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IOT Based Child Safety System to Detect and Prevent Child Abuse

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Abstract

Current advancements in digital technology and computing are paving the way for automation of real-world entities. In the current scenario children are facing harassment at any place and safety has reduced to nil. Harassment, kidnapping and teasing are more common problems faced by young children at an early stage. With the development in technology, a solution has been developed to alert the parents in case of any harassment experienced by the children. This solution is based on Internet of Things technology where sensors like respiratory sensors and heart beat sensors are fixed on the children to track any changes in the child during abuse or harassment. In case of any abnormal detection, an alert will be sent to the parent's mobile along with the location of the child. The location of the child is detected by the GPS. This new system could be used to alert the parents regarding the harassment immediately and take necessary actions to save the child.

Keywords: Child Abuse, Location Tracking, Child Safety, Webbing Belt, Beats Per Minute (BPM)

1. Introduction

In the current world, the threats against girl children like child abuse, kidnapping and sexual assault are increasing rapidly. We propose a system that works on security solution using smart devices based on Internet of Things. The system works with a wireless technique in the form of embedded device namely Raspberry Pi along with respiratory senor, heartbeat sensor and GPS mobile app. Security systems is designed to monitor the heart beat and the respiratory function of the child through the respiratory and the heart beat sensors affixed on their body. Any change in the respiratory function and heartbeat will be sensed and intimated to the parents along with location of the child through GPS mobile app. The sensed information of the child are recorded regularly in the cloud. This security system is designed to track the child from any unpleasant situations. This saves the time and that child gets help without loss of time. The system provides speed monitoring of the child and tracks the location using GPS. GPS is used to find location of the child and latitude and longitude location along with health data stored in server.

2. Literature Review

Shruthi et al. [1] discussed the application of Internet of Things (IoT) technology in detecting and preventing child abuse. The study highlighted the use of smart sensors and monitoring devices to track children's activities, identify potential threats, and send alerts to parents during emergency situations. The authors emphasized that IoT-based solutions can improve child safety through continuous monitoring and timely notifications.

Dr. S. Mary Praveena et al. [2] proposed an IoT-based system to improve child safety through real-time monitoring and location tracking. The system uses ESP32, ESP8266, GPS, GSM, heartbeat and temperature sensors, and an emergency switch to monitor the child's health and location. It also provides live camera access and sends SMS alerts with GPS coordinates to parents during emergencies. The study demonstrated that IoT technology can provide an effective solution for child protection through continuous monitoring, instant notifications, and emergency communication.

Lahare Nirag et al. [3], proposed an IoT-based wearable device to enhance child safety through real-time monitoring and location tracking. The proposed system integrates GPS and GSM modules with a microcontroller, heartbeat sensor, temperature sensor, and MEMS accelerometer to monitor the child's activities and identify emergency situations.

Helen et al. [4] proposed the idea of a Smart watch for Women Safety. The main component of this watch is a sensor used to detect the heart beat of a person. The principle used is, heartbeat rate becomes high at sudden moment by the secretion of epinephrine hormone from hypothalamic-pituitary-adrenal axis. When this occurs, the alert system gets activated and alarm is sounded to gain the attention of nearby people and automatically makes a call to the registered contact persons. It also helps in tracking the location using GPS and sends the coordinates via GSM to the nearby police station.

Choudhury et al. [5] proposed an SMS based security system where the press of a button notifies the given emergency contacts. An alert message along with GPS location of the sender is transmitted. A mobile application is used to configure the hardware device. This system is reliable and very cost-effective due to its specific functionality.

Harikiran et al. [6] proposed a Security System for Women. A Smart phone is connected to the Smart Band through Bluetooth to detect the real-time situation of women. The device communicates with the smart phone through a mobile application. Data directed by the smart band such as the pulse rate, temperature and motion of the body is continuously monitored by the application which is pre-installed in the phone. The GPS in the smart phone is used to track the victim. Finally, an SOS message is sent to the family members and the nearest police station through the GSM facility that is inbuilt in the phone.

3. Proposed System

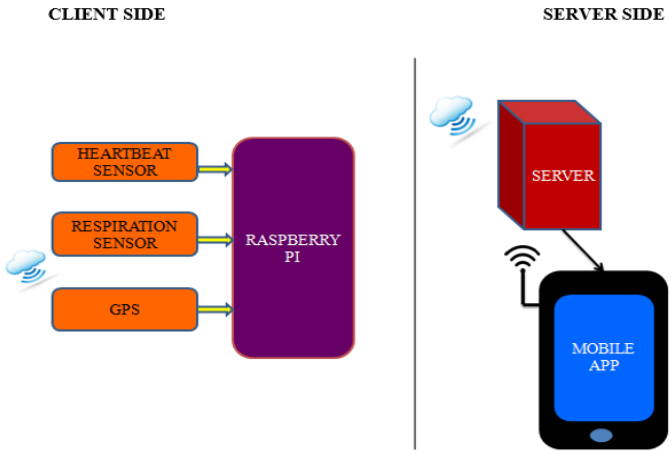


Fig. 1 Block Diagram

The proposed IoT-Based Child Safety System to Detect and Prevent Child Abuse aims to enhance child protection through continuous health monitoring, real-time location tracking and emergency alert mechanisms.

