VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY
(An Autonomous Institute Affiliated to University of Mumbai)
Department of Computer Engineering

Project Report on

SafeGuard:AI Driven Child Safety

Submitted in partial fulfillment of the requirements of the degree

BACHELOR OF ENGINEERING IN COMPUTER ENGINEERING

By

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University of Mumbai
(AY 2024-25)

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

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Department of Computer Engineering

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CERTIFICATE

This is to certify that the Mini Project entitled **"SafeGuard:AI Driven Child Safety"** is a bonafide work of **Sakshi Valecha (D17C-71), Vaibhavi Shetty (D17C-59), Tanya Lilani (D17C-40), Chirag Mangtani (D17C-45)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Computer Engineering"** .

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Mini Project Approval

This Mini Project entitled "**SafeGuard:AI Driven Child Safety**" by **Sakshi Valecha (D17C-71), Vaibhavi Shetty (D17C-59), Tanya Lilani (D17C-40), Chirag Mangtani (D17C-45)** is approved for the degree of **Bachelor of Engineering in Computer Engineering.**

Examiners

1...
(Internal Examiner Name & Sign)

2.......................23/10/24.......................
(External Examiner name & Sign)

Date: 23|10|2024

Place: Chembur.

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Sakshi	Tanya
(Signature)	(Signature)
Sakshi Valecha (71)	Tanya Lilani (40)
(Name of Student & Roll No.)	(Name of Student & Roll No.)
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Date: 23/10/24

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We express our hearty thanks to them for their assistance without which it would have been difficult in finishing this project synopsis and project review successfully.

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Abstract

SafeGuard is an innovative AI-driven solution dedicated to enhancing child safety through a wearable device seamlessly integrated into children's clothing. This device continuously monitors critical environmental factors such as temperature, humidity, and oxygen levels while providing real-time location tracking. By transmitting data to a cloud server, SafeGuard enables parents to monitor their child's safety via a user-friendly web interface and receive immediate alerts for any deviations from safe conditions. The project focuses on three key quotients: Safety, Social, and Emotional. Safety is ensured through round-the-clock supervision, providing peace of mind for families and fostering a secure environment for children. The Social Quotient emphasizes community engagement, encouraging connections between families and ensuring quick emergency responses. Meanwhile, the Emotional Quotient addresses the emotional well-being of children, empowering them with a sense of security and support through continuous monitoring. SafeGuard incorporates advanced technology, including Raspberry Pi and various sensors, offering predictive analytics and adaptive learning tailored to individual needs, particularly for children with disabilities. Practical use cases illustrate the device's effectiveness in real-world scenarios, such as alerting parents when children are left unattended in unsafe conditions or if a kidnapping is suspected. Overall, SafeGuard presents a comprehensive approach to child safety, emphasizing proactive measures, timely interventions, and enhanced support for families, ultimately improving the overall well-being of children in diverse environments.

Chapter 1: Introduction

1.1 Introduction

SafeGuard is an innovative AI-driven solution designed to enhance child safety through a groundbreaking wearable device that is seamlessly integrated into children's clothing. This device continuously monitors critical environmental factors, such as temperature, humidity, oxygen levels, and the child's location in real-time. By utilizing advanced technology, the device collects and transmits data to a central cloud server, allowing parents to access vital information through a user-friendly web interface. The ability to receive immediate alerts for any deviations from safe conditions empowers parents to act swiftly, ensuring their child's safety in various environments.

The project emphasizes a holistic approach to child safety, focusing on three essential quotients: Safety, Social, and Emotional. The Safety Quotient provides round-the-clock supervision, fostering a secure environment and peace of mind for families. The Social Quotient enhances community engagement, encouraging meaningful connections between families and enabling rapid emergency responses. Meanwhile, the Emotional Quotient addresses the emotional well-being of children, instilling a sense of security and support through continuous monitoring. By integrating these components, SafeGuard aims to provide comprehensive protection and support for children, particularly those with special needs, ensuring that families can navigate everyday challenges with confidence.

1.2 Motivation

The motivation behind SafeGuard stems from the urgent need to enhance child safety in an increasingly unpredictable world. With rising concerns about children's well-being, including the risks of abduction, environmental hazards, and the unique challenges faced by children with disabilities, there is a pressing demand for innovative solutions that provide real-time monitoring and support. SafeGuard aims to empower parents by offering peace of mind through continuous oversight, allowing them to respond promptly to any potential threats. Additionally, by fostering emotional well-being and encouraging community connections, SafeGuard seeks to create a supportive environment where children can thrive safely. This project is driven by a commitment to ensuring that every child feels secure, supported, and connected, enabling families to focus on nurturing their children's growth and development without constant worry.

1.3 Problem Definition

The problem of child safety is a growing concern in today's society, as parents face numerous challenges in protecting their children from various potential threats. These threats include environmental hazards, the risk of abduction, and the unique needs of children with disabilities, all of which can lead to heightened anxiety for caregivers. Traditional safety measures often fall short, lacking real-time monitoring and the ability to quickly respond to emergencies. This gap in existing solutions highlights the need for a more comprehensive approach that integrates technology to provide continuous oversight and immediate alerts for any deviations from safe conditions.

To address these challenges, SafeGuard proposes an AI-driven solution that combines wearable technology with advanced monitoring capabilities. By seamlessly integrating a device into children's clothing, SafeGuard enables real-time tracking of location and environmental factors, allowing parents to stay informed about their child's safety at all times. This innovative approach not only enhances the immediate response to potential dangers but also supports the emotional well-being of children by fostering a sense of security. Ultimately, the goal is to create a robust safety net that empowers families, reduces anxiety, and ensures that children can navigate their surroundings confidently and safely.

Objectives:

- **Ensure Child Safety:** Provide continuous monitoring and distress alerts to safeguard children in various environments.
- **Real-Time Monitoring and Alerts:** Utilize predictive analytics for instant analysis, AI detection, and proactive interventions to enhance response times.
- **Enhance Caregiver Response:** Deliver timely information and emergency alerts to enable quick action by caregivers during critical situations.
- **Adaptive Learning and Personalized Monitoring:** Implement adaptive models that cater to individual needs through personalized monitoring and AI-driven learning.
- **Integration of Advanced Technology:** Leverage affordable technology, such as Raspberry Pi, to facilitate effective child safety solutions.
- **Cultural Awareness and Sensitivity:** Ensure AI models are culturally aware, interpreting behaviors in a context-sensitive manner to better serve diverse populations.

