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Remote Health Monitoring System Using Simulated IoT Sensors

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Abstract—**The Internet of Things (IoT) has revolutionized healthcare by enabling real-time monitoring of patient vitals. This paper presents a Remote Health Monitoring System using simulated sensors to monitor vital signs such as heart rate, temperature, oxygen saturation (SpO2), and fall detection. Unlike traditional hardware-based systems, the proposed setup uses Python and JavaScript to generate realistic health data, which is sent to Firebase and visualized on a web dashboard. This simulation-centric approach is cost-effective, scalable, and serves as a powerful educational tool. The paper also includes a literature review of existing systems, discusses implementation, and highlights future possibilities such as real sensor integration and AI-powered predictive diagnostics.**

1. INTRODUCTION

Remote health monitoring is gaining traction due to its ability to track patient conditions without requiring hospital visits. Traditional monitoring systems use expensive sensors and dedicated hardware, which limits accessibility in low-resource settings. This paper addresses that gap by introducing a fully simulated IoT health monitoring platform that mimics sensor data and supports real-time analysis using Firebase.

The platform simulates vital signs through code and delivers the data via a cloud backend to a web dashboard. This not only supports continuous monitoring but also offers a valuable resource for IoT learners and prototypers.

2. LITERATURE REVIEW

Various research efforts have explored IoT-based health systems using actual sensors. However, simulation-based platforms are rare. Table 1 below compares seven research papers with this project.

Table 1: Literature Comparison

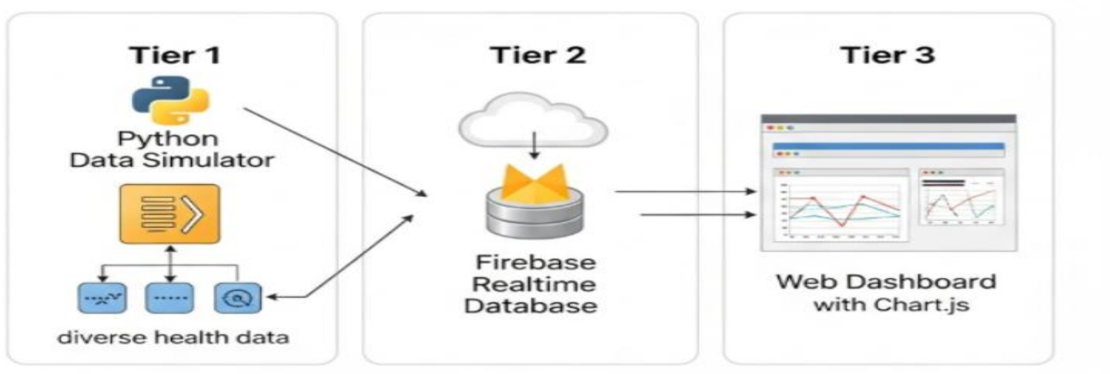
Paper No.	Title & Authors	Sensors Used	Cloud Platform	Real-time Alerts	Simulation Support	Remarks
1	A Low-Cost IoT Health Monitor (Kumar et al.)	DHT11, Pulse Sensor	ThingSpeak	Yes	No	Real sensors only
2	Health Monitoring via Wearables (Lee et al.)	Apple Watch	iCloud	Yes	No	Commercial wearables
3	IoT-Enabled Smart Health System (Rao et al.)	Heartbeat Sensor, Temp	Azure IoT Hub	No	No	No alerts
4	Home-Based Patient Monitoring (Chaudhary et al.)	Temp, SpO2	Firebase	Yes	No	Real sensor dependency
5	A Review on IoT Health Frameworks (Deshmukh et al.)	Multiple sensor types	Generic	Partial	No	Theoretical models
6	Simulated Sensor IoT Lab (Patel et al.)	None	Firebase	Yes	Yes	Limited to temp only
7	Real-time IoT Health Dashboard (Saxena et al.)	Pulse, SpO2	Google Cloud	Yes	No	Complex setup
8 (This Paper)	Simulated IoT Health Monitor	Simulated	Firebase	Yes	Yes	Full simulation + dashboard

The novelty of this paper lies in its simulation of four key vitals with cloud integration, making it ideal for academic and prototyping purposes without costly hardware.

