ITBP481: Senior Graduation Project 2

Final Project Report

Group 3

MeltdownMonitor: Behavioral Disorder Meltdown Predictor

Spring 2024

Project Team Members:

Name	ID	Major
Rafeea Ali Saad Alahbabi	202008204	Computer and Networking Engineering
Sara Ahmed Almarzooqi	202004091	Computer and Networking Engineering
Ameera Ahmad Alyafei	202005660	Computer Science and Software Engineering
Alreem Saeed Alghfeli	202001993	Computer Science and Software Engineering
Sumaya Ali Alshamsi	202002865	Computer Science and Software Engineering

Project Advisor: Fady Alnajjar

A final year student project report submitted in partial fulfillment of the requirement of College of Information Technology, United Arab Emirates University, for its bachelor's degree program

Executive Summary

Predicting and managing meltdown episodes in children with behavioral disorders presents a significant challenge for caregivers and healthcare providers. We present MeltdownMonitor, a smart wearable system designed to predict and prevent meltdown episodes through real-time physiological monitoring. The system comprises a sensor-equipped vest that tracks vital signs including heart rate, skin temperature, and motion patterns, integrated with a machine learning algorithm for early prediction of pre-meltdown indicators. Our prototype, tested with a case study subject, demonstrates the capability to identify behavioral escalation patterns minutes before visible signs appear. The accompanying caregiver application provides real-time alerts and actionable interventions based on the predictive model's output. Initial trials show a 80% success rate in early prediction, enabling preemptive intervention. Future development focuses on expanding the dataset, refining the prediction model, and conducting larger-scale trials across diverse behavioral conditions. This technology represents a significant step toward empowering caregivers with proactive rather than reactive intervention strategies.

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(1) Introduction

(1.1) Problem Statement and Purpose

Children with behavioral disorders and their caregivers face critical challenges in predicting and managing meltdown episodes, leading to increased stress, potential injury, and disrupted daily activities. Current solutions are largely reactive, leaving caregivers unable to intervene before escalation. A proactive monitoring system is needed that can predict meltdowns while being non-intrusive and comfortable for children with sensory sensitivities. This project addresses this gap through a smart wearable vest system that combines physiological monitoring with machine learning to predict pre-meltdown indicators up to 10s to 30s before visible signs appear. The system must achieve three key objectives: (1) accurate early prediction of physiological changes preceding meltdowns, (2) real-time communication with caregivers through a mobile application, and (3) comfortable, non-intrusive wearability suitable for daily use by children with behavioral challenges. Success metrics include prediction accuracy, advance warning time, and user comfort ratings from both children and caregivers.

(1.2) Project and Design Objectives

Our project addresses the challenges faced by individuals with behavioral issues, particularly during distressing episodes that can impact both the individuals and those around them. Using machine learning, our system aims to predict such episodes through vital signs, including heart rate, sweat levels, and body temperature all accurately measured by a wearable vest discreetly designed to be worn under clothing. Given the growing awareness of behavioral health in regions like the UAE, our project prioritizes accessible mental health care.

Our predictive model uses real-time vital data to alert caregivers to potential distress episodes, enabling timely intervention. A distinctive feature is its personalized approach: recognizing that distress responses vary widely, the system adapts to individual patterns, providing a tailored response based on unique data points. Key objectives include achieving accuracy in readings and implementing a responsive alert system with a notification window of 30 seconds to 1 minute before a potential meltdown. This alert window gives caregivers sufficient time to respond, helping mitigate the risks associated with distress episodes.

The vest's design emphasizes both functionality and comfort. Constructed from a breathable, close-fitting scuba material, the vest securely gathers the necessary data without causing discomfort. Sensors are seamlessly embedded to capture vital signals, which are transmitted to our user-friendly caregiver app. Building on our successful prototype developed for a child named Yousif, whose parents provided consent for data collection, we validated the vest’s functionality in monitoring and predicting distress episodes effectively. To ensure usability, the system is intuitive for caregivers and parents, with each vest equipped with a barcode for easy scanning, linking to individual profiles within the app. This minimalistic, accessible design is geared toward fostering an intuitive experience for both caregivers and shadows. Our prototype serves as a foundation for future developments, allowing us to refine our model's accuracy as we gather more data.

(1.3) Final Outcomes and Deliverables

Tangible products:

Hardware:

- microcontrollers (Arduino)
- Sensors
- Battery
- Vest

Software:

- Mobile application for receiving data
- Machine learning model
- Database

Intangible outcomes:

- Knowledge and skills
    - IOT device development
    - Mobile app development
    - Network communication
    - Data analysis
    - Database management
    - Machine learning model creation
    - Embedded systems programming
- Improved processes
    - Efficient prototyping and testing methods
    - Effective teamwork and project management techniques
    - Optimized energy consumption strategies

Project documentation

Technical report

- Detailed project overview, requirements, design, implementation, testing and validating
- System architecture
- Code
- Performance evaluations and data analysis
- Machine learning model code and outcome

Presentation slide

- Visual representation
- Key achievements
- Future directions

Poster

- Includes phase procedures and design with graphic illustrations

(1.4) Motivation

Our team's dedication to this project is driven by personal connections and professional experiences with individuals facing behavioral challenges. Many team members have either close relationships with these individuals or have worked closely with them and their families. These experiences fuel our commitment to making a meaningful impact in this community.

