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IOT BASED CHILD TRACKING SYSTEM

**Mr.B.Sobhan Babu[1], P. Srinivasarao[2], M. Prasanth Reddy[3], K. Diendra Kumar[4]
N. Naga Rithvik[5]**

[1] Mtech, Assistant Professor, [2, 3, 4,5] Students
[1, 2, 3, 4,5] Department of IT, SR Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh–521356, India.

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ABSTRACT

Child safety and health monitoring are crucial concerns for parents and guardians. This project presents an IoT-based child tracking and monitoring system using Arduino, integrating multiple sensors to ensure real-time health tracking and location monitoring. The system includes a heart rate sensor for continuous health monitoring, a panic button for emergency alerts, and sound and fall detection sensors to identify distress situations. A GPS module provides real-time location tracking, while a GSM module enables communication in emergencies. All collected data is uploaded to an IoT platform, allowing parents to remotely monitor their child's safety and well-being. By combining real-time monitoring with AI-driven analysis, this system enhances child safety, ensures quick emergency response, and provides efficient tracking, making it ideal for school children, toddlers, and children with special needs.

"INDEX TERMS: *IoT-based Child Tracking, Real-time Location Monitoring, Arduino Sensors, Health and Safety System, Emergency Response for Children, Smart Wearable Technology, Remote Parental Monitoring, AI in Child Safety, Wireless Communication in Safety Systems, Assistive Technology for Special Needs Children*

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1. INTRODUCTION

With growing safety concerns, parents often face challenges in ensuring their child's well-being, especially when they are away. Traditional methods such as manual supervision or mobile communication are not always reliable. To address this issue, technology-driven solutions like IoT-based child monitoring systems provide an efficient way to track and safeguard children in real-time. This paper presents a smart child tracking and monitoring system using Arduino, integrating multiple sensors to monitor a child's health, detect emergencies, and provide real-time location tracking.

The system comprises a heart rate sensor to detect abnormal heart conditions, a panic button for emergency alerts, a sound sensor to recognize distress signals, and a fall detection sensor to identify accidental falls. Additionally, GPS and GSM modules enable real-time location tracking and communication, ensuring that alerts are transmitted even in areas with limited internet connectivity. All collected data is uploaded to an IoT platform, allowing parents or guardians to remotely monitor their child's health and safety via a mobile or web application.

By combining IoT, AI-driven analysis, and real-time alerts, this system enhances child safety, ensures quick emergency responses, and reduces risks associated with accidents, kidnappings, and health issues. It is particularly beneficial for school children, toddlers, and children with special needs, offering a cost-effective, reliable, and efficient solution for child safety and monitoring.

2. LITERATURE REVIEW

Child safety has always been a major concern for parents and guardians, especially when children are away from home. Traditional methods of supervision, such as manual monitoring and mobile communication, often prove unreliable. To address these challenges, researchers and developers have explored technology-driven solutions, particularly IoT-based child tracking and monitoring systems.

Several studies have been conducted to develop smart child tracking systems utilizing IoT, GPS, GSM, and AI-driven analytics. The integration of wearable sensors and smart devices has significantly improved real-time monitoring, emergency response, and location tracking.

Existing Work in Child Safety Monitoring

1. IoT and Wearable Technology for Child Safety
   Research has shown that IoT-based wearable devices can effectively monitor children's health and location. Heart rate sensors, fall detection systems, and panic buttons have been implemented in various child safety solutions. These systems ensure real-time alerts and emergency response in distress situations.
2. GPS and GSM-Based Tracking Systems Traditional GPS-based tracking devices have been widely used for location monitoring. However, standalone GPS trackers often face

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network and connectivity issues. To overcome these challenges, researchers have combined GPS with GSM modules, ensuring continuous communication and data transmission even in areas with weak internet signals.

3. Cloud-Based Monitoring and IoT Integration
Cloud computing and IoT platforms like Thingspeak, Firebase, and MQTT have been utilized in smart monitoring systems. These platforms provide remote data access, allowing parents to track their child's location and health status in real time through mobile or web applications.