- **Contextual Awareness:** Address challenges related to AI context to minimize false positives and negatives in monitoring.
- **Accessibility for Special Needs:** Identify and bridge design gaps in AI technology to support children with disabilities and sensory or cognitive impairments.
- **Specific Therapeutic Interventions:** Offer targeted treatments and customized therapies tailored to individual conditions for enhanced care.
- **Emotional and Physical Demands:** Recognize and alleviate stress, fatigue, and emotional strain experienced by families caring for children.
- **Round-the-Clock Supervision:** Ensure 24/7 monitoring for continuous oversight and peace of mind for families.
- **User-Friendly Interface:** Create an easy-to-use, intuitive design that allows parents to monitor their child's safety effortlessly.
- **Behavior Monitoring:** Track actions and observe patterns in children's behavior to identify any concerning changes.
- **Content Filtering:** Implement screening measures to restrict access to potentially harmful content, ensuring a safe environment.

1.4 Lacuna of the existing systems

Existing systems for child safety exhibit significant gaps that limit their effectiveness. Many lack personalized learning and support, failing to adapt to individual children's needs. Behavior monitoring and emotion detection capabilities are often underdeveloped, leaving caregivers without crucial insights. Real-time alerts may not be timely or accurate enough, while content filtering mechanisms frequently fall short in ensuring online safety. Additionally, predictive analytics are rarely integrated, hindering the ability to foresee potential risks. Location tracking can be inadequate, especially for unattended children, increasing vulnerability. Cultural sensitivity is often overlooked, leading to a one-size-fits-all approach. Contextual awareness issues can result in false positives or negatives in alerts. User experience and accessibility remain challenges, preventing effective utilization by all caregivers. Overall, these gaps highlight the need for a more comprehensive solution that addresses the multifaceted challenges of child safety.

1.5 Relevance of the Project

The relevance of the SafeGuard project lies in its timely and innovative approach to addressing the critical issue of child safety in today's complex and often unpredictable environment. As concerns about children's well-being grow, the need for effective solutions that combine real-time monitoring, personalized support, and proactive interventions has never been greater. SafeGuard not only enhances parental awareness through continuous tracking of environmental factors and location but also fosters emotional well-being and social connections. By integrating advanced technology with a focus on cultural sensitivity and accessibility, the project aims to empower families and provide tailored support, particularly for children with special needs. Ultimately, SafeGuard's comprehensive framework addresses pressing safety challenges while promoting a nurturing environment, making it a vital contribution to the field of child safety and family support.

1.5 Methodology Used

The methodology for the SafeGuard project involves a comprehensive approach combining qualitative and quantitative research techniques. Initially, extensive literature reviews and market analysis were conducted to identify existing child safety solutions and their limitations. Surveys and interviews with parents, caregivers, and child safety experts provided insights into the specific needs and concerns regarding child safety. Based on this feedback, the design of the wearable device was conceptualized, focusing on essential features such as real-time monitoring and environmental data collection. Prototyping was carried out using a Raspberry Pi and various sensors, including BME680, MIX8410, and GPS HAT, to evaluate performance and functionality. The development of a user-friendly web interface was informed by user experience testing, ensuring accessibility for all users, including those with special needs. Finally, case studies were established to simulate real-world scenarios and assess the effectiveness of the device in enhancing child safety and caregiver response. Continuous iterations of testing and refinement were implemented to address any challenges encountered during the development process, ensuring a robust and effective solution.

Chapter 2: Literature Survey

2.1 Research Papers Referred

Research Papers Referred

SR. NO	TITLE	POSSIBLE IDENTIFIER	ACTION TAKEN	GAP ANALYSIS
1.	L. Orriens & C. Erasmus, "Social and emotional impact of anterior drooling in school-age children and young people with neurodevelopmental disabilities", August 15,2024	- Anterior drooling - Neurodevelopmental disabilities - Social and emotional impact.	**Social Interaction:** The paper highlights the impact of drooling on social interactions and self-esteem, which aligns with the objective of addressing challenges faced by children in social settings. **Emotional Support:** Findings on emotional dissatisfaction and peer avoidance support the need for interventions that provide emotional and social support.	**Lacks Real-Time Monitoring:** The study doesn't address real-time monitoring or intervention strategies. **No Technological Solutions:** It doesn't explore AI or IoT for personalized, real-time support. **Missing Tech Integration:** The research lacks discussion on using technology for immediate intervention.
2.	K.Moussa & B. Xu, "Revolutionizing Healthcare: Seamless Integration of Cloud Technology and IoT for Health Monitoring Systems", August 1, 2024	**IoT and Cloud Integration:** Real-time health monitoring. **Raspberry Pi:** Data measurement and transmission. **MQTT Protocol:** Enhanced communication and data management.	**Healthcare Monitoring:** The paper aligns with real-time health data collection using Raspberry Pi and IoT. **Real-Time Reporting:** Integration of MQTT supports real-time data transmission and reporting. **System Efficiency:** Focuses on high reliability and scalability through cloud computing.	**Privacy and Security:** Lacks coverage of data protection and compliance with health regulations. **User Interface:** Does not discuss system usability or accessibility for healthcare professionals and patients. **Integration:** Does not address how the system fits with existing healthcare infrastructure. **Long-Term Analysis:** Omits long-term data analysis and trends for improving health outcomes.
3.	J. Anderson & C.	- Dance	**Dance Intervention**	**Social Skills Impact:**