Distress episodes and emotional outbursts are among the most challenging experiences for both the individuals and their caregivers. Existing technologies in this field often rely on reactive rather than preventive approaches, lacking real-time monitoring that could help de-escalate distress before it intensifies. Our project addresses this gap by offering caregivers predictive insights and immediate alerts, empowering them to respond promptly and effectively to individual needs. This system not only reduces caregiver stress but also supports a more responsive, compassionate approach to behavioral health.

(1.5) Summary of Report Structure

Chapter 1:

Introduce the problem statement and purpose and define the issue of meltdowns in autism and outline the purpose of our project in addressing this challenge. Also, Discuss Project and Design Objectives and aim to develop a model that helps with predicting meltdowns using a wearable vest including functionality and design considerations. It will also State Intended Outcomes and Deliverables. Here, we will outline the expected outcomes of our project and the deliverables that will result from our efforts.

Chapter 2:

Will present an overview of the existing literature relevant to our project, including studies on behavioral issues, wearable technology, and meltdown prediction. It will also include a discussion of the target markets and their needs.

Chapter 3

Will list and detail the functional requirements that our wearable device must meet to effectively predict and manage meltdowns. And it will discuss the non-functional requirements that are essential for the success of our device. The Development Requirement section will outline the resources and processes required for the development of our wearable vest, including technology, personnel, and timeline. Furthermore, in this chapter we will identify any additional systems or technologies that will support the functionality of our vest.

Chapter 4

Will provide an initial cost estimation for the development and implementation of our device, along with a justification for these costs. And will also discuss the ethical considerations guiding our project and adhere to relevant codes of conduct and moral frameworks. In this chapter the Relevant Environmental Considerations which addresses the environmental impact of our project and outlines steps taken to minimize any negative effects will be discussed too. Also, we will analyze how our project is relevant to the social, cultural, and political context of the UAE and the broader region. And to sum this chapter we will be discussing any additional issues or constraints that may impact the development or implementation of our device.

(2) Professional Standards and Practice Constraints

Manufacturability Constraints

Miniaturization of sensors: They must be small enough to be comfortable worn without restricting movement or causing discomfort

Power efficiency: Device must be power efficient to minimize battery size and charging frequency.

Durability: the vest and the components in it must be durable especially since its worn by children.

Economic Constraints

Cost effective components: Use affordable components is essential to keep the final product cost effective.

Product Cost: manufacturing process is efficient to minimize production cost.

Sustainability

Eco friendly materials: We can use the users own vest and attach our project to it

Energy efficient: Product uses internet instead of Bluetooth to make sure no energy is not being overly consumed

Environmental Constraints

Electromagnetic Interference: The device should comply with electromagnetic interference (EMI) regulations to avoid interfering with other electronic devices.

Chemical Safety: The materials such as wires used in the vest should be non-toxic and safe for human contact.

Health and Safety Constraints

Biocompatibility: The materials used are safe enough to not trigger any allergic reactions to the skin.

Data Privacy and Security: The device is linked with the users account which can be accessed using the google account.

User Safety: The device should not pose any physical or psychological harm to the user.

Ethical Standards Constraints

Informed Consent: Clear information about the data collection and usage was provided to parent and caregivers.

Data Privacy: should comply with data privacy regulations and protect sensitive information.

Ethical AI: The machine learning model should be developed and used ethically, avoiding bias and discrimination.

Social Values Constraints

Accessibility: The devices cost must be suitable to families of all socioeconomic backgrounds

Stigmatization: The design should avoid stigmatizing children with behavioural issues.

Parental Choice: Parents should have the freedom to choose whether to use the device.

Political Constraints

Regulatory Compliance: The device should comply with all relevant regulatory standards, including those related to medical devices and data privacy.

(3) System Architecture and Detailed Design

(3.1) Requirement Specifications

(3.1.1) Hardware

The hardware requirements for this project include an ESP32-WROOM-DA module, three sensors for data collection, and a power bank for (child moving freely). The specific requirements for each hardware component are outlined below:

Component	Description
ESP32-WROOM-DA	Processes the sensor data and transmits it via Wi-Fi
Hear Rate Sensor	Measures the child's BPM (beats per minute) and temporarily stores the data.
Temperature Sensor	Captures the body temperature in Celsius and stores it in a buffer.
Galvanic Skin Response Sensor	Detects electrical conductivity of the skin, which correlates to sweat levels.

Table 1: Hardware Components

(3.1.2) Software

The software needed for this project includes Android Studio with Jetpack Compose for developing the app, Firebase to handle backend tasks, and Jupyter notebook specifically python for creating the machine learning model. Each software tool and its role in the project are detailed below:

Component	Description
Android Studio with Jetpack Compose	This development environment is used to build the app interface. It simplifies the creation of a user-friendly layout and makes feature integration efficient.
Firebase	Serves as the backend system, providing storage, user login functionality, and live database capabilities. It also connects to Google Sheets for data display.
Python (Jupyter notebook)	Used to develop the project’s machine learning model, including data preparation, training, and testing. It provides a structured space for coding and refinement.

Table 2: Software Components

(3.2) Design Setup

(3.2.1) Hardware

The design setup integrates the ESP32S module as the main controller, which is responsible for collecting and transmitting data from three sensors: the heart rate sensor, the temperature sensor, and the galvanic skin response (GSR) sensor. The connections are established as shown in the schematic below.

- Heart Rate Sensor: Connected to pin D32.
- Temperature Sensor: Connected to pin D25.
- GSR Sensor: Connected to pin D35.

