MONITOR AND DETECT THE HEART ATTACKS USING IOT

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LIST OF ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS	DEFINITION
AEDs	Automated External Defibrillators
BPM	Beats Per Minute
ECG	Electrocardiogram
EMS	Emergency Medical Services
GPS	Global Positioning System
IoT	Internet Of Things
LED	Light Emitting Diode
PPG	Photoplethysmography

Chapter 1

INTRODUCTION

1.1 Introduction

The initiative to use IoT technology to monitor and identify heart attacks is extremely important to society. It promises to transform cardiac healthcare and maybe save countless lives by utilizing IoT sensors and real-time data processing. For those suffering from cardiovascular disorders, early diagnosis of heart attacks can lower death rates, save healthcare expenses, and enhance overall quality of life. Moreover, proactive self-care practices are encouraged when patients are equipped with real-time insights regarding their cardiac health condition. In addition to improving access to healthcare, especially for marginalized communities, the project provides important data for medical research, which advances the development of cardiovascular disease prevention and treatment methods. In the end, this research has the potential to significantly influence society by advancing patient outcomes, encouraging early intervention.

Advancements in sensor technology have played a crucial role in enhancing the capabilities of IoT-enabled cardiac monitoring systems. Emphasized the importance of wearable sensors for real-time data capture,integrated wearable devices with wireless modules for data transmission. These studies underscored the significance of sensors such as ECG and PPG sensors in enabling continuous monitoring of vital signs. Data analysis techniques have been a focal point in IoT-enabled cardiac monitoring research, with studies employing machine learning algorithms for real-time analysis and anomaly detection. Utilized machine learning for data analysis in their wearable monitoring system, integrated data processing units for real-time signal processing. These approaches enable effective detection of cardiac anomalies and provide actionable insights for clinical decision-making.

1.2 Aim of the project

The aim of this project is to develop an IoT-enabled system for the early detection and intervention of cardiac attack and to continually monitor vital signs, evaluate data in real-time, and send timely notifications to patients and healthcare providers. Internet of Things (IoT) technology to create a system capable of swiftly detecting and responding to cardiac attacks, thereby improving patient outcomes and reducing mortality rates associated with cardiac events. By integrating various sensors and devices, such as wearable monitors, ECG sensors, and blood pressure monitors, the system continuously monitors vital signs and physiological parameters in real-time.

1.3 Project Domain

The main project domain of an MONITOR AND DETECT THE HEART ATTACKS USING IOT system lies at the intersection of healthcare, medical technology, and Internet of Things (IoT) innovation. It encompasses the development and implementation of advanced sensor technologies, wearable devices, and real-time data analytics to address critical challenges in cardiac care. Within the healthcare domain, the project focuses on improving patient outcomes and reducing mortality rates associated with cardiac events. By leveraging IoT technology, it seeks to enable early detection of cardiac abnormalities and timely intervention, ultimately enhancing the quality of care delivered to patients experiencing cardiac emergencies. In the medical technology domain, the project aims to innovate new solutions for cardiac monitoring and intervention that leverage the capabilities of IoT devices and sensors. This involves the design and development of wearable monitors, implantable devices, and remote monitoring systems that seamlessly integrate into existing healthcare infrastructure.

1.4 Scope of the Project

The project aims to develop an innovative IoT-based system dedicated to cardiac attack detection and intervention. Central to this initiative is the design and implementation of wearable sensors capable of continuously monitoring key vital signs, including heart rate, blood pressure, and electrocardiogram (ECG) readings. These sensors will be equipped to transmit real-time data to a centralized platform where sophisticated algorithms will analyze the information. The algorithms will be programmed to detect any abnormal patterns or fluctuations in the vital signs that could potentially indicate a cardiac event or distress.

Upon identifying such anomalies, the system will automatically trigger a series of predefined responses aimed at providing immediate assistance and intervention. This could involve notifying medical professionals or emergency services with the precise location of the individual in distress, thanks to integrated GPS tracking capabilities. Simultaneously, the system may also offer real-time first aid instructions or alerts to the user, guiding them through potentially life-saving actions until professional help arrives.

