BIOSYNC: WEARABLE HEALTHCARE IOT PLATFORM

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Abstract.

The study investigates the promise of Healthcare Internet of Things (HIoT) by creating a mobile application as a practical demonstration. It looks at how HIoT can connect medical devices, sensors, and healthcare providers to improve healthcare delivery, especially in remote regions where access to quality medical services is limited. The research emphasizes key advantages, such as real-time monitoring of patients to enhance safety, improved workflows for greater operational efficiency, and better access to medical services. Moreover, the paper illustrates the transformative capabilities of HIoT through personalized medicine and predictive analytics, underscoring its importance in delivering proactive and individualized healthcare. The results act as a stimulus for additional research and innovation, motivating stakeholders to participate in the development and implementation of HIoT.

Keywords. Healthcare, Internet of Things, Mobile application, Feasibility, Predictive analytics

1. INTRODUCTION

The health sector [1] has seen a remarkable expansion over the last few years, emerging as a major contributor to revenues and employment. The convergence of IoT technology and cloud computing [3] has facilitated the creation of an IoT framework for the health sector, which provides seamless data transmission between medical devices and sensors and healthcare networks. A Healthcare IoT (HIoT) system has three key components: the publisher (sensors and medical devices that gather patient data), the broker (cloud computing for data processing and storage), and the subscriber (devices such as smartphones for real-time monitoring). The publisher processes data and gives feedback regarding physiological abnormalities, with continuous monitoring of the patient. BioSync [2] is a next-generation Wearable Healthcare IoT platform that improves real-time monitoring of health through wearable devices with personal tracking and wellness information [15]. Such enhancements not only enhance healthcare effectiveness but also enhance knowledge evaluations through ongoing real-time monitoring of data.

2. LITERATURE REVIEW

Bikash et al. [1] have utilized the Distributed Computing Environment (DCE) to update information and maintain the integrity of the healthcare system. The authors also explored the use of Radio Frequency Identification (RFID) with Zigbee protocols to enable efficient tracking and monitoring of healthcare equipment. Mahdi et al. [3] have focused on the technology and tools employed in the integration of Edge and Cloud, along with the utilization of MQTT, to enhance data processing and real-time analysis in IoT applications. Jashandeep et al. [10] have implemented Flutter, a cross- platform development framework, to create efficient and high-performing applications. Satish et al. [9] undertook an in-depth exploration of the implementation of Spring Boot, an open-source framework, for the development of microservices in Java-based IoT applications. In a study conducted by Mihaita Tinta [11], the combination of Flutter, Spring Boot, and Rest API was explored as a powerful solution for cross-platform application development and efficient communication. Flutter [16] mobile application consume a Spring Boot Rest API, to explore the challenges that developers might encounter when building an end-to- end solution running on a local machine.

3. METHODOLOGY

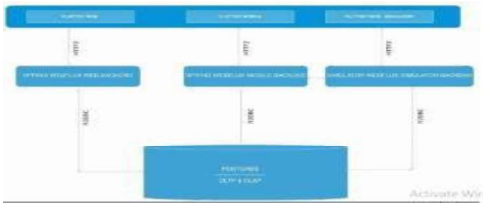
In healthcare IoT wearable platforms, front-end and back-end technology selection becomes an essential aspect for providing an uninterrupted user experience and trustworthy data management. The front-end is the interface presented to patients and medical professionals, while back-end executes, stores and analyzes health data. Flutter a platform for cross-platform UI with Dart language, allows for the creation of mobile and desktop applications from one codebase. Spring Boot, which is based on Java, makes developing and deploying applications simpler with embedded conventions The platform has three primary modules, Firstly Home Screen to Show live health data (e.g., blood oxygen level, blood pressure level) with health recommendations. Profile Section which Saves user data then Sidebar which Is easy to navigate. The system has a three-tiered architecture to allow for smooth functionality and user interaction. The system provides communication between its three layers with the HTTP/2 protocol. Both the Spring WebFlux application and Flutter Web application use the R2DBC driver to communicate with a PostgreSQL database for asynchronous access and concurrent request handling efficiency.The architecture consists of the following tiers:

Presentation tier: This tier is responsible for displaying the user interface and handling user interactions. It is implemented using Flutter Web.

Application tier: This tier contains the business logic of the application. It is implemented using Spring WebFlux.

Data tier: This tier stores and manages the application data. It is implemented using PostgreSQL

Figure 1: Architecture of the web application



Algorithm 1: Data Collection from IoT Devices:

Input: Health data collected from IoT devices (heart rate, blood pressure, temperature, etc.)

Output: Success or failure message Backend Spring Boot Implementation:

Function sendDataToBackend(token, healthData): Verify user authentication using token Store health data in database Return success or failure message

Algorithm 2: Data Storage and Processing: Output: Processed health data

Backend Spring Boot Implementation: Function processData():

Retrieve stored health data Apply data processing algorithms

Return processed data

Function storeProcessedData(processedData): Store processed data in database Return success or failure message

Algorithm 3: Real-time Monitoring and Alerts: Input: Processed health data Output: Real-time health monitoring alerts Backend Spring Boot Implementation:

Function generateAlerts(processedData): Apply algorithms to detect anomalies Send alerts if necessary

Algorithm 4: Data Visualization:

Input: Processed health data

Output: Visualized health data (charts, graphs) Frontend Flutter Implementation:

Function generateChartsAndGraphs(processedData): Render charts and graphs using Flutter widgets Display visualized health data to user

The generateChartsAndGraphs function renders these visualizations using Flutter widgets and displays them to the user in the mobile application.

Algorithm 5: Integration Testing and Deployment: Output: Deployed system

Perform Integration Testing:

Test communication between Flutter and Spring Boot

Verify functionality of each feature Deploy System:

Deploy Spring Boot backend to cloud server Upload Flutter app to app stores

4. RESULTS AND DISCUSSION

The combination of Flutter and Spring Boot in a healthcare IoT platform provides more effective patient care through convenient communication and real- time monitoring of health. The easy-to-use application presents critical health indicators and personalized reports, with a safe UserID system providing customized access to patients records, enhancing healthcare management.

Figure 2: Home page which displays health parameters and tips

Figure 3: Using UserID to fetch health data

Figure 4a depicts health parameters such as heart rate and blood pressure in the normal range, as indicated by green, for optimal health. Figure 4b displays health measures such as heart rate, blood pressure, SpO2, and temperature in red when outside the normal range, as a sign of potential health issues.

Figure 4a and 4b: Fetched health parameters when it is in normal and abnormal range

5. CONCLUSIONS AND FUTURE WORK

This paper examines the HIoT system, describing its structure, building blocks and network of communications a blocks and network of communications and highlighting IoT's revolutionary power of remote diagnosis, monitoring and extended health accessibility. With the integration of Flutter (client) and Spring Boot (server), user experience is improved, scalability increased and security optimized, transforming patient care and management Advancements in the future can also leverage AI and machine learing for interpretation of wearable health data to provide personalized advice risk scores, and preventative alerts.

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