Real Time Monitoring and Controlling System for Newborn Babies in The Hospital: Review

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Abstract: The safety and security of newborns in hospitals is one of the most common problems in the world. There are many problems related to the security of children, such as cases of Kidnapping and exchange of children in hospitals and public places. In this research, we will review most of the recent works that have been implemented to protect children from cases of Kidnapping and exchanging by using several smart devices, including Arduino, GPS technology in cooperation with (WIFI or RFID). Where, parents can monitor their children remotely or receive messages via GSM technology, where the child's information is sent through smart devices to the parents' mobile phone. Also, for the safety of children, there are many smart devices that can be used for this purpose such as a pulse sensor and a temperature sensor to enable the parents to know the child's pulse and temperature. So, the parent can access the child's data intermittently by communicating through this smart gadget. This makes guardians defend the kids even in their absence. Eventually, the data is stored in the cloud permanently to keep a history of children's old data tracking.

Keywords: Safety, Security, Newborn Monitoring, Arduino, GSM.

1. Introduction

The health and well-being of patients, as well as the ability to provide high-quality healthcare services, are the primary goals of healthcare organizations. With the rise in patient safety concerns in hospitals, technology is frequently used to overcome any barriers that obstruct healthcare operations. This is especially true when dealing with patients who require special attention and protection, such as infants. Various cases of infant swapping, mismatching, and abduction have been reported around the world, which hospitals should be aware of and take rapid action to resolve. Although infant abduction or mismatching in the pediatric area of hospitals is a rare occurrence, the consequences for parents and healthcare providers can be devastating (Lahtela, 2009) (Al Osaimi, Al Kadi, & Saddik, 2017). The Parents and guardians need better ways to keep an eye on their children, but most security systems are designed to prevent theft or other unlawful activities and aren't well suited for child monitoring. Hiring manned guards or deploying video surveillance are two common approaches, however guards aren't realistic or inexpensive when it comes to monitoring children, and video surveillance systems sometimes have blind zones. Furthermore, parents and guardians do not have access to surveillance videos in order to keep an eye on their children.

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Although several research has conducted using wireless communication-based personal monitoring systems for children, these methods require specific platforms that are expensive and difficult to use and maintain. As a result, a low-cost, simple-to-use system that can track the location and status of kids in real time must be developed. Child Guard is a security strategy for monitoring children that makes use of ubiquitous computing devices, such as smartphones or wearable gadgets, which are gaining in popularity and performance. The use of such gadgets to track children's whereabouts and activities, as well as to warn children and their guardians of potential dangers (Gao et al., 2017). Scientists are developing more and more technologies that can automatically get data, like sensors and RFID technologies. These technologies are meant to improve integrated environmental information systems (IEISs), decision support systems (DSSs), and environmental management. Scientists, engineers, and people in charge of the government all have a lot of work to do on this topic. It goes far beyond the use of many different technologies. The Internet of things (IOT) is that when actuators and sensors work together seamlessly with the environment around us and share information across platforms to build a picture of how to run things (Fang et al., 2014). The internet of things (IoT) is a network of interconnected physical devices that can be accessed over the internet. It describes the ever-expanding network of physical items with an IP address for internet access, as well as the communication that takes place between these objects and other Internet-connected devices and systems(Luthra, Garg, Mangla, & Berwal, 2018). IoT is typically thought to provide improved connectivity of systems, devices, and services that extends beyond machine-to-machine “M2M” interactions and encompasses a wide range of protocols, domains, and applications(Chatterjee & Armentano, 2015). The interconnectivity of these embedded devices (including smart items) is predicted to bring automation to practically every industry, while also allowing sophisticated applications such as a smart grid and spreading into areas such as smart cities.

RFID (Radio Frequency Identification) is a good way to monitor of health care. This technique for radio waves can be beneficial in order to locate and protect instruments, prevent, and contain hospital-acquired infections, protect infants, and improve patient service and safety. It can also identify tagged people and items from a given distance away. Thus, the RFID technology, allow them to change their business processes, decrease costs and better serve to their patients while still keeping track of hospital assets. (Abd Rahman, Abidin, & Vasudavan,2013) (Ngai, Poon, Suk, & Ng, 2009).