4.2.3 Sequence Diagram for Cardiac Attack Detection

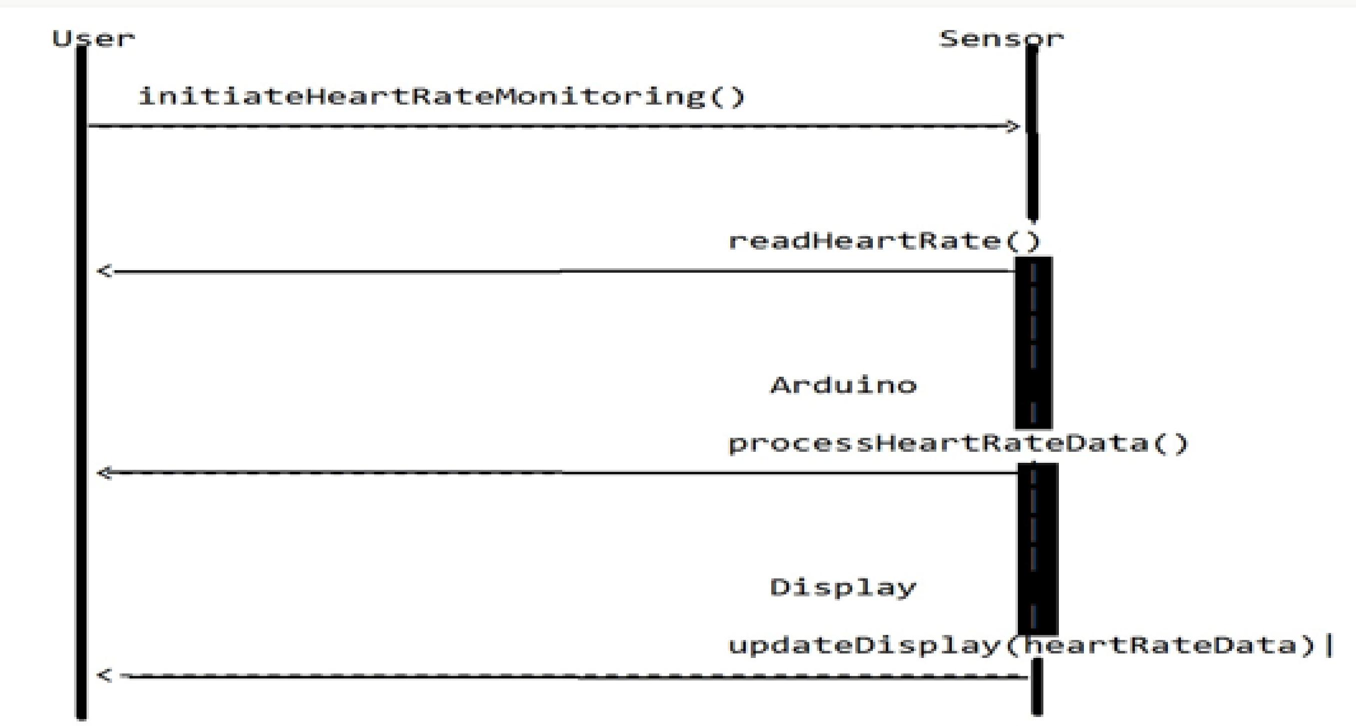

Figure 4.4: **Sequence Diagram for Cardiac attack detection**

Figure 4.4 shows the sequence diagram depicts interactions between the user, sensor, Arduino, and display components. The User lifeline initiates heart rate monitoring. Concurrently, the Sensor reads the heart rate data. Once the heart rate data is read, the Arduino processes it. Concurrently, the Display updates with the processed heart rate data. Each lifeline represents a parallel process occurring independently in the system. The interaction between various components involved in monitoring, identifying, and responding to cardiac events is illustrated in a sequence diagram for cardiac attack detection. Actors like the patient, a central monitoring system, a heart monitor, emergency services, and medical professionals are usually included. First, the patient's vital signs are continuously collected by the cardiac monitoring equipment and sent to the central monitoring system for real-time analysis. The healthcare provider receives notification from the system when it detects a possible cardiac attack. The provider examines the information and verifies the occurrence. In the event that emergency services are required, the healthcare provider or the system makes contact with them. This diagram ensures timely delivery by helping to see the information flow and the order of actions.

