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Smart Health Monitoring System

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ABSTRACT

In this project, we present a Smart Health Monitoring System that integrates a smartwatch, mobile phone, and laptop to enable real-time health tracking. The system is developed using Kotlin and Java, and leverages Bluetooth communication to connect all three devices. The user registers using their email ID through a mobile interface designed for demonstration. The smartwatch continuously monitors the heart rate, and this data is visualized on the mobile device through live graphs. A simple rule-based health outcome is also provided: if the heart rate falls below 60 bpm or rises above 100 bpm, the outcome is flagged as "Bad"; otherwise, it is labelled as "Good." The collected data is simultaneously pushed to Firebase for long-term storage and future reference. This system aims to provide an accessible, portable, and effective solution for basic real-time health monitoring.

Keywords: Smart Health Monitoring, Wearable Devices, Firebase, Bluetooth Communication, Heart Rate Monitoring, IoT in Healthcare

INTRODUCTION

With the growing concern for personal health and wellness, especially in the wake of rising lifestyle-related diseases, continuous health monitoring has become a necessity rather than a luxury. Traditional health check-ups are periodic and often fail to detect early signs of abnormal conditions. In recent years, wearable technologies, Internet of Things (IoT), and cloud-based platforms have emerged as powerful tools to bridge this gap by enabling real-time, remote health monitoring outside clinical environments.

IoT allows the integration of smart devices such as wearables and mobile phones to collect physiological data like heart rate, blood pressure, and more. These data can then be transmitted over wireless networks to cloud services such as Firebase, where they are securely stored, processed, and visualized. This continuous and remote monitoring can assist both individuals and healthcare professionals in early detection and management of health issues, even when the patient is not physically present in a hospital or clinic.

OBJECTIVES

- To design and develop a smart health monitoring system using wearable and mobile technologies.
- To integrate a smartwatch, mobile phone, and laptop via Bluetooth for seamless data exchange.
- To collect and monitor heart rate data from the user in real time.
- To display live heart rate graphs and determine health outcomes based on predefined thresholds.
- To implement Firebase as a cloud-based platform for secure data storage and future reference.
- To demonstrate the potential of IoT and cloud technologies in enabling remote and continuous health monitoring.
- To provide a simple, accessible solution for individuals to track their heart health outside clinical environments.

SCOPE and NOVELTY

This project focuses on the integration of consumer-grade wearable devices and mobile applications to create a user-friendly health monitoring solution. While many existing systems rely on expensive medical equipment, our system leverages Bluetooth for device communication and Firebase for lightweight cloud storage, making it suitable for use. The system not only tracks the heart rate in real-time but also provides instant visual feedback and simple health outcome predictions, making it both informative and accessible to non-technical users.

Unlike many existing models that use machine learning or complex sensors, our approach prioritizes portability, simplicity, and reliability, making it well-suited for students, elderly users, or those seeking a basic preventive health check mechanism.

LITERATURE REVIEW

Recent advancements in wearable technology, IoT, and cloud computing have significantly enhanced the scope of remote health monitoring. Various systems have been developed to track vital signs and transmit physiological data for further analysis.

In the paper titled *"Smart Health Monitoring System"* [1], the authors propose a basic real-time monitoring solution using sensors and mobile applications. While effective, the system lacked cloud integration for long-term data storage and remote access.

The study *"Smart Health Monitoring Systems: An Overview of Design and Modelling"* [2], published in the *Journal of Medical Systems*, provides a comprehensive review of health monitoring architectures and frameworks. However, many of the proposed systems rely on advanced hardware or expensive infrastructure, making them less accessible to common users.

The IEEE paper titled *"Smart Health Monitoring System With IoT"* [3] describes an IoT-based system that collects patient health data and stores it over the internet. This approach aligns closely with our design, as our system also depends on a continuous internet connection — particularly for real-time data synchronization with Firebase and for registering users through email-based authentication.

Our project distinguishes itself through its focus on simplicity, mobile integration, and visualization. It offers a cost-effective and portable system where heart rate data is transmitted via Bluetooth, displayed graphically on a mobile device, and stored in the cloud for future reference.

METHODOLOGY

The Smart Health Monitoring System prototype is developed using Kotlin and Java to create a mobile interface that demonstrates the core functionalities. The project connects three key components — a smartwatch, a mobile phone, and a laptop — via Bluetooth and cloud integration to achieve seamless health data monitoring and storage.

The system workflow can be divided into the following stages:

1. User Registration
   The mobile interface requires users to register using a valid email ID. This authentication step is performed online and is necessary for identifying users and linking their data for personalized monitoring.
2. Bluetooth-Based Connection
   Once registered, the smartwatch is paired with the mobile phone via Bluetooth. The smartwatch continuously monitors the heart rate of the user and transmits the data in real time to the mobile interface.
3. Real-Time Graphical Display
   The mobile interface receives the heart rate readings and plots them on a graph, providing a visual representation of the user's health data. A simple decision rule is applied:

- If the heart rate is below 60 bpm or above 100 bpm, the system flags the health outcome as "Bad".
- If the heart rate falls between 60–100 bpm, the outcome is marked as "Good".

4. Cloud Storage Using Firebase
   Simultaneously, the heart rate data is pushed to Firebase, a real-time cloud database. This enables users (or healthcare professionals) to review past readings and analyse trends over time. Firebase is accessed via the laptop for data logging and verification.

This architecture ensures continuous and remote health monitoring with basic hardware and simple connectivity. The system is lightweight and can function effectively in any environment with stable internet and Bluetooth availability.