In hospitals (RFID) technology, in general, tracking patients across the hospitals uses a wireless connection technology to link lab and medication monitoring (Hu, Ong, Zhu, Liu, & Song, 2015). However, on the other hand, bar coding uses an optical scanner to electronically collect the information included in the product, is another related technique employed in the healthcare context. Typically, hospitals utilize it to match pharmaceuticals to patients, for example, by using bar codes on both prescriptions and patients' arm bands. Each inventory item has a unique ID number thanks to RFID tags. Furthermore, barcodes must be scanned one at a time with a reader in close proximity, limiting usefulness. In a single swipe, an RFID scanner can read hundreds of distinct RFID tags, and they can do it from a distance of up to ten feet (three meters). As a result, Consultants in information technology provide a new viewpoint on the hospital's technological difficulties via objectively evaluating an existing system to translate existing demands for new solutions. (Garfinkel, 2006). In Figure 1, can be seen how RFID used in a hospital environment.

Figure 1: RFID technique in the hospital system. (Abd Rahman et al.,2013)

The goal behind this work is to explore most of the recent works that have been implemented using different technologies for preventing infant swapping, mismatching and abduction issues as well as other applications that are related to baby monitoring system such as new born heart rate, drug and milk control system, oxygen levels …etc. to show the advantage and disadvantage of each technique. The remaining of the paper is organized as follows. Section 2 presents a theory of monitoring and controlling child in terms security and safety, section 3 provides a related work on various techniques used for child monitoring in terms security and safety system, section 4 presents a comparison and discussion on various techniques used in that cases, finally, last section concludes the research work.

2. Related work

In our time, new-born babies are monitored physically, where the safety and security of new-born baby is taken care of by the hospital staff by conducting the necessary examinations for the child in the neonatal department. Therefore, with the development of technology, there are various technical methods to protect the children from kidnapping and other problems, this study attempts to discuss the systems in which infants can be monitored by using various technology methods.

2.1 Monitoring Child Based on Security System

The role of Radio Frequency Identification (RFID) technology in improving infant safety in terms of mismatching, swapping and abduction; is explored by(Al Osaimi et al., 2017) to assess nursing staff acceptance of the technology and workflow improvement after implementing the Infant Protection System. An exploratory study was conducted at King Abdul-Aziz Medical City in Riyadh to meet objectives. To achieve the first goal, two rounds of cross-sectional data collection were used. The first one performed before the system was implemented. The second round examined post-implementation data. Then the rounds were compared to determine the infant name, MRN, and RFID similarity percentage. To achieve the second and third objectives, 237 nurses were given self-administered questionnaire. The survey was completed by 190 nurses. Data were analyzed using SPSS and Java. The results showed that 65.8% of nursing staff believe RFID is effective in tracking infant movement and 62.1% believe RFID is effective in identifying infants correctly.

Many technologies have been used for monitoring infants for instance, (Jayanthi, Malathi, Munaf, & Bharathi, 2020) proposed a system that make use of Short Message Service (SMS) enabled text connection between the child wearable device and the relevant parent. As a starting point, a global mobile communication network is being proposed. Using phrases like "Temperature" "SOS" "Location" "Buzz" etc., the parent must send a text message into the wearable device. Then, it sends a text message as an information that shows the child's current position and provides the child's temperature, therefore, the parents may keep tracking if their child's temperature isn't appropriate. The use of a bright SOS Light is the next step in preparedness. Wearable device's distress alert can be triggered via parents through text message (SMS) to show the (SOS) signal extremely obviously and ring the alarm, so that the general population in the area is aware and may act quickly to ensure the safety of the kid, they can also try to call the parents and help locate the kids. To show how a child safety and security system can be constructed through the device that is worn by a child. Figure 2 shows a high-level view of the system, which includes the ATmega328p.

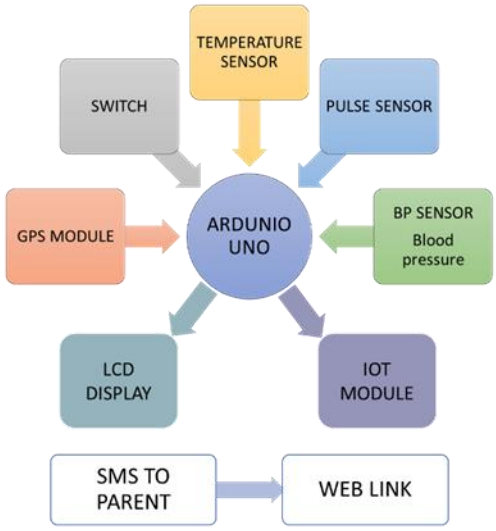

Figure 2: The child safety system blog diagram (Chowdhury et al., 2019)

