Industrial Internship Report on

”MediLoRa: Smart Health Monitoring System”

Prepared by

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Executive Summary
This report provides details of the Industrial Internship provided by UpSkill Campus and The IoT Academy in collaboration with Industrial Partner UniConverge Technologies Pvt Ltd (UCT). This internship was focused on a project/problem statement provided by UCT. We had to finish the project including the report in 6 weeks’ time. My project was to design a smart health monitoring system that tracks key health parameters such as pulse rate, body temperature, GSR level, etc. The system transmits data wirelessly using LoRa communication for real-time monitoring, emergency alerts and data logging via a Node-RED dashboard . This internship gave me a very good opportunity to get exposure to industrial problems and design/implement solution for that. It was an overall great experience to have this internship.

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1 Preface

Over six weeks we designed a smart health monitoring system that uses LoRa connectivity to send data over vast distances while monitoring temperature, heart rate and skin response. First, we established the development environment, chose hardware, and planned the project. After that, we calibrated and linked health sensors with Arduino to guarantee precise data collecting. A gateway was set up to forward data to a cloud platform, and LoRa modules were setup for dependable long-range connectivity. In addition to adding features like warnings and historical data recording, we developed a dashboard for real-time visualization on Node-Red. We improved the gadget by implementing basic data encryption for safe communication and optimizing power usage through sleep modes. Lastly, we documented the procedure and tested the fully integrated system to ensure dependability and usability.

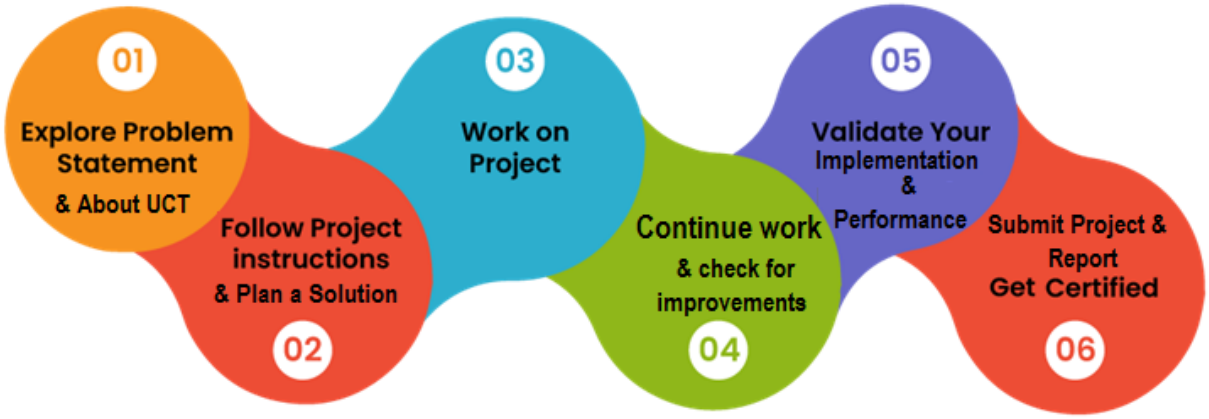
With applications in smart homes, healthcare, agriculture, and industrial automation, the Internet of Things is a quickly expanding subject that is very relevant in today's job market. Building end-to-end IoT systems require practical expertise in hardware integration, sensor interfaces, communication protocols, and cloud platforms, which are acquired during the IOT internship program.

Continuous health monitoring and timely data transfer is difficult in rural and distant locations with poor internet connectivity and little access to medical facilities. Many wearable health monitoring devices now on the market rely on short-range communication technologies, such as Bluetooth or Wi-Fi, which are not appropriate for transmitting data over long distances. Many devices also have low power efficiency, which makes them unsuitable for extended usage in settings with limited resources.

By creating a wearable health monitor using sensors to measure vital indicators (heart rate, SpO_2, and temperature) and utilizing LoRa connectivity for low-power, long-range data transfer, this project tackles these issues. To promote prompt interventions and enhance healthcare outcomes in underserved areas, the system seeks to provide real-time health monitoring and data accessible over great distances.

