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Evaluations of an Ingenious Medical Hypertension Alarm System for Infants Using IoT

[1]Maria Amur Khalfan Al-Shabibi, [2]Dr. Kamal Hamood Zaid Al Sabahi, [3]Dr. Ramesh Palanisamy

[1,2,3]Department of Information Technology, University of Technology and Applied Sciences – Ibra, Oman

Authors E-mail: [1]36j1947@utas.edu.om, [2]kamal.alsabahi@utas.edu.om, [3]ramesh.palanisamy@utas.edu.om

***Abstract* - Mobile devices, TVs, and even houses are getting the "smart" treatment, and the demand for self-monitoring is growing. The Working Group of the European Society of Hypertension evaluates blood pressure measuring equipment in order to assist consumers in making informed decisions. This is the first independent device validation report. O'Brien and colleagues, 2001.) Smart blood pressure measurement devices are costly and slow, making them unsuitable for children. Because primary hypertension is more common in adolescents, it is more difficult to obtain products. Grewal, Mattoo, and Kapur, 2023. For the Internet of Things, a smart measuring tool for children's hypertension will be developed, allowing them to live a happy life free of their parents' worry and concern. Providing an IoT-based Smart Pediatric Hypertension System in order to reduce the number of deaths caused by delayed medical attention. IoT and Arduino are used to create a device that measures high blood pressure in children. The main idea is to control conventional hypertension measurement and obstacle detection using an Arduino microcontroller, GSM/GPS tool, blood pressure sensor, IFTTT platform, and lithium batteries. By developing an Internet of Things-based intelligent pediatric hypertension solution, this project aims to provide a profitable and full-time job with respectable employment for everyone, as well as promote balanced, equitable, and sustainable economic development. Comparisons between projects have been made to make selecting the right components easier. The critical components for the IoT-based Smart Pediatric Hypertension for Children alerting System will be identified, and the circuit design will be provided. Data on a variety of issues is collected using samples from hypertensive children aged 4 to 13. To provide accurate hypertension readings, compatibility and light components are used. Wi-Fi enabled Arduino Nano bracelet with blood pressure sensor, notification feature, IFTTT platform, GSM/GPS module, Lithium Batteries, and call and message warning.**

Keywords: Intelligent Pediatrics Hypertension; Internet of Things Technology; Arduino; detection of obstacles.

1. Introduction

Contemporary technological advancements have enabled the availability of blood pressure monitoring equipment, and self-monitoring is becoming more popular. The European Society of Hypertension's Working Group on Blood Pressure Monitoring evaluates blood pressure measuring apparatus on a regular basis to help consumers make purchasing decisions. A number of technologies, including IoT and artificial intelligence, have been built on a smart measurement device for high blood pressure to allow children to walk freely and safely. However, the software system's response time is extremely slow, making these products difficult to obtain. A clever determining device to monitor children's hypertension will be developed for the Internet of Things, allowing them to accurately detect their elevated blood pressure without the need for traditional high blood pressure measuring equipment. The Internet of Things-based Smart Pediatric Hypertension Alarming System contributes to a lower death rate in children with hypertension. Creating a device to measure high blood pressure in children. The goal of this project is to create an Internet of Things-based intelligent pediatric hypertension solution that is both cost-effective and readily available to children with high blood pressure. It will benefit human life, safety, and economic growth.

2. Literature Review

Analyzing an earlier publication in the same field is essential for understanding the guiding principles of a specific project. This provides you with a clear picture of how they implement it, what components they use, what technology they have adopted, how they are tested, and what limitations they encountered and overcame in the project being presented. For this reason, three journal articles on the same topic will be critically examined. Furthermore, each project will be compared to the others in order to determine which concept should be used.