If the (GSM) module was unable to comprehend a message containing multiple valid keywords. like (Location, temperature, buzz and SOS), SMS "BUZZ" or "SOS" will be sent instead of sending measurements to the user's phone, the light or buzzer would produce a signal in this case. The SOS light with the sound of the siren. An alarm would first be sounded and then the SOS light would be flashed before a buzzer could accomplish it. Figure 3 illustrates the circuit diagram of the system.

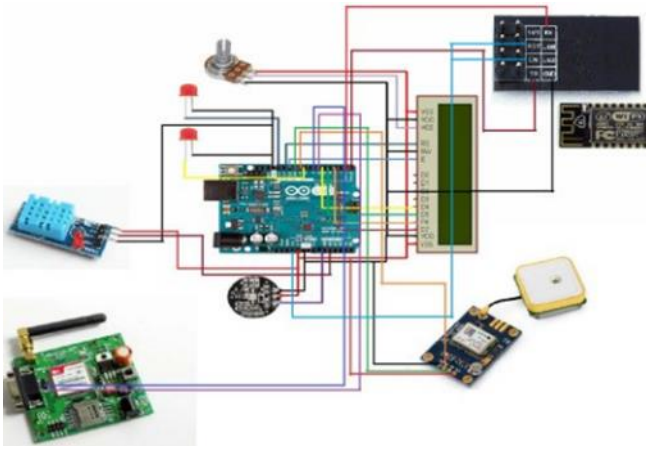

Figure 3: circuit diagram of the system (Chowdhury et al., 2019)

Another system has been proposed by (Bhogamma & Gadgay, 2018) that focused on warning people around the baby so they could find the baby in a safer place before the parents arrive. Out of all the wearable devices that can send the information about a child's location, actions, and so on to the parents via wireless Wi-Fi and Bluetooth, Bluetooth and Wi-Fi (wireless fidelity), are the least reliable methods to contact. thus, the plan was to use SMS/MAIL as a way for the parent and child wearable devices to contact to each other when IOT technology was put into place. The project was built with an Arduino Uno microcontroller board based on the ATmega328P. The ability to receive SMS (text messages), MAIL (email), and phone calls is made possible by connecting Arduino Uno to the internet through a NODE Mcu. The extra modules they used inform them what was going on with the child at the time via message/MAIL. The SOS Light and Alarm Buzzer are both external alert systems that are programmed into the Arduino UNO board. They are used to show that the situation is dangerous.

To reduce the potential risks of infants theft, bad care and abnormal body temperature; the researchers (Cheng, 2012) proposed a simple and effective newborn monitoring system. The proposed technology can easily distinguish between the various locations of newborn babies with wristband active RFID tags connected. After active RFID readers have received varying intensities of electromagnetic waves sent by active RFID tags, the system can accurately determine the locations of newborn newborns using Bayesian network classifier. The body temperature sensors in the infant monitoring system can also detect temperature anomalies in newborn babies in real time.

In addition, RFID technology has already been applied in some private hospitals in Malaysia and China for various reasons and practices. So, (Abd Rahman et al., 2013) proposed a system combines smart phones and RFID readers. Some problems in using RFID in government hospitals are also discussed. The advantages of RFID over barcode for hospital asset tracking are compared, and the advantages of RFID over barcode for the hospital asset tracking are stressed. The primary and the secondary data collecting methods are utilized to collect data for exploring RFID in public hospitals. The system's desktop and mobile application prototypes are shown in figure 4. Incentives to embrace RFID technology is a key hurdle for hospitals. Expenses of this nature are not rewarded. Cost became an issue for hospitals in underdeveloped countries, particularly public hospital. This is due to the high cost of RFID technology, a lack of expertise, and the hospital management's struggle to obtain the hardware and software when no budget is allocated for the system. It establishes the signal and communicates with the active tags after handshaking. The patient's wrist will be wrapped in a thin lithium polyester rechargeable battery to replace the two CR2025 batteries. It has a memory that stores

the patient's biographical information, such as registration, prescriptions, pharmacists, nurses, and medical history. The wake-up gadget on the ceiling will fully charge all tags in a ward before administering medicine to patients. In addition, the nurse will administrate medicine to patients whose ID numbers match. If not, a message and a buzzer will be shown on the tag, after delivery, the tag will switch off.