UpSkill Campus/UniConverge Technologies offers a 6-week IoT internship program that gives us practical instruction in IoT principles such device integration, communication protocols, and practical applications. As they create and implement IoT systems, hands-on experience with sensors, microcontrollers, and cloud platforms are gained. The program's emphasis on practical skills allows us to work on projects like smart agriculture, environmental monitoring, and home automation while improving our technical presentation, teamwork, and project management skills. The program prepares us for advanced opportunities in IoT through exposure to industry practices, career guidance, and mentorship. Certification and a strengthened professional portfolio are the end results.

How Program was planned



Knowledge of IoT's ability to solve practical issues, particularly in the healthcare industry, has grown as a result of this experience, which has also greatly improved my technical and professional skills for any future work in the area. Critical problem-solving and technical skills have also been built through difficulties such as power consumption optimization, long-distance dependable data transmission, and health sensor calibration and also highlighted how crucial documentation, teamwork, and precision are to developing scalable IoT solutions.

I want to sincerely thank ASDM Assam, IIT Guwahati, and UniConverge Technologies/UpSkill Campus for giving me the amazing chance to intern and work on the Smart Health Monitoring System Project utilizing LoRa Communication. I would like to express my gratitude to my mentor, Nishant Kumar, and Kaushlendra Singh Sisodia, CEO of UniConverge Technologies, for their important advice and guidance.

I also want to express my sincere gratitude to Manasjyoti Baishya and Mehtaz Begum, my project partners, for their cooperation, commitment, and teamwork, all of which were crucial to the success of this project. My professional development, technical expertise, and practical insights have all been greatly enhanced by this experience, which has been made possible by this industrial internship.

I want to thank everyone for making my internship so special.

Teamwork and collaboration are essential; helping one another not only improves the caliber of the work but also makes the experience more pleasurable and significant. Never stop being inquisitive, try out novel concepts, and don't be afraid to ask questions or look for mentorship.

2 Introduction

2.1 About UniConverge Technologies Pvt Ltd

A company established in 2013 and working in Digital Transformation domain and providing Industrial solutions with prime focus on sustainability and RoI.

For developing its products and solutions it is leveraging various **Cutting Edge Technologies e.g. Internet of Things (IoT), Cyber Security, Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end** etc.

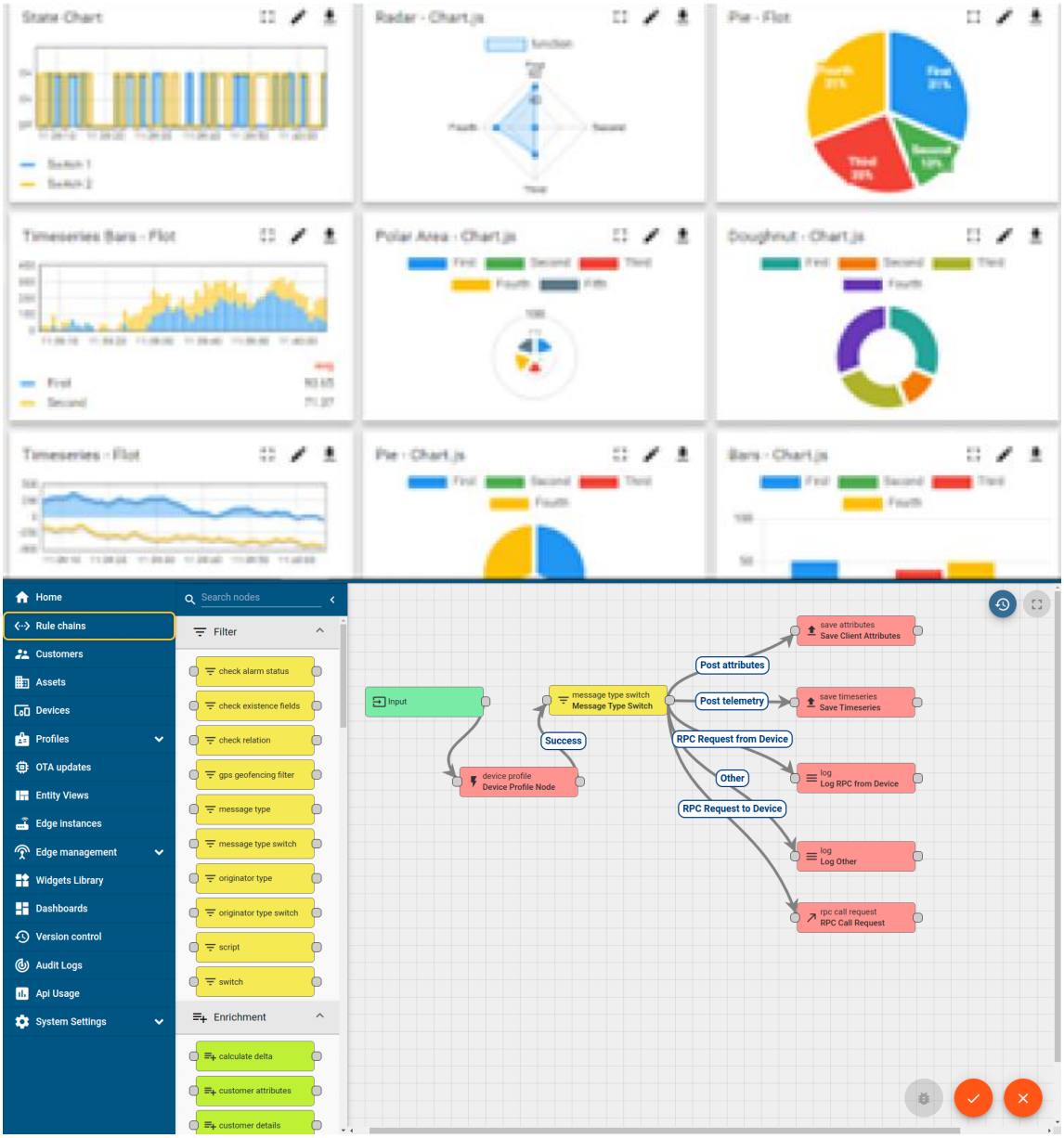
i. UCT IoT Platform (UCT Insight)

UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA
- It supports both cloud and on-premises deployments.

It has features to

- Build Your own dashboard
- Analytics and Reporting
- Alert and Notification
- Integration with third party application (Power BI, SAP, ERP)
- Rule Engine



ii. Smart Factory Platform (FACTORY WATCH)

Factory watch is a platform for smart factory needs.

It provides Users/ Factory

- with a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling up to digital twin for your assets.
- to unleased the true potential of the data that their machines are generating and helps to identify the KPIs and also improve them.
- A modular architecture that allows users to choose the service that they what to start and then can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to save time, cost and money.

Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
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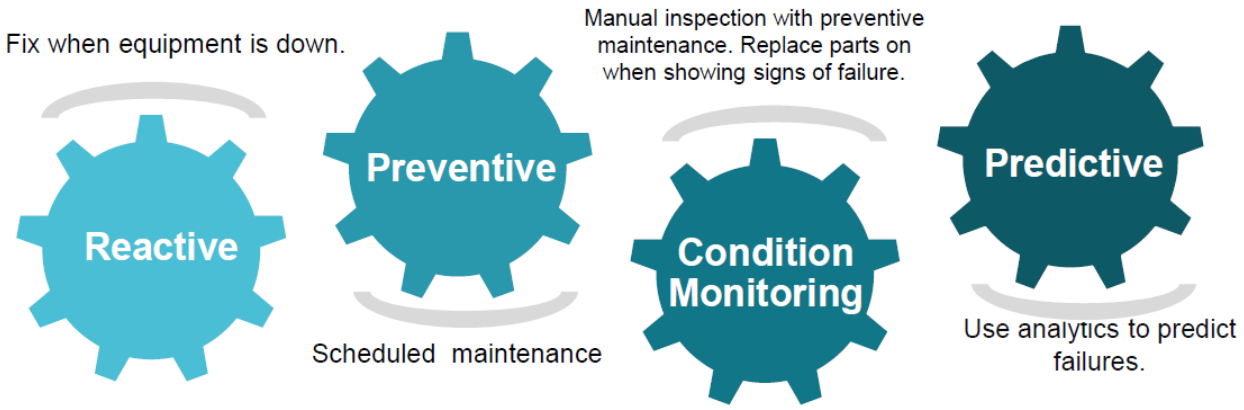
iii. LoRaWAN based Solution

UCT is one of the early adopters of LoRaWAN technology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