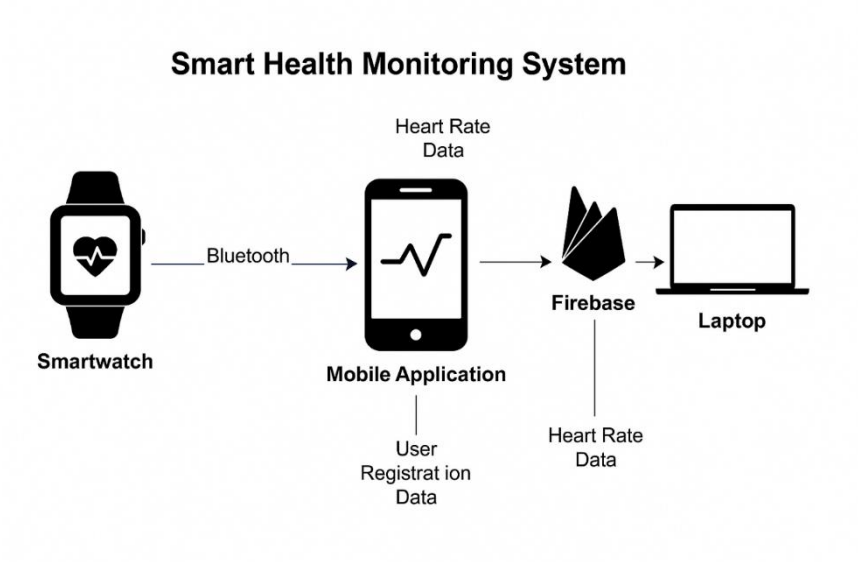


Figure 1: Architecture Diagram

Table 1: Technologies used in System

Component	*Technology / Tool*	*Purpose*
Mobile Interface	Kotlin	Front-end interface and Bluetooth communication
Backend Functions	Java	Business logic, health outcome calculation
Wearable Device	Smartwatch (HR Sensor)	Real-time heart rate monitoring
Connectivity	Bluetooth	Data transfer between smartwatch and mobile
Cloud Storage	Firebase (Realtime DB)	Cloud-based data storage and retrieval
Data Visualization	Android Graph Library	Live plotting of heart rate data on mobile
Data Access / Logging	Laptop (Firebase Console)	For developers to monitor and analyze data

RESULTS

The Smart Health Monitoring System was successfully developed and tested using a smartwatch, Android mobile device, and a laptop connected through Bluetooth and Firebase.

Upon user registration through the mobile interface, the system initiated real-time data collection from the smartwatch. The heart rate readings were continuously captured and transmitted to the mobile interface, where they were plotted using a live graph component for visualization.

The system applied a rule-based classification to provide immediate feedback on the user's health outcome:

- If the heart rate was less than 60 bpm or greater than 100 bpm, the result displayed "Bad".
- If the heart rate was between 60–100 bpm, the system indicated a "Good" outcome.

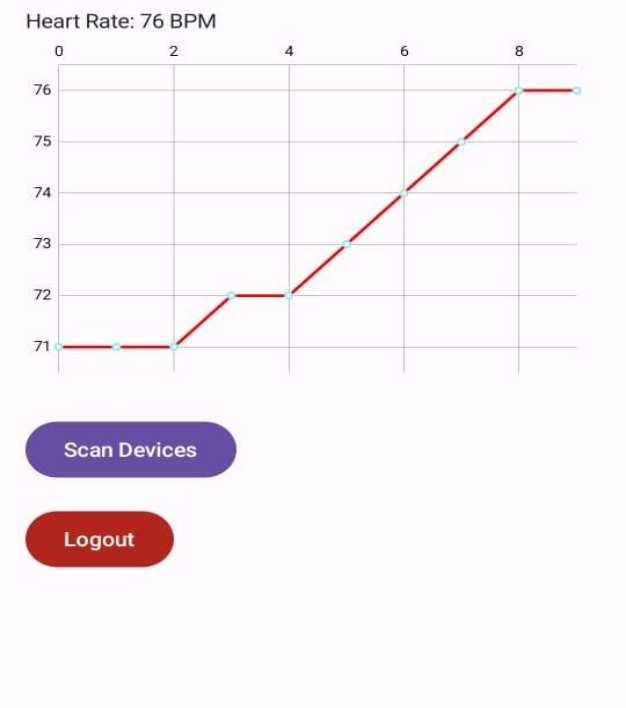
All heart rate data was also sent to Firebase, where it was stored and could be viewed via the Firebase console on a laptop. This allowed for future access to historical data and monitoring of trends.

During testing, the system successfully performed the following:

- Smooth Bluetooth communication between smartwatch and mobile
- Accurate display of real-time heart rate graphs
- Consistent outcome classification logic
- Successful cloud synchronization with Firebase

Overall, the system demonstrated reliability, real-time performance, and user-friendliness under standard testing conditions.

Figure 2: Real-time heart rate graph as displayed on the mobile application.



CONCLUSION and FUTURE WORK

In this paper, we presented a Smart Health Monitoring System that integrates a smartwatch, mobile phone, and cloud platform to enable real-time heart rate monitoring. The system offers a simple yet effective solution for basic health tracking, combining Bluetooth-based communication, real-time data

visualization, and Firebase storage. At this stage, the system functions as a prototype interface, and future development could transform it into a full mobile application.

The prototype interface successfully identifies and classifies heart health outcomes based on heart rate thresholds, providing immediate feedback to the user. The data storage on Firebase further allows for longitudinal health monitoring and future analysis.

For future improvements, the system can be extended by:

- Adding more health parameters such as blood oxygen level, temperature, or ECG
- Integrating machine learning models to predict health risks more accurately
- Enabling alert notifications in case of abnormal readings
- Improving the UI/UX design for better accessibility
- Expanding compatibility with other wearable devices and platforms

This project demonstrates how IoT and mobile development can work together to make healthcare more accessible and personalized, especially for preventive care and early detection.

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