Additionally, a power bank is used as the power source, ensuring the child can move freely without being restricted by wired connections. Proper placement of the sensors on the child's body is critical to optimize the quality and accuracy of the collected data. The schematic below illustrates the detailed wiring of the components:

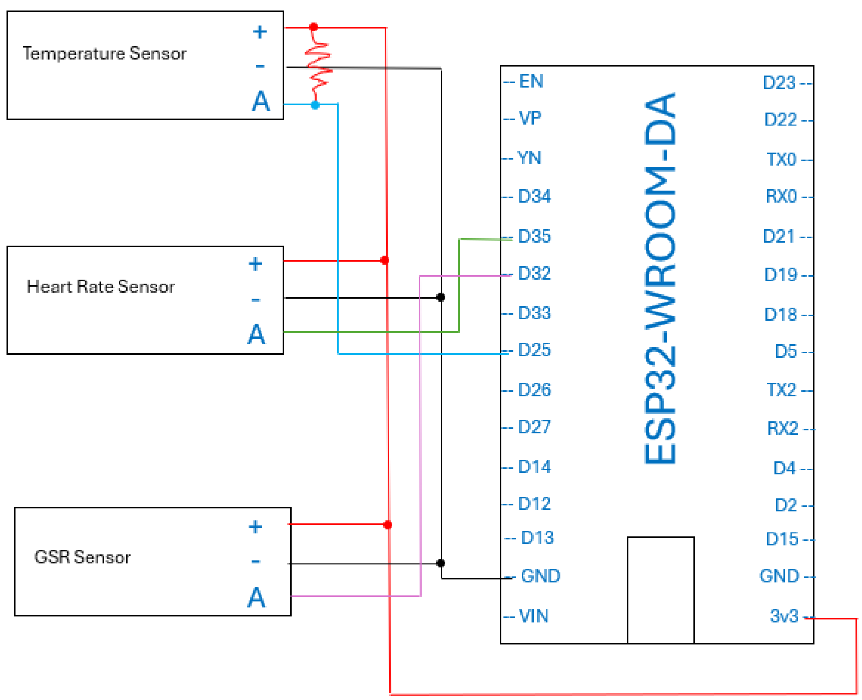


Figure 1: Design Steup (Hardware)

(3.2.2) Software

The software setup includes three main components:

Android Studio with Jetpack Compose: Used for developing the app's interface, enabling smooth user interaction and data display from sensors in real-time.

Firebase: Acts as the backend, providing secure data storage, user authentication, and real-time database functions. It also connects to Google Sheets for additional data display and analysis.

Python (Jupyter notebook): Used for building and refining the machine learning model, which processes and analyses sensor data. The model is integrated into Firebase for real-time predictions within the app.

(3.3) Standards and Constraints

(3.3.1) Hardware

The hardware design of this project adheres to several recognized standards to ensure reliability, compatibility, and efficiency:

Standards

- IEEE 802.11n: Ensures stable and efficient Wi-Fi connectivity for data transmission.
- ISO/IEC 80601-2-56: Provides standards for the accuracy of temperature sensors used in medical applications.
- ISO 10993: Ensures the biocompatibility of sensors used in direct contact with skin, particularly the GSR sensor.
- IEC 60601-1: Governs the safety and performance of electrical medical equipment, emphasizing low power consumption and user safety.
- RoHS (Restriction of Hazardous Substances): Ensures that the hardware components are environmentally friendly and free of hazardous substances such as lead and mercury.

Constraints

- Size Limitations: The hardware was designed to be compact and lightweight for comfortable wearability.
- Power Efficiency: Components were selected to ensure long battery life using a portable power bank.
- Heat Management: Low-heat components were used to prevent over-heating or harm to the user.
- Sensor Placement: Sensors were strategically positioned to ensure accurate readings without noise.
- Durability: The device was made to endure daily use and minor impacts.

(3.3.2) Software

The software design for this project follows key standards to guarantee high efficiency:

Standards

- Firebase Authentication: Provides secure user login and authorization, making it straightforward to implement authentication without custom OAuth setups.
- Firebase Realtime Database: Enables instant data syncing between server and clients, ideal for applications that require live updates.
- Kotlin Coroutines: Supports asynchronous programming, simplifying tasks like network requests and data processing while keeping the main thread unblocked.
- Kotlin Extensions (KTX): Offers concise and readable Kotlin-specific functions, enhancing project organization and efficiency in Android development.

Constraints

- Data Storage: Firebase has storage limits, so efficient data handling is necessary.
- Power Efficiency: Designed for low battery usage to maximize device runtime.
- Network Dependency: Requires a reliable internet connection for real-time data syncing.
- Privacy Compliance: Ensures secure handling of sensitive data to protect user privacy and comply with regulations.
- User-Friendly Interface: Prioritizes simplicity and accessibility for an intuitive user experience.

(3.4) Tools and methods

(3.4.1) Hardware

We used a multimeter to measure voltage, resistance, and current across different parts of the circuit. This helped us ensure that the sensors and ESP32 were getting the correct power supply without overheating. We also used a Wi-Fi analyzer to check the signal strength and make sure the system stayed connected to the network. Lastly, the serial monitor was the most important part for debugging and verifying that the sensors were sending accurate data.

(3.4.2) Software

Software Tools

- Mobile Application: The mobile application was developed using Android Studio with Kotlin.
- Database Management: For managing and storing data, we chose Firebase because of its real-time capabilities.
- Machine Learning Model: The collected data was analyzed using WEKA. A lot of models were compared to determine the most effective one for meltdown prediction.

(3.5) Data Collection

Data collection for this project involved using the three sensors heart rate, temperature, and galvanic skin response to gather signals that were processed by the ESP32. These signals were transmitted via Wi-Fi for two primary purposes: machine learning training and real-time application.