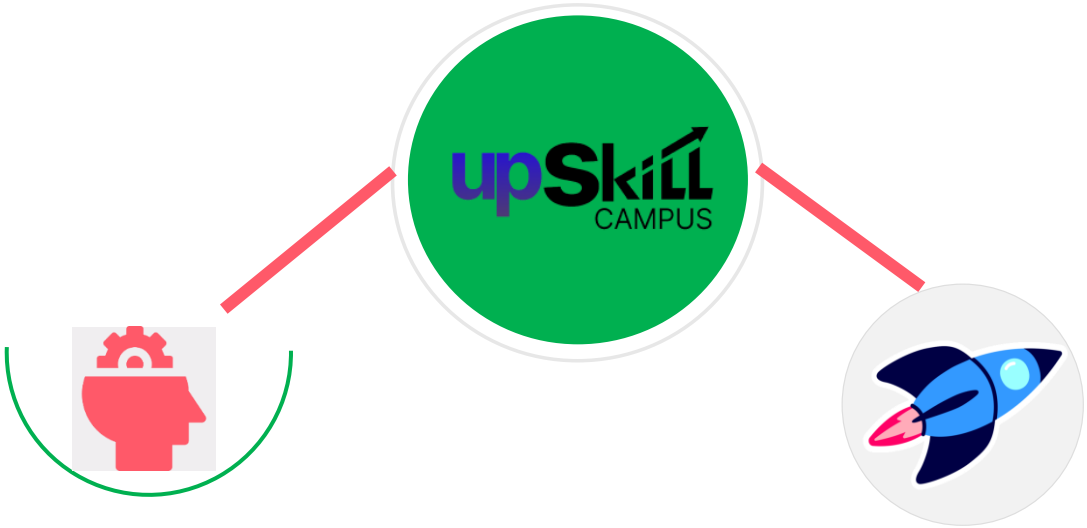
iv. Predictive Maintenance

UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



2.2 About upskill Campus (USC)

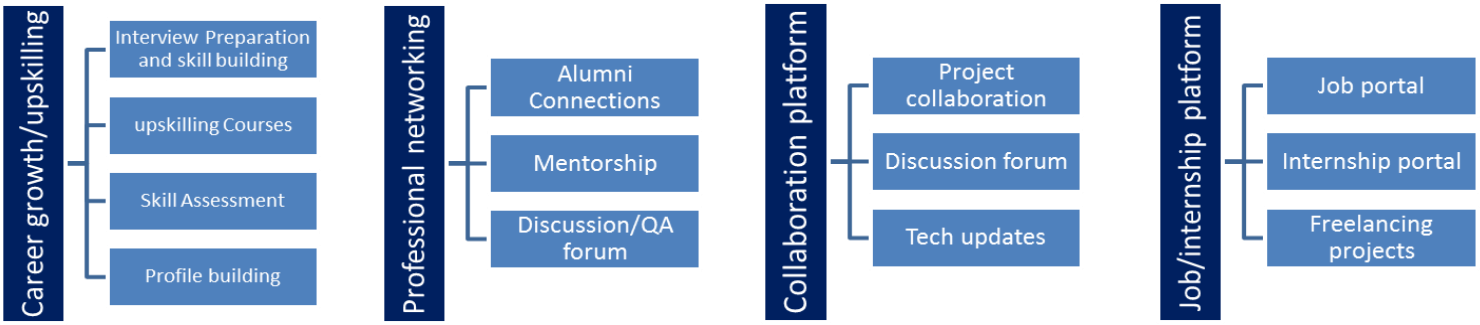
upskill Campus along with The IoT Academy and in association with UniConverge technologies has facilitated the smooth execution of the complete internship process. USC is a career development platform that delivers **personalized executive coaching** in a more affordable , scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

upSkill Campus aiming to upskill 1 million learners in next 5 year

https://www.upskillcampus.com/



2.3 The IoT Academy

The IoT academy is EdTech Division of UCT that is running long executive certification programs in collaboration with EICT Academy, IITK, IITR and IITG in multiple domains.

2.4 Objectives of this Internship program

The objective for this internship program was to

- ☛ get practical experience of working in the industry.
- ☛ to solve real world problems.
- ☛ to have improved job prospects.
- ☛ to have Improved understanding of our field and its applications.
- ☛ to have Personal growth like better communication and problem solving.

3 Problem Statement

Continuous health monitoring for patients and at-risk persons becomes difficult in rural and isolated locations with poor internet connectivity and limited access to medical facilities.

Explanation of problem statement:

Health Monitoring Issues in Remote Locations:
People find it challenging to consistently obtain healthcare services in remote locations due to a lack of infrastructure. Patients with chronic disorders, the elderly, and those recuperating from illnesses frequently need ongoing monitoring.