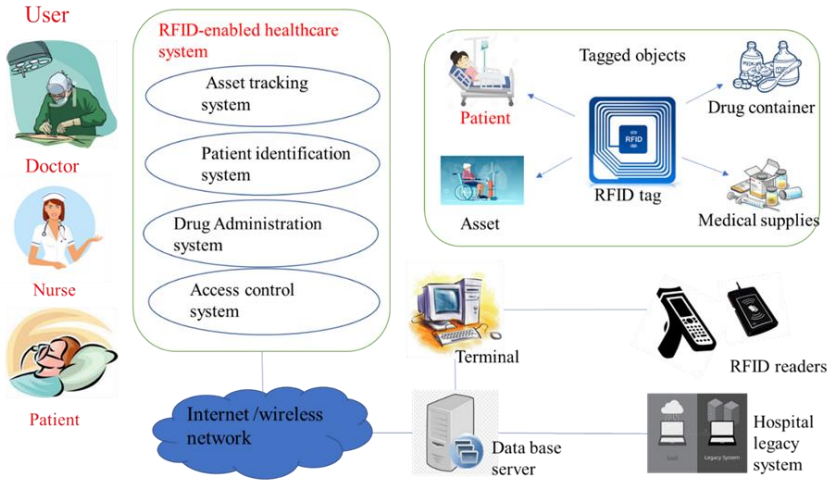

Figure 4: RFID technology- enabled healthcare system (Hu et al., 2015)

Also, an RFID-based for smart new born monitoring system is proposed by (Yadav, Pandey, Saraogi, & Tribhuwan, 2016) to decrease the potential dangers with integrated RFID modules, the smart infant monitoring system can be employed in neonatal departments in hospitals. The smart new born monitoring system is able to detect any unauthorized infant handlings and keep tracking of all infants in the facility. Child monitoring system (CMS) and Server Room System (SRS) make a smart new born monitoring system. The results of the smart monitoring system's testing revealed that it is a simple method of securing the infants. In the future, the system's security can be enhanced by adding a biometric module for medical employees, allowing only the authorized individuals to grant the access to enter the room.

On the other hand to deal with the cost-worthy design of an embedded device for real time monitoring of new born babies in the incubator suggested by (Sivamani, Sagayaraj, Ganesh, & Ali, 2018). In a smart incubator, doctors and nurses can view a child's medical records via mobile phones or computers from any location where they have an access to the internet. To send a message to the signed user, a message with the parameter values is sent to their “Ubidots” account. When the Wi-Fi network is connected to the Arduino, in every second, the values can be checked. The smart incubator continuously monitors the new born baby and sends the medical data to the cloud storage, where the data are kept. Mobile phones and computers allow patients to access and act on their medical records no matter where they are or what they're doing. This strategy can be used to keep a close eye on changes in health-related parameters. As a result, doctors are able to easily monitor the health of the baby and avert any complications.

A novel method for biometric identity verification for new born babies in maternity wards based on fingerprint minutiae suggested by (Lalović, Tot, & Trikoš, 2019). The information system uses a dual fingerprint scanner to provide data on the mother's and baby's fingerprints at the time of birth, as well as to guarantee maternity for each new born baby with 100 percent accuracy by generating a unique

ID reference and encrypting these data with cancellable biometrics. This is a relatively new approach for establishing identification based on the minute details of a baby's fingerprints.

A tracking system using active RFID-tag and RSSI method to identify and monitor new born babies was suggested by (Hung, Chu, Weng, & Lu, 2013). The technology is used in Taipei's Cathay General Hospital. This system can successfully avert situations such as kidnapping and switched babies include the integration of wireless devices and information technology, and it meets the BFHI requirement (Baby-Friendly Hospital Initiative). The nursing department can conveniently organize normal nursing tasks and improve nursing care quality. The approach provides hospitals with a higher ratio of 24-hour new born rooming-in care, allowing them to more successfully meet the requirement of being a baby-friendly hospital.

