



# IOT BASED HEALTHCARE MONITORING SMARTWATCH

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**Abstract:** Using IoT to monitor healthcare smartwatches can be a smart healthcare partner. He tries to help people by constantly monitoring their health and seeking help when necessary. This little watch has a small screen for health tracking, an ESP32 brain, and multiple sensors to track your Heart Rate, Body Temperature, ECG and Blood Oxygen Saturation. Think of your device as a personal health monitor that constantly monitors your health. It can alert you or alert the doctor if it detects a serious problem, such as a fast heart rate. Your doctor can also view your health information in the cloud.

**Index Terms - IoT, ESP32, Heart Rate, Body Temperature, ECG, Blood Oxygen Saturation.**

## I. INTRODUCTION

ECG, or electrocardiogram, is a medical test that captures the electrical activity of the heart over time. This test is often used to detect and diagnose many heart conditions by monitoring the electrical impulses produced when the heart contracts and pumps blood. The resulting image, called an electrocardiogram, shows the rhythm of the heart and can reveal important information about your general health. The device then captures the pulses, creating a picture of the heart's electrical activity. AD8232 sensor and ECG cable are used to receive ECG signals. The percentage of heme saturated with oxygen in the blood relative to the total heme content is called oxygen saturation or SpO<sub>2</sub>. Red blood cells contain hemoglobin, a protein that binds and transports oxygen throughout the body. Oxygen saturation levels indicate how well oxygen is delivered to the body's tissues and organs. It is important in determining the health of the lungs and blood vessels. Most healthy people have an oxygen saturation of 95% or higher. A pulse oximetry sensor, such as the MAX30102 sensor module, is an automated device commonly used to measure heart rate and blood oxygen saturation. The sensor is usually attached to the patient's fingertip.

## II. LITERATURE REVIEW

According to [1] Today's healthcare industry relies on wireless sensing node technology to make progress. With inadequate treatment, patients are at risk of sudden death from heart disease and stroke. The purpose of this is to monitor the elderly and alert doctors and their loved ones. We came up with a new idea that would reduce the rate of sudden death by monitoring the patient's health using sensor technology and the internet to connect with loved ones in times of crisis. The device uses temperature and heart rate to monitor the patient's health. Both sensors are connected to Arduino Uno. Microcontrollers are used to monitor the health status of patients. The microcontroller monitors the patient's health and sends the data to the web server through wireless sensor nodes and LCD display. When the patient's heart rate or body temperature suddenly changes, an alert will be sent via the Internet of Things. The system provides real-time temperature and heart rate monitoring over the internet. IoT-based patient healthcare services use the Internet to effectively monitor the health of patients, allowing users to monitor loved ones at work, and the capacity can save lives.

According to [2] Heart failure is the leading cause of death among the elderly and elderly. Good cardiac monitoring can detect abnormal heart conditions and aid diagnosis in critical cases. Distance between patients and doctors can hinder access to appropriate care, leading to problems with timely diagnosis. IoT-based healthcare is a popular application in healthcare. ECG monitoring is often used to diagnose heart disease. In this study, an Internet of Things (IoT) based electrocardiogram monitoring system was developed. This study uses portable devices to record patients' electrocardiogram signals, which are then stored in a database that only authorized personnel can access. When an abnormality is detected, an email will be sent to the user and the doctor to determine the severity and provide immediate medical assistance. Evaluation of many patients has confirmed the reliability and effectiveness of immediate collection of ECG data for diagnosis.

According to [3] People have become increasingly concerned about their health in recent years as sickness rates have risen. As a result, regular health monitoring is critical. This paper discusses the development and deployment of an IoT-based health monitoring system including temperature and pulse rate sensors. The doctor can check the patient's condition while sitting in front of a computer screen. When a patient's health deteriorates, an alert is sent to the doctor by mail, allowing for rapid diagnosis and maybe saving their life. This project intends to update doctors on their patients' health state over time.

### III. EXISTING SYSTEM

In the paper [1] the authors aimed at providing an option for the family members and the loved ones to monitor their health remotely using IOT. They came up with this patient health monitoring system using IoT which uses sensor technology with micro-controller and Wi-Fi module to help the user monitor their loved ones. The device is intended for home use by patients who are not in a life-threatening situation but require immediate monitoring by doctors or relatives. We can simply save many lives by giving quick care. According to studies, health monitoring systems are intended to meet the needs of patients. The conformist technique is still in use, despite being bulky and expensive in comparison to more modern systems. Furthermore, it takes longer than a minute to get reliable findings. This system provides more medical instrument capabilities on a single chip than traditional solutions. According to the authors of paper [2] a system is designed to frequently monitor the Electrocardiogram (ECG) signal collected from patient's body using wearable sensors and the data is stored into the database which can be accessed by authorized personnel only. Using Arduino UNO and AD8232 ECG Sensor Modules they have developed a system to achieve their objectives. In various different papers and publications we saw

