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Heart Rate Monitoring System using IOT

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ABSTRACT: Conventional Heart disease patient need to go to hospitals to check regular basis. This system uses machine learning to predict heart disease risk factors based on clinical and patient data at home. The study compares 2 machine learning models, Random Forest, and SVM.

I. INTRODUCTION

Heart disease remains a leading cause of mortality worldwide, making early detection and continuous monitoring critical to improving health outcomes. Traditional approaches to heart disease diagnosis are often reliant on periodic testing and medical consultations, which may not be frequent enough to detect symptoms in time for effective treatment. Recently, advancements in IoT (Internet of Things) and machine learning have introduced new possibilities in healthcare for real-time, predictive analysis, especially for chronic conditions like heart disease.

This literature review explores existing studies on the application of IoT-based sensor networks and machine learning algorithms for heart disease prediction. It investigates different IoT frameworks for capturing vital signs such as heart rate, blood pressure, and SPO2 data, as well as the machine learning models used for processing and predicting potential health risks. The review covers various methodologies and technical approaches, highlighting key findings, limitations, and potential improvements.

By analysing recent research, this review aims to provide a comprehensive understanding of current efforts in using IoT and machine learning to predict heart disease risk. It also identifies gaps in the literature where further research and technological innovation can enhance the effectiveness, accuracy, and accessibility of such systems for early diagnosis and personalized patient monitoring.

II. RELATED WORK

- Authors: Sharma, A., Gupta, R., Verma, S.
- Journal: IEEE Internet of Things Journal, 2020
- Summary: This study explores an IoT framework equipped with sensors to capture ECG and heart rate data. It uses machine learning models, including Decision Trees and SVM (Support Vector Machine), to predict heart disease risk. Results show high accuracy, with SVM outperforming other models. The paper emphasizes the importance of real-time monitoring for critical conditions and showcases system accuracy improvements with higher sampling rates.
- Authors: Zhang, L., Wang, X., and Chen, M.
- Journal: Journal of Healthcare Engineering, 2021
- Summary: This work discusses the application of IoT for heart disease detection using machine learning algorithms, including Naïve Bayes, Logistic Regression, and K-Nearest Neighbors. The study demonstrates that data accuracy and sensor quality significantly influence prediction reliability. Additionally, it discusses the challenges of scalability, as data flow increases with multiple patients in a networked environment.
- Authors: Kim, H., Lee, J., and Park, D.
- Journal: International Journal of Medical Informatics, 2022
- Summary: This paper investigates deep learning approaches like CNN (Convolutional Neural Network) and RNN (Recurrent Neural Network) for heart disease prediction based on ECG patterns collected from wearable IoT devices. The use of CNN provides significant accuracy, especially for detecting abnormalities in ECG. Results underscore CNN's robustness compared to traditional ML algorithms.

III. METHODOLOGY

The **methodology** for a Heart Disease Prediction System using IoT and machine learning involves several steps, incorporating sensor data acquisition, data processing, and machine learning for prediction. This approach leverages the **MAX30100 sensor** for vital sign measurements, **NodeMCU** for data transmission, and a trained **machine learning model** for predictive analysis. This methodology combines IoT data collection, efficient processing, and machine learning prediction, forming a reliable system for continuous heart disease monitoring. By leveraging real-time data and predictive analysis, the system can provide early warnings, potentially improving patient outcomes in healthcare.