Another mechanism proposed by (Hung, 2015) to create a safer rooming-in environment, which comprises a hybrid technique integrating Location Fingerprint and K-nearest neighbor (KNN) algorithm, as well as active radio frequency identification (RFID) technology employing received signal strength indicator transmission method. This device is up to the standard established by the baby-friendly hospital programmed and can successfully avoid situations such as a stolen or exchanged baby. Routine nursing tasks can be readily organized, and nursing quality can be improved. The hospitals benefit from the scheme because the ratio of people requesting rooming-in care has increased.

Besides, to recognize the patient tracking using RFID and also to identify certain operational processes that is improved by (Zainal, Zulkifli, & Wahap, 2019) . The (B-Tag& Track®) has become the first indoor virtual positioning system and application for mothers and infants, adopting RFID technology to the Malaysian public hospital. RFID tags for the mother, newborn, and baby crib are used in the system. With the newborn tags, specially designed hypoallergenic straps with tamper-alert features are employed. The RFID tags come in a set and can be used for both single and multiple births. Following the implementation and adaptation of (B-Tag& Track®) to the work flow, process, and procedure being used at the Malaysian Government Hospital via the intervention of the spin-off space technology, RFID, B-Tag& Track® has revolutionized and modernized the public health sector's safety and security landscape. Despite the fact that there is still a long way to go and many obstacles to overcome on this path, B-Tag& Track® has taken a tiny step to instill and educate along with a technology transfer package to its successful pioneer pilot implementation end user at Hospital Banting in Selangor.

(Shelke & Dere, 2019) offered an android-based solution to help parents tracking their children's location in real time using IoT implications. GPS technology is utilized to track the child's position, and a biometric identification system is employed to verify the child's identity. When a kid boards a bus, the system recognizes the child and updates the server's logs. This data, which includes the current position and time, will be saved on the school server and sent to the parent's phone. Also, when the child arrives home, the parent should send a text message to the school server ID, which will serve as confirmation that the child arrived home safely.

Furthermore, to maintain a regular communication between the child and parent using a device that assists in locating the child's location, pulse, and temperature using a device equipped with a pulse sensor, temperature sensor, and GPS tracker, as described by the researchers in (Ranjeeth, Reddy, Reddy, Suchitra, & Pavithra, 2020). This device uses IoT to enable communication between the child and parent through the use of a WIFI module. Interfacing with this device allows the parent to obtain intermittent access to the child's data. This causes guardians to defend children even when they are not

there. The data is permanently stored in the cloud to maintain track of the children's previous data for future reference. When the sensors are subjected to various activities, they are automatically triggered.

2.2 Monitoring Child Based on Safety System

On the other hand, many works have been implemented for monitoring child's safety, for example, (Clenisha, Sandra, Sajin, & Sam, 2018) developed an excellent telemonitoring system with accessible data by utilizing the IoT (Internet of Things) for the child safety systems. This approach is expected to assist parents in keeping track of their children throughout the day. Using the appropriate sensors, an infant's heart rate and temperature were detected in real time. The data was then transferred to the Arduino Maker NANO microcontroller through sensor circuits. On the microcontroller, there are LEDs that show the infant's temperature and heart rate. Through the technology, those data were also sent to the data cloud. This system uses the (Thing Speak) app for data storage and display to end users. One benefit of keeping data in the cloud is that users can access it in real time. The system also comprises a wristband-style wearable device. According to the findings, the desired data may be acquired in real time within the specified time frame and simultaneously pushed to the cloud for storage. This system's wearable handset was very comfortable for infants.

In addition, because the environment for GSM mobile connection is existing everywhere, (Elakiya & Radhika, 2019) concentrated on having an SMS text enabled communication medium between the child's wearable and the parent. The parent can send a text with specific keywords like (LOCATION, TEMPERA TURE, UV, SOS, BUZZ, etc..), and the wearable device will respond with a text containing the child's real-time accurate location, which when tapped will provide directions to the child's location on Google Maps, as well as the surrounding temperature and UV radiation index, so that the parents can keep track if the temperature or (UV) radiation is not suitable for the child, and people in the child's immediate environment who could react quickly to ensure the child's safety until the parents arrive or who could contact the parents and assist in their whereabouts are the secondary measure. The secondary strategy was to use a bright (SOS) light and distress alarm buzzer on the wearable gadget, which when activated by the parents via SMS text should brightly show the SOS signal and sound an alert that a passer-by may easily identify as a sign of distress.