### IV. PROPOSED SYSTEM

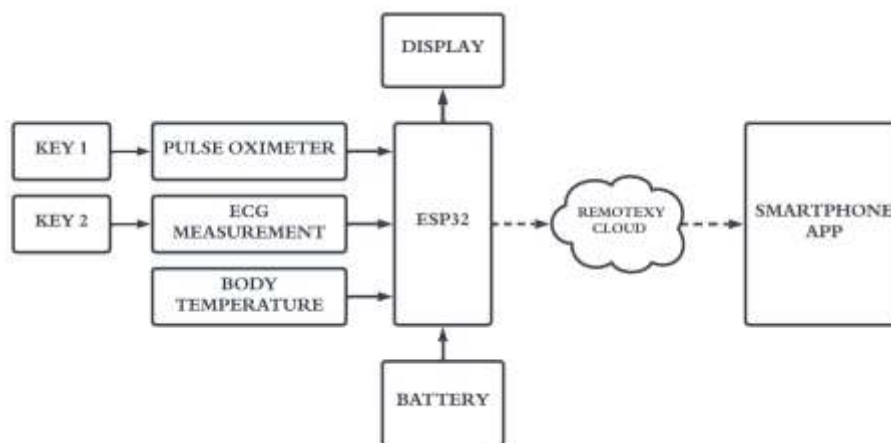


Fig. 1: Block Diagram

We use ESP32 as the Microcontroller which acts as the brain of the entire system. The ESP32 is a low-cost, low-power chip-based system with Wi-Fi and dual-mode Bluetooth capabilities. Tensilica Xtensa LX6 microprocessors (both dual-core and single-core), Xtensa LX7 dual-core microprocessors, and a single-core RISC-V microprocessor is used in the ESP32 series. It also has built-in antenna switches, an RF balun, a power amplifier, a low-noise receive amplifier, filters, and power management modules. ESP32 was developed by Espressif Systems, a Shanghai-based Chinese firm, and is produced by TSMC utilizing 40 nm technology. This is the ESP8266 microcontroller's successor.



Fig. 2: ESP32 Microcontroller

#### 4.1 Measurement of BPM

BPM (Beats Per Minute) measurement is an important feature of healthcare monitoring, especially in the IoT-Based Healthcare Monitoring Smartwatch. This smartwatch uses the Max30102 sensor module and photoplethysmography (PPG) to measure cardiovascular health non-invasively by sensing changes in blood volume in microvascular tissue. The sensor sends light into the skin, and by evaluating how much light is absorbed or reflected by blood vessels, it detects the pulsatile component of blood flow. The smartwatch's OLED screen displays real-time BPM statistics, allowing users to rapidly monitor their heart rate. Furthermore, the ESP32 microcontroller transmits this data to the cloud platform, allowing healthcare professionals to monitor it remotely and discover inconsistencies early on, so contributing to proactive healthcare management.

#### 4.2 Measurement of SPO2

SpO2 (Blood Oxygen Saturation) measurement is an important part of the IoT-Based Healthcare Monitoring Smartwatch's health monitoring features. Using the Max30102 sensor module, this smartwatch uses a photoplethysmography technology to measure oxygen saturation in the bloodstream. The sensor sends light into the skin, and the amount of light absorbed or reflected by oxygenated and deoxygenated blood enables the device to determine SpO2. The smartwatch's OLED screen displays real-time SpO2 statistics, providing wearers with immediate insight into their respiratory health. The collected data is transferred to the cloud platform via the ESP32 microcontroller, giving healthcare professionals remote access for continuous monitoring and rapid intervention in the event of any oxygen saturation anomalies.



Fig. 3: Max30102 Pulse Oximeter Sensor

#### 4.3 Measurement of ECG

ECG (Electrocardiogram) readings are an important part of the IoT-Based Healthcare Monitoring Smartwatch's health monitoring system. The smartwatch uses the Ad8232 sensor module to record electrical impulses generated by the heart. These data are then amplified and processed to produce a graphical picture of the heart's electrical activity, also known as an ECG. The ECG measurement offers important information about the heart's rhythm and detects irregularities such as arrhythmias or abnormalities in the electrical conduction system. Wearers can view their ECG in real time on the smartwatch's OLED display, allowing them to stay aware of their cardiovascular health. The ESP32 microcontroller guarantees that ECG data is seamlessly integrated and transmitted to the cloud platform, allowing healthcare experts to remotely monitor and analyze the wearer's heart activity for early diagnosis and intervention in the event of any irregularities. This ECG measurement capabilities expands the smartwatch's role in proactive cardiac health management, making it a vital tool for continuous monitoring and early detection of potential heart problems.