4.2.4 Activity Diagram for Cardiac Attack Detection

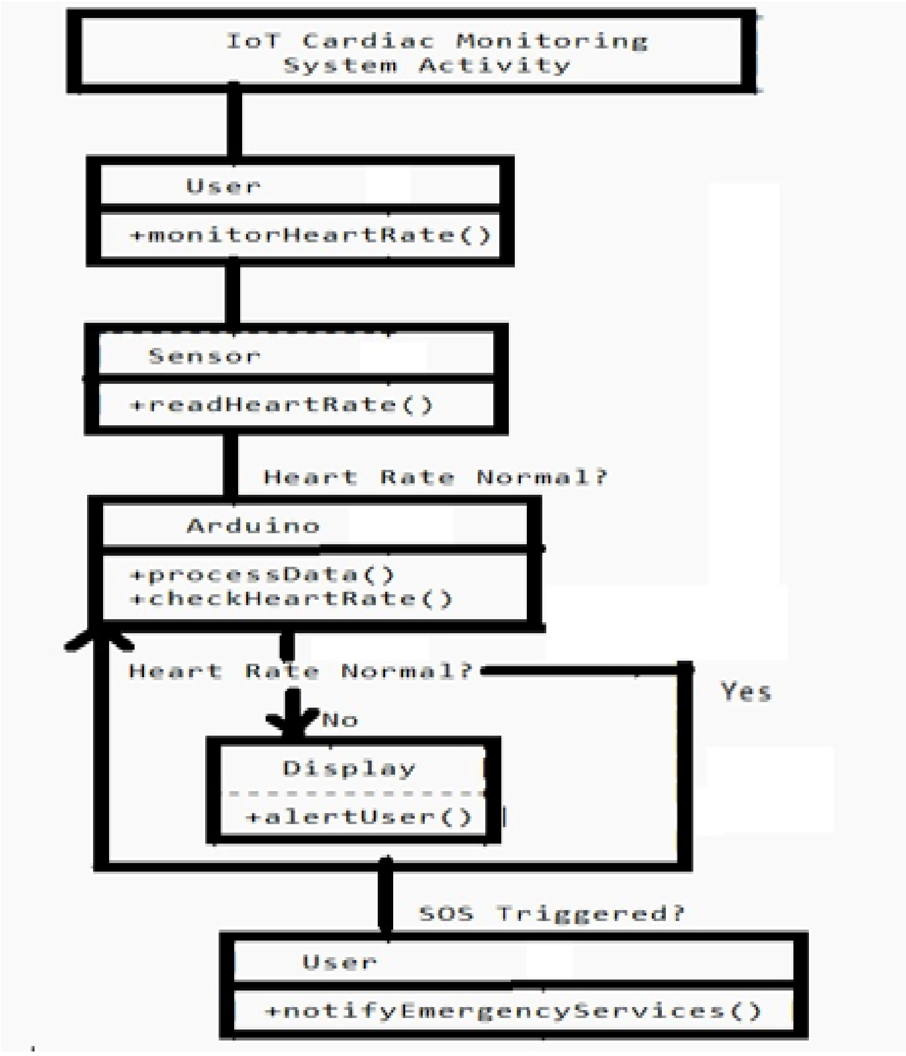

Figure 4.5: **Activity Diagram for Cardiac Attack Detection**

Figure 4.5 shows the user initiates heart rate monitoring. The sensor reads the heart rate data. The Arduino processes the data and checks if the heart rate is normal. If the heart rate is normal, the system proceeds with normal operations. If the heart rate is abnormal, the system alerts the user through the display. If the user triggers an SOS signal, the system notifies emergency services. The cardiac monitoring equipment first gathers information on vital signs, such as heart rate and electrocardiogram, which is subsequently sent to a central monitoring system for immediate analysis. The system sends out an alert and tells the healthcare professional if it notices any anomalies that could be signs of a heart arrest. After verification, the medical professional calls emergency services, who come to the patient's location and administer the required care.