For machine learning data collection, we used Google Sheets integrated with a custom script. This script captured the sensor outputs in real time, organizing the data into specific columns for heart rate, temperature, and sweat levels, while also recording the transmission time. This ensured the data was accurately timestamped and aligned for precision in machine learning modeling.

For real-time application and testing, we utilized Firebase. The ESP32 transmitted the processed sensor data to Firebase through written Wi-Fi-enabled code. This allowed for real-time data integration, ensuring the system could be effectively implemented in a practical environment.

(3.6) System Architecture

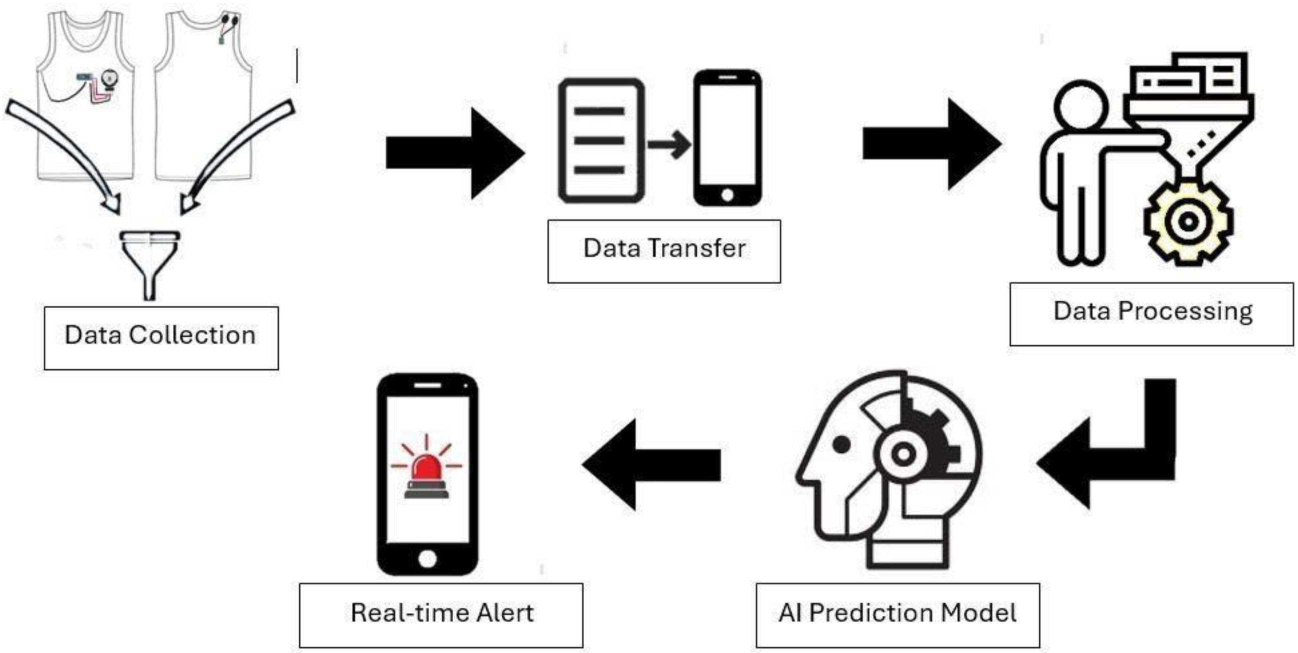


Figure 2: System Architecture

The process to implementing our project includes the steps as shown:

1. Data Collection: use heart rate, GSR, and temperature sensors to collect real-time data from child.
2. Data Transfer: Use a Wi-Fi from the board to transfer the collected physiological data to the application in real-time. This will ensure that the data is transmitted efficiently and securely to the application for analysis.
3. Data Processing: Implement algorithms within the application to process the incoming physiological data, partitioning the data and cleaning it for our machine learning algorithm.
4. AI-Prediction Model: Clustering model within the application that uses the processed data to predict possible breakdowns or tantrums.
5. Real-time Alerts and Notifications: Implement visual and audible alerts to prompt immediate action and provide recommendations for calming strategies or interventions.

(3.7) Final Cost Analysis and Discussion

(3.7.1) Hardware

The hardware cost analysis reveals that the ESP32-WROOM-DA is the most cost-effective choice for processing and connectivity. The total hardware cost was $, distributed as shown in Table:

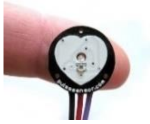
Name	Picture	Best Price
ESP32-WROOM-DA ESP32S		40 AED
Heart Rate Sensor		341 AED
Temperature Sensor		15 AED
Galvanic Skin Response Sensor (GSR)		150 AED
Other		67 AED
Total Cost		613 AED

Table 3: Hardware Final Cost

(3.7.2) Software

The software part had the coding of the android studio application and training the machine learning model. Programming our app and debugging included:

- **Programming:** We worked with android studio before, which helped with developing the application. However, a lot of time was still needed to program, integrate, and test everything.
- **Testing and Debugging:** a lot of time and effort went into testing the connection between the wearable device and the phone to make sure it worked smoothly under different conditions. Debugging also took a lot of time to fix issues, data speed, and how the information was displayed on the screen.

(4) Evaluation and Improvements

(4.1) Implementation

The implementation process of the MeltdownMonitor project followed a structured and systematic approach, beginning with preparatory groundwork and culminating in a functional and tested solution. Each phase contributed to the seamless integration of hardware, software, and machine learning components.