4.AI-Driven Safety and Alert Mechanisms Artificial Intelligence (AI) has been increasingly incorporated into child tracking systems to analyze sensor data and detect abnormal patterns. AI-driven analysis can help predict potential emergencies by monitoring heart rate fluctuations, sudden falls, or unusual movement patterns, triggering instant alerts for parents or guardians.

Challenges and Research Gaps

Despite advancements in child safety technology, some challenges remain:

- Network Dependency: Some tracking systems fail in areas with poor GSM or internet connectivity.
- Battery Life: Wearable safety devices require long battery life for continuous operation.
- User Acceptance: The effectiveness of child tracking systems depends on how well parents and children adopt them in daily life.

Proposed Solution

This paper presents an IoT-based child tracking and monitoring system using Arduino, integrating multiple sensors for real-time health and location tracking. The system includes:

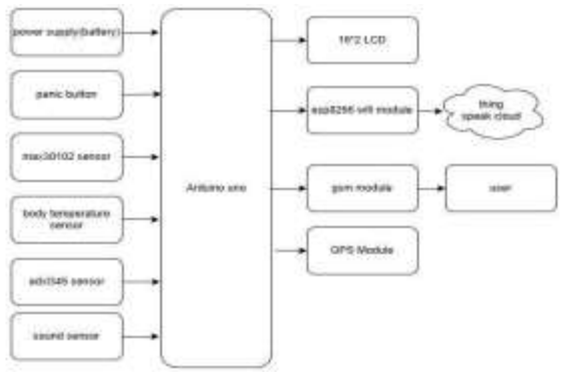
- Heart rate sensor for continuous health monitoring.
- Panic button for emergency alerts.
- Sound and fall detection sensors to identify distress situations.
- GPS and GSM modules for real-time tracking and communication.
- IoT platform integration for remote monitoring and AI-driven analysis.

By addressing existing challenges and leveraging IoT and AI, this project offers a cost-effective, reliable, and efficient solution for child safety. It is particularly useful for school children, toddlers, and children with special needs, ensuring quick emergency response, enhanced monitoring, and improved parental awareness.

3. METHODOLOGY

The Arduino Uno receives input from all connected sensors and the panic button. 2. The sensor data is processed and sent to different communication modules: ¬ ESP8266 uploads data to ThingSpeak Cloud for remote monitoring. ¬ GSM Module sends emergency alerts (if required) via SMS to the reregistered user¬ GPS Module provides real-time location tracking. 3. The 16×2 LCD Display presents real-time status updates. 4. The user can monitor the child's safety via the cloud-based platform or receive alerts directly via GSM.

System Architecture : The system is based on an Arduino Uno microcontroller, which acts as the central processing unit, collecting data from various sensors and transmitting it toa cloud platform and users via Wi-Fi (ESP8266) and GSM modules.



Components and Their Functions

1. **Power Supply (Battery):** • Provides necessary power to the Arduino and all connected components.
2. **Panic Button:** • When pressed, it triggers an immediate emergency alert via GSMto the registered users
3. **Sensors:**
   - MAX30102 Sensor (Heart Rate & Oxygen Sensor): Monitors the child's heart rate and oxygen level.
   - Body Temperature Sensor: Measures the child's temperature to detect health-related issues.
   - ADX345 Sensor (Accelerometer): Detects sudden movements or falls.
   - Sound Sensor: Captures loud noises that may indicate distress.
4. **Communication Modules**
   - ESP8266 Wi-Fi Module: Sends real-time sensor data to the Thing Speak cloud for remote monitoring.
   - GSM Module: Sends alerts and notifications to the user's mobile phone via SMS.
   - GPS Module: Tracks the child's real-time location.

5 . **Output Devices**

- 16×2 LCD Display: Displays real-time sensor readings and system status.

Working Principle 1. The Arduino Uno receives input from all connected sensors and the panic button. 2. The sensor data is processed and sent to different communication modules: ¬ ESP8266 uploads data to Thing Speak Cloud for remote monitoring. ¬GSM Module sends emergency alerts (if required) via SMS to the registered user. ¬ GPS Module provides real- time location

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tracking. 3. The 16×2 LCD Display presents real-time status updates. 4. The user can monitor the child's safety via the cloud-based platform or receive alerts directly GSM.