	Toolan, "A novel dance intervention program for children and adolescents with developmental disabilities", May 14, 2024	intervention - Developmental disabilities - Randomized control trial	**Program:** Implemented a 10-week online dance program for children with developmental disabilities. **Assessment:** Used the Motor Assessment Battery for Children and Social Responsiveness Scale to measure outcomes. **Feasibility Study:** Conducted a pilot randomized control trial to evaluate the impact on motor skills and social abilities.	Limited evidence of significant improvement in social skills. **Program Reach:** Study highlights feasibility but needs broader implementation for generalizability. **Long-Term Effects:** Lack of data on long-term benefits and sustainability of the dance program. **Sample Diversity:** Limited sample size and scope may affect the applicability of results to a wider population.
4.	F.Altinay & A.Tlili, "Meta-In or Meta-Out of Students with Special Needs: A Systematic Review on the Use of Metaverse in Special Education",May 8,2024	• **Metaverse Technologies**: Immersive tools and platforms. • **Special Education**: Focus on learners with disabilities. • **Challenges**: Technological, pedagogical, psychological, accessibility, communication, and inclusion issues.	**Technological Integration:** Highlights the use of metaverse technologies for enhancing learning, aligning with IoT and AI integration. **Accessibility:** Addresses challenges in equal access and inclusive participation for children with special needs. **Personalized Learning:** Supports individualized care and interventions, similar to the real-time feedback in your project.	**Implementation Details:** Lacks specific strategies for real-time monitoring and support. **Real-Time Interventions:** Discusses general challenges but not practical applications for immediate support. **Technology Integration:** Emphasizes metaverse design but not the integration of IoT and AI for behavior detection.
5.	L.Arya & P.Ranade & T.Goswami, "Intellectually Disabled Child Holistic Growth Management Platform: Voice Interaction and	**Digital Platform:** Voice interaction for child growth. **Human-Centered Design:** Focused on children's needs. **Holistic Growth:** Supports skill development and	**Support for Holistic Growth:** Aligns with the objective of supporting overall development in children with intellectual disabilities. **Assistive Technology:**	**Real-Time Monitoring:** Lacks focus on real-time monitoring and immediate feedback systems, a critical gap for timely interventions. **Integration with**

	Scheduling", May 8, 2024	learning.	Proposes voice-based tech to aid learning and development. **Parental Involvement:** Includes features for parents to track and support their child's progress.	**Other Technologies:** Primarily centers on voice interaction and scheduling, without discussing integration with AI or IoT for enhanced real-time support. **Detailed Emotional and Social Support:** Does not cover emotional and social support mechanisms, *missing* a crucial aspect of comprehensive child development.
6.	Y. Wang & Y. Liu, "Working memory predicts receptive vocabulary", April 29, 2024	- Working memory - Receptive vocabulary - Intellectual disabilities	**Emotional Support:** The study highlights cognitive interventions' role in improving communication, indirectly supporting emotional well-being. **Personalized Interaction:** It suggests targeting working memory through personalized strategies, aligning with the need for tailored educational approaches.	**Real-Time Monitoring and Feedback:** The study does not address real-time monitoring or immediate interventions, focusing instead on longitudinal changes. **Technological Integration:** It lacks exploration of AI-driven tools for cognitive support, unlike your project's focus on real-time technological solutions. **Holistic Approach:** The research focuses on cognitive aspects without considering a broader approach that includes emotional, social, and practical support.
7.	P. Simon & N. Grosbois, "How do Children with Intellectual Disabilities	- Empathy - Intellectual disabilities - Comparison with typically	**Social Interaction:** The paper addresses empathy in children with ID, aligning with the goal of	**Real-Time Monitoring and Feedback:** The paper does not focus on real-time monitoring

	Empathize in Comparison to Typically Developing Children?", April 12, 2024	developing children	understanding social challenges. **Emotional Support:** Findings on empathy can inform interventions for emotional and social support.	or immediate interventions. **Technological Integration:** The study lacks exploration of technological tools for enhancing empathy. **Holistic Approach:** The research is focused on empathy but does not address a *comprehensive* approach including real-time and interactive support.
8.	K.Boyd & V.Baril, "Aging with intellectual and developmental disabilities", March 30, 2024	- Aging - Intellectual and developmental disabilities	**Comprehensive Care**: The chapter emphasizes a biopsychosocial model and patient-centered management, which supports a broad approach to care. **Personalized Interaction**: Case examples and tools for tailored care align with the need for individualized support strategies.	**Real-Time Monitoring**: The chapter does not cover real-time monitoring or immediate feedback mechanisms. **Technological Integration**: It does not address the use of technology for monitoring or enhancing support. **Interactive Support**: The focus is on general care rather than interactive support tools or solutions.

Chapter 3: Requirement Gathering for the Proposed System

The requirements for the project titled **"SafeGuard Ai Driven Child Safety"** comprises of :-

3.1 Functional Requirements

Functional requirements outline the specific features and capabilities that SafeGuard must possess to effectively ensure child safety. These may include:

- Real-time location tracking
- Continuous environmental monitoring
- User-friendly web interface for parents
- Instant alert system for deviations from safety parameters
- Emergency response features, including a panic button
- Geofencing capabilities for safe area monitoring
- Secure data storage and remote access via cloud server
- Customizable alert settings for caregivers
- Integration of multiple sensors with Raspberry Pi
- Accessibility features for users with disabilities
- Behavior monitoring and analysis
- Content filtering for enhanced safety

3.2 Non-Functional Requirements

Non-functional requirements specify the quality attributes, system performance, and constraints that SafeGuard must adhere to. These may include:

- Performance: The system must provide real-time updates with a latency of less than 2 seconds for location and environmental data.
- Scalability: The architecture must support a growing number of users and devices without degradation in performance.
- Reliability: The system should have an uptime of 99.9%, ensuring continuous monitoring and alert capabilities.
- Security: Data transmission and storage must be encrypted to protect sensitive information from unauthorized access.
- Usability: The web interface should be intuitive, requiring minimal training for parents and caregivers to navigate effectively.

- Compatibility: The system must be compatible with various devices and operating systems, including desktops and mobile platforms.
- Maintainability: The software should be designed for easy updates and maintenance, allowing for the integration of new features and improvements.
- Accessibility: The interface must meet accessibility standards to accommodate users with disabilities, ensuring all features are usable by everyone.
- Interoperability: The system should be able to integrate seamlessly with third-party applications and services for enhanced functionality.
- Response Time: The alert system must notify users within 5 seconds of detecting any unsafe conditions or events.
- Data Retention: The system must adhere to legal and regulatory requirements for data retention, ensuring compliance with privacy laws.
- User Support: Provide comprehensive documentation and support resources to assist users with troubleshooting and usage inquiries.

