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A Unified Smart Solution for Child Security and Parental Insights

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Abstract: *Child safety has become an increasingly important concern in today's fast-paced and technology-driven world, where parents often find it difficult to continuously ensure their children's well-being. To address this challenge, an Internet of Things (IoT)-based child monitoring and protection system is proposed, providing real-time tracking and health monitoring. The system, developed using embedded C, integrates GPS, temperature, and heartbeat sensors along with GSM and an ESP32-CAM module to deliver both location tracking and live visual updates.*

The system automatically sends instant SMS alerts to parents or caregivers during emergencies, abnormal health readings, or when the child moves beyond a predefined safe zone. Features such as geo-fencing, a panic button, and data logging enhance the system's reliability and responsiveness. By combining IoT-based monitoring with proactive alert mechanisms, the system aims to support parental supervision and ensure a safer environment for children in modern lifestyles.

Keywords: Child Safety, Internet of Things (IoT), GPS Tracking, Heartbeat Monitoring, Geo-fencing, Real-time alerts

I. INTRODUCTION

Ensuring child safety in modern environments has become a critical priority for parents and caregivers. With increasing concerns regarding health, mobility, and personal security, technology-driven solutions are emerging as effective tools to support parental supervision. Such systems not only provide parents with reassurance but also help children develop a sense of security in their daily surroundings. Furthermore, by analyzing historical sensor data, parents can identify behavioral or health-related patterns, enabling timely and informed interventions. However, technology alone cannot guarantee complete safety; effective child protection also requires parental awareness, social responsibility, and support from the surrounding community. In addition, the integration of intelligent sensing and communication technologies offers a scalable and adaptable approach to addressing diverse child-safety scenarios. To address these challenges, the proposed system integrates IoT technologies with real- time monitoring features to enhance child safety and well-being.

II. PROPOSED SYSTEM

The proposed system is an IoT-based child monitoring and protection solution designed to assist parents in ensuring the safety and well-being of their children, even in their absence. The system integrates GPS, temperature and heartbeat sensors, GSM technology, and an ESP32-CAM module to provide comprehensive monitoring capabilities.

Real-time location tracking and health monitoring are enabled through continuous data acquisition from sensors. In the event of an emergency—such as irregular health measurements or when the child moves beyond the predefined geo-fenced area—the system automatically sends an SMS alert to the registered parent or caregiver. Features such as geo-fencing and a dedicated panic button enhance the system's reliability by triggering immediate notifications during critical situations.

Unlike conventional child tracking devices that focus solely on location, the proposed system offers a holistic safety solution by incorporating both physiological monitoring and environmental awareness.

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The ESP32-CAM module provides live visual feedback, enabling parents to observe the child's surroundings in real time and respond appropriately. The system is implemented using Embedded C to ensure efficient communication among modules, accurate data processing, and real-time operation. By combining IoT technology, alert mechanisms, and visual monitoring, the proposed solution delivers a dependable and practical approach to child safety.

A. WORKING

The proposed system is built around the ESP32 microcontroller, which acts as the central processing unit, coordinating all sensor inputs and module operations to ensure real-time monitoring of the child's safety and health. The system integrates multiple sensors and modules—temperature sensor, heartbeat sensor, and MAX30100—to continuously measure the child's body temperature, heart rate, and oxygen saturation (SpO_2) levels. The ESP32-CAM module provides live visual monitoring of the child's surroundings, enhancing situational awareness.

In case of abnormal readings or emergency conditions, the ESP32 activates a buzzer to provide an audible alert and transmits instant notifications to parents or guardians via the GSM module. The system also includes an emergency button, enabling the child to manually trigger an alert in distress situations. The LCD display presents real-time health and status information, ensuring transparency and ease of monitoring. A regulated power supply maintains stable operation of all components.

Overall, the hardware components work in coordination to create a reliable, IoT-based monitoring system that provides continuous health tracking, visual surveillance, and instant alert generation. This integrated approach ensures quick parental response and enhances the overall safety and well-being of the child.