Constraints of Current Solutions:
Numerous health monitoring devices rely on mobile internet, Bluetooth, or Wi-Fi, all of which have a short range or need consistent internet access.
Commercial solutions might not be made for low-power, long-distance communication or they might be costly.

4 Existing and Proposed solution

Current options, such as commercial wearables (like the Fitbit and Apple Watch), provide sophisticated health tracking but are expensive, require internet connectivity, and rely on short-range Bluetooth or Wi-Fi. Although telemedicine systems make remote monitoring possible, they are power-intensive and need complicated infrastructure. Prototypes for LoRa-based health monitoring offer low-power, long-range solutions, however they are primarily experimental and have limited availability and usefulness. Conventional medical equipment, such as pulse oximeters, must handle data manually and do not have remote connection capabilities.

There is a need for a low-cost, long-range smart device using LoRa connectivity because existing solutions have issues with cost, range, battery efficiency, and accessibility in distant locations.

Smart Health Monitoring System with LoRa Communication is a low cost, internet-free, remote health status monitoring system that transmits and receives data over LoRa communication and visualization of received data on Node-Red dashboard. A critical health status alerting system is also included herewith. Wearable Health Monitor is beneficial for remote locations where internet connectivity is an issue.

4.1 Code submission (Github link)

https://github.com/mehtaz11/upskillcampus

4.2 Report submission (Github link)

https://github.com/mehtaz11/upskillcampus

5 Proposed Design/ Model

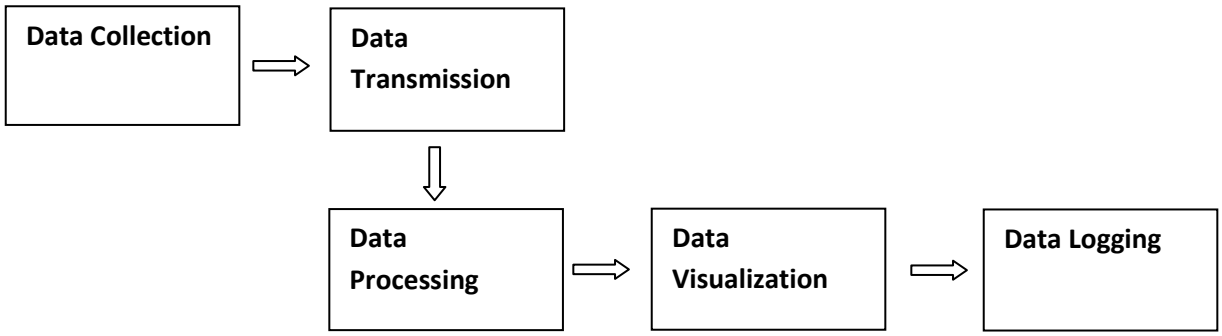


Figure 1: **Basic design flow**

1. Data Collection: Sensors measure health parameters and send the data to the LoRa-Arduino transmitter.

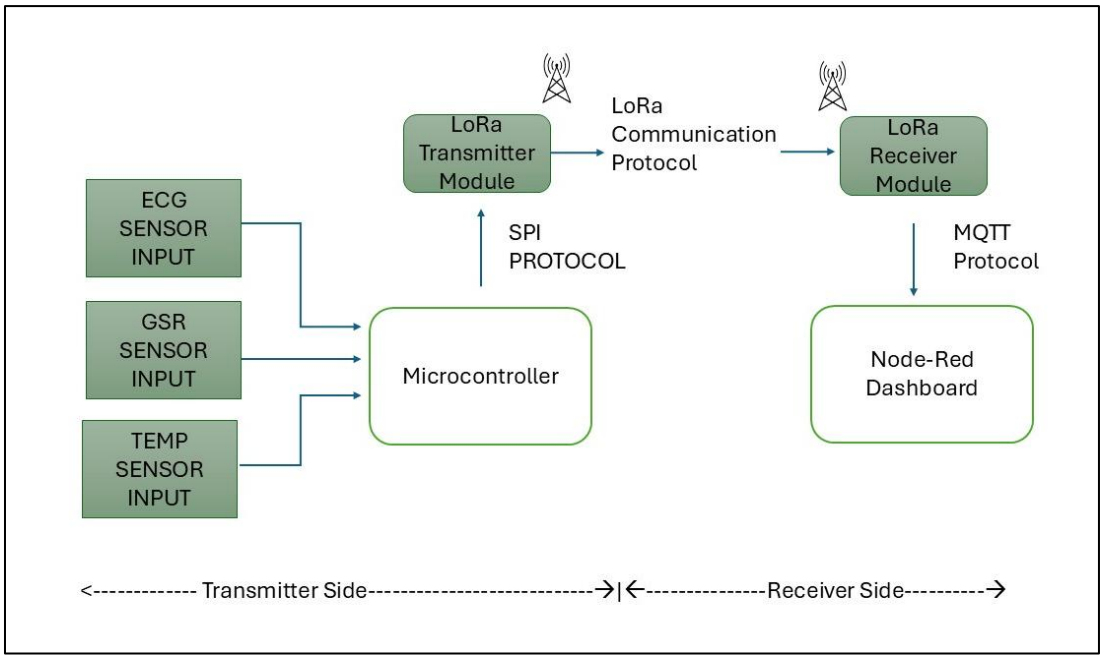
2. Data Transmission: Transmitter packages and sends the data wirelessly to the LoRa-Esp8266 receiver using LoRa communication.

