



# **Enhancing Senior Wellness: Monitoring and Managing Heart Health with IoT-Powered Healthcare Solutions for the Elderly**

**S.L. FATHIMA RUKSANA**  
**Reg. No.: MS23005280**

A THESIS  
SUBMITTED TO  
SRI LANKA INSTITUTE OF INFORMATION TECHNOLOGY  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF  
MASTER OF SCIENCE IN INFORMATION TECHNOLOGY

December 2024

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

Prof. Anuradha Jayakody

Approved for MSc. Research Project:

MSc. Programme Co-ordinator, SLIIT

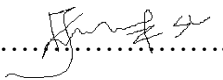
Approved for MSc:

---

Head of Graduate Studies, FoC, SLIIT

# DECLARATION

This is to certify that the work is entirely my own and not that of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Sri Lanka Institute of Information Technology or to any other institution for assessment for any other purpose.

Sign: ..........  
S. L. F. Ruksana

Date: .....2024-09-12.....

# ABSTRACT

The development of technology across all spheres of society has led to a waste of elders' desire for efficient management and monitoring of their cardiac health. IoT is a significant and helpful technology that helps to address the issues that seniors experience on a daily basis. This project includes continuously monitoring the elderly to detect heart problems early and treat them, giving doctors and caregivers access to the elderly's status and information to provide real-time alarms, developing a system for routinely monitoring the elderly with automated reminders, and safeguarding the elderly's sensitive information.

Building an Internet of Things (IoT)-based heart health monitoring system that incorporates machine learning for predictive analysis is the system's main objective, according to the statement. ESP 32 microcontroller, which helps to gather data from a variety of sensors, the MPU 6050 Accelerometer, the Gyroscope, and the DHT11 sensor, which helps to measure temperature and humidity. The HW-827 is also used to monitor the elders' heart rates, and the GPS and sensor data are sent to the fire base for real-time database storage and further analysis.

Additionally, it is crucial to identify the unusual health status of the elderly in this system. The data is processed by a machine learning model, and the system employs a random classifier machine learning model to detect abnormalities based on past sensor readings. Additionally, the random forest model aids in identifying anomalous patterns in elders by using the labeled data for training. Additionally, this uses GPS data to provide location-based contexts, which aids in providing senior location-based info in an emergency. Additionally, a mobile application that uses the Flask API to retrieve the processed data and predictions from the machine learning model is used to offer real-time notifications and location-based alerts when any possible health risks are identified.

In addition to improving safety and response capabilities in healthcare and elder personality monitoring applications, this project intends to showcase the possibilities of IoT and machine learning in real-time assistance and environmental monitoring.

# **ACKNOWLEDGEMENT**

While at Sri Lanka Institute Information Technology, I have benefited from having great advisors who seem to agree about very little. Prof. Anuradha Jayakody was a great mentor, providing advice, constant constructive criticism of my ideas and writing, access to his web of contacts and friends and the freedom to work on my own projects on his research account's time.

# TABLE OF CONTENTS

DECLARATION .....	ii
ABSTRACT .....	iii
ACKNOWLEDGEMENT .....	iv
TABLE OF CONTENTS .....	v
List of Figures .....	vii
List of Tables.....	viii
Chapter 1 Introduction.....	1
1.1 Chapter Overview .....	1
1.2 Background .....	1
1.3 Problem Statement.....	2
1.4 Research Gap .....	3
1.5 proposed solution.....	4
1.6 Research Objectives .....	6
1.7 Contribution .....	6
1.8 Research Significance .....	7
1.9 Report Structure .....	7
Chapter 2 Related works .....	9
2.1 Overview of IoT in healthcare .....	9
2.2 Heart health monitoring solution.....	10
2.3 IoT based heart health monitoring system .....	10
2.4 Machine Learning with IoT based heart health monitoring system .....	11
2.5 Regulatory and ethical consideration .....	12
2.6 Future directions in IoT enable elderly healthcare. ....	13
2.7 Summary of Related Works.....	14
Chapter 3 Managing and monitoring the heart health of elders with IoT solutions.....	39
3.1 IoT based heart health Managing and monitoring system .....	39
3.2 Real time data collection and analysis .....	42
Chapter 4 Methodology.....	44
4.1 System Design and Architecture.....	44
4.2 Data Collection and Monitoring Process .....	48
4.3 Real-Time Data Transmission and Storage.....	49
4.4 Data Preprocessing: Cleaning and Filtering.....	50
4.5 Implementation of the system .....	51
Chapter 5 Evaluation and Results.....	74
5.1 Introduction to Evaluation Metrics .....	74
5.2 User experience and usability testing.....	76

5.3 Security and privacy assessment.....	77
5.4 Discussion of Results .....	78
Chapter 6 Discussion.....	81
6.1 Findings of the proposed system.....	81
6.2 Limitations .....	82
6.3 Strengths.....	83
6.4 Recommendations .....	84
6.5 Comparative analysis with existing system .....	84
6.6 Comparison with proposed framework .....	87
6.7 Future works.....	88
Chapter 7 Conclusion .....	90
Reference.....	92
Appendix .....	97
Arduino coding (sensor code) .....	97
Machine Learning Training (Python) .....	99
API (Python).....	101
Mobile app codes (Flutter) .....	102
Validation through domain experts .....	118
Data collection request letter by supervisor.....	125
Certification of datasets .....	125
Datasets .....	126

# List of Figures

Figure 1 Architecture of the system .....	44
Figure 2 Hardware components.....	52
Figure 3 Arduino code for ESP32 with sensors.....	53
Figure 4 Get Real-time data from Fire base .....	54
Figure 5 Make prediction and send to mobile app.....	54
Figure 6 Code for live data read and ML Detection .....	55
Figure 7 Code for live location tracking.....	56
Figure 8 User Authentication .....	57
Figure 9 Real-time sensor data management.....	58
Figure 10 .CSV dataset used to train Machine Learning .....	61
Figure 11 ML Training code .....	62
Figure 12 Trained model saved .....	62
Figure 13 Machine learning training and accuracy .....	63
Figure 14 Loading page.....	65
Figure 15 User Registration page .....	65
Figure 16 Login Page .....	66
Figure 17 Patient Dashboard .....	66
Figure 18 Detect Abnormal by Machine Learning.....	67
Figure 19 Detect Normal by Machine Learning.....	67
Figure 20 Patient Location tracking page.....	68
Figure 21 Evaluation of system Accuracy.....	74
Figure 22 Overview output of Normal prediction .....	79
Figure 23 Overview output of Abnormal prediction .....	79
Figure 24 Results of Location tracking .....	80



# List of Tables

Table 1 Summary of related works.....	15
Table 2 Summary of Test and Validation.....	71
Table 3 Key difference between existing and proposed system .....	86