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A Real-Time System for Monitoring Vital Signs to Protect Kids' Health

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ABSTRACT

Strengthening healthcare services is the first step to improving children's lives, and improving primary healthcare is a key part of this. Individuals can be involved in their healthcare by using personal health information systems, which provide engaging medical tools to the public. Our goal is to provide a smart system with a GSM network that can fully monitor the health and safety of kindergarten children. This system works using GSM technology, a computer, temperature and heartbeat sensors, and an LCD screen. When the system detects an odd temperature or heart rate, it immediately alerts the parents through the GSM network. Our younger students' health and safety are protected by this reliable method, which works well for kids of all ages and has been thoroughly tested and proven.

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1. Introduction

Children's physical, mental, social, and emotional health begins in early life. Building trust and stability in early childhood prepares children for a healthy life. Preventative treatment and well-baby visits promote early childhood health. These checkups help doctors diagnose and treat emerging health issues and prevent disease [1, 2]. Parents heavily influence the physical, cognitive, and emotional development of children. Doctors can counsel parents on childrearing during preventive health checks [3].

Parents can monitor their children's health 24/7 thanks to technology [4]. The paper describes a cutting-edge GSM-based intelligent kindergartener health monitoring system. This system alerts parents via GSM when vital signs change using a microcontroller, temperature, heartbeat, and LCD screen.

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This research promotes kindergarten healthcare by offering a new, technologically enhanced child well-being monitoring approach. This study's innovations:

One: monitor kindergarteners' vital indicators like temperature and heartbeat in real time to detect health issues.

Two: Emergency Alert System: Notifies parents of critical health issues for immediate action.

Three: Technical Integration: The baby healthcare monitoring system utilizes microprocessors, sensors, and GSM networks.

Kindergartners require a modern healthcare system that monitors and alerts children quickly. If a modern healthcare system is not in place, children may experience delays or illness. This study addresses this problem with a novel approach that could improve kindergarten healthcare and protect our youngest kids.

Unveiling the Power of GSM in Smart Health Monitoring, the Outline of the System, Section 1: Introduction, Section 2: Related Work, Section 3: Presentation of the Power of GSM in Smart Health Monitoring, Section 4: Proposed System, Section 5: Benefits of Smart Kindergarten Healthcare Monitoring Systems, Section 6: Conclusion, and Future Work.

2. Related works

In [5], The Arduino Child Safety Car Information System notifies the driver if a child is inadvertently left in the vehicle. The system's assembly involves utilizing an Arduino board with sensors and a GSM module. Pressure and motion sensors scan the car's back seat for the presence of children. The inclusion of GSM enables rapid driver alerts. GSM was chosen due to its faster data rates and lower energy consumption per bit. Both FSR and PIR sensors are employed.

Leverages GSM to determine the child's latitude and longitude. The GSM modem transmits all location data to the smartphone. Two channels assist the GSM modem in locating the child. The primary objective is to monitor the child's location and inform their caregiver. It securely links to the child and activates when they leave the designated area. The tracker can be remotely activated via SMS from a phone [6].

Our goal is to establish a cost-effective, real-time Internet of Things air quality monitoring system [7]. Sensors oversee gaseous contaminants, such as carbon monoxide, to assess air quality. Additionally, an Arduino Nano development board with a Wi-Fi module transmits data to a ThingSpeak web channel platform for immediate air quality visualization. ThingSpeak sends emails regarding poor air quality using HTTP protocols. The system visually tracks concentration through channels for remote communication. A threshold is set; when pollutants reach hazardous levels, the system triggers alarms and notifies authorities via email. This study demonstrated that Arduino and ThingSpeak can be utilized to construct an economical air quality monitoring system.

Introduces a system using multiple RFID readers to detect a child in a specific area. To connect parents to Thinger.io, an Android smartphone app was developed [8]. The program utilizes GPS to display the child's location on a map and sends an alert message over 3G to the global mobile network system when the RFID reader detects the mobile tag. Tests conducted in the designated area revealed that the RFID reader could detect the child's movement within distances of 4.5 to 9 meters from other RFID devices. The device could also pinpoint the child's real-time location without requiring an internet connection. Additionally, the technology was both inexpensive and lightweight.

Addresses the increasing incidents of child kidnapping and disappearance [9]. Every parent undergoes trauma when a child goes missing. To mitigate this catastrophe, various safety measures have been implemented. Modern technology, such as GPS and GSM, allows for effective child tracking. Advanced child monitoring systems tend to be costly, and family standards of living vary. This study proposes an affordable child-tracking method with real-time updates.