III. BLOCK DIAGRAM:

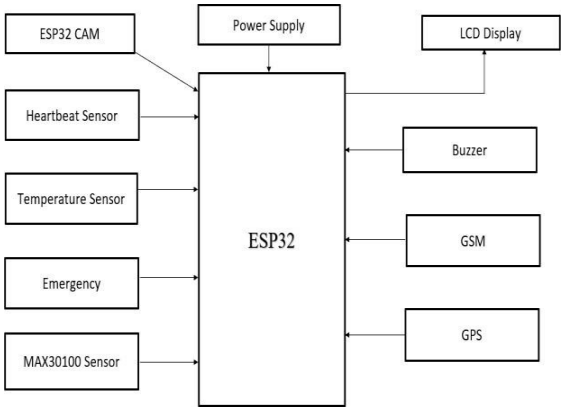

Fig 1. BLOCK DIAGRAM

IV. HARDWARE DESCRIPTION

A. ESP32 BOARD

The ESP32 module serves as the main control unit of the proposed child safety and health monitoring system. It is a low-cost, low-power microcontroller with built-in Wi-Fi and Bluetooth capabilities, enabling efficient data processing and wireless communication. The ESP32 interfaces with multiple sensors, including temperature, heartbeat, MAX30100, GPS, and GSM modules, to collect and analyze real-time data. In emergency situations, it processes the sensor inputs and triggers alerts to parents or guardians through the GSM module. Its high processing speed, energy efficiency, and versatility make it an ideal choice for IoT-based child safety and monitoring applications.

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Fig 2. ESP32

B. ESP32 CAM

The ESP32-CAM module is the core of the system, serving as both the controller and the camera interface for real-time child monitoring. It is a compact IoT microcontroller with a built-in OV2640 camera, Wi-Fi connectivity, and multiple GPIO pins to connect sensors like temperature, heartbeat, and GPS. In this system, the ESP32-CAM captures live images or video, collects and processes sensor data, displays essential information on the LCD, and sends emergency alerts via the GSM module when any abnormal condition is detected. Its combination of processing power, camera capability, low power consumption, and small size makes it ideal for a portable, reliable, and cost-effective child safety and parental insight solution.

Fig 3. ESP32 CAM

C. HEARTBEAT SENSOR

The heartbeat sensor is an essential component in the proposed child safety and health monitoring system. It continuously measures the child's pulse rate by detecting variations in blood flow beneath the skin, typically using optical techniques such as infrared light. In this system, the heartbeat sensor provides real-time monitoring of pulse rate and allows detection of irregularities, including unusually high or low heart rates.

Upon detecting abnormal readings, the ESP32-CAM triggers alerts to parents or guardians through the GSM module. The sensor's reliability, ease of integration, and capability for real-time monitoring make it a crucial element of the IoT-based child safety solution.

Fig 4. HEARTBEAT SENSOR

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D. TEMPERATURE SENSOR

The temperature sensor is a key component in the proposed child safety and health monitoring system, responsible for continuously measuring the body temperature of the child. It detects thermal variations and converts them into electrical signals that can be interpreted by the ESP32-CAM microcontroller. In the system, the temperature sensor provides real-time monitoring, enabling detection of abnormal conditions such as fever or unusually low body temperature. Upon identifying any irregularity, the ESP32-CAM processes the data and sends immediate alerts to parents or guardians via the GSM module. The sensor's accuracy, real-time responsiveness, and ease of integration make it an essential part of the IoT- based child monitoring and safety solution.

Fig 5. TEMPERATURE SENSOR

E. MAX30100 SENSOR

The MAX30100 sensor is an integrated pulse oximeter and heart-rate monitor used in the proposed child safety system. It measures blood oxygen saturation (SpO_2) and pulse rate using photoplethysmography (PPG) techniques. The sensor continuously sends real- time data to the ESP32-CAM microcontroller, enabling detection of abnormalities such as low oxygen levels or irregular heartbeat. Upon detecting critical conditions, the ESP32-CAM sends alerts to parents or guardians via the GSM module. Its compact design and dual-function capability make it ideal for real-time health monitoring in IoT-based child safety applications.

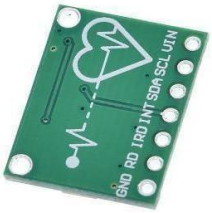

Fig 6. MAX30100 SENSOR

F. GSM MODULE

The GSM module provides long-range communication in the proposed child safety and health monitoring system. It enables the ESP32-CAM microcontroller to send SMS alerts to parents or guardians when abnormal conditions are detected, such as irregular heartbeat, low SpO_2, or elevated temperature. The module operates on standard cellular networks, ensuring reliable and real-time notifications even when the child is away from home. Its compatibility with microcontrollers, low power consumption, and wide coverage make it an essential component for emergency communication in IoT-based child monitoring solutions.