4.MODELING

ARDUINO UNO: The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform;c) Training and Testing:

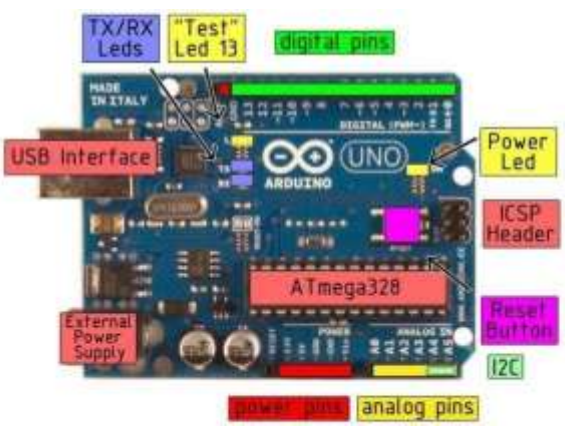

Fig .2: Annotated Arduino Uno Board with Key Components

Technical specifications of arduino: Microcontroller: ATmega328 Operating Voltage: 5V Input Voltage (recommended): 7-12V Input Voltage (limits): 6-20V Digital I/O Pins 14 (of which 6 provide PWM output) Analog Input Pins 6 DC Current per I/O Pin 40 mA DC Current for 3.3V Pin 50 mA Flash Memory 32 KB of which 0.5 KB used by bootloader SRAM 2 KB EEPROM 1 KB Clock Speed 16 MHz**d**

LCD: A Liquid Crystal Display (LCD) is a flat-panel display technology widely used in electronic devices for visual output. It consists of multiple color or monochrome pixels arranged in front of a light source or reflector. Each pixel contains liquid crystal molecules suspended between two transparent electrodes and two perpendicular polarizing filters. The liquid crystals twist the polarization of light, allowing it to pass through and create a visible display. LCDs are commonly used with microcontrollers to display information in embedded systems. Popular modules include 16x1, 16x2, and 20x2 displays, which indicate 16 or 20 characters per line with one or two lines. These LCDs are often built around smart display modules like the NT-C1611, which are cost-effective, user-friendly, and capable of displaying ASCII characters and mathematical symbols.

LCDs can operate in either 4-bit or 8-bit mode when interfacing with microcontrollers. They typically require a +5V power supply and 10 I/O lines for 8-bit mode or 6 I/O lines for 4-bit mode. The tri-state data lines ensure that when the LCD is not enabled, it does not interfere with the operation of the microcontroller. LCDs feature Display Data RAM (80x8 bits), Character Generator ROM (160 different 5x7 dot-matrix characters), and User-Defined Character Generator RAM (8 programmable 5x7 dot-matrix characters). They also support various instructions for cursor control, display shift, blinking characters, and more. Additionally, built-in features such as a reset circuit and an oscillator ensure stable operation.

LCDs are available in different sizes and configurations, ranging from 8 to 40 characters per line in single, double, or four-line versions. Various liquid crystal technologies, such as twisted nematic (TN) and supertwist LCDs, provide improved contrast and viewing angles. Some LCD modules come with backlighting options, such as LED or electro-luminescent lighting, to enhance visibility in low-light conditions. LCDs with one controller have 14 pins, while those with two controllers have 16 pins, with extra pins dedicated to backlight connections.

In conclusion, LCDs are a crucial component in microcontroller-based applications, offering an easy and efficient visual interface. Their affordability, compatibility, and user-friendliness make them an ideal choice for displaying real-time data in embedded systems, control panels, and portable electronic devices.