Fig. 4: AD8232 ECG Sensor with Leads

#### 4.4 Measurement of Temperature

Body temperature measurement is an important part of the IoT-Based Healthcare Monitoring Smartwatch's comprehensive health monitoring system, which employs the DHT11 sensor module. This sensor measures body temperature precisely by detecting infrared radiation emitted by the wearer's skin. The DHT11 Sensor's precision enables constant temperature readings, which add valuable information to the wearer's overall health assessment. The smartwatch's OLED screen displays real-time body temperature information, allowing users to quickly assess their thermal health. The ESP32 microcontroller assists in transmitting this data to the cloud platform, allowing remote healthcare providers to observe and evaluate the wearer's temperature trends over time. This temperature sensing function boosts the utility of the smartwatch, especially in cases where monitoring for fever or changes in thermal patterns is vital, making it valuable.



Fig. 5: DHT11 Temperature Sensor

All the above-mentioned parameters are measured and the values are displayed on the OLED Display. It is also transmitted to a Smartphone app using RemoteXY Cloud Server and the values can be seen on the smartphone app.

#### V. METHODOLOGY

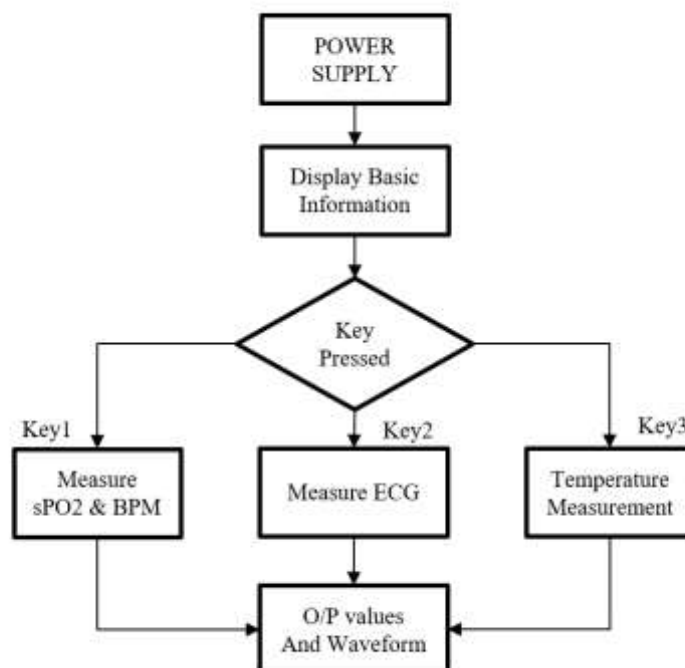


Fig. 6: Flowchart

The Smartwatch is turned on and power is supplied to the modules and the ESP32 With Display Unit. The Display displays the details of the buttons. When 1<sup>st</sup> key is pressed, the MAX30102 Pulse Oximeter Sensor is activated. The Max30102 measures the average heart rate and blood oxygen (SPO2) and displays it on the built-in display. When the 2<sup>nd</sup> key is pressed, the AD8232 ECG Sensor is activated. When the leads are connected and the electrodes are placed on the human body, the ECG waveform is measured and displayed on the built-in display. When the 3<sup>rd</sup> key is pressed, the DHT11 Sensor is activated and the temperature is measured. The value is displayed on the OLED Display. The results are displayed on the app. In case of an emergency the care takers and authorities are notified about the location and condition of the patient.

## VI. CONCLUSION

Finally, our healthcare monitoring innovation goes beyond the boundaries of existing approaches, providing a comprehensive real-time solution that addresses all aspects of wellness. This is far more than a technology advancement; it is a passionate compass for the world of healthcare. It effortlessly blends advanced sensors, intuitive displays, and self-sufficient emergency response, bringing healthcare into the current day. This inclusive design enables anybody to participate, regardless of location or resource level. As we imagine a future in which preventative medicine is commonplace, crises require fast treatment, and data informs larger health initiatives, evidence-based technology like this stands out as a sign of progress. This is more than just a prototype; it's a pledge to a healthier, more connected future for

## ACKNOWLEDGMENT

The happiness and ecstasy that accompany the successful completion of any endeavor would be incomplete without mentioning the people who made it possible, whose persistent advice and support ensured the efforts' success. We are deeply grateful to our project guide, Dr. Aswathappa P., Associate Professor and Head of the Department, Department of Electronics and Instrumentation Engineering B.I.T., for his unwavering support and advice throughout the project.

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