3. METHODOLOGY

The system comprises two core modules: a data generator (Python) and a frontend dashboard (JavaScript).

3.1 Architecture Diagram



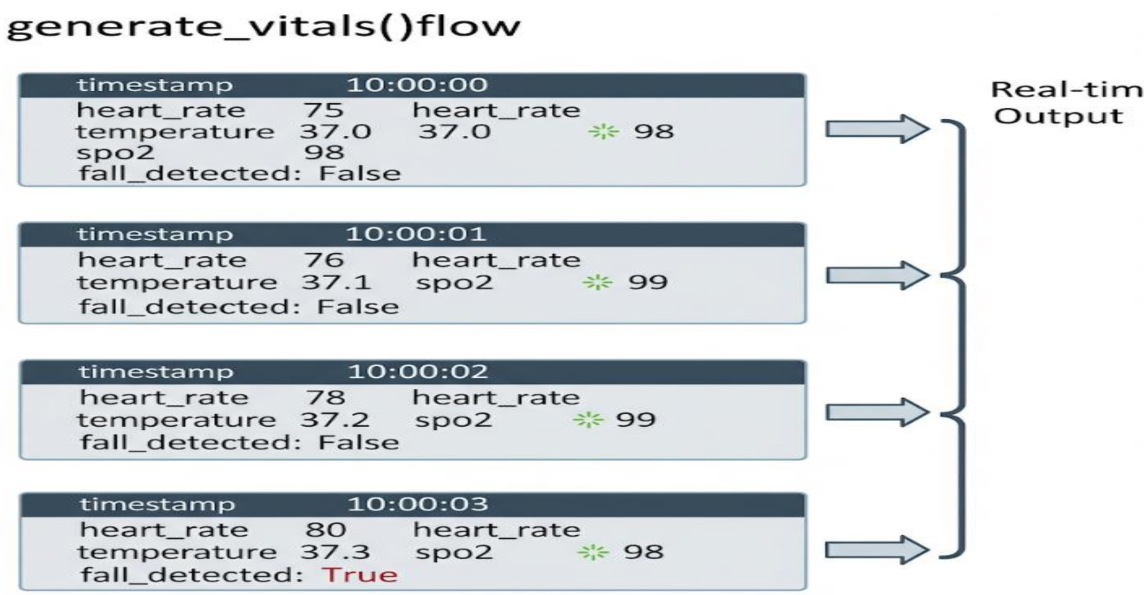
3.2 Sample Circuit Diagram (Conceptual)

Since it's a simulation, here's a logical "circuit-style" diagram:

3.3 Sample Python Code – Data Simulation

```python
import random, time, firebase_admin
from firebase_admin import credentials, db

cred = credentials.Certificate("serviceAccountKey.json")
firebase_admin.initialize_app(cred, {
    'databaseURL': 'https://your-project-id.firebaseio.com/'
})

def generate_vitals():
    return {
        "heart_rate": random.randint(60, 100),
        "temperature": round(random.uniform(97.0, 99.5), 1),
```

```
        "spo2": random.randint(94, 100),
        "fall_detected": random.choice([True, False])
    }

while True:
    vitals = generate_vitals()
    db.reference("vitals").set(vitals)
    print("Sent:", vitals)
    time.sleep(5)
```