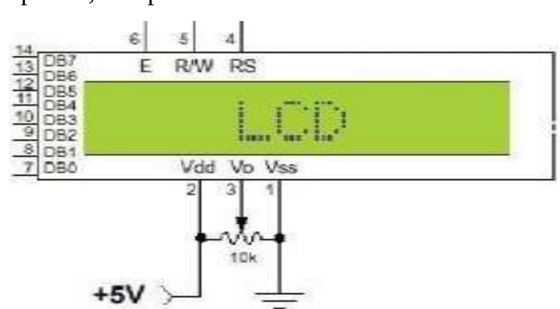

Fig .3: Pin Diagram of 1x16 lines lcd

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PIN	SYMBOL	FUNCTION
1	Vss	Power Supply(GND)
2	Vdd	Power Supply(+5V)
3	Vo	Contrast Adjust
4	RS	Instruction/Data Register Select
5	R/W	Data Bus Line
6	E	Enable Signal
7-14	DB0-DB7	Data Bus Line
15	A	Power Supply for LED B/L(+)
16	K	Power Supply for LED B/L(-)

Table .1: LCD Pinout Table

Global System for Mobile Communications (GSM) Overview:

GSM (Global System for Mobile Communications) is a cellular network technology that enables mobile phones to communicate by connecting to nearby base stations. Operating in various frequency bands, most GSM networks function at 900 MHz and 1800 MHz, while some regions, particularly in the Americas, utilize 850 MHz and 1900 MHz due to existing allocations. Additionally, 400 MHz and 450 MHz bands are used in select countries that previously employed first-generation systems. The GSM- 900 standard covers 890–915 MHz (uplink)

and 935–960 MHz (downlink), providing 124 RF channels spaced at 200 kHz. An extended version, E-GSM, expands the band to 880– 915 MHz uplink and 925–960 MHz downlink, adding 50 more channels.

GSM utilizes Time Division Multiple Access (TDMA), enabling eight full-rate or sixteen half-rate speech channels per RF channel. A TDMA frame comprises eight time slots, with half-rate channels using alternate frames within the same time slot. The channel data rate is 270.833 kbps, and the frame duration is 4.615 ms.

GSM Network Architecture

The GSM network consists of three primary subsystems:

1. Switching System (SS): Manages call routing, subscriber authentication, and mobility.
2. Base Station System (BSS): Handles radio communication with mobile devices.
3. Operation and Support System (OSS): Monitors and Maintains network performance.

GSM Network Areas

The GSM network is structured into several geographic zones:

- Cells: Smallest coverage areas with a base station.
- Location Areas (LAs): Group of cells managed by a Location Register.
- MSC/VLR Service Areas: Areas covered by a Mobile Switching Center (MSC) and Visitor Location Register (VLR).
- Public Land Mobile Network (PLMN): Entire network operated by a mobile service provider.

GSM Technical Specifications

- Frequency Band: 1,850–1,990 MHz (mobile station to base station).
- Duplex Distance: 80 MHz (separation between uplink and downlink).
- Channel Separation: 200 kHz (spacing between adjacent carrier frequencies).
- Modulation: Uses Gaussian Minimum Shift Keying (GMSK) for signal transmission.
- Transmission Rate: Digital system with 270 kbps over-the-air bit rate.
- Access Method: Employs TDMA, where multiple calls share a single frequency with assigned time slots.
- Speech Coding: Utilizes Linear Predictive Coding (LPC) to compress speech to 13 kbps, ensuring efficient transmission.