3.3 Constraints

- Device Compatibility
- Environmental Conditions
- Battery Life
- Internet Connectivity
- Sensor Calibration
- User Proximity
- Mobile Device Support
- Privacy Regulations
- Alert Limitations
- Accessibility Standards

3.4.Hardware, Software , Technology and tools utilized

Software Requirements :-

- AI and Machine Learning algorithms for behavior detection
- Real-time processing software

Hardware Requirements :-

- Raspberry Pi
- BME680 sensor
- MIX8410 sensor
- GPSHAT
- GPU Computer

3.5 Techniques utilized till date for the proposed system (Prototyping)

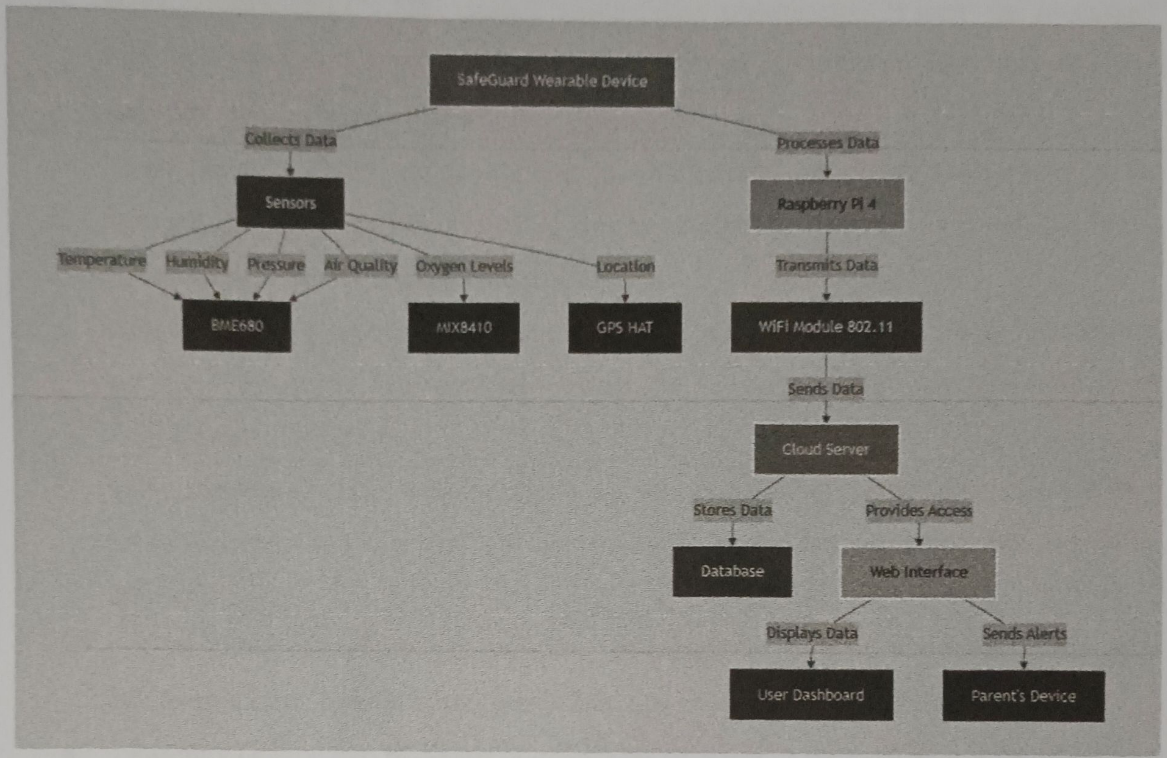
- Sensor Integration: Utilizing various sensors (BME680, MIX8410, GPS HAT) for real-time monitoring of environmental conditions and location tracking.
- Data Processing: Implementing Raspberry Pi as a central processing unit to collect and analyze data from the sensors.
- Cloud Computing: Leveraging cloud storage for secure data management and remote access to monitoring information.
- Web Development: Creating a user-friendly web interface to provide parents with real-time updates and alerts.
- Real-Time Communication: Using Wi-Fi module 802.11 for instant data transmission between the device and the cloud server.
- Alert Mechanism: Establishing an automated alert system to notify caregivers of unsafe conditions or emergencies.
- Geofencing Technology: Implementing geofencing to create virtual boundaries and trigger alerts if the child leaves designated safe areas.
- Machine Learning: Exploring machine learning algorithms for predictive analytics to enhance response capabilities based on historical data.
- User-Centric Design: Employing user experience design principles to ensure the interface is intuitive and accessible for all users.
- Prototyping and Testing: Conducting iterative prototyping and user testing to refine device functionality and user interaction.

3.6. Tools utilized till date for the proposed system (Prototyping).

- Raspberry Pi: A compact computer serving as the central processing unit for data collection and analysis.
- BME680 Sensor: Used for monitoring temperature, humidity, pressure, and air quality.
- MIX8410 Sensor: Employed for detecting oxygen levels to assess air quality.
- GPS HAT: Facilitates real-time location tracking of the child.
- Wi-Fi Module 802.11: Enables wireless communication between the device and the cloud server.
- Cloud Storage Services: Utilized for secure data storage and remote access (e.g., AWS, Google Cloud).
- Web Development Frameworks: Tools like HTML, CSS, and JavaScript for creating the user-friendly web interface.
- Database Management Systems: Utilized for storing and managing sensor data (e.g., MySQL, Firebase).
- Data Visualization Tools: Used for displaying real-time data and alerts on the web interface.
- Prototyping Tools: Software such as Fritzing or Tinkercad for designing and simulating the device's circuitry.
- Testing Frameworks: Tools for performance testing and debugging (e.g., Postman for API testing).
- Machine Learning Libraries: Libraries like TensorFlow or Scikit-learn for implementing predictive analytics.