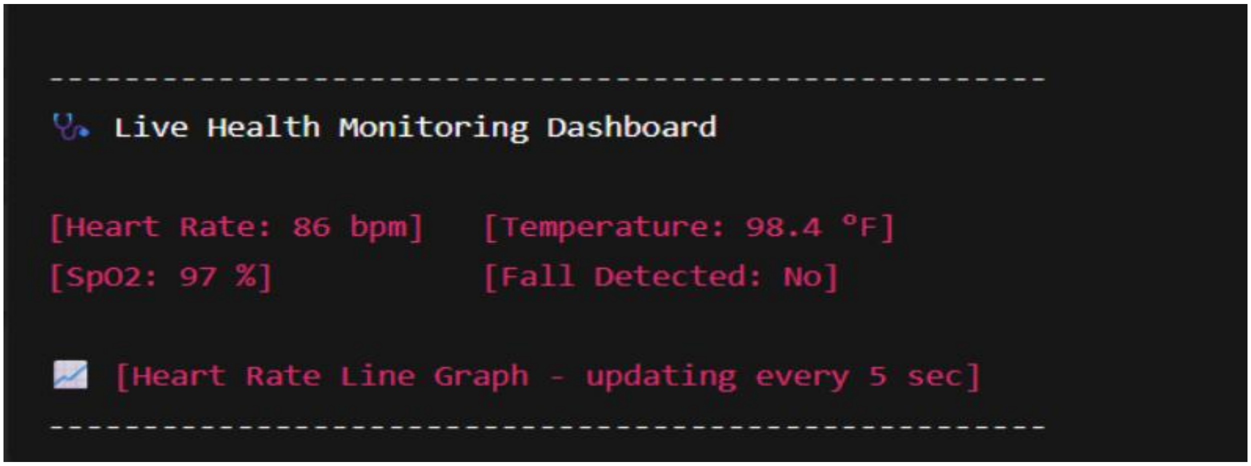


3.4 Sample JavaScript Code – Dashboard Display

html

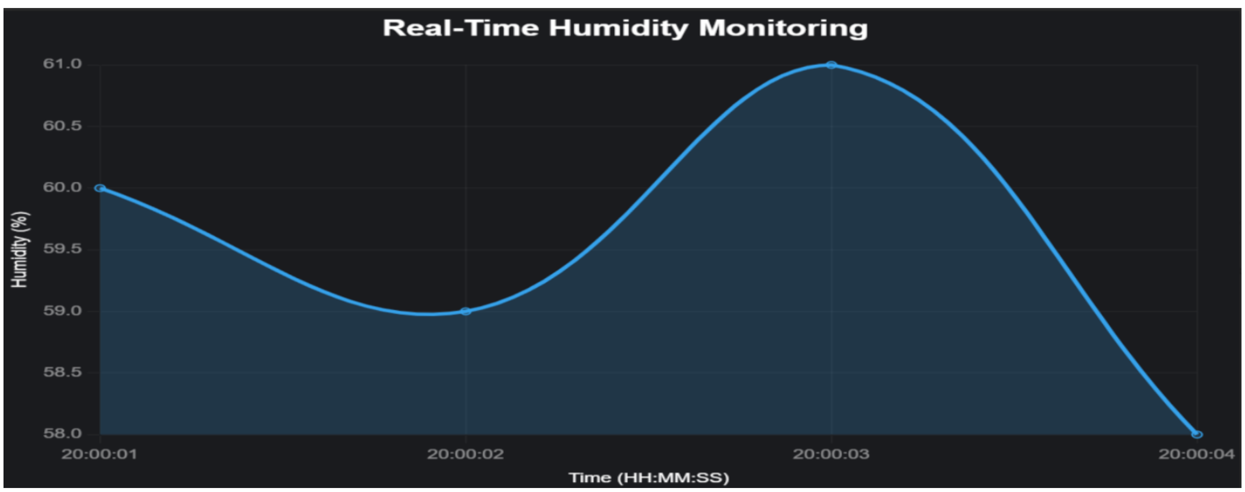
```
<script src="https://www.gstatic.com/firebasejs/8.10.0/firebase-app.js"></script>
<script src="https://www.gstatic.com/firebasejs/8.10.0/firebase-database.js"></script>
<script>
var config = {
  apiKey: "...", databaseURL: "https://your-project.firebaseio.com/"
};
firebase.initializeApp(config);
var dbRef = firebase.database().ref("vitals");

dbRef.on("value", function(snapshot) {
    let data = snapshot.val();
    document.getElementById("heart_rate").innerText = data.heart_rate;
    document.getElementById("temperature").innerText = data.temperature;
    document.getElementById("spo2").innerText = data.spo2;
    document.getElementById("fall_detected").innerText = data.fall_detected ? "Yes" : "No";
});
</script>
```