The system uses wearable sensors to monitor the child's physiological parameters, including heart rate and respiratory rate, while GPS technology tracks the child's geographical location. The collected information is transmitted through a wireless communication network to a cloud-based platform. Parents or authorised caregivers can access the child's health status and location through a mobile application.

When the system detects abnormal physiological conditions, unexpected location changes, or emergencies, it sends immediate alerts to parents or caregivers, enabling timely intervention.

Fig. 1 represents the block diagram of the proposed system 'IoT Based Child Safety to Detect and Prevent Child Abuse'. The components of the proposed system are Raspberry Pi 3 Model B+, Heartbeat Sensor, Respiratory Sensor, GPS and Mobile App.

Raspberry 3 Model B+

The latest Raspberry Pi 3 Model B+ has a faster 64-bit 1.4GHz quad core processor, 1GB of RAM, faster dual-band 802.11 b/g/n/ac wireless LAN, Bluetooth 4.2 and significantly faster 300Mbit/s Ethernet. The Pi 3 B+ has significantly faster wired networking. Raspberry 3 Model B+ is represented in Fig. 2.



***Fig. 2* Raspberry Pi 3 Model B+**

Heartbeat Sensor

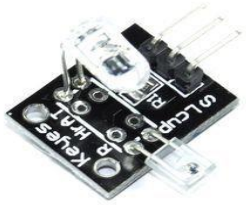


Fig. 3 Heartbeat Sensor

The heartbeat sensor as shown in Fig.3 is based on the principle of photo phlethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region).

Respiratory Sensor



Fig. 4 Respiratory Sensor

The respiration sensor as shown in Fig.4 is a sensitive girth sensor worn using an easy-fitting, high-durability woven elastic band fixed with a length-adjustable webbing belt. It detects chest or abdominal expansion/contraction and outputs the respiration waveform.

GPS

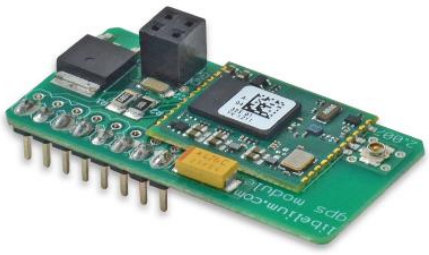


Fig. 5 GPS

GPS sensors represented in Fig. 5 are receivers with antennas that use a satellite-based navigation system with a network of 24 satellites in orbit around the earth to provide position, velocity, and timing information. It shows the longitude and latitude of the location.

4. Working Methodology of Proposed System

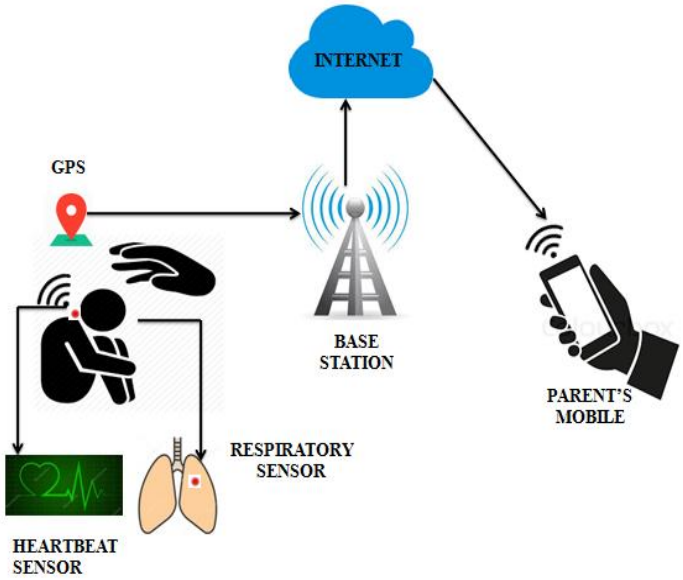


Fig. 6 Working Methodology

Fig. 6 represents the working methodology of the proposed system. The system works with a wireless technique in the form of an embedded device namely Raspberry Pi along with respiratory senor, heartbeat sensor and a GPS mobile app. The wearable sensors like the respiratory sensor and heartbeat sensor, are fixed on the child to track any changes in the child during abuse or harassment. In case of any abnormal detection, an alert will be sent to the parent's mobile along with the location of the child. The location of the child is detected by the GPS. This new system could be used to alert the parents regarding the harassment immediately and take necessary actions to save the child.

5. Outputs and Discussions

The output interface displayed in Fig.7 displays the real-time health and geographical information of the child collected through the IoT-enabled wearable monitoring device.

- ***Respiratory Rate:*** Displays the child's breathing rate in breaths per minute, helping monitor respiratory variations that may indicate potential physical distress.

- ***Latitude:*** Represents the child's geographical position in the north-south direction, obtained through the GPS module.

- ***Longitude:*** Represents the child's geographical position in the east-west direction, enabling accurate location identification.