However, another researcher (Hussain et al., 2019) used a smart multimodal system to analyze a baby's behavior. Traditional wearable sensors like as heartbeat make the baby uncomfortable and some new born are worried about sensors. To examine baby behavior, the vision-based baby monitoring framework uses a process improvement technique called control charts. They created a control chart for real-time frames generated by a Raspberry Pi vision sensor. A baby's motion is indicated by points on a control chart; a baby's motion that exceeds or falls below the upper control limit (UCL) is considered abnormal. Whenever such a behaviour is observed, a signal is sent to the IoT interconnected devices to warn babysitters at smart health care facilities. Adaptable framework suggested approach outperforms the benchmark dataset in terms of accuracy and efficiency. control charts for smart homes and nurseries detailed proposed infant monitoring system in detail. The RPi with attached camera mounted over the baby bed provides video frames as input. Two separate motion detection methods are applied individually to the video frames, with the results combined to improve accuracy. White pixels show infant movements in a binary picture. This binary picture is used to draw a point on a control chart. The control chart for an interval (currently 5 frames) is reviewed for anomalies. A majority of points crossing the upper or lower barrier in a single interval is considered abnormal. The created notice is sent to guardians or parents for immediate action, with choices to observe the baby's present state via live streaming as further illustrated in Figure 5.

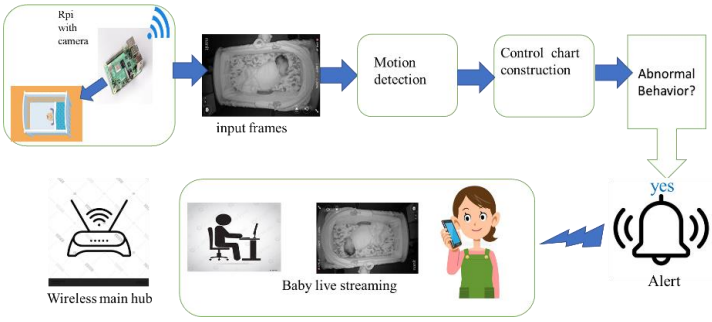

Figure 5: proposed baby monitoring framework by (Hussain et al., 2019)

a new structure to enable parents, particularly working women, manage with their new born children while not being physically present at home is presented by (Tripathy & Biswal, 2020). It is shown here how a child monitoring system has been implemented using several sensors and modules such as the Raspberry Pi and Arduino Uno, as well as thermometers and moisture sensors, PIR sensors, voice recognition modules, and speaker modules. Additionally, a servo motor has been connected to the support so that it can swing when the child screams or its rest is disturbed. Cradle swings and an audio in their parent's tone is automatically activated if temperatures rise and the baby begins to scream due to IoT technology. On the website page, it is possible to see the child's current status in real time, and the data from the sensors is constantly refreshed. Parental notifications about their child's well-being are also delivered to them via audio alert as necessary, they will be able to monitor their children in the outside through this framework.

Additionally, an android application system for the temperature and heart rate monitoring system has been proposed by (Chamim, Rinaldi, Ardiyanto, Iswanto, & Ma'arif, 2020). To connect with an Android smartphone, the system employs Bluetooth connection. The technology was created to eliminate measuring errors caused by human error in manual measurements such as stethoscopes. As seen in figure 6, the device has a pulse sensor and an infrared sensor that are both connected to an Arduino Pro Mini and Android studio. The heart rate is detected by the pulse sensor, and the body temperature is detected by the infrared sensor. The sensor data is delivered to the Arduino, which processes it, and the outputs are the measured conditions. The measurements' findings are shown on the Android interface through Bluetooth, as the information is kept in a database and displayed graphically, this device has a 95.67 percent accuracy in heart rate monitoring and a 98.45 percent accuracy in body temperature monitoring.

