Design of an FPGA based patient history tracking, monitoring and Diagnostic support system

And Report submitted to GITAM (Deemed to be University) as a partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Electronics and Communication



DEPARTMENT OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING

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**DECLARATION**

I/We declare that the project work contained in this report is original and it has been done by me under the guidance of my project guide.

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**CERTIFICATE**

This is to certify that Madicharla Vishnu Teja (BU22EECE0100461), Harshit Ramesh Hundia (BU22EECE0100442) and Darshan H (BU22EECE0100464) has satisfactorily completed Mini Project Entitled in partial fulfillment of the requirements as prescribed by University for VIIth semester, Bachelor of Technology in “Electronics and Communication Engineering” and submitted this report during the academic year 2025-2026.

[Signature of the Guide] [Signature of HOD]

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**Chapter 1: Introduction**

**1.1 Overview of the problem statement**

The project titled “FPGA-Based Patient Monitoring System” focuses on improving healthcare by providing continuous monitoring of patient health parameters using FPGA technology. The system integrates external sensors such as heart rate monitors, temperature sensors, and pulse oximeters to collect real-time data without interrupting the core functions of the circuit. The FPGA processes the raw sensor inputs through filtering and analysis algorithms to generate accurate and meaningful health metrics with minimal latency. A graphical user interface is designed to display patient information, alerts, and health trends, enabling clinicians to make quick and informed decisions. In addition, the system logs historical data to help track patient health over time and improve diagnostic accuracy. The project also incorporates decision support mechanisms using AI-based algorithms, which can provide diagnostic recommendations and trigger alerts in case of emergencies. Furthermore, it supports integration with electronic health record (EHR) systems, ensuring continuity of care and comprehensive patient history management. Overall, this FPGA-based approach enhances patient outcomes by offering real-time monitoring, high accuracy, and timely interventions. Future enhancements include the addition of more sensors, refinement of data analysis algorithms, mobile accessibility, and the ability to monitor multiple patients simultaneously, making it a scalable and intelligent healthcare solution.

**1.2 Objective**

The objective of this project is to design and implement a real-time FPGA-based system that efficiently tracks and manages patient medical histories, including surgeries, tests, and treatments. The system aims to provide continuous monitoring and diagnostic support by integrating medical data with rapid hardware processing capabilities. Additionally, it plans to incorporate external sensor interfaces to detect vital signs such as temperature and heart rate, continuously update patient records, and generate alerts for any abnormalities to enhance timely medical intervention. This project combines high-speed data handling with healthcare management to improve accuracy, accessibility, and responsiveness in patient monitoring and diagnostics.

**Goals**

*Main Goals*

* Design and develop an FPGA-based system for tracking patient medical history.
* Store and update records of patient procedures, operations, and test results accurately.
* Enable real-time monitoring and retrieval of patient historical data.
* Provide diagnostic support for healthcare professionals using fast hardware processing.
* Ensure reliable, secure storage and communication of patient information

*Additional Goals*

* Integrate external sensor circuits for automatic acquisition of vital signs (e.g., temperature, heart rate).
* Continuously update medical history with real-time physiological data.
* Implement an alert system to notify abnormalities for prompt clinical response.

**Chapter 2: Literature Review**

1. Health Monitoring and Jaundice Detection System Using Verilog

*Author:* Nandana Murali, Rajesh Kannan Megalingam, Chebrolu Gowtham

*Journal:* IEEE Xplore

*Key takeaways:* The Verilog code implemented a health monitoring and jaundice detection system. The system outputs the abnormality in heart and blood pressure rates and also predicts the presence of Jaundice. If the abnormality in vitals is continuous for three counts, then an alert is generated

1. Design and Implementation of Smart Healthcare Monitoring System Using FPGA

*Author:* Prem Kumar Badiganti, Sumanth Peddirsi, Alla Tirumala Jagannadha Rupesh, and Suman Lata Tripathi

*Journal:* Google scholar

*Key takeaways:* Heart rate, temperature, BP and ECG are health parameters considered. The data is measured from the patient using specialized medical sensors which are to be interfaced with an FPGA board.

1. Design of Health Monitoring System using FPGA

*Author:* Anjali Chindham, Donthagani Rakesh, Sabavath Virisha, Racha Ganesh

*Journal:* Google scholar

*Key takeaways:* The patient’s health vitals are considered as the input parameters and the patients’ health status is displayed on the FPGA board in the form of 0’s and 1’s.

1. FPGA-Based Smart Health Monitoring Systems for Wearable Devices

*Author:* Muthukumaran Vaithianathan, Shivakumar Udkar, Manjunath Reddy, Deepanjan Roy, Senkadir Rajasekaran

*Journal:* Google scholar

*Key takeaways:* By combining FPGA computing with cutting-edge sensor technology, intelligent health monitoring systems employ FPGA. Photoplethysmography (PPG) sensors quantify heart rate, while accelerometers document motion, among numerous other physiological attributes assessed by the extensive sensor networks of these systems.