3. Presentation of the power of GSM in smart health monitoring

In Europe and other locations, GSM is a popular digital mobile network. It uses 900 or 1,800 MHz TDMA. GSM's features have made it a popular component of EDGE, HSCSD, GPRS, and UMTS.

Strong network infrastructure makes it a reliable communication option. GSM lets consumers make international calls without high roaming fees. GSM provides global coverage and high-quality transmission through interference cancellation in most places.

User-friendly switching between phone models and signal stability and compatibility with CDMA and LTE make Subscriber Identity Module (SIM) cards useful. While GSM devices have long talk times, repeaters increase coverage.

GSM also has downsides. During concurrent use, bandwidth constraints may cause lag and transmission difficulties. Certain electrical equipment are affected by electromagnetic interference, requiring limits in sensitive areas. In addition, coverage expansion and data rate capability are issues. Qualcomm patent licensing, tower size restrictions, and a maximum call site range complicate matter.

Our kindergarten smart monitoring system improves health monitoring and emergency warnings with GSM, despite these shortcomings. Young learners are safer and healthier because of GSM's flawless connection, interoperability, and worldwide reach. For an effective and trustworthy monitoring system for the targeted user base, trade-offs must be carefully considered, including pros and negatives.

4. Proposed system

Improving children's lives requires a strong healthcare foundation, starting with the fundamentals. People can actively control their healthcare with private health information systems, a huge advance. A GSM-integrated cutting-edge smart monitoring system improves healthcare for our youngest citizens. This method systematically checked the health of kindergarteners. A CPU, LCD screen, temperature, and heartbeat sensors make up our smart monitoring system. This device monitors a child's vital signs and discovers abnormalities quickly. GSM alerts parents to abnormal temperatures or heart rates. Our design is versatile and reliable for kids of all ages. This smart device monitors vital indicators in real-time and alerts parents in emergencies, revolutionizing kindergarten healthcare. It provides a safe, healthy, and well-developed healthcare environment for our youngest students, improving their future as shows in Fig 1.

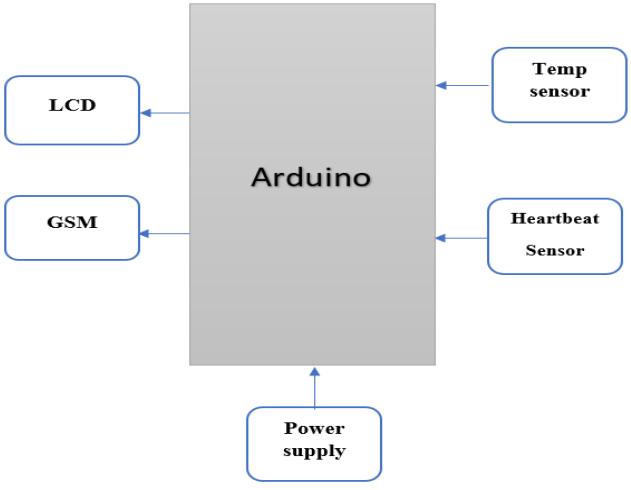

Fig. 1 - The block diagram of the system.

Algorithms describe the system's steps:

1. start the system.
2. Continuously gather sensor data on temperature and heartbeat.
3. Process data using the microprocessor.
4. Check for abnormalities in temperature or heart rate.
5. Detect abnormalities: • Operate an alert mechanism.
6. Create an alert message detailing the child's condition.

7. Send alerts to parents' mobile devices via the GSM network.
8. Continue monitoring if no abnormalities are detected.
9. Perpetuate steps 2–6 continuously.

In the smart monitoring system, real-time data collection, processing, and alerting are essential to kindergarteners' safety. The system alerts for an abnormal heart rate or temperature. Parents receive instant GSM notifications from this system. Parents receive alerts on their phones, so they can act quickly. The smart system components are shows in Fig. 2.