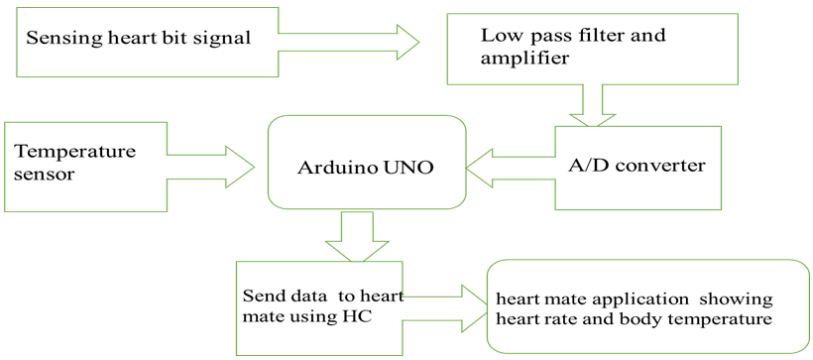

Figure 6: The block diagram of the system(Chamim et al., 2020)

(Dobre, x Mavromoustakis, Garcia, Goleva, & Mastorakis, 2016) proposed the usage of an Arduino board system to provide continuous help to patients and children in urgent situations inside or outside

of hospitals, rather than using traditional medical devices. With this project, the goal is to perform signal analysis operations on a global scale by monitoring, transmitting, and storing data from wearable sensors in real time. This gadget can collect data from a variety of sensors, including temperature, humidity, respiration rate, and pulse monitoring to achieve this goal. In order to be able to place the sensors in precise locations on the body, the interface between the sensors and the board must be made possible by the use of flexible semiconductors, such as textile stainless yarns or polymer fibers "filamentary and spun yarns".

Another system has been proposed by (Benisha et al., 2021) that advocated for the use of a modern technology for child protection, such as GSM, in order to prevent children from feeling abandoned when dealing with such societal difficulties. The challenges were overcome with the use of Arduino UNO, GSM, sensors, MEMS, temperature, and a panic button, all of these were enabled through the Internet of Things. In such a circumstance, Heartbeat Sensor determines the optimal heart rate for children and sends an emergency message using the GSM to call the contacts that have been saved. In today's world, such an approach is actually beneficial for youngsters. As a result, this provides a sense of comfort to the children as well as the feeling of security for the parents.

Table1: Monitoring child based on security system

Ref.	Year	devices	Advantages	Disadvantages
(Jayanthi et al., 2020)	2020	Bluetooth Wi-Fi GSM GPRS	Due of the huge cellular range, no internet access is necessary while using GSM technology.	The main downside of this band is that it uses Bluetooth to communicate between parent and kid. Also, the (GSM) unit was unable to understand several correct keywords intended as a one message.
(Bhogamma & Gadgay, 2018)	2018	Arduino Uno Wi-Fi, Bluetooth	Using IOT technology, parents may monitor their child's environment in real time from anywhere in the world.	The issue with wearable devices was that they used Wi-Fi and Bluetooth, which were becoming inconsistent communication resources. So, unless using IOT technology, these two communications aren't adequate for the project.
(Elakiya & Radhika, 2019)	2019	Arduino RFID	Because GSM mobile connectivity is almost	The problem with this device is that it has a

			everywhere, the focus is on having SMS text enabled communication between the child's wearable and the parents. Therefore, it gives parents a sense of security for their children.	battery, but it does not take for long time, it should be longer
(Abd Rahman et al.)	2016	RFID	RFID radio waves technology can assist locate and secure equipment, prevent and contain hospital acquired infections, protect infants, and improve patient care and safety.	It has an issue with the expensive cost of RFID technology, hardware, and software, as well as a lack of expertise among hospital administration.
(Al Osaimi et al., 2017)	2017	RFID	The study found that 65.8% of nursing staff believe RFID technology is helpful in tracking new born movement and accurately identifying infants.	The primary causes of discontent were the identified as insufficient training and c computer skills. However, to improve nursing satisfaction with the system, more system training and computer skills are required.
(Yadav et al., 2016)	2016	RFID	It is a good means of securing the infants by preventing baby mismatches by verifying them with the details contained in the	Because the system was not secure enough, they decided to install a biometric module for hospital employees so that only authorised people could enter the room.

			tag at the time of registration.	Enhanced security door automation can be programmed.