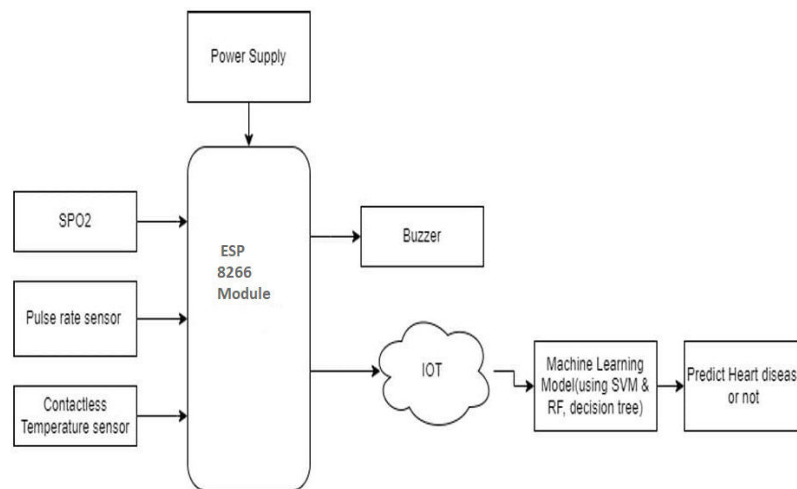


Fig. 1.0 Block diagram

A. WORKING

1. **Data Acquisition:**
 - The MAX30100 sensor reads heart rate, oxygen level, and temperature, sending data to the NodeMCU.
2. **Data Transmission:**
 - The Node MCU processes and transmits data to the cloud using Wi-Fi.
3. **Machine Learning Analysis:**
 - The cloud-hosted ML model receives data, analyses it, and generates a heart disease risk prediction
4. **Sensor Setup and Data Collection**
 - **MAX30100 Sensor:** This sensor measures heart rate, blood oxygen (SpO₂) levels, and temperature.
 - **Node MCU Microcontroller:** Interfaces with the MAX30100 sensor, collects data, and transmits it wirelessly to a server or cloud platform.
 - **Data Acquisition:** Regular intervals of heart rate, SpO₂, and temperature readings are gathered, ensuring consistent and accurate monitoring of the patient's health parameters.
5. **Data Preprocessing and Transmission**
 - **Data Preprocessing:** To improve accuracy, raw sensor data is pre-processed:
 - Noise removal and signal smoothing algorithms (such as moving averages) are applied to reduce fluctuations.
 - Data normalization is conducted to standardize the features.
 - **Data Transmission:** The processed data is sent from the NodeMCU to a cloud database or local server where it is aggregated for real-time or batch analysis.
6. **Machine Learning Model for Prediction**
 - **Model Selection:** A suitable machine learning model is chosen based on its effectiveness in classification tasks, e.g., **Logistic Regression, SVM, or Random Forest** for simpler implementations, or **Neural Networks** for more complex, high-accuracy predictions.
 - **Training Dataset:** The model is trained on a dataset containing labelled instances of heart disease conditions, including heart rate, oxygen levels, and body temperature.

- **Feature Selection:** Heart rate, SpO₂, and temperature are used as input features to predict heart disease risk, with data from MAX30100 and temperature sensors.
- **Model Training:** The model is trained using supervised learning, where it learns patterns indicative of heart disease.
- **Model Evaluation:** Validation techniques like k-fold cross-validation and metrics like accuracy, precision, recall, and F1-score are used to assess model performance.

7. Deployment and Real-Time Prediction

- **Model Deployment:** Once trained, the model is deployed on the server, where it can receive data from IoT devices.
- **Real-Time Analysis:** Incoming data from the NodeMCU is analyzed in real time. The model processes each data point, determining the probability of heart disease risk.
- **Alert Generation:** If the model detects parameters indicating high heart disease risk, it triggers an alert. This alert can be sent to healthcare providers or caregivers through SMS or app notifications.

8. User Interface for Monitoring

Dashboard Interface: A dashboard allows users or medical personnel to monitor the patient's vitals and receive alerts. It may display historical data, trends, and risk scores based on predictive analysis.