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FIG 7. GSM MODULE

G. GPS MODULE

The GPS module provides real-time location tracking in the proposed child safety system and supports geofencing to define safe zones for the child. The ESP32- CAM continuously monitors the child's location, and if the child moves outside the predefined boundary, the system immediately sends alerts to parents or guardians via the GSM module. This integration ensures location- based safety and prompt emergency notification. The module's accuracy, real-time tracking, and geofencing capability make it an essential component of the IoT- based child monitoring solution.

FIG 8. GPS MODULE

V. SOFTWARE REQUIREMENTS:

A. EMBEDDED C

Embedded C, an extension of the widely-used C programming language, was introduced by the C
Standards Committee to address the unique challenges of programming embedded systems. Initially, assembly language dominated the field of embedded systems programming. However, C emerged as a dominant force due to its portability and simplified development process. In the early stages, developers encountered limitations with available tools, and C emerged as a superior alternative, providing reliability, scalability, and cross- platform compatibility. Unlike assembly language, which offered efficiency but posed challenges for larger projects, C boasted advantages such as a shallower learning curve, processor independence, and streamlined direct hardware control. With the widespread availability of compilers, C swiftly became the preferred choice, offering flexibility and robust support for low-level data manipulation.

VI. RELATED WORK:

A. INTERNET OF THINGS (IoT)

The Internet of Things (IoT) refers to the network of everyday objects that are connected through the internet, allowing them to communicate, share information, and operate intelligently. With IoT, devices can collect and exchange data across different locations, enabling smarter decision-making and real- time interactions. This technology introduces a high level of connectivity, supporting seamless communication between people, systems, and organizations. IoT is widely recognized as a transformative innovation because it influences not only information technology but also the way people live and how businesses operate. Its applications—from smart homes and smart cities to automated industrial systems— simplify daily activities and improve overall quality of life. However, since IoT devices often gather sensitive information, concerns related to privacy and security remain significant. This makes the development of strong protective measures essential for maintaining trust and safety within IoT systems

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B. SENSOR

A Several studies emphasize the importance of using multiple sensors in IoT-based child monitoring systems to provide complete and reliable safety coverage. GPS sensors help in real-time location tracking, allowing parents to follow their child's movements and set safe zones that trigger alerts whenever the child crosses those boundaries. Heartbeat or pulse sensors continuously track the child's heart rate, helping detect early signs of stress, unusual activity, or potential health issues. Temperature sensors monitor both body and environmental temperature, which is vital for identifying fever or exposure to unsafe weather conditions. GSM modules make instant communication possible by sending SMS alerts to parents during emergencies, such as abnormal health readings or unexpected movement. The ESP32-CAM module adds another layer of safety by capturing images or live video, giving parents immediate visual awareness of the child's surroundings through a mobile application. Research also highlights the importance of developing systems that are reliable, energy-efficient, and comfortable enough for children to wear throughout the day. By integrating GPS, heartbeat sensors, temperature sensors, GSM, and camera modules, modern IoT-based child safety systems enable proactive monitoring and fast emergency response— greatly increasing parental confidence and improving child safety in everyday environments.

C. RESULT AND DISCUSSION:

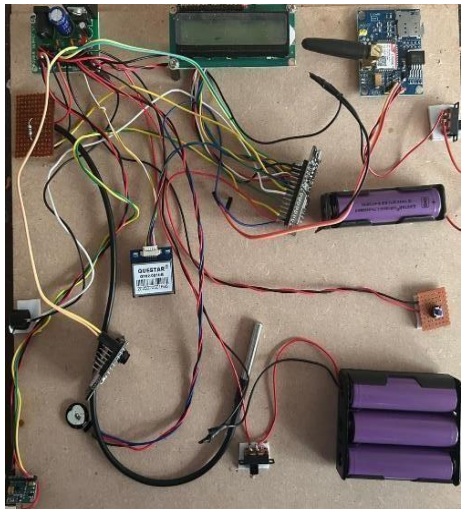

Fig 8. SAMPLE OUTPUT

VII. CONCLUSION

The IoT-Based Child Safety and Health Monitoring System was successfully developed and implemented to provide real-time monitoring of a child's vital signs and ensure immediate response during emergencies. The system integrates multiple sensors, including the MAX30100 for SpO_2 and pulse measurement, as well as temperature and heartbeat sensors, connected through an

ESP32-CAM microcontroller with GSM communication. Through continuous sensing and data processing, the ESP32 efficiently analyzed physiological parameters to detect abnormalities such as elevated temperature, irregular heartbeat, or low oxygen saturation. In emergency situations, the system automatically activated a buzzer and sent SMS alerts to parents or guardians for prompt action. The GSM module facilitated long-range communication, while the LCD interface provided local display and monitoring options. The results confirm that the prototype functions as a reliable, low-cost, and portable solution for real-time child monitoring. Its modular architecture and multi- sensor design make it adaptable for broader health tracking and safety applications. Overall, the system effectively achieves its objectives of

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improving child safety, enhancing parental awareness, and ensuring prompt emergency response through an intelligent integration of IoT and embedded system technologies.