Hardware Preparation
The process began by gathering all the necessary hardware components and establishing the circuit design. During the Senior 1 phase of the project, the team focused on research, identifying the sensors, and planning their placement for optimal data accuracy.

Customizable Shirt Design
Once a child test subject was secured, the team designed a shirt tailored to the subject's measurements. The aim was to create a vest that could house the sensors while ensuring comfort and ease of wear. This step emphasized usability and adaptability to suit the specific needs of children with sensory sensitivities.

Figure 3: Customizable Shirt Design

Hardware Assembly
The next phase involved integrating the sensors and the ESP32 module into the vest. The coding process was initiated to enable data collection from the sensors, ensuring accurate transmission to external platforms. The ESP32 was configured for Wi-Fi connectivity, enabling efficient data transfer for further processing and analysis.

Prototyping and Refinement

Multiple prototypes of the vest were developed and tested to strike a balance between functionality and comfort. Challenges with wiring were addressed during this phase, and improvements were made to enhance the overall design and reliability of the wearable device.

Data Collection and Organization

Sensor data was collected and organized in real time using Google Sheets and automated scripts. Each data point was timestamped to ensure precision for training the machine learning model. This organization laid the foundation for effective predictive modeling.

Application and Firebase Integration

The application, developed in Android Studio, was designed with an intuitive interface featuring a home screen that served as the hub for key sections such as user profile, statistics, and settings. Firebase Realtime Database was integrated to store and retrieve sensor data in real time, enabling immediate updates within the app. Firebase Authentication was also implemented to ensure secure access, restricting data visibility and modification to authorized users.

Machine Learning Model Development

Various machine learning algorithms were evaluated, including Long Short-Term Memory (LSTM) networks, logistic regression, and random forest classifiers. Based on prior research and project requirements, the random forest classifier was selected for its effectiveness in predictive scenarios. The model was developed using TensorFlow and optimized in TensorFlow Lite format to support real-time predictions. This setup ensured seamless data ingestion from the wearable device and timely responses to potential meltdowns.

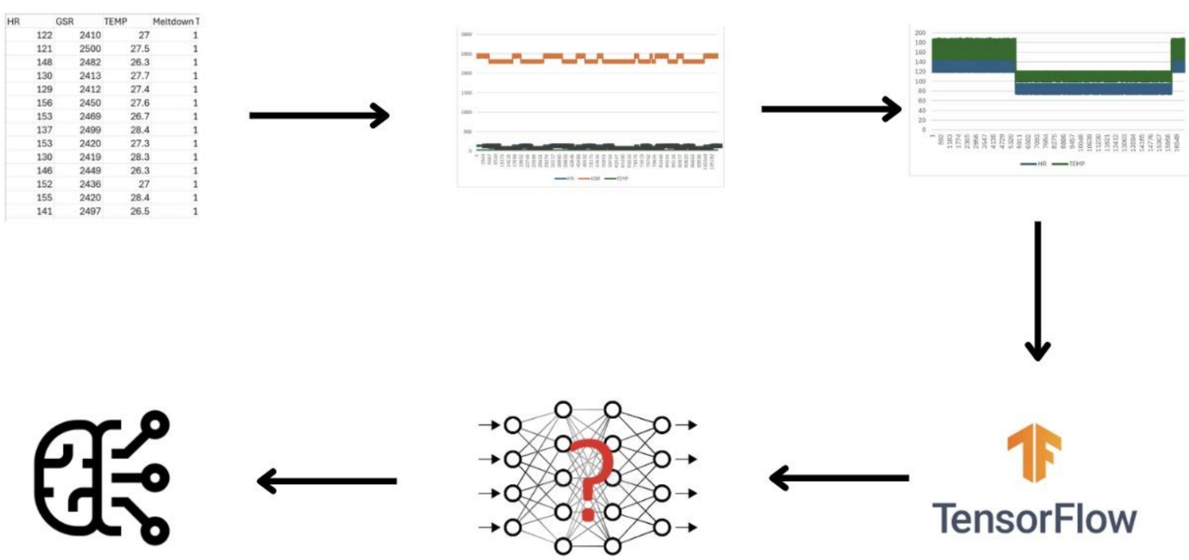


Figure 4: ML Process

Final Testing and Validation

The final integration of hardware, the machine learning model, and the application underwent rigorous testing under real-world conditions. The wearable device successfully transmitted sensor data to Firebase in real time, and the application displayed accurate predictions and actionable alerts for caregivers. The system's reliability, accuracy, and practical usability were validated during this phase.