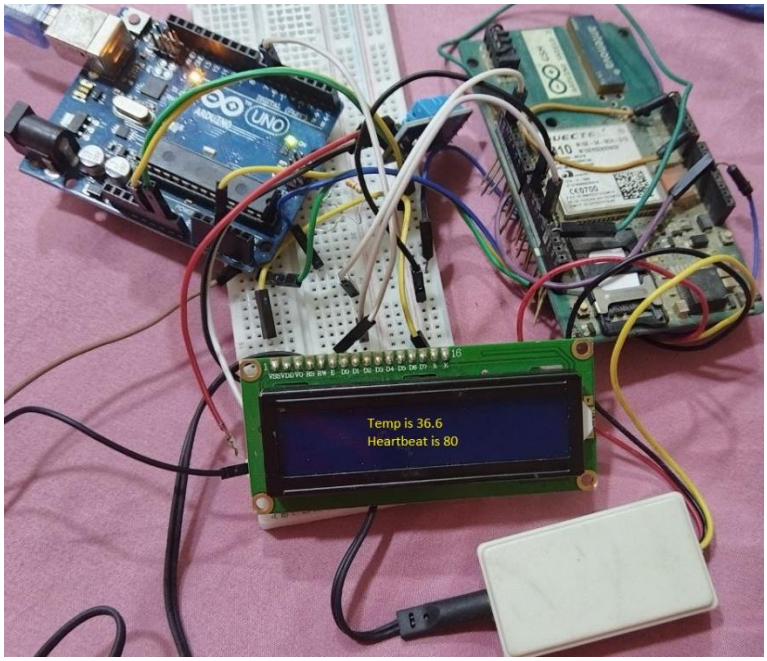

Fig. 2 - The block diagram of the system.

These hardware components, in tandem with the GSM network, form a cohesive smart monitoring system that ensures the health and well-being of kindergarten students while providing parents with timely and crucial information.

Table 1 - System hardware components.

Component	Description
Microcontroller	Utilizes Arduino, an open-source electronics platform, for processing inputs and executing commands. Enables various actions, such as starting motors or activating LEDs [14, 15].
Temperature Sensors	Continuously monitors a child's body temperature, providing real-time data to identify sudden changes indicative of fever or other health issues [16].
Heartbeat Sensors	Pulse sensors detect and measure a child's heart rate, offering insights into cardiac health. Alerts parents to anomalies, such as rapid increases or decreases [17].
LCD Screen	Serves as the user interface, displaying essential health and system information visually. Presents temperature and heartbeat data for real-time parental monitoring.

Software requirements: Arduino uses a C++ variant. The code is C++ with unique methods and functions. Fig. 3 shows the Arduino IDE's high-level architecture, which includes Arduino core, app, and build. Module functionality will be explored in module organization. Discussing the Common Design Model follows. The Code line methodology examines the project structure before identifying development stakeholders [19, 20].

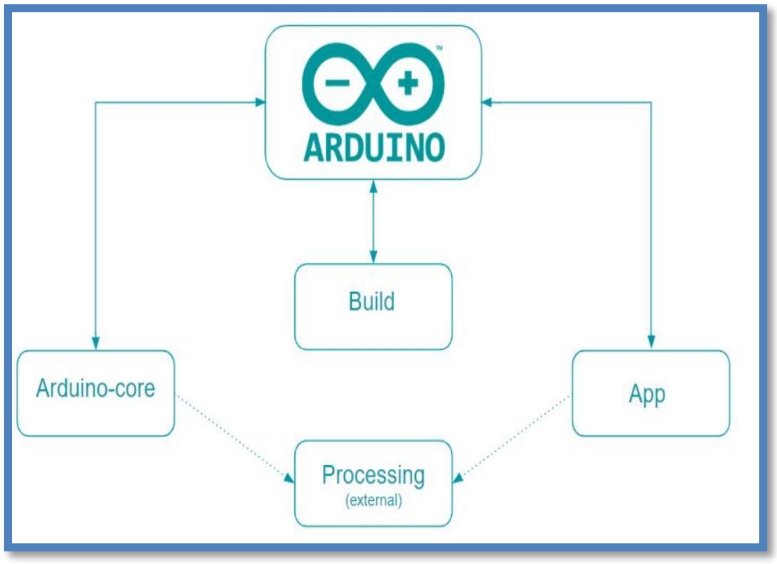

Fig. 3 - High-level architecture of the Arduino IDE.

5. Benefits of smart kindergarten healthcare monitoring systems

The benefits are shown in Table 2. The comprehensive Table 3 shows the advantages of smart kindergarten healthcare monitoring systems over traditional approaches in various aspects of child health and well-being.