4.3 Algorithm & Pseudo Code

4.3.1 Algorithm for Cardiac attack detection

Step 1: Start.
Step 2: Collect ECG data from the sensor attached to the patient.
Step 3: Continuously analyze ECG data to detect abnormal cardiac patterns indicative of a cardiac attack.
Step 4: Set predefined thresholds for heart rate, rhythm irregularities, or other cardiac parameters to trigger alerts.
Step 5: If abnormal cardiac activity is detected, generate alerts or notifications to healthcare providers via the IoT platform.
Step 6: Based on the severity of the cardiac event, initiate appropriate interventions such as sending emergency alerts, activating AEDs, or contacting EMS.
Step 7: Send relevant cardiac data, including ECG readings and event timestamps, to the IoT platform for remote monitoring and analysis.
Step 8: Visualize cardiac data on the IoT platform dashboard for real-time monitoring by healthcare professionals.
Step 9: Stop.

4.3.2 Pseudo Code

```
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

class Sensor:
    def init(self, name):
        self.name = name

    def read_data(self):
        # Simulate sensor readings
        if self.name == "heart_rate":
            return np.random.randint(60, 120)  # Simulate heart rate between 60 and 120 bpm
        elif self.name == "blood_pressure":
```

Figure 5.6 displays the output from the serial monitor, indicating a blood pressure reading of 227, providing crucial data for monitoring and assessing cardiovascular health. Typically, a normal blood pressure reading is around 120/80 mmHg.

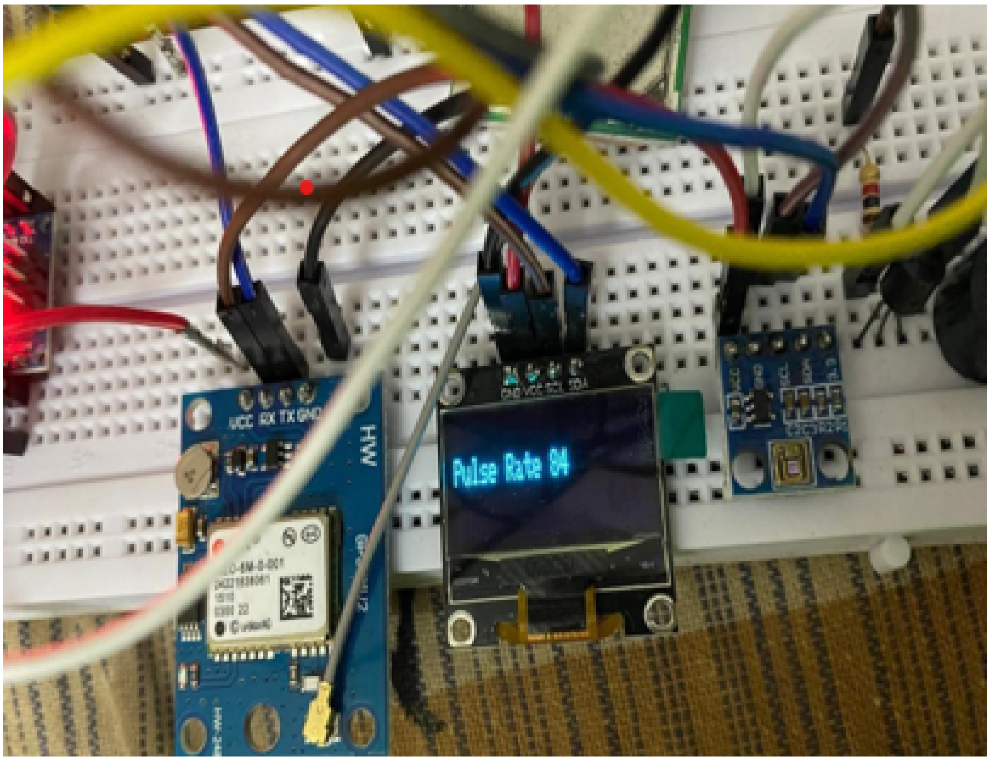

Figure 5.7: **Output for Pulse Rate Detection**

Figure 5.7 shows the pulse rate 84 beats per minute (BPM) is generally considered to be within the normal range for adults at rest. However, it's essential to consider factors such as age, fitness level, and overall health when interpreting pulse rate. In most cases, a pulse rate of 84 BPM would be considered normal for an adult.

Certainly, here are the simplified ranges for heart rate:
1. High: Above 100 BPM
2. Normal: Between 60 and 100 BPM
3. Median: Around 72 BPM
4. Low: Below 60 BPM