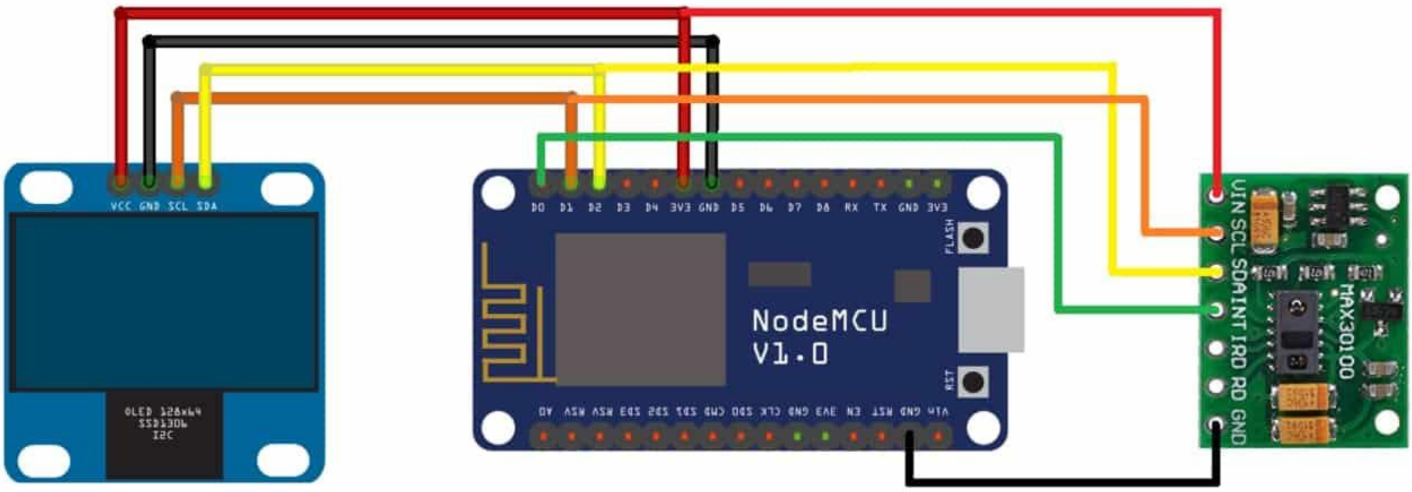

Fig.No: 5.1 pulse oximeter using esp8266 and blynk

5.4 FLOW CHART

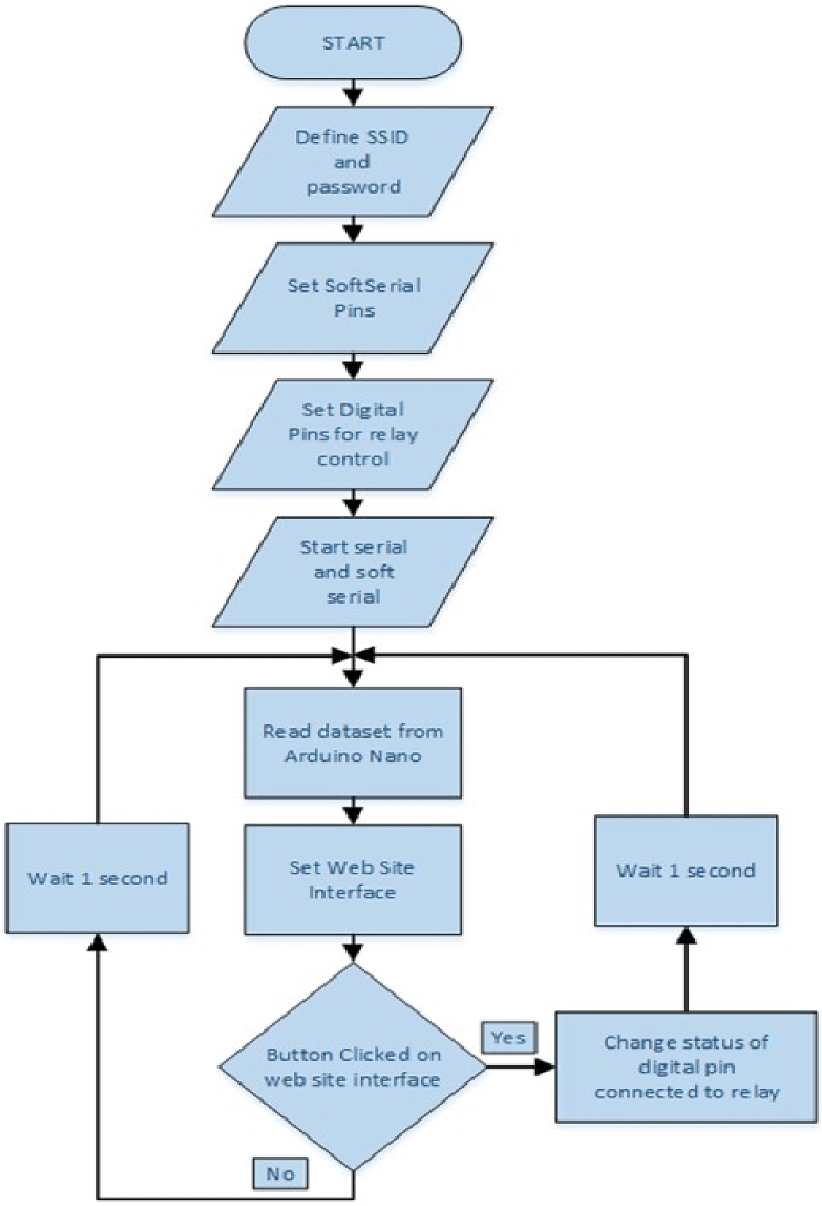

Fig. No: 5.4 Flow chart

CHAPTER 6

6.1 RESULT AND DISCUSSION

Real-time Monitoring: The project aims to provide real-time monitoring of heart rate and blood oxygen saturation levels through the Blynk app. The expected result would be the ability to view accurate and updated pulse oximeter readings remotely in real-time, allowing users to monitor their vital signs conveniently.

Data Visualization and Analysis: The Blynk app offers various visualization tools such as gauges, graphs, or value displays. These visual representations allow users to easily interpret and analyze their pulse oximeter data. The expected outcome is that users can gain insights into their health trends, identify patterns, and make informed decisions about their well-being.

Remote Access and Mobility: With the IoT-based system, users can access their pulse oximeter data remotely from anywhere with an internet connection. This provides convenience and mobility, allowing individuals to monitor their vital signs even while on the move. The expected result is the ability to access pulse oximeter readings seamlessly and effortlessly from a distance.

Alerts and Notifications: The project incorporates the capability to set alerts or notifications based on predefined thresholds or abnormal readings. This feature ensures that users are promptly notified when their heart rate or blood oxygen saturation levels deviate from the normal range. The expected outcome is the ability to receive timely warnings, enabling users to take appropriate actions or seek medical attention if necessary.

Data Sharing and Collaboration: The IoT-based system allows for easy data sharing with healthcare professionals or caregivers. Users can share their pulse oximeter readings directly from the Blynk app, facilitating remote consultations and healthcare management. The expected result is improved communication and collaboration between users and healthcare providers, leading to better-informed decisions and personalized care.