3. Data Processing: The receiver processes the data, checks for emergency conditions, and triggers alerts if necessary.

4. Data Visualization: Node-RED subscribes to the data stream via MQTT, visualizing it on a dashboard in real time.

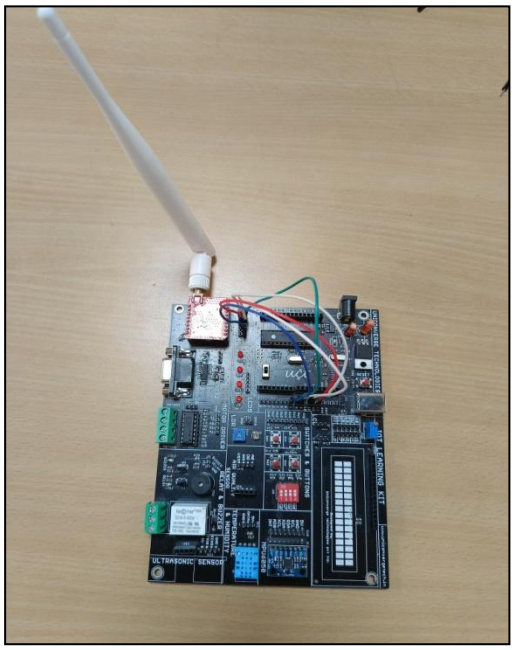
5. Data Logging: Node-RED stores sensor data in Excel format for historical records and comparative analysis.