Table 2: Monitoring child based on safety system

Ref.	Year	Devices	Advantages	disadvantages
(Ali, Haxha, Alam, Nwibor, & Sakel, 2020)	2020	ESP8266 WIFI Heartbeat, temperature sensors	The utilized technology accurately calculates heart rate and body temperature. It can be used to continuously monitor children and adults, especially the elderly. The measured vitals are displayed on the onboard LCD and sent to an Android phone through the HC-05 Bluetooth module.	With the high cost of traditional child health monitoring systems, many underdeveloped nations are unable to afford them
(Koroma, 2020)	2020	Heart rate sensor, 433MHz RF module, a pulse sensor, a vibrating motor, and a couple of LEDs	A useful tool for deaf parents. A way for deaf parents and babies to connect. To avoid a circumstance where a baby is injured and cries for their parents.	The device performed perfectly but it might be improved with video monitoring. Video monitoring requires a larger, more complex gear, but it is more efficient in monitoring a baby.
(Ranjeeth et al., 2020)	2020	WIFI module, IoT, Heart Rate Sensor, Temperature Sensor, GPS tracking	The project had a positive impact on society's crime rates. It also has a low cost of implementation and construction, making it easier for authorities to solve child kidnapping instances.	There are no issues, although code complexity may be significant due to the utilisation of multiple hardware and software components to store and analyse data.
(Benisha et al., 2021)	2021	Arduino UNO IOT GSM, GPS, Heartbeat Sensor, temperature	The proposed technology tracks children in real time. The planned solution finds the child's exact location using GPS	A camera application could be added to the system to improve it. Because the proposed system can identify

		sensors	and updates the end user, i.e., their parents or relatives, via mobile application and SMS. It is a safe and reliable way to protect youngsters.	violence with high accuracy, it can be applied with Raspberry Pi in the future for improved results.
(Zakaria, Saleh, & Razak, 2018)	2018	IoT ESPresso Lite V2.0 Body temperature	Using a wearable sensor, this device monitors the body's temperature. The data was wirelessly sent to their parents. Interfacing mobile phones with the system allows remote monitoring.	There are no problems from using the device, but they suggested a monitor at the lowest cost and adding another sensor to monitor different types of vital signs such as respiratory rate, heart rate, oxygen saturation and humidity

3. Comparison and Discussion

Throughout this review, many different techniques of Monitoring and Controlling System for New Born Babies in the Hospitals have been discussed and each one has shown different performance (advantages and disadvantages) as further illustrated in the table 1. The most significant and comparable results are compiled from all the different types of techniques, aggregation methods and different loss. From Table 1 which is related to security part for child monitoring, it can be seen that the method which is proposed by (Elakiya & Radhika, 2019) has achieved great success where it used Arduino system with RFID where, this device has the possibility of tracking and responding quickly by providing the correct location for the child due to the navigating through Google GPS maps although, it has a simple problem which is, the device has a battery that is may not last for long time.. Additionally, (Jayanthi et al., 2020) used (GSM) technologies which is beneficial as the cellular range is vast therefore, no internet connectivity is required but, the most significant drawback of this band is that it uses Bluetooth as the method of communication between parent and child since, this technology has a short distance for the communication. Moreover, older Bluetooth devices can be exposed to the risk of unexpected security vulnerabilities. On the other hand, from table 2 which is related to safety part for physically monitoring the child, it can be noticed that the authors (Benisha et al., 2021) used an Arduino UNO, GSM, GPS, Heartbeat Sensor, temperature sensors reading of the child's body. In addition, this work has one of the most important benefits which is that the child’s location and emergency information can be shared through SMS messages to mobile phones registered at police stations via GSM and GPS. Overall, in the experiment, there was no apparent problem, but this work can be more enhanced by adding a camera application since the proposed system can detect the violence with good accuracy, so for better performance in future it can be implemented with (Raspberry pi) instead of using Arduino UNO. Also, (Koroma, 2020) used many techniques to monitor the safety of the child, including (Heart rate sensor, “433MHz RF” module, a vibrating motor, a pulse sensor, and a couple of “LEDs”), the results showed that the devices were worked very well and did

not have any problem. Although, it could be enhanced with video monitoring. Where, video monitoring would mean a bigger, huger, and more complex device, but it will serve the purpose of monitoring a baby.

4. Conclusion

In conclusion, despite the development of technology and modern smart devices, there are many ways to protect new born babies in hospitals from cases of kidnapping and child exchange using a group of devices such as (Arduino boards, WIFI, RFID, GPS, GSM...etc..). This paper, discussed the importance of these devices and the necessity of their use in hospitals and public places because children are more at risk than adults. We can also protect children from a physical point of view, such as protecting their body temperature, heart rate…. etc. Finally, this study noticed that protecting children through these devices has a good and beneficial results for everyone.

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