IoT Based Ambulatory Vital Signs Data Transfer System

ABSTRACT

In emergency medical situations, delays in monitoring and treatment can lead to severe complications and life-threatening consequences. This project presents an IoT-based ambulatory vital signs data transfer system designed for continuous and real-time monitoring of critical patient parameters such as heart rate, ECG, and SpO_2 levels. The system integrates the AD8232 ECG sensor and MAX30100 pulse oximeter with the ESP8266 NodeMCU. Sensor data is transmitted via Wi-Fi to the ThingSpeak IoT platform for real-time visualization, while MATLAB Online analyzes the data and generates alerts when preset threshold values are exceeded. The proposed system enables remote monitoring, timely medical intervention, and improved patient safety, especially in ambulatory and emergency healthcare environments.

CHAPTER 1: INTRODUCTION

1.1 Problem Description

If treatment of a patient in an emergency situation is delayed, the patient's condition may deteriorate rapidly. Such delays can result in complications, increased pain, and potentially life-threatening outcomes. In ambulatory environments like ambulances, continuous monitoring of vital signs is crucial to ensure timely medical decisions and interventions.

1.2 Aim and Objectives

Aim: To develop an IoT-based ambulatory vital signs data transfer system for seamless monitoring of a patient's health and for providing alerts during emergency conditions.

Objectives: - To continuously monitor vital signs of patients inside an ambulance. - To measure ECG, heart rate, and SpO_2 parameters in real time. - To transmit patient health data wirelessly using IoT technology. - To generate alerts when abnormal vital signs are detected. - To increase the chances of saving lives through early detection and intervention.

CHAPTER 2: SYSTEM OVERVIEW

The proposed system integrates biomedical sensors with an IoT-enabled microcontroller to enable real-time health monitoring. The MAX30100 sensor measures heart rate and blood oxygen saturation (SpO_2), while the AD8232 sensor captures ECG signals. These sensors are interfaced with the ESP8266 NodeMCU, which processes and transmits the data wirelessly to the ThingSpeak cloud platform.

MATLAB Online analyzes the received data stream and compares it against predefined threshold values. When abnormal conditions are detected, alerts are generated to notify healthcare professionals, enabling prompt medical action.

CHAPTER 3: HARDWARE AND SOFTWARE DESCRIPTION

3.1 Hardware Components

- **ESP8266 NodeMCU Board:** Acts as the main controller and provides Wi-Fi connectivity.
- **AD8232 ECG Sensor:** Used to monitor and record ECG signals.
- **MAX30100 Pulse Oximeter Sensor:** Measures heart rate and SpO_2 levels.

3.2 Software Components

- **Arduino IDE:** Used for programming the NodeMCU and handling sensor data acquisition.
- **ThingSpeak IoT Platform:** Cloud platform for real-time data visualization and storage.
- **MATLAB Online:** Used for data analysis and alert generation based on threshold values.

CHAPTER 4: WORKING PRINCIPLE

The sensors continuously acquire physiological data from the patient. The NodeMCU reads this data and transmits it to a ThingSpeak channel using Wi-Fi. MATLAB Online retrieves the data from ThingSpeak and analyzes it in real time. If any parameter exceeds predefined limits, alerts are generated to inform healthcare personnel. This workflow ensures continuous monitoring, accurate data processing, and timely medical intervention.

CHAPTER 5: APPLICATIONS

- Ambulance-based patient monitoring
- Emergency healthcare services
- Postoperative patient care
- Chronic disease monitoring
- Elderly healthcare support

CHAPTER 6: ADVANTAGES

- Real-time remote monitoring of vital signs
- Early detection of medical emergencies
- Improved patient safety and care quality
- Reduced burden on healthcare professionals
- Scalable and cost-effective solution

CHAPTER 7: CONCLUSION AND FUTURE SCOPE

7.1 Conclusion

The IoT-based ambulatory vital signs data transfer system provides an effective solution for continuous patient monitoring during emergency transport. By integrating biomedical sensors with cloud-based

platforms, the system enables real-time monitoring, timely alerts, and proactive medical intervention, thereby improving patient outcomes and healthcare efficiency.

7.2 Future Enhancements

- Integration of additional biomedical sensors
- Development of a mobile application for real-time alerts
- Use of predictive analytics for early disease detection
- Enhanced data security and privacy mechanisms
- Integration with electronic health record (EHR) systems

REFERENCES

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2. R. Prakash et al., “Real-Time Remote Monitoring of Human Vital Signs Using IoT,” IEEE, 2015.