5.1 Block Diagram

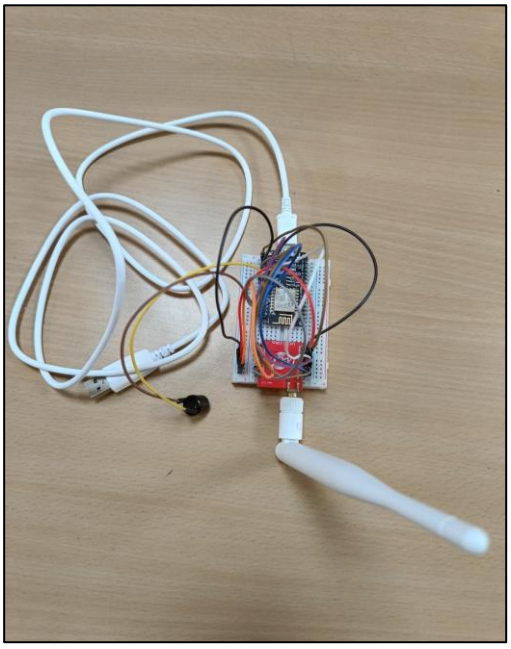


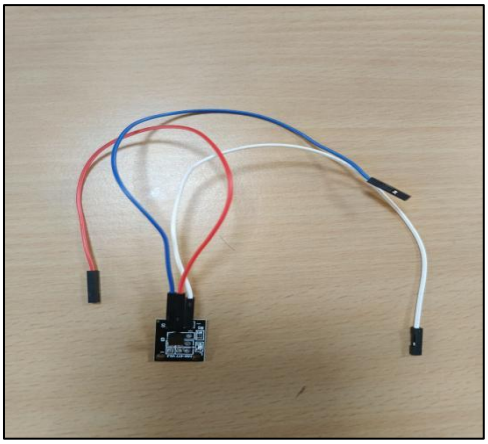
5.2 Project Photos

LoRa-Arduino Transmitter

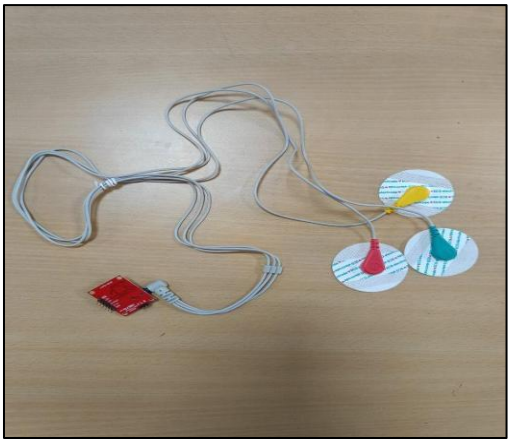


LoRa-Esp8266 Receiver

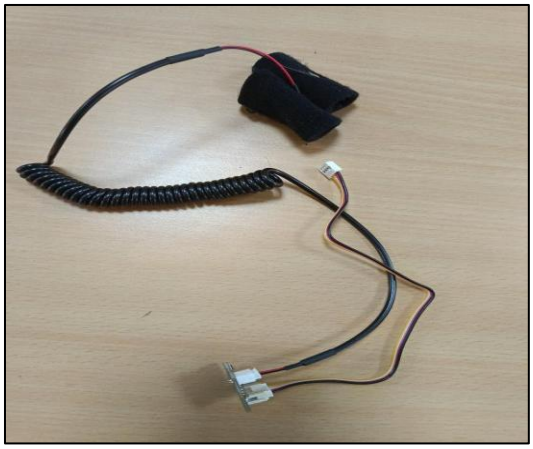




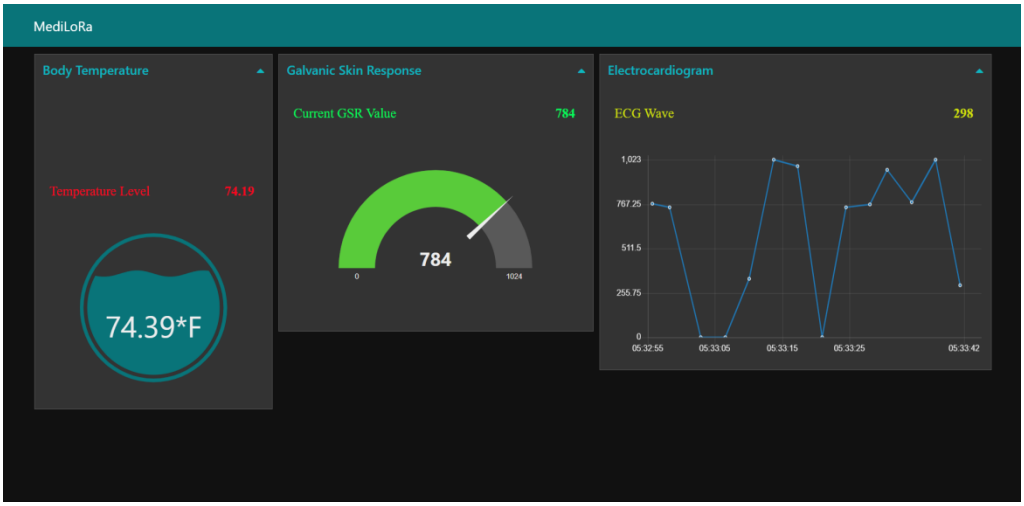
Body Temperature Sensor

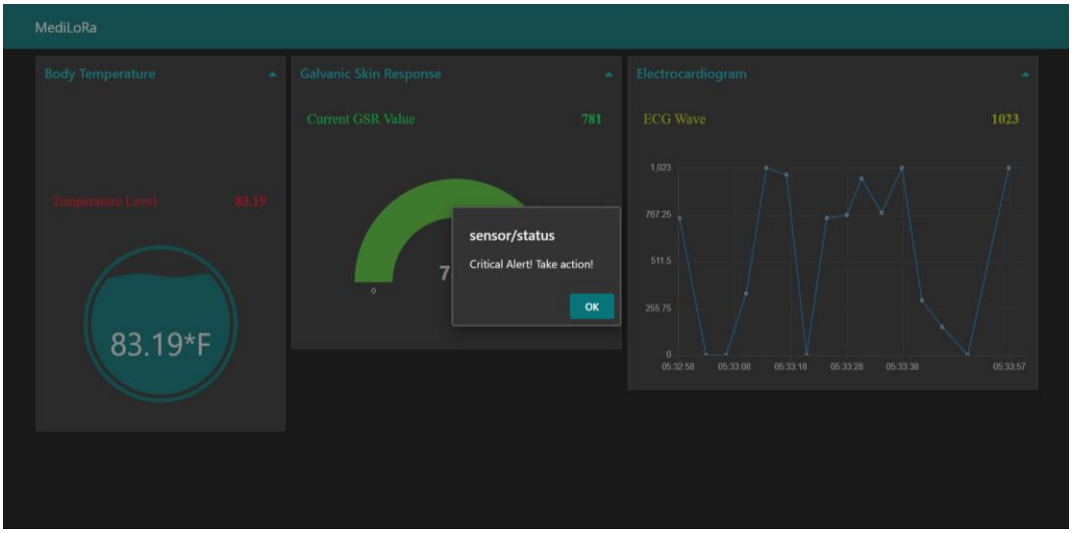


ECG Sensor



GSR Sensor





Node-RED Dashboard

6 Performance Test

When designing a **Smart Health Monitoring System with LoRa Communication**, several constraints were considered and addressed in the following ways:

1. Memory Constraints

- LoRa-based devices often have limited RAM and flash memory.
- We optimized firmware by using efficient coding practices, reducing buffer sizes, and leveraging lightweight data structures.
- The system only transmits essential health parameters to reduce data storage needs.

2. Processing Speed (MIPS) Constraints

- The microcontroller was chosen based on the required MIPS to process sensor data efficiently.
- We used interrupt-driven programming to ensure real-time response to critical health events.
- Computationally expensive tasks (e.g., signal processing) were optimized for low-power execution.

3. Restrictions on Accuracy

- To guarantee medical-grade accuracy, high-quality sensors (such as temperature, SpO2, and heart rate) were chosen.
- Measurement errors were reduced using data calibration techniques.
- In order to improve anomaly detection, machine learning methods were tested.

4. Limitations on Durability

- For extended use, the hardware was housed in a sturdy, water-resistant housing.
- To make sure the gadget can survive drops and vibrations, shock-resistant materials were chosen.

7 My learnings