Chapter 4: Proposed Design

4.1 Block diagram representation of the proposed system



This block diagram represents the structure and data flow of the SafeGuard wearable device system, designed for continuous child safety monitoring. Here's a breakdown of each component and its role in the system:

1. **SafeGuard Wearable Device:** This is the central unit, containing various sensors and processing components that collect and transmit data related to the child's environment and location.
2. **Sensors:**

The device uses several sensors to monitor environmental parameters:

- **BME680:** Measures Temperature, Humidity., Pressure, and Air Quality. These readings help determine the child's immediate surroundings and detect potentially unsafe environmental conditions.
- **MIX8410:** Measures Oxygen Levels to ensure the air quality is safe and adequate for the child.
- **GPS HAT:** Tracks the Location of the child in real-time, enabling caregivers to monitor the child's whereabouts.

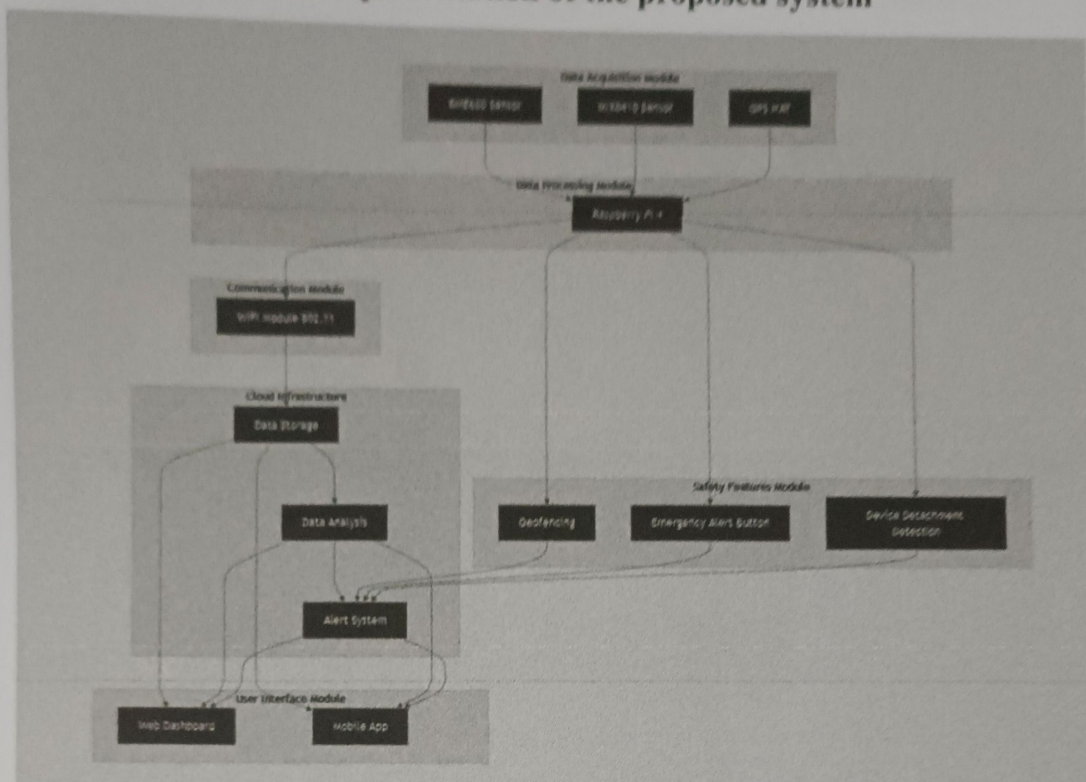
3. **Raspberry Pi 4:** This serves as the processing unit within the wearable device. It collects data from the sensors, processes it, and prepares it for transmission. The

Raspberry Pi interprets the readings and determines if any parameters are outside the safe range, which would trigger alerts.

4. **WiFi Module 802.11:** This module handles data transmission. It sends the processed data from the Raspberry Pi to the Cloud Server via an internet connection, ensuring real-time updates are available.
5. **Cloud Server:** The Cloud Server acts as a centralized data storage and access point. It receives data from the wearable device, stores it, and makes it accessible to connected devices for monitoring and alerting.
6. **Database:** The Cloud Server uses a database to store the sensor data. This allows historical data tracking, enabling caregivers to review past environmental and location data if needed.
7. **Web Interface:** The web interface is the user-facing component that allows caregivers (parents) to access the data collected by the device. It provides two main functions:

- User Dashboard: Displays real-time data from the sensors, showing information like temperature, humidity, oxygen levels, and the child's current location.
- Parent's Device Alerts: Sends notifications or alerts to the caregiver's device if any environmental parameter deviates from the safe range or if the child's location changes unexpectedly.

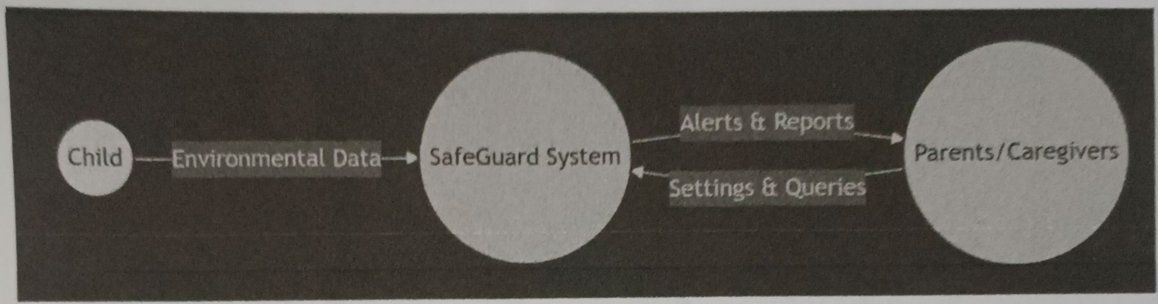
4.2 Modular diagram representation of the proposed system