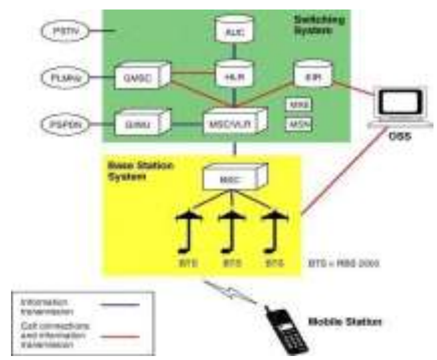

Fig .4 : Mobile Communication System Architecture

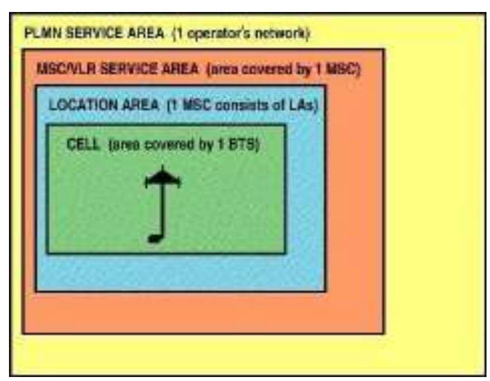

Fig .5: Cellular Network Coverage Hierarchy

Global Positioning System (GPS) Overview

The Global Positioning System (GPS) is a satellite-based navigation system that provides accurate location, speed, and time information anywhere on Earth. Developed by the United States Department of Defense, it operates through a constellation of 24 to 32 Medium Earth Orbit satellites managed by the United States Air Force 50th Space Wing. GPS is widely used in navigation, mapping, surveying, scientific research, telecommunications, and emergency response systems.

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GPS Functionality

GPS satellites continuously transmit microwave signals containing:

1. Time-stamped messages (to track transmission time).
2. Precise orbital data (ephemeris) for satellite location.
3. System health information (almanac) about all satellites.

A GPS receiver calculates its position by measuring the time delay of signals received from at least four satellites, using trilateration to determine latitude, longitude, altitude, and precise time. In some cases, three satellites can be used for a two-dimensional position fix when altitude is known.

Key Features of GPS Modules

- Provides latitude and longitude in the WGS-84 geodetic datum.
- Converts position data into user-required formats.
- Uses NMEA 0183 version 3.0 for data transmission.
- A 12-channel receiver can continuously track multiple satellites, even in obstructed environments.

Integration of GPS with GSM for Tracking

In real-time tracking systems, a GPS module is combined with a GSM module to send location data to users via SMS.

1. User sends an SMS to a GSM modem.
2. Microcontroller processes the request and sends a command to the GPS module.
3. GPS module retrieves coordinates (latitude, longitude, altitude, and speed) and sends them back to the microcontroller.
4. Microcontroller transmits the processed data to the user's phone via SMS.
5. Additional security features, such as remote vehicle locking, can be implemented by sending control commands via SMS.

Applications of GPS

- Navigation & Mapping: Used in road navigation, aviation, and maritime transport.
- Scientific Research: Earthquake monitoring and climate studies.
- Telecommunications: Synchronization of networks.
- Security & Tracking: Vehicle theft prevention, fleet management, and personal tracking.

Arduino IDE: Initial Setup

The **Arduino IDE** provides a simple interface for writing, compiling, and uploading code to Arduino boards. Upon opening, it starts with a **blank sketch** where users can immediately begin programming.

1. Board Setup

- Connect the **Arduino board** to the PC via **USB cable**.
- In the **Arduino IDE**, navigate to **Tools > Board** and select the appropriate board (e.g., **Arduino Uno** for Uno or compatible clones like Funduino or SainSmart).

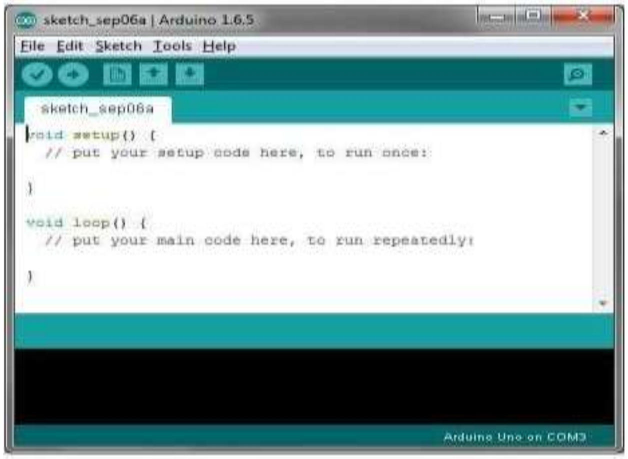

Fig .6: Arduino IDE Interface

2. COM Port Setup

- If the **Arduino drivers** installed correctly, the IDE should automatically recognize the board and its **COM port**.
- Navigate to **Tools > Port** and select the correct **COM port** associated with the board. The port name should appear in the **bottom-right corner** of the IDE.