- ***Heartbeat:*** Displays the child's heart rate in beats per minute (BPM), facilitating continuous monitoring of physiological changes.

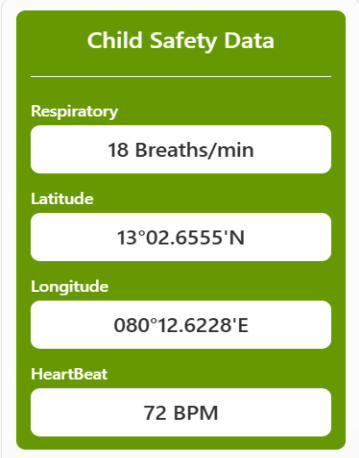


Fig. 7 Child's Health & geographical Information

The collected information is transmitted through the wireless communication network and made accessible to parents through the monitoring system.

This output provides a simple and user-friendly interface for real-time child health monitoring and GPS-based location tracking, thereby strengthening child safety and supporting timely emergency response.

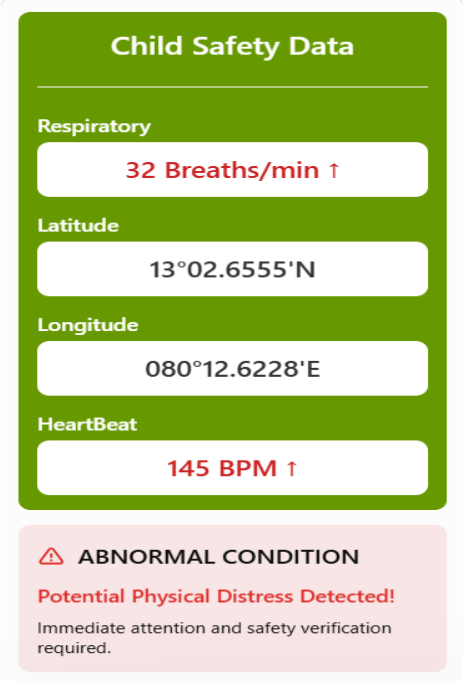


Fig. 8 : Child's Abnormal Status Detected

The output interface in Fig. 8 illustrates a hypothetical emergency situation in which the IoT-based child safety system identifies abnormal physiological readings that may indicate physical or emotional distress.

- ***Respiratory Rate (32 Breaths/min):*** The respiratory sensor detects an elevated breathing rate, which may indicate fear, anxiety, physical exertion or respiratory distress.

- ***Latitude (13°02.6555'N):*** Displays the child's geographical location in the north-south direction, obtained through the GPS module.

- ***Longitude (080°12.6228'E):*** Indicates the child's geographical location in the east-west direction, helping parents identify the child's exact position on a digital map.

- ***Heartbeat (145 BPM):*** The heart rate sensor records an elevated heartbeat, which may indicate stress, fear or physical distress.

- ***Abnormal Condition Alert:*** When the respiratory rate and heartbeat exceed their configured thresholds, the microcontroller identifies a potential distress condition and triggers an emergency notification.

- ***Location Tracking:*** Along with the abnormal health readings, the GPS coordinates are transmitted to the cloud server and made accessible through the parents' mobile application.

The proposed IoT system monitors these variations and identifies potential emergency conditions. When abnormal readings are detected, it automatically generates alerts and shares the child's geographical location with parents or authorised caregivers, facilitating immediate safety verification and timely intervention.

The system acts as an early-warning mechanism by integrating physiological monitoring, GPS tracking and emergency notifications to strengthen child protection and support timely intervention.

6. Conclusion

The IoT-Based Child Safety System to Detect and Prevent Child Abuse provides an effective technology-driven approach to monitoring children's safety and identifying potential distress situations. By integrating wearable sensors, GPS tracking, a microcontroller, cloud technology, and a mobile application, the system continuously monitors the child's physiological parameters and location. When abnormal heart rate or respiratory rate readings are detected, an alert is generated and sent to parents or authorised caregivers along with the child's location, enabling timely safety verification and appropriate intervention.

This system aims to enhance child protection through real-time monitoring, prompt communication, and location tracking. It can serve as a supportive safety mechanism, helping parents respond quickly to potential emergencies. Although abnormal physiological readings alone cannot confirm child abuse, the proposed system offers a promising foundation for developing intelligent, IoT-based child safety solutions.

7. Future Enhancements

The proposed IoT-Based Child Safety System to Detect and Prevent Child Abuse can be further enhanced by integrating Artificial Intelligence and Machine Learning techniques to analyse physiological patterns and identify potential distress conditions more accurately. Advanced GPS tracking and geofencing features can provide alerts whenever a child enters or leaves predefined safe

zones. The system can also be extended with real-time audio analysis to identify distress signals, automatic emergency notifications to multiple authorised contacts, and an enhanced mobile application with live tracking and alert history. Furthermore, cloud-based data analytics, tamper detection, improved battery efficiency, and stronger data encryption can enhance the system's reliability, security, and privacy. These advancements can transform the proposed system into a more intelligent and comprehensive child safety solution, enabling early identification of potential risks and timely intervention by parents and authorised caregivers.

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