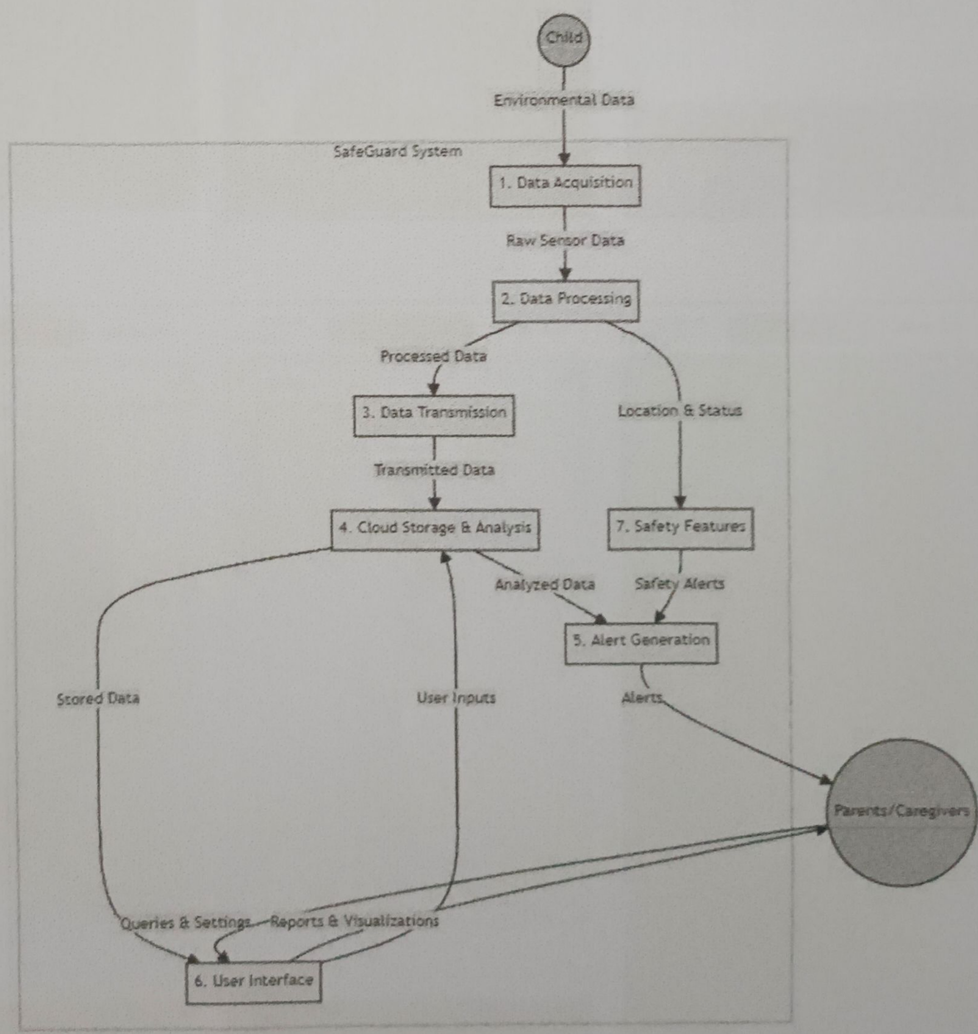
This diagram shows the SafeGuard wearable device's data flow for continuous child safety monitoring. The device includes sensors (BME680, MIX8410, and GPS HAT) that collect data on environmental factors (temperature, humidity, pressure, air quality, oxygen levels) and location. This data is processed by a Raspberry Pi 4, which then transmits it via a WiFi Module 802.11 to a Cloud Server. The server stores data in a Database for record-keeping and provides access through a Web Interface. The web interface features a User Dashboard for live data visualization and sends alerts to the Parent's Device when unsafe conditions are detected, ensuring real-time safety monitoring and response.