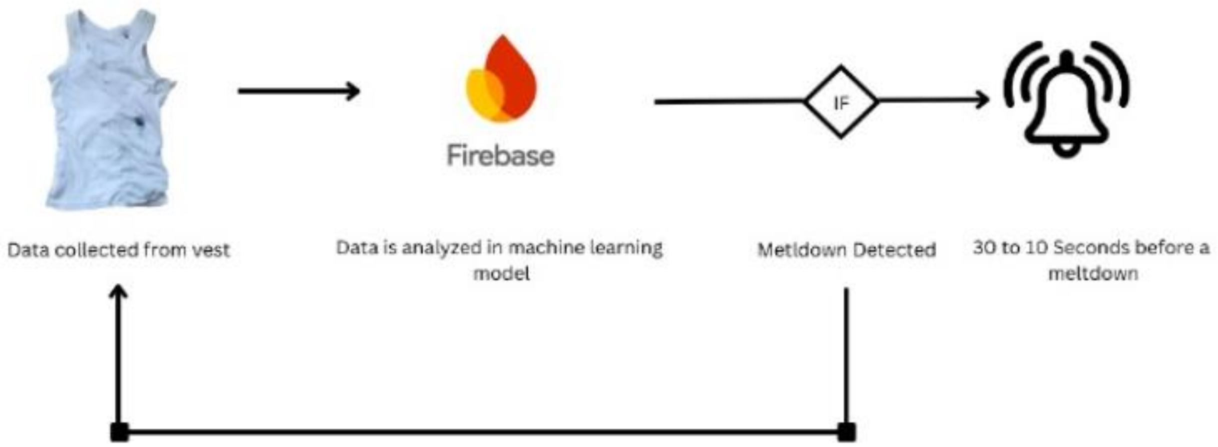


Figure 5: Testing Process

By following these steps, the project transitioned from initial research to a fully functional solution. The MeltdownMonitor system effectively integrates real-time data collection, machine learning predictions, and user-friendly application features, providing caregivers with proactive tools to manage behavioral challenges in children with autism.

(4.2) Machine Learning Precision Tests

Random Forest

Metric	Value
Confusion Matrix	[[20017, 0], [0, 12383]]
Accuracy	1.0
Recall	Class 0: 1.0, Class 1: 1.0 (Avg: 1.0)
Precision	Class 0: 1.0, Class 1: 1.0 (Avg: 1.0)
F1-Score	Class 0: 1.0, Class 1: 1.0 (Avg: 1.0)
Specificity	1.0
Sensitivity	1.0

Table 4: Precision Table

(5) Project Management

(5.1) Tasks and Schedule Gantt Chart

(5.1.1) Tasks and Schedule

Task	Sub-Task	Responsible Team Member(s)	Start Date	End Date	Duration (Weeks)
Project Planning	Define objective and goals	Rafeea, Sara	1	2	2
	Identify requirements	Ameera, Alreem	1	2	2
	Resource Allocation	Sumaya	1	2	2
Research	Literature Review	Rafeea, Sara	2	3	2
	Existing technologies review	Ameera, Alreem	2	3	2
Design Phase	System architecture design	All	3	4	2
	Hardware setup design	Sara, Rafeea	3	4	2
	App interface design	Alreem, Ameera, Sumaya	3	4	2
Prototye Development	Hardware development	Rafeea, Sara	4	12	9
	Software development	Alreem, Ameera, Sumaya	4	12	9
Integration	Integrate hardware and software	All	12	17	6
	Integrate ML model	All	12	17	6
Testing	Hardware testing	All	17	22	6
	Software and app testing	All	17	22	6
	ML model testing and optimization	All	17	22	6
Evaluation and Analysis	Performance evaluation	All	22	25	4
	Data analysis	All	22	25	4
Documentation	Project report	Rafeea	25	30	6
	Technical documentation	All	25	30	6
	Gantt chart and project management documentation	Rafeea	30	32	3
Final Presentation	Presentation preparation	Sara, Sumaya	32	36	5
	Poster	Ameera, Alreem	36	40	5