1. FPGA Based Health Monitoring System

*Author:* Fazal Noorbasha, Bevara Kishore, Koushik Reddy, Kongara Srinivas

*Journal:* Google scholar

*Key takeaways:* This paper is mainly used to track heart conditions, respiratory system and body conditions by monitoring age, heart rate, breathe rate and body temperature. All the data that is tracked by various sensors are integrated into the system to process of health data. Health report and Health status as outputs where health report contains Body temperature conditions, Heart conditions and Respiratory conditions.

1. An FPGA Implementation of Health Monitoring System using IOT

*Author:* U. Mehta, K. Chaudhary, A. Singh, A. Rana, A. Garg, D. Chaudhary

*Journal:* IJRASET

*Key takeaways:* This study presents a health monitoring system that can be accessed from anywhere and is compatible with mobile devices. The use of FPGA allows for fast data processing, while Internet connectivity enables real-time monitoring. The system transmits data to a server, which can be accessed through a user interface.

**Chapter 3: Strategic Analysis and Problem Definition**

* 1. SWOT Analysis
  2. Project Plan - GANTT Chart
  3. Problem statement

**Chapter 4: Methodology**

4.1 Description of the approach:

Our project's fundamental approach is to create a **real-time, integrated health monitoring system** using an FPGA as the central processing unit. Here's a step-by-step breakdown of how it works:

1. **Data Acquisition:** The system begins by collecting continuous data on a patient's vital signs—such as heart rate, body temperature, and oxygen levels—using multiple external biomedical sensors.
2. **Data Processing:** This raw data is sent directly to the FPGA. The FPGA processes this information in real-time, using specialized filtering and signal processing algorithms to ensure the data is accurate and reliable. This is a key advantage of using an FPGA, as its hardware-level processing is extremely fast and efficient.
3. **Data Visualization:** Once processed, the health metrics are displayed on a Graphical User Interface (GUI). This allows clinicians and healthcare professionals to easily view and interpret the patient's real-time health status, enabling them to make quick and informed decisions.
4. **Low Latency & High Accuracy:** This entire process is designed to have very low latency (minimal delay), which is critical in a medical setting. The combination of direct sensor input and rapid FPGA processing ensures that the monitoring is both immediate and highly accurate, making it suitable for clinical applications.

4.2 Tools and techniques utilized:

* **Hardware:**
  + **FPGA Development Board:** This is the core of your project. You will use a board from a manufacturer like **Xilinx** or **Intel (formerly Altera)**.
  + **Biomedical Sensors:** These are the external devices that will measure the patient's vital signs (e.g., heart rate monitors, temperature sensors).
* **Software and Programming:**
  + **Hardware Description Languages (HDLs):** You will program the FPGA's logic using either **VHDL** or **Verilog**. These languages are used to describe the electronic circuits and how they should function.
  + **Development and Simulation Tools:** For writing, testing, and debugging your HDL code, you will use professional software suites like **Xilinx Vivado** or **ModelSim**. These tools allow you to simulate your design before implementing it on the physical FPGA board.
  + **GUI Development:** You will create a user-friendly interface to display the patient's data in an easy-to-understand format.
* **Advanced Techniques:**
  + **AI-Based Algorithms:** To make the system "smarter," you will integrate **Artificial Intelligence (AI) algorithms**. These algorithms will help provide diagnostic support by identifying potential health issues and can automatically trigger alerts in emergency situations.

4.3 Design considerations:

* **Accuracy and Reliability:** The system must be highly accurate and reliable, as it deals with sensitive medical data. Accuracy is achieved by carefully calibrating the sensors and using the FPGA to filter out any "noise" or errors in the data. Reliability comes from using robust hardware and software that can operate continuously without failure in a demanding healthcare environment.
* **Scalability:** The system is designed to be **scalable**, meaning it can be expanded in the future. This includes the ability to add more sensors for monitoring other vital signs, implement more advanced predictive analytics, or even adapt it to monitor multiple patients at once.
* **Efficiency:**
  + **Low-Latency Processing:** As mentioned, the system must process data with minimal delay to be useful for real-time monitoring.
  + **Power Efficiency:** The design also takes power consumption into account, which is important for creating a practical and sustainable medical device.

**Chapter 5: Implementation**

* 1. Description of how the project was executed
  2. Challenges faced and solutions implemented

**Chapter 6: Results**

* 1. outcomes
  2. Interpretation of results
  3. Comparison with existing literature or technologies

**Chapter 7: Conclusion**

Here write Suggestions for further research or development and Potential improvements or extensions

**Chapter 8 : Future Work**

Here write Suggestions for further research or development Potential improvements or extensions

**References**

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