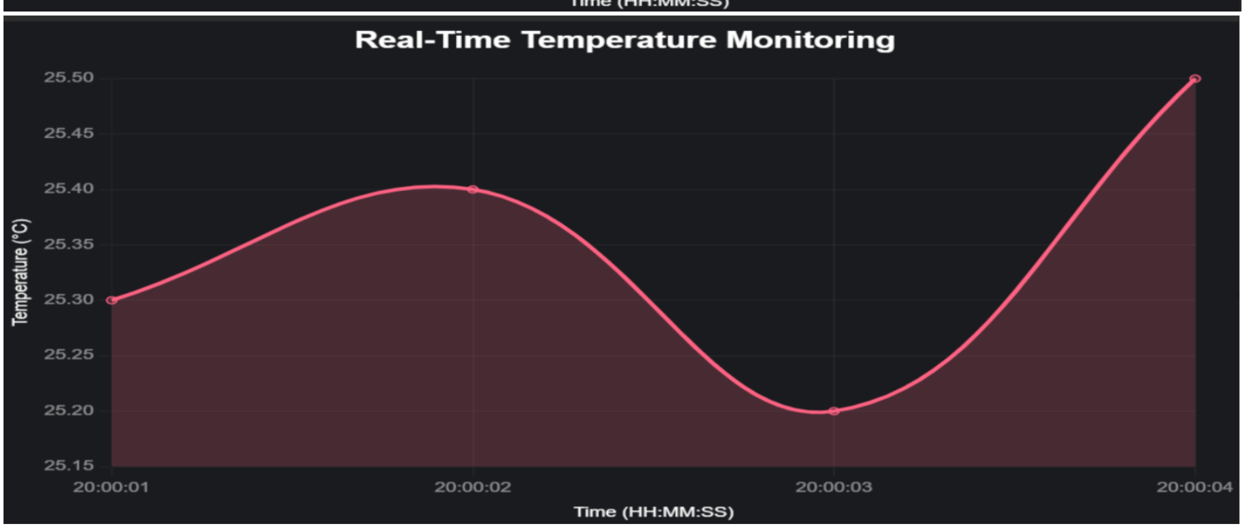
3.5 Sample Output Screenshot

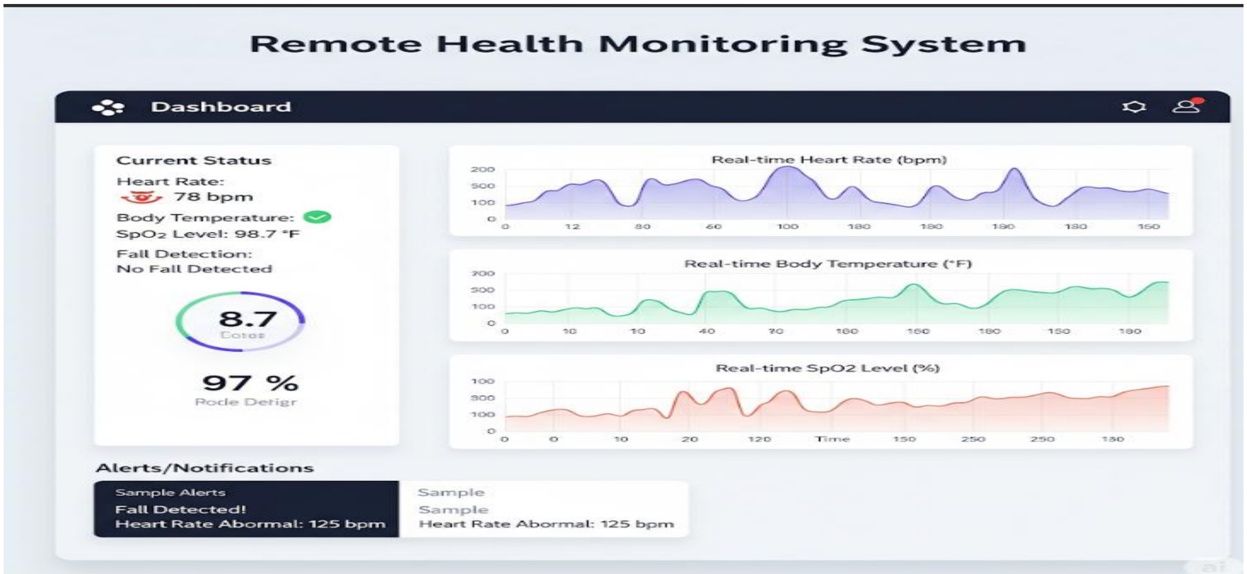


Live Health Monitoring Dashboard

- Heart Rate: 86 bpm
- Temperature: 98.4 °F
- SpO2: 97%
- Fall Detected: No

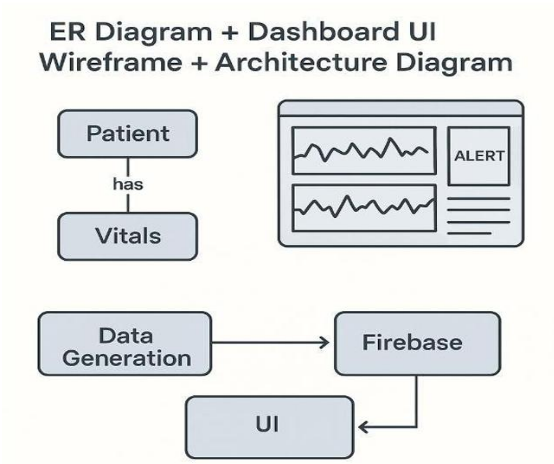




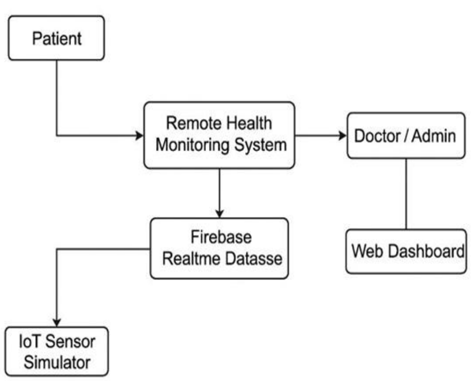


4. SYSTEM DESIGN

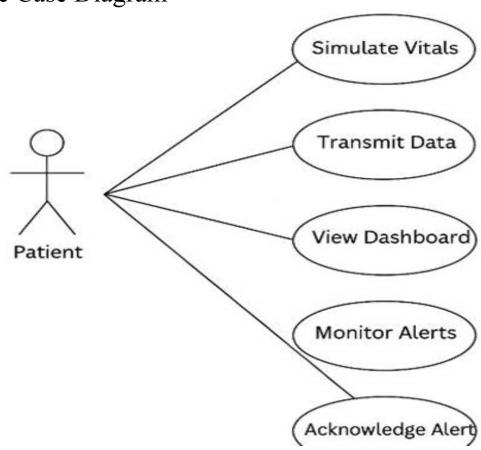
ER Diagram



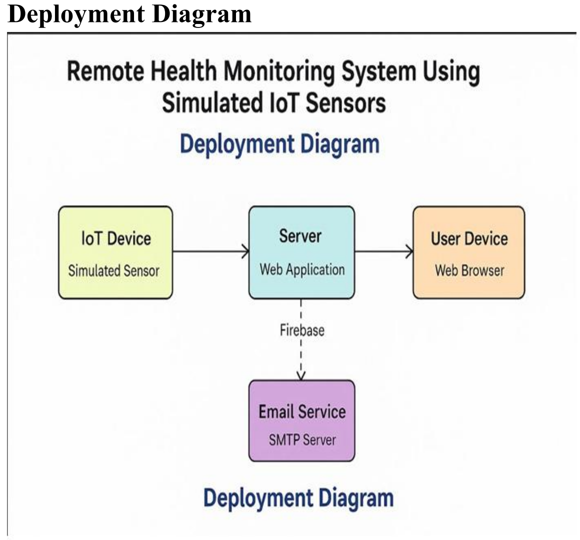
Data Flow Diagram



Use Case Diagram



Deployment Diagram



Final Prototype View

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Books

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[3] Mueller, J.P. (2019). Beginning IoT Projects. Wiley.
[4] McLaughlin, B. (2015). Making Sense of IoT. O'Reilly.
[5] Sierra, K., & Bates, B. (2014). Head First JavaScript. O’Reilly.

Web Resources

[1] Firebase Docs: https://firebase.google.com/docs
[2] Chart.js Docs: https://www.chartjs.org/docs/latest
[3] ReactJS: https://react.dev
[4] Pyrebase: https://pypi.org/project/python-firebase/
[5] GitHub Firebase SDK: https://github.com/firebase/firebase-js-sdk
[6] ResearchGate - IoT in Healthcare: https://www.researchgate.net
[7] GeeksforGeeks IoT Projects: https://www.geeksforgeeks.org/iot-projects/