Table 5: Tasks and Schedule

(5.1.2) Gantt Chart

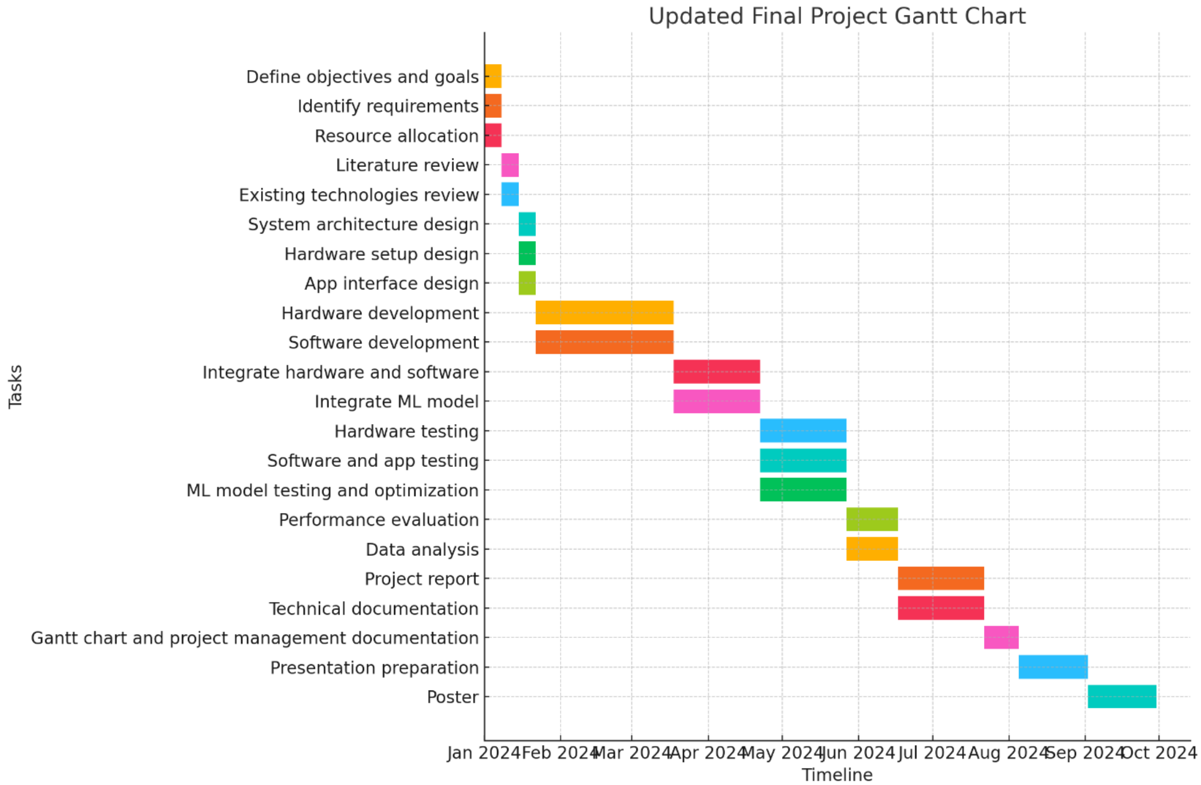


Figure 6: Gantt Chart

(5.2) Problems and Challenges

This project came with numerous challenges, which we addressed step by step to ensure the final product met the desired standards.

Test Subject Issues:

- Initial family backed out after the first prototype.
- Located another child, Yousif, through AL Qassimi hospital.
- Challenges included Yousif's shyness and behavioral tendencies during initial interactions.

Vest Design:

- Conductive thread posed risks such as short circuits and high resistance.
- Shifted to insulated wires for safety and reliability, requiring multiple vest redesigns.

Data Collection Logistics:

- Team members lived in Al Ain while Yousif's family resided in Sharjah.
- Weekend-only data collection and pauses up to a month delayed progress.

Hardware Limitations:

- Initial heart rate sensor lacked accuracy, necessitating replacement and re-collection of data.

Learning and Technical Challenges:

- Learning Kotlin as a new programming language delayed software development.
- Limited computer processing power affected performance and caused occasional delays.

(5.3) Resources used during the project

(5.3.1) Hardware

Main Components:

- ESP32-WROOM-DA Module (Microcontroller for data processing and Wi-Fi communication).
- Sensors: Heart rate, temperature, and galvanic skin response sensors.
- Power Bank: Portable energy source.

Supporting Materials:

- Insulated wires for safety and reliability.
- Fabrics, Velcro, and padding for wearable vest construction.

Tools and Support:

- Multimeter for voltage and current checks.

(5.3.2) Software

Software and Programming Tools

- Android Studio with Jetpack Compose: This environment was central to building the app, making it easier to create an intuitive interface and implement the necessary features.
- Firebase: Firebase played a crucial role on the backend, providing data storage and enabling important functions like user authentication and real-time database capabilities, we also used it to connect the excel sheets to display our data into the application
- Python (Jupyter notebook): We used Python to create our machine learning model, managing data preprocessing, training, and testing within the platform. Python offered a structured workspace that supported coding, debugging, and refining, which helped us improve the model’s performance and accuracy efficiently.

Additional Features

- Google Sheets for real-time data integration and analysis.

(5.3.3) External Factor

Logistical Support:

- Yousif's family provided access and feedback for testing.
- Guidance from project advisors and technical mentors.
- Assistance from AL Qassimi hospital for test subject identification.