4.3 Design of the proposed system with proper explanation of each :

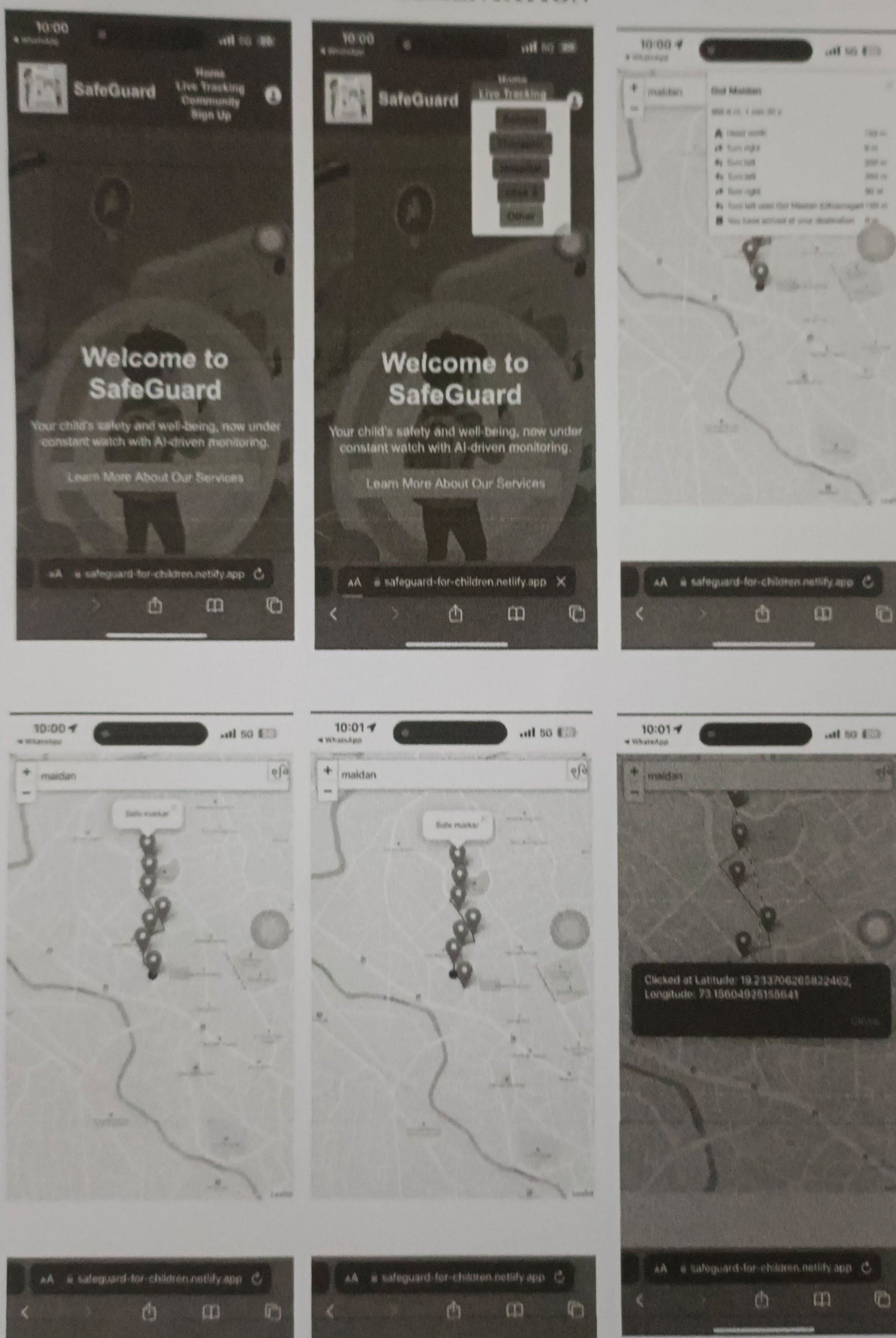
- **DFD LEVELS**
- **Level 0 :**

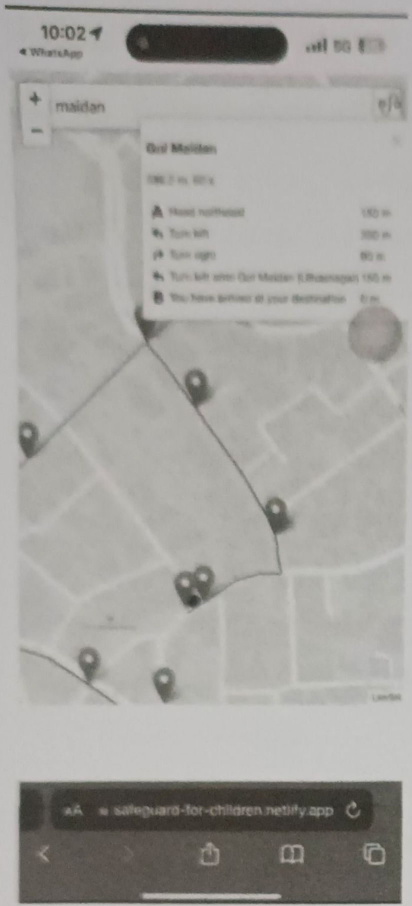


- **Level 1:**



- **SCREENSHOTS OF IMPLEMENTATION**

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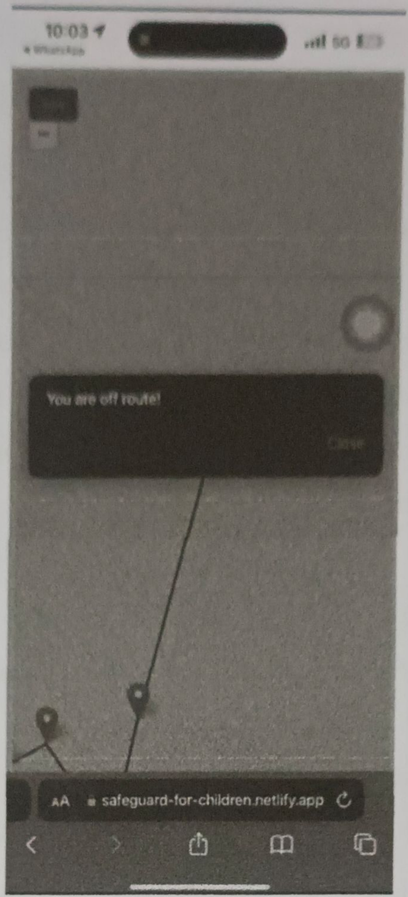
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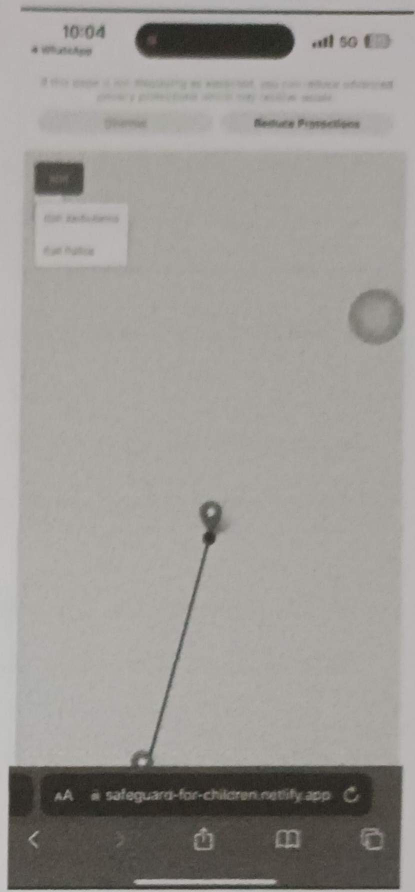
safeguard-for-children.netlify.app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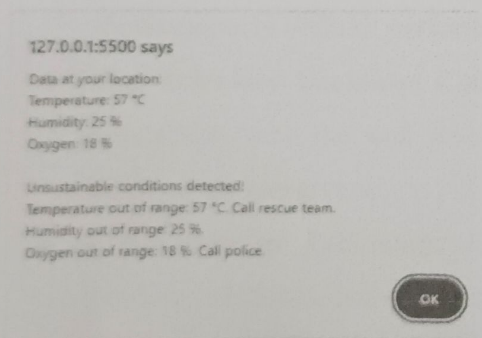
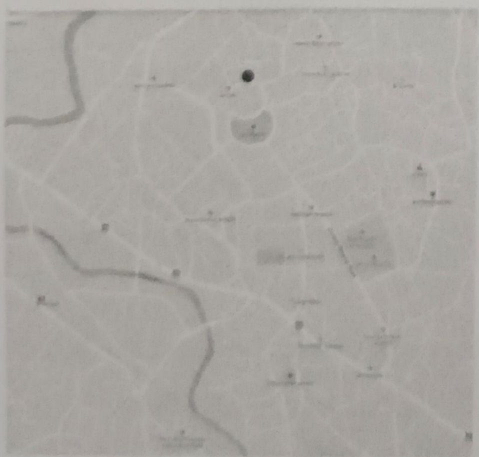