Table 2 - Benefits of the system

Benefit	Description
Enhanced Child Safety	Real-time vital sign monitoring and alerting mechanisms safeguard kindergarteners from potential health issues.
Prompt Medical Intervention	Parents receive reminders for medical treatment, potentially preventing serious health issues.
Peace of Mind for Parents	Continuous health monitoring offers parents peace of mind, especially for children in school or kindergarten.
Improved Healthcare Accessibility	Integration of educational institutions with healthcare practitioners enhances accessibility in remote or underprivileged areas.
Parental Authorization	Empower parents to make active healthcare decisions for their children, promoting control and well-being.
Data-Driven Healthcare	Enables clinicians to access past information for informed medical decisions, contributing to data-driven healthcare.
Versatility for Early Childhood Healthcare	Suitable for children of various ages, accommodating the specific needs of early childhood healthcare.
Reliability and Accuracy	Thorough testing ensures the reliability of the vital sign monitoring apparatus.

Table 3 - The advantages of smart kindergarten healthcare monitoring systems over traditional approaches

Feature	Smart Kindergarten Healthcare Monitoring Systems	Traditional Monitoring Approaches
Child Safety	Real-time monitoring and alerting for swift response to health issues.	Less immediate awareness, and potential delays in identifying health concerns.
Medical Intervention	Prompt reminders for timely medical treatment, preventing serious issues.	Relies on sporadic check-ups and less proactive intervention.
Parental Peace of Mind	Continuous monitoring provides ongoing reassurance for parents.	Relies on occasional updates during check-ups, causing potential anxiety.
Healthcare Accessibility	Integration with healthcare practitioners enhances accessibility.	Limited interaction between educational and healthcare institutions.
Parental Authorization	Empower parents to actively make healthcare decisions for their children.	Limited involvement in decision-making, relying on external assessments.
Data-Driven Healthcare	Enables informed medical decisions based on past health data.	Limited historical health data is available during periodic check-ups.
Versatility for Early Childhood Healthcare	Tailored for various age groups, addressing specific early childhood needs.	Less adaptability to the diverse healthcare needs of different ages.
Reliability and Accuracy	Thorough testing ensures a reliable vital sign monitoring apparatus.	Reliability was dependent on intermittent check-ups and assessments.

Integrating these critical components, our smart monitoring system monitors kindergarteners' vital signs and informs parents of health risks. Technology's parental healthcare participation improves our youngest learners' safety, well-being, and development. For neonates to kindergarteners, our smart monitoring system is versatile. Considering age-specific health monitoring needs, the system works throughout development. In Fig. 4, GSM alerts appear.

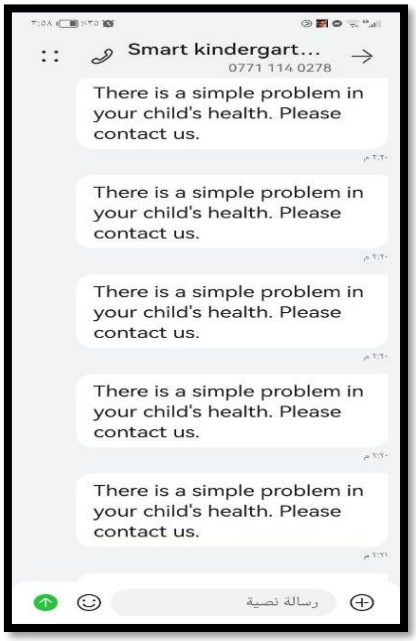

Fig. 4 - Alarm system.

6. Conclusion and future suggestions

Improve kindergarten student health with smart monitoring systems and GSM networks. This innovative tool alerts parents to health risks by monitoring vital signs in real-time. It lets parents help with their child's health and makes school safer and healthier. Future technologies, data analysis, and healthcare integration may benefit kids. By wisely and fairly utilizing these breakthroughs, we can enhance future generations. AI and machine learning algorithms may improve health pattern recognition in future smart monitoring systems. Predictive analytics and early health trend detection could improve child well-being. Finally, the smart monitoring system shows how technology can transform educational healthcare and create a pattern for the industry. We can continue to protect our youngest learners through innovation and child-centred care.