I learnt a lot about IoT systems from this project, especially about dealing with LoRa connectivity, SPI and MQTT protocols, and utilizing Node-RED to create interactive dashboards. I had hands-on experience integrating hardware, resolving connectivity issues, and efficiently visualizing real-time data. My understanding of how IoT can be used to address practical issues, like remote health monitoring, has improved because of this practical experience. My career will advance thanks to these technical skills as well as enhanced problem-solving and project management talents, especially in positions that emphasize embedded systems, IoT, or cutting-edge technology development.

8 Future work scope

- Data Logging and Analytics:

Adding real-time data logging and storage capabilities using SD cards or databases to enable trend analysis and historical data review.

- Advanced Sensor Integration:

Adding sensors for parameters like blood glucose, oxygen saturation (SpO2), or motion to expand functionality.

- AI and Predictive Features:

Using AI algorithms to detect potential emergencies early by analyzing historical data patterns.

- Scalability for Multi-Patient Monitoring:

Enhancing the system to monitor multiple patients simultaneously using a centralized dashboard.

- Mobile App Integration:

Developing a companion mobile app for caregivers to receive real-time alerts and monitor patient data remotely.

- Portability and Wearable Design:

Optimizing power efficiency and designing a compact, lightweight wearable device for better comfort and convenience.

- LoRaWAN or GSM Integration (Optional):

Expanding connectivity options for areas that require internet-dependent or long-range global communication.

- Emergency Automation:

Automating external systems (like emergency lights or communication with local emergency services) via relays in critical situations.

- Open-Source Platform:

Making the system open-source for wider collaboration and customization in healthcare innovation.

- Data Visualization and Reporting:

Incorporating tools like Power BI or Excel-based reporting for detailed analysis and visualization.