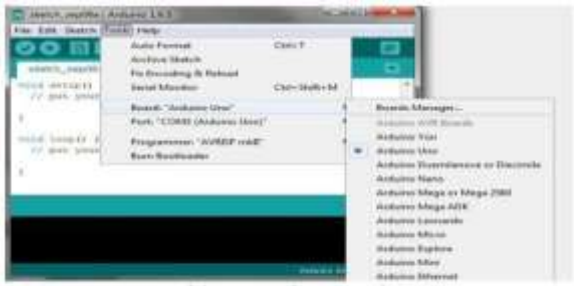

Fig .7: Arduino IDE: Borad Setup Procedure

3. Testing Your Setup: Uploading Blink Sketch

- Open the **Blink** example via **File > Examples > 01.Basics > Blink**.
- Click **Upload** to transfer the sketch to the board. If successful, the onboard **LED labeled"L"** (connected to **pin 13**) will blink, confirming the board is correctly configured.

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Fig .8: Arduino IDE: COM Port Setup

Fig .9: Arduino IDE: Loading Blink Sketch

ThingSpeak IoT Platform

ThingSpeak is an Internet of Things (IoT) platform that enables real-time data collection, visualization, and analysis. It allows users to create channels to store and process data from various sensors.

1.Integration with IoT:bit (Micro:bit & Other Platforms)
ThingSpeak can be used with IoT:bit (a micro:bit extension) and various hardware/software platforms to upload sensor data.

2.Supported Sensor Data Types

- Temperature & Humidity
- Light Intensity & Noise Levels
- Motion & Raindrop Detection
- Distance & Location Data

By integrating Arduino with Thing Speak, users can create smart IoT applications such as weather monitoring, remote sensing, and data analysis.

Fig.10: Thingspeak Configuration

5 . EXPERIMENTAL RESULTS

Step 1: Go to https://thingspeak.com/, register an account and login to the platform

Fig 11: ThingSpeak IoT Platform Interface

Step 2 Choose Channels -> My Channels -> New Channel

Fig 12 : ThingSpeak Channel Navigation

Step 3 : Input Channel name, Field1 , then click "Save Channel" • Channel name: smart-house• Field 1: Temperature

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Step 4: You will see a chat for data field1

Fig 13: ThingSpeak Temperature Chart

Step 5 : Open your web browser, go to https://thingspeak.com , select your channel > "API Keys", copy the API key as follows:

Fig 14: ThingSpeak API Key Retrieval

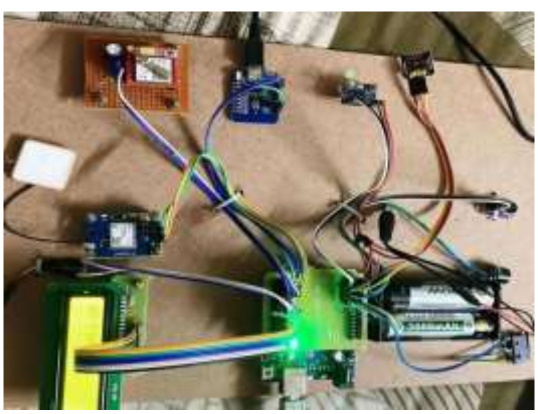

Fig 15 : Child tracking IoT Device Prototype

Fig 16 : Arduino IDE Code for Child Tracking

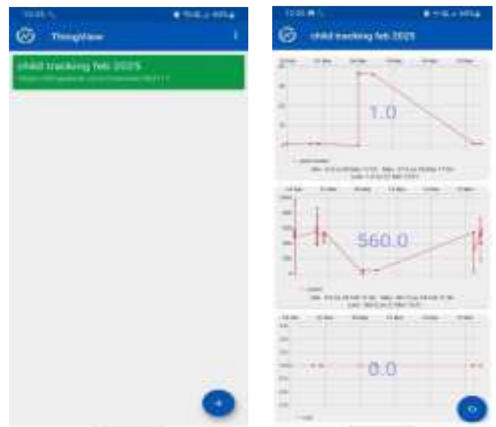

Fig 17 : ThingView Mobile App User Interface and App Displaying Child Tracking DataCharts

Fig 18 : SOS Text Message with Location Details

6.CONCLUSION

The integration of IoT, GSM, GPS, and sensor-based monitoring in the proposed child tracking and safety system provides a comprehensive, efficient, and real- time solution for ensuring child security and health monitoring. Utilizing advanced sensors for heart rate monitoring, fall detection, panic alerts, and sound detection, the system enables instant notifications to parents, allowing them to respond immediately in case of emergencies.