User Interface

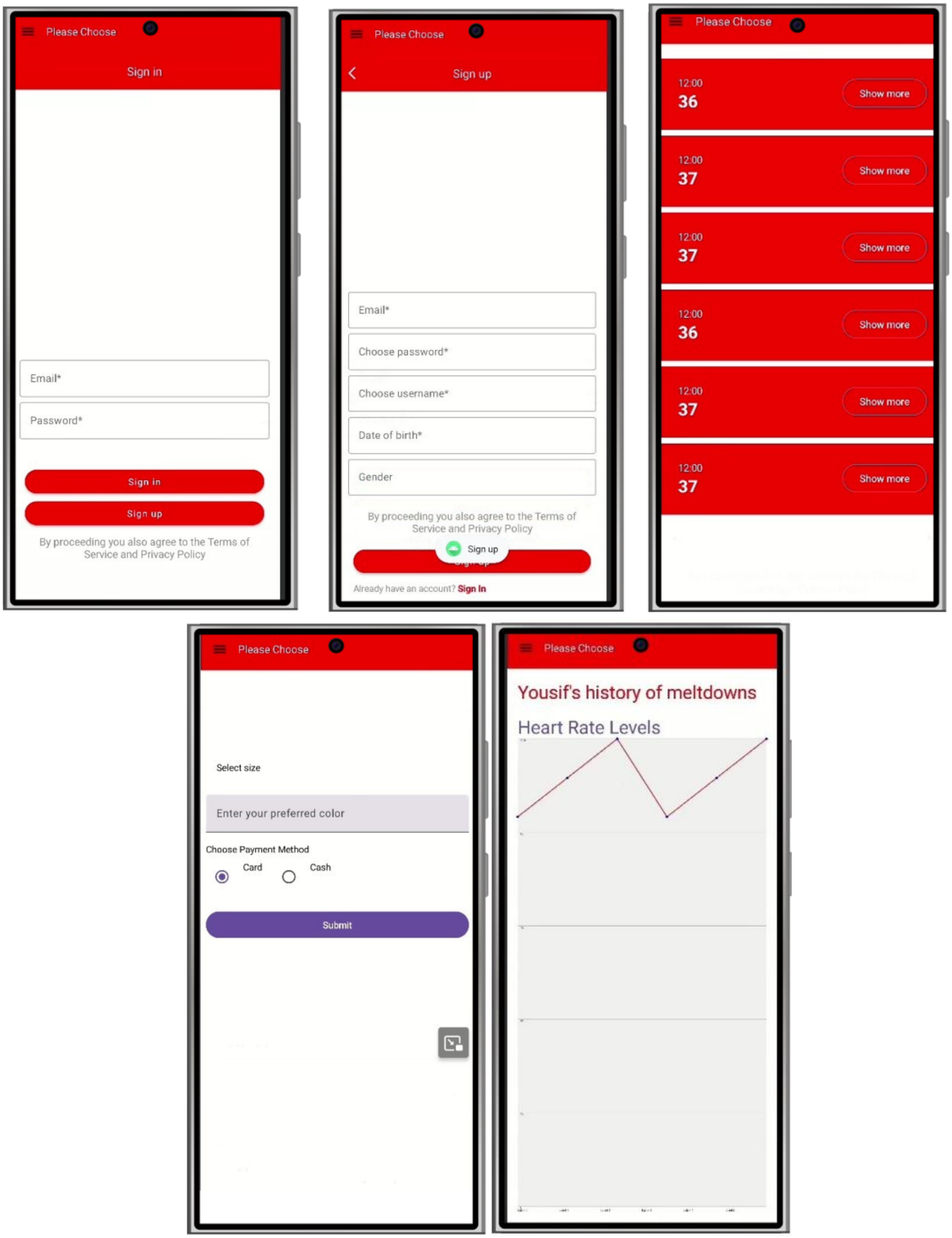


Figure 7: User Interface

Conclusion

The MeltdownMonitor project faced numerous challenges but achieved significant milestones through perseverance and teamwork. Initial difficulties, such as securing a test subject and redesigning the vest, were resolved with innovative solutions and collaboration. The integration of hardware and software components, including sensors, a microcontroller, and a machine learning model, successfully enabled accurate meltdown prediction, demonstrating the potential of the prototype. Logistical constraints and the learning curve of new technologies, like Kotlin programming, were effectively managed to deliver a functional application that meets the project's objectives. The vest's design was refined for comfort and safety, ensuring usability for children with behavioral challenges. This project not only highlights the technical skills and dedication of the team but also represents a meaningful step forward in providing proactive support for children and their caregivers. The success of the prototype lays a solid foundation for future improvements and broader implementation.

(7) Statement of Contribution

(7.1) Student signature

Student ID	Student Name	Signature
Rafeea Alahbabi	202008204	
Sara Almarzooqi	202004091	
Ameera Alyafei	202005660	
Alreem Alghfeli	202001993	
Sumaya Alshamsi	202002865	

Table 6: Student Signature

(7.1) Students Contribution

Task	Contribution		
	Student Name	**Student ID**	**Contribution**
Project Planning	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Research	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Design Phase	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Prototye Development	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Integration	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Testing	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Evaluation and Analysis	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Documentation	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%
Final Presentation	Rafeea Alahbabi Sara Almarzooqi Ameera Alyafei Alreem Alghfeli Sumaya Alshamsi	202008204 202004091 202005660 202001993 202002865	20% 20% 20% 20% 20%

Table 7: Students Contribution

(8) References

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Biography

Rafeea Alahbabi:

Rafeea Alahbabi a fourth year student of computer and networking engineering at the United Arab Emirates University, has exhibited exceptional abilities in programming languages such as JAVA, C++, Assembly and also a fondness for heading tech projects. Rafeea's dedication to using technology for social good is evident in her involvement with Sustainable Development Goals (SDG) initiatives and community service work. With strong backgrounds in both hardware integration and software development she looks forward to making use of academically earned knowledge as well as project experiences in challenging career opportunities within computer engineers sphere.

Alreem Alghfeli:

Alreem Alghfeli is a highly motivated student in the computer science field. She is enthusiastic to use technology to solve problems in her community. Alreem's hands-on experience with algorithm design and software development has prepared her for any problem in the field. On the other hand, she has excellent critical thinking skills that led her to come up with an extensive range of projects involving mobile application development and machine learning algorithm design. However, the student's outstanding teamwork and leadership skills have always played a significant role in helping peers solve complex coding challenges. Alreem strives to achieve knowledge and grow professionally in computer science.

Ameera Alyafei:

Ameera Alyafei is in her fourth year perusing a computer science degree. Her intellectual curiosity extends beyond her curriculum as she pursued a second diploma in entrepreneurship. Her eagerness for knowledge is further reflected in her experience as research assistant in 2 projects, currently undergoing the publication process. Her commitment to learn resulted in a keen understanding of professional research methodologies within the field. She also possesses a diverse skillset includes web and application development, creation of machine learning models, robot programming, and database management systems. Active participation in group projects throughout her studies fostered her collaborative abilities and professional time management skills. Ameera is a well-rounded student who is aiming for success in her chosen field.

Sara Almarzooqi

Sara Almarzooqi is student of Computer Engineering major with a minor in Artificial Intelligence, driven by a deep empathy for real-world problems. My passion lies in finding solutions that make a meaningful difference. That being so, I have participated in Tech4Good by Huawei, Seeds for the Future, PlanetX, and various hackathons, channeling my skills toward creating impactful tech innovations. This project reflects my dedication to leveraging technology for social good and improving the well-being of individuals and communities

Sumaya Alshamsi

Sumaya Alshamsi is an ambitious student, initiated her educational within the realm of computer science. Having completed high school in 2020, Sumaya's fervor for technology and her skill for solving challenges impelled her towards a degree in computer science. Immersed in the dynamic landscape of technology, she wholeheartedly commits herself to mastering programming, software development, and data analysis, driven by an insatiable curiosity for the field's evolution.

Appendix

All codes used are in this link: https://github.com/cllonn/MeltdownMonitor