ML BASED SMART HEALTHCARE SYSTEM

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INTRODUCTION

Chronic diseases, aging populations, and limited rural healthcare access demand proactive monitoring. This project introduces a Smart Healthcare Monitoring System using IoT-enabled wearables, a hybrid Machine Learning model (Random Forest + Decision Tree), and an LLM-powered chatbot. The system tracks vital signs in real time, detects falls, issues GPS-based emergency alerts, and delivers user-friendly feedback with 97.93% accuracy. It bridges the gap between patients and healthcare providers, promoting timely, preventive, and accessible care.

HYBRID LLM

The system employs a hybrid Machine Learning model combining Random Forest (RF) and Decision Tree (DT) classifiers for both robust accuracy and interpretability. A tunable weight parameter (β) balances their influence, achieving a precise and adaptable prediction framework.

To enhance usability, a Large Language Model (LLM) translates structured outputs into conversational feedback, guided by a second parameter (α) that blends rule-based responses with AI-generated explanations.

<u>Performance Highlights:</u>

* Overall accuracy: 97.93%

* Level 0: Recall 100%, F1-score 0.9229

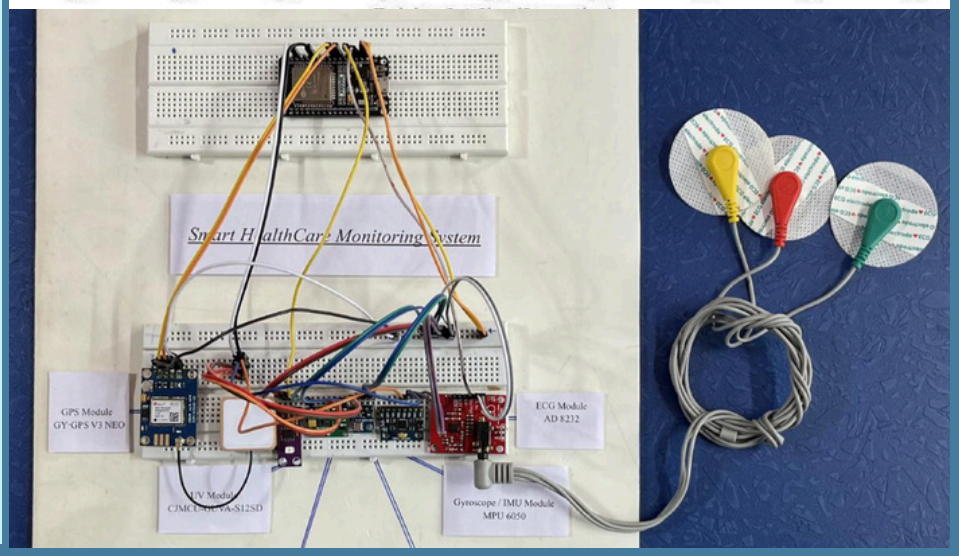
* Level 1: Precision 0.9962, F1-score 0.9839

* Level 2: Precision 1.0000, F1-score 0.9948

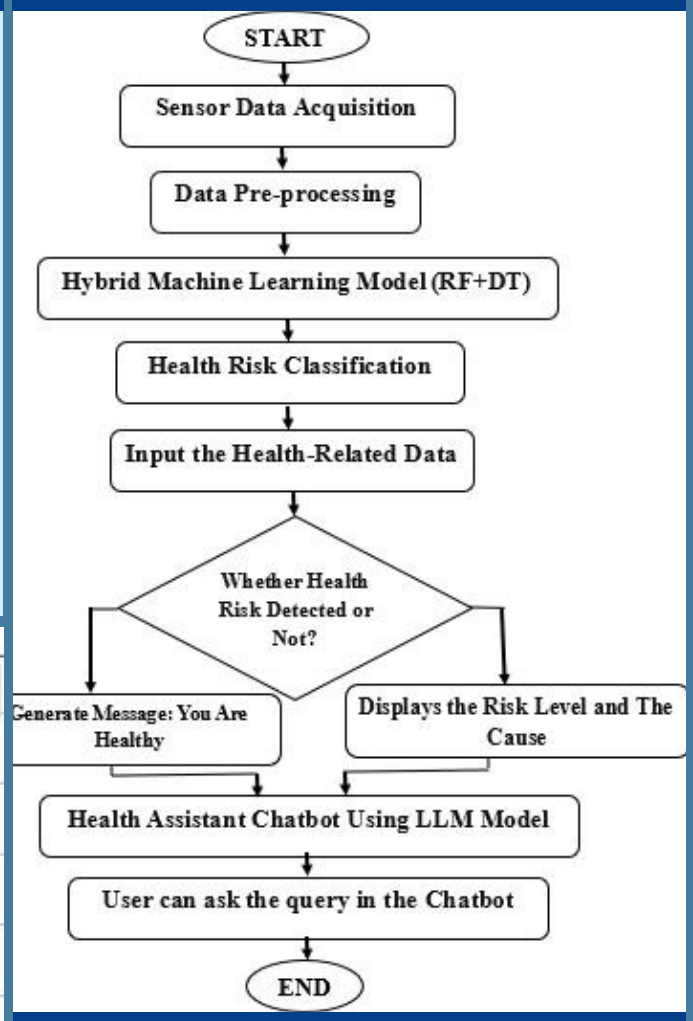
PROPOSED MODEL

To accurately assess a person's health based on several physiological and environmental factors, a hybrid machine learning model that combines the benefits of both Random Forest and Decision Tree classifiers has been developed for the proposed Intelligent Healthcare monitoring system.

1. Data Gathering in Real-Time from Health Band
2.IoT Communication Using MQTT & Node-RED
3. Feature Engineering and Data Preprocessing
4. Classification and Labeling of Health Risks
5. Proposed Hybrid Machine Learning Model (Decision Tree + Random Forest)
6. Intelligent Warning System
7. An Algorithm for Detecting Falls
8. Online Health Tracking Interface for Chatbot
9. Conversational Support Driven by LLM
10. Ngrok Deployment for Remote Access



PROCESS FLOW



CONCLUSION & REFERENCES

The Smart Healthcare Monitoring System, tested with real-time vitals from wearable devices, achieved 97.93% accuracy using a hybrid ML model. It effectively classifies health risks, detects falls, and triggers GPS alerts. The LLM chatbot adds personalized feedback, enhancing user experience. The system ensures proactive monitoring, faster response, and improved healthcare access, especially for elderly and remote patients.

1. *Rahman, A. et al. (2024). Machine Learning and Deep Learning-based Approach in Smart Healthcare: Recent Advances, Applications, Challenges, and Opportunities. AIMS Public Health, 11(1), 58–109.*

2. *Zhou, J. et al. (2024). Continuous Monitoring of Blood Pressure by Measuring Local Pulse Wave Velocity Using Wearable Micromachined Ultrasonic Probes. IEEE Transactions on Biomedical Engineering. doi:10.1109/TBME.2024.3514878.*