B. Functional Flow Diagram

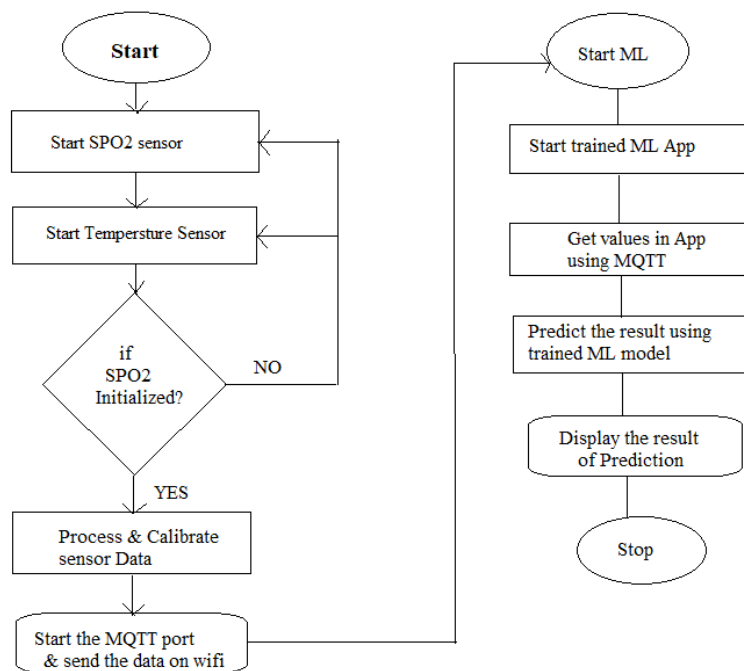


Fig. 1.1 Flow chart

IV. RESULTS

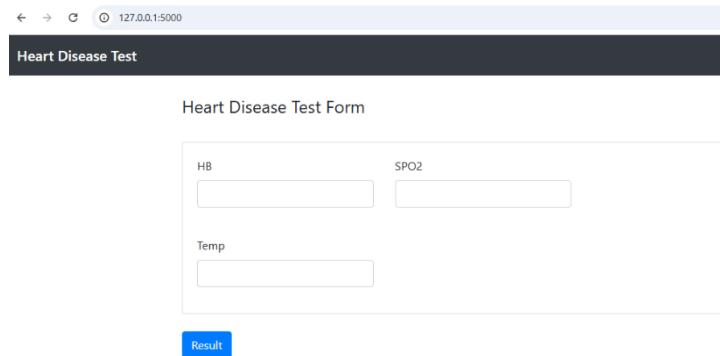


Fig. 1.2 Webpage for ML prediction

Figure Hardware Implementation

In conclusion, the integration of IOT sensors and ML algorithm for predicting heart disease is promising approach for enhancing healthcare. By continues monitoring this system can offer timely and accurate predictions . Overall this combinations of technology holds great potential for proactive and effective heart disease monitoring and prediction management.

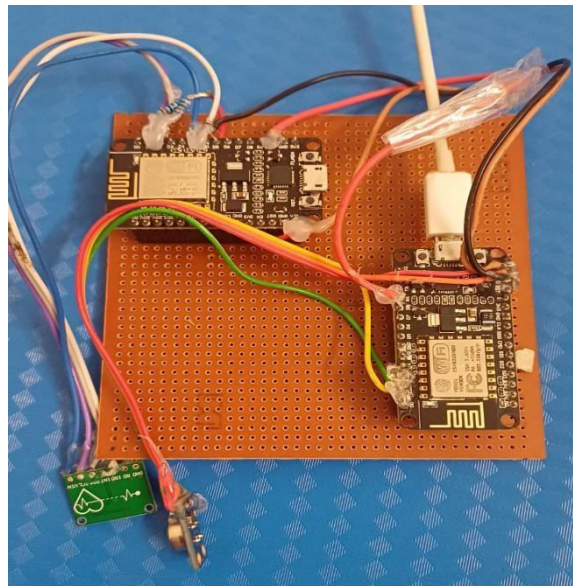


Fig 1.3 Hardware implementation

V. CONCLUSION AND FUTURE SCOPE

In conclusion, the integration of IOT sensors and ML algorithm for predicting heart disease is promising approach for enhancing healthcare. By continues monitoring this system can offer timely and accurate predictions . Overall this combinations of technology holds great potential for proactive and effective heart disease monitoring and prediction management.

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