127.0.0.1:5500 says
Data at your location:
Temperature: 57 °C
Humidity: 25 %
Oxygen: 18 %
Unsustainable conditions detected:
Temperature out of range: 57 °C. Call rescue team.
Humidity out of range: 25 %.
Oxygen out of range: 18 %. Call police.
OK



Chapter 5: Proposed Results and Discussions

5.1. Determination of Efficiency

- **Response Time:** Measure the latency in transmitting sensor data from the device to the cloud server and displaying it on the web interface. An ideal response time is under 2 seconds for real-time alerts.
- **Battery Efficiency:** Assess the power consumption of the Raspberry Pi and sensors to ensure the device operates for at least 12 hours on a single charge.
- **Data Accuracy:** Validate the precision of sensor readings, such as temperature, humidity, oxygen levels, and GPS location, against standard equipment to ensure reliable data output.
- **Network Connectivity:** Monitor the stability and bandwidth requirements of the Wi-Fi module to maintain continuous data transmission, especially in areas with limited coverage.
- **Alert System Reliability:** Test the responsiveness and effectiveness of the alert mechanism to ensure notifications are sent promptly in emergencies or when unsafe conditions are detected.
- **Scalability Testing:** Evaluate the system's ability to handle multiple devices and users simultaneously without performance degradation.
- **User Interface Usability:** Conduct user testing to gauge ease of navigation and user satisfaction with the web interface, ensuring it meets accessibility standards and is intuitive for caregivers.
- **Cloud Storage Efficiency:** Analyze the data storage methods to ensure efficient handling, retrieval, and organization of large datasets over extended periods.
- **Environmental Tolerance:** Test the device's durability and functionality in various temperature and humidity conditions to confirm its effectiveness in diverse environments.
- **Error Rate:** Measure the frequency of false positives and negatives in alerts to optimize the accuracy and reduce unnecessary notifications.

5.2 Determination of Accuracy

- **Sensor Calibration:** Regularly calibrate the BME680 and MIX8410 sensors to ensure accurate readings of temperature, humidity, pressure, and oxygen levels. Accuracy can be cross-verified with standard reference devices.

- **Location Precision:** Validate GPS accuracy by comparing recorded locations to known coordinates, ensuring location tracking is within an acceptable margin of error, ideally under 5 meters.
- **Data Consistency:** Conduct repeated tests in various environments to ensure consistent sensor readings. Variations beyond a specified tolerance level may indicate inaccuracies that need adjustment.
- **Alert Accuracy:** Track the accuracy of the alert system by measuring the frequency of false alerts (e.g., alerts triggered by minor fluctuations or non-harmful conditions) and refine thresholds to minimize these errors.
- **Predictive Analytics Validation:** For systems using predictive analytics, compare predictions to actual events, measuring accuracy through metrics such as precision, recall, and F1-score to assess the predictive models' effectiveness.
- **Real-Time Monitoring Reliability:** Test the system's ability to maintain real-time updates without lag or data loss, particularly in areas with varying network quality, to ensure location and sensor data are accurately reported.
- **User Feedback on Accuracy:** Collect feedback from test users on the perceived accuracy of location and environmental monitoring, using this information to make adjustments where necessary.
- **Geofencing Precision:** Verify geofencing capabilities by conducting boundary tests, ensuring alerts are triggered precisely when the child crosses designated safe zones.
- **Environmental Condition Testing:** Test device performance under various environmental conditions to confirm that sensor accuracy is not compromised by factors such as extreme temperatures or humidity.
- **Data Integrity:** Ensure that data transmitted to and stored in the cloud matches the raw data collected from sensors, verifying that no data is altered or lost during the transmission process.

Chapter 6: Plan of Action for next Semester

6.1 Work done till Date

Work done to date on the SafeGuard project includes the conceptualization and initial design of the wearable child safety device, along with the development of key features. A prototype was created using a Raspberry Pi as the central processing unit, integrating various sensors such as the BME680 for monitoring temperature, humidity, and air quality, the MIX8410 for oxygen level detection, and a GPS HAT for location tracking. A functional web interface was designed, allowing parents and caregivers to access real-time location data and environmental information. The cloud storage setup was implemented to store and manage sensor data securely, and a basic alert system was established to notify users of any deviations from safety thresholds, such as low oxygen levels or unsafe location changes. Case scenarios, including situations like unattended children in hazardous environments or device detachment, were developed to simulate real-world emergencies. Initial testing of the prototype validated the data collection capabilities, and improvements were made based on feedback from simulated scenarios. Currently, work is ongoing to enhance the accuracy of alerts and integrate accessibility features to cater to children with special needs.

6.2 : Plan of Action for Project II

The next phase of the SafeGuard project will concentrate on enhancing the Social Quotient and Emotional Quotient, focusing on improving the device's ability to provide more insightful and context-aware notifications related to the child's emotional and social well-being. This will involve refining data analysis to detect patterns in the child's behavior and environment that could indicate signs of distress, loneliness, or social challenges, and notifying caregivers accordingly. Additionally, efforts will be made to optimize the system's functionality to better support children with special needs, promoting inclusivity and emotional security. By focusing on these areas, SafeGuard will continue to deliver reliable safety monitoring while addressing broader aspects of child well-being without introducing new interactive features.

Chapter 7: Conclusion

In conclusion, the SafeGuard project has laid a robust foundation in child safety by focusing on continuous monitoring and proactive alerts, addressing the essential aspects of physical safety and well-being. Through innovative integration of sensor technology and real-time data processing, the system empowers parents with vital insights into their child's environment, enabling timely responses to potential hazards. Looking ahead, the next phase will emphasize enhancing the Social and Emotional Quotients, broadening SafeGuard's scope to address not only physical safety but also the emotional and social dimensions of child development. By refining our analysis and alert capabilities, SafeGuard is committed to fostering a comprehensive, supportive environment that ensures children's safety while promoting emotional resilience and social connection, underscoring our mission to provide holistic care for every child.

Chapter 8: References

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