User-Friendly Interface: The Blynk app provides a user-friendly interface that is easy to navigate and interact with. Users can customize the app's layout, choose preferred visualization widgets, and adjust settings according to their preferences. The expected outcome is an intuitive and personalized user experience, enhancing the usability and effectiveness of the system.

CHAPTER 7

CONCLUSION

In conclusion, the IoT-based Pulse Oximeter using ESP8266 & Blynk project offers a convenient and efficient solution for remote monitoring of heart rate and blood oxygen saturation levels. By integrating the MAX30100 sensor module, ESP8266 microcontroller, and the Blynk app, the project enables users to access real-time pulse oximeter data on their smartphones or tablets from anywhere.

The project's advantages include remote monitoring, accessibility, real-time alerts, data visualization, historical analysis, enhanced connectivity, and collaboration with healthcare providers. These benefits empower individuals to actively monitor their health, detect abnormalities or trends in vital signs, and make informed decisions about their well-being. Additionally, the system promotes timely intervention and communication with healthcare professionals, leading to personalized care and improved health outcomes.

Through the design and development process, the project demonstrates the potential of IoT technology in the healthcare domain, showcasing how wireless connectivity, sensor integration, and cloud-based applications can revolutionize remote patient monitoring. The combination of ESP8266 and Blynk offers a user-friendly interface and seamless data transmission, ensuring a smooth and intuitive user experience.

While the project has its strengths, it is important to consider certain limitations and areas for future improvement. These may include the accuracy and reliability of the pulse oximeter readings, the need for validation against clinical standards, and the scalability of the system for large-scale deployments. Addressing these aspects would further enhance the effectiveness and practicality of the IoT-based Pulse Oximeter.

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