REFERENCES

[1] G. Vishnupriya, K.K, K. K. V and P. S, "Contextualized Advanced Wearable Technology for Child Safety with Behavioral Response Systems," 2025 International Conference on Computing and Communication Technologies (ICCCT), Chennai, India,2025,pp.1-6

[2] G. M, A. S and G. R, "Bluetooth-based Voice- Activated Smart Home System using Arduino Uno for Cost-Effective Automation," 2025 5th International Conference on Trends in Material Science InventiveMaterials(ICTMIM),Kanyakumari India, 2025, pp. 353-359

[3] N. Agrawal, R. Kumar and S. Tapaswi, "Improved Child Safety Using Edge-Fog-Cloud Enabled Smart IoT Wearable Device: An Architecture," 2024 16th International Conference on communication Systems & NETworkS (COMSNETS), Bengaluru, India, 2024, pp. 61-66

[4] A. S, M. F. A. M, N. M, P. J and S. P, "IOT Based Infant Surveillance System," 2024 4th International conference on Advancement in Electronics & Communication Engineering (AECE), GHAZIABAD, India, 2024, pp. 564-568

[5] P. K. P, A. Katkar, M. Kanukuntla, J. Bodakunta, K. Yarraboina and S. Jamalapuri, "Smart Device for Child Safety with Parental Alerts," 2024 2nd International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT), Bengaluru, India, 2024, pp. 1617-1623

[6] K. S, S. k. C, T. M and V. p. C. V, "Child Safety and Activity Monitoring System Using IoT," 2024 Second International Conference on Advances in Information Technology (ICAIT), Chikkamagaluru, Karnataka, India, 2024, pp. 1-5

[7] U. Chowdhury et al., "Multi-sensor Wearable for Child Safety," 2019 IEEE 10th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), New York, NY, USA, 2019, pp. 0968-0972

[8] M. S. Farooq, A. Masooma, U. Omer, R. Tehseen, S. A. M. Gilani and Z. Atal, "The Role of IoT in Woman's Safety: A Systematic Literature Review," in IEEE Access, vol. 11, pp. 69807-69825, 2023

[9] K. I. Masud, M. H. Shuvo, A. Al Mamun, J. Mallick, M. R. Jannat and M. O. Rahman, "Developing an IoT- based Child Safety and Monitoring System: An Efficient Approach," 2023 26th International Conference on Computer and Information Technology (ICCIT), Cox's Bazar, Bangladesh, 2023, pp. 1 -6

[10] T. Thamaraimanalan, R. Pathmavasan, T. R. Pradeep, N. Praveen and R. Srija, "IoT based Safety Gadget for Child Monitoring and Notification," Coimbatore, India, 2023, pp. 783-786

[11] S. L. R and S. L, "Wearable Smart Gadget for Child Monitoring based on the Internet of Things," 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2023, pp. 1827-1831

[12] J. Swaroop, T. J. Nagalakshmi and S. Subash Sharma, "Girl Child Security System based on IOT Technology with GPS Tracker Comparing with Fuzzy Classifier Based Safety Device," 2022 International Conference on Cyber Resilience (ICCR), Dubai, United Arab Emirates, 2022, pp. 1- 6

[13] A. Moodbidri and H. Shahnasser, "Child safety wearable device," 2017 International Conference on Information Networking (ICOIN), Da Nang, Vietnam, 2017, pp. 438-444

[14] M. Benisha et al., "Design of Wearable Device for Child Safety," 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), Tirunelveli, India, 2021, pp. 1076-1080

[15] A. Srinivasan, S. Abirami, N. Divya, R. Akshya and B. S. Sreeja, "Intelligent Child Safety System using Machine Learning in IoT Devices," 2020 5th International Conference on Computing, Communication and Security (ICCCS), Patna, India, 2020,pp.1-6