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References

[1] B. Ciren, A. Hu, E. K. Aadland, and H. Wergedahl, "Traces of sustainability in food practices in a Norwegian kindergarten," *Nordisk Barnehageforskning*, vol. 19, no. 3, pp. 85–103, 2023.
[2] N. Vitale and C. Coccia, "Impact of a Montessori-Based Nutrition Program on Children's Knowledge and Eating Behaviors," *Journal of School Health*, vol. 93, no. 1, pp. 53-61, 2023.
[3] N. M. Younis, "Evaluation the health lifestyle of kindergarten students at Mosul city/Iraq," *International Journal of Medical Toxicology Legal Medicine*, vol. 26, no. 1and2, pp. 148-152, 2023.
[4] V. Perumal, "Smart cradle monitoring system for babies," *AIP Conference Proceedings*, vol. 2581, no. 1, p. 050011, 2023.
[5] A. Hazizan, N. A. Md Lazam, and N. I. Hassan, "Development of Child Safety Car Alert System Using Arduino and GSM Module," *IOP Conference Series: Materials Science and Engineering*, vol. 834, no. 1, p. 012071, 2020.
[6] D. Z. Khutar, O. H. Yahya, and H. T. Salim Alrikabi, "Design and Implementation of a Smart System for School Children Tracking," *IOP Conference Series: Materials Science and Engineering*, vol. 1090, no. 1, p. 012033, 2021.
[7] A. H. Kelechi et al., "Design of a low-cost air quality monitoring system using arduino and thingspeak," *Comput. Mater. Contin*, vol. 70, pp. 151-169, 2022.
[8] N. Ahmed, S. K. Gharghan, and A. H. Mutlag, "IoT-based child tracking using RFID and GPS," *International Journal of Computers Applications of Solar Energy*, vol. 45, no. 5, pp. 367-378, 2023.
[9] T. A. Taha, A.-S. T. Hussain, H. Desa, F. H. Taha, and Y. Bektaş, "Child tracking system using smartphone," Bulletin of Electrical Engineering Informatics, vol. 12, no. 5, pp. 2745-2752, 2023.
[10] M. Jamshidi, S. I. Yahya, L. Nouri, H. Hashemi-Dezaki, A. Rezaei, and M. A. Chaudhary, "A super-efficient GSM triplexer for 5G-enabled IoT in sustainable smart grid edge computing and the metaverse," *Sensors*, vol. 23, no. 7, p. 3775, 2023.
[11] G. Moloudian, S. Soltani, S. Bahrami, J. L. Buckley, B. O'Flynn, and A. Lalbakhsh, "Design and fabrication of a Wilkinson power divider with harmonic suppression for LTE and GSM applications," *Scientific Reports*, vol. 13, no. 1, p. 4246, 2023.
[12] R. Nappi, L. Tiranini, E. Martini, D. Bosoni, C. Cassani, and L. Cucinella, "Different local estrogen therapies for a tailored approach to GSM," *Climacteric*, vol. 26, no. 4, pp. 361-366, 2023.
[13] M. T. Younis, N. M. Hussien, Y. M. Mohialden, K. Raisian, P. Singh, and K. Joshi, "Enhancement of ChatGPT using API Wrappers Techniques," *Al-Mustansiriyah Journal of Science*, vol. 34, no. 2, pp. 82-86, 2023.
[14] S. Arduino, "Arduino Documentation," 2015, Available: https://search.iczhiku.com/paper/TFzDJhGhd6VMaDsI.pdf.
[15] S. N. AlSaad and N. M. Hussien, "Landmark based shortest path detection in alarm system," *Al-Mustansiriyah Journal of Science*, vol. 29, no. 2, pp. 135-140, 2018.
[16] F. Xie et al., "Thermochromic-based bimodal sensor for strain-insensitive temperature sensing and synchronous strain sensing," *Chemical Engineering Journal*, vol. 471, p. 144504, 2023.
[17] R. K. Nv, B. E, and P. S, "Detection and monitoring of the asymptotic COVID-19 patients using IoT devices and sensors," *International Journal of Pervasive Computing Communications*, vol. 18, no. 4, pp. 407-418, 2022.
[18] M. M. Gabriel and K. P. Kuria, "Arduino uno, ultrasonic sensor HC-SR04 motion detector with display of distance in the LCD," *International Journal of Engineering Research Technical Research*, vol. 9, pp. 936-942, 2020.
[19] N. M. Hussien, Y. M. Mohialden, M. M. Akawee, and M. A. Mohammed, "The software requirements process for designing a microcontroller-based voice-controlled system," *Bulletin of Electrical Engineering Informatics*, vol. 12, no. 1, pp. 539-543, 2023.
[20] Arduino. (2024). The Arduino software. Available: https://www.arduino.cc/en/software