With the combination of GSM and GPS, tracking remains uninterrupted, even in areas with poor internet connectivity, making it a reliable and versatile solution for diverse environments. The cloud-based monitoring feature ensures 24/7 access to critical data, enhancing safety with minimal parental effort.

Beyond personal use, this system can be implemented in schools, daycare centers, parks, and public spaces, adding an extra layer of protection for children in high-risk environments. As technology continues to evolve, future improvements such as AI-powered predictive analytics, enhanced battery life, and stronger security features will further optimize its efficiency.

Overall, this scalable and adaptable IoT-based child monitoring system offers a smart, proactive, and reliable approach to child safety, giving parents peace of mind while ensuring a secure environment for children.

REFERENCES

1. *Zuherman Rustam, FildzahZhafarina, Glori Stephani Saragih, Sri Hartini; Pancreatic cancer classification using logistic regression and random forest.*
2. *Emmanuel Briones, Angelyn Lao, Geoffrey A. Solano; A Pancreatic Cancer Detection Support Tool Using Mass Spectrometry Data and Support Vector Machines*
3. *Wazir Muhammad, Gregory R. Hart, Bradley Nartowt, James J. Farrell, Kimberly Johung, Ying Liang1 and Jun Deng; Pancreatic Cancer Prediction through an Artificial Neural Network.*
4. *WismajiSadewo, Zuherman Rustam, Hamidah Hamidah and AlifahRoudhohChusmarsyah; Pancreatic Cancer Early Detection Using Twin Support Vector Machine Based on Kernel.*
5. *Kao-Lang Liu, Tinghui Wu, Po-Ting Chen, Yuhsiang M Tsai, Holger Roth, Ming-Shiang Wu, Wei-Chih Liao, Weichung Wang; Deep learning to distinguish pancreatic cancer tissue from non- cancerous pancreatic tissue: a retrospective study with cross-racial external validation.*
6. *Wilson Bakasa and SerestinaViriri; Pancreatic Cancer Survival Prediction: A Survey of the State-of the-Art.*
7. *Yasukuni Mori, Hajime Yokota, Isamu Hoshino, Yosuke Iwatate, Kohei Wakamatsu, Takashi Uno & Hiroki Suyari1Suyari; Deep learning- based gene selection in comprehensive gene analysis in pancreatic cancer.*
8. *Guimin Dong, Mehdi Boukhechba, Kelly M. Shaffer, Lee M. Ritterband, Daniel G. Gioeli, Matthew J. Reilley; Using Graph Representation Learning to Predict Salivary Cortisol Levels in Pancreatic Cancer Patients.*
9. *Shanjida Khan Maliha, Romana Rahman Ema, Simanta Kumar Ghosh, Helal Ahmed, Md. Rafsun Jony Mollick, Tajul Islam; Cancer Disease Prediction Using Naive Bayes K-Nearest Neighbour and J48 algorithm.*
10. *Khouloud Fakhfakh, Ahmed Maalel and Waad Farhat; Towards a Pancreatic Lesions Disease Classification System based on Ontologies.*
11. *Qiuliang Yan, Dandan Hu, Maolan Li, Yan Chen; The Serum MicroRNA Signatures for Pancreatic Cancer Detection and Operability Evaluation.*
12. *Behrouz Alizadeh Savareh, Hamid Asadzadeh Aghdaie, Ali Behmanesh, Azadeh Bashiri, Amir Sadeghi; A machine learning approach identified a diagnostic model for pancreatic cancer through using circulating microRNA signatures.*
13. *Dingwen Zhang, Jiajia Zhang, Qiang Zhang, Jungong Han, Shu Zhang, JunweiHan; Automatic Pancreas Segmentation Based on Lightweight DCNN Modules and Spatial Prior Propagation.*