The difference between the blood pressure readings obtained by an MS and the two backup electronic devices was calculated by Lim and Kim (2022), and it was discovered that SBP had a significantly different difference (mean differences: -0.52 and -0.62 mmHg, P=0.76). In order to determine which

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BP measurement technology is best suited to replace MS in future surveys, a comparable design study of the Korean National Health and Nutrition Examination Survey Program was conducted in 2018. When the three devices were directly evaluated using carefully monitored measuring techniques, it became clear that there were significant differences between the manufacturers' products for children and adolescents versus adults, particularly for DBP .

Two new guidelines for hypertension in children allow the use of oscillometric devices for blood pressure screening, but if the results indicate hypertension, the auscultatory approach must be used to verify the readings. ABPM may help in the diagnosis of hypertension when manual blood pressure readings are elevated. Stergiou, Boubouchairopoulou, and Kollias (2017) discovered Validation Techniques for Children's Blood Pressure Monitors. Any method used to measure blood pressure must be precise. Independent validation studies on the accuracy of electronic blood pressure monitors should be conducted, and the necessary procedures have been developed.

Kids distinctive structural as well as functional traits pose a variety of difficulties for the validation of blood pressure monitors, including relatively low blood pressure levels, small arms with wide variation necessitating multiple cuff sizes, and difficulties in precisely measuring diastolic BP due to the aforementioned challenges in defining Korotkov sounds K4 and K5 in children. Therefore, numerous adjustments must be made in order for the validation strategies created for adults to be fully applicable to children. More importantly, these results suggest that an electronic blood pressure monitor designed specifically for children that has undergone extensive adult testing may be inaccurate. In order to validate BP monitors, children must therefore be treated as a separate group, requiring separate validation tests.

Gillman & Cook's (1995) study revealed that new blood pressure measurements (1–18 years) For the 2017 AAP recommendation, a new BP percentile chart based on kids with normal weight (BMI 85th percentile) was created. The teens who were listed in the percentile table represented a significant portion (21%) of those who were overweight or obese in the previous guideline from 2014. As a result, the current BP values are lower than they were in 2004. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) normal values were determined using the percentiles for age, sex, height, and weight.

The table now includes height information in centimeters and inches (DBP). The AAP guidelines' blood pressure chart is simple to use for primary care physicians. The 90th percentiles for height, age, and sex were used to calculate these data. For kids whose blood pressure was found to be elevated, the expanded percentile table made for diagnosis should be used; for kids ages 13 and older, the value of 120/80 mm Hg should be used.

In the chapter's critical evaluation of three journal articles, the following subjects were covered. A concise explanation of the project's objectives, strategies, elements, testing procedures, and challenges that had to be overcome in order to finish the assignment. Comparisons between the projects have been done in order to make the process of choosing the appropriate components easier.

3. Data Analysis and Findings

The authors of Lim and Kim's paper (2022) presented a technique for in the aneroid sphygmomanometer, a set of mechanical springs and bellows are used in place of a mercury pressure gauge. As opposed to MS, the aneroid sphygmomanometer's accuracy can vary between manufacturers. Studies on its accuracy in clinical settings show that the frequency of faulty devices can range from zero to more than 35%. The need for maintenance and recalibration with aneroid sphygmomanometers, which is not necessary with the MS, is another significant issue. In accordance with the validation requirements, this device's accuracy must be routinely evaluated (no more frequently than every six months).

Make sure the needle is not pointing to 0 mmHg when the manometer valve is opened to quickly verify the calibration. Finally, benefits Using Korotkoff tones, the auscultator blood pressure measurement system directly monitors SBP and DBP. As a result of its low price, portability, and battery-powered operation, it has developed into the industry standard for determining young people's blood pressure and diagnosing hypertension. The auscultator method has the drawback that a qualified examiner must perform the measurement.

Korotkoff noises are difficult to detect, especially in young children, so measurement errors by the examiner are also possible and may result in an underestimation of SBP or a Korotkoff mix-up. The small blood vessels in newborns make it difficult to hear the Korotkoff sounds, and resting the stethoscope on the arm causes the bias because it raises diastolic pressure. The auscultator method should not be used on newborns as a result.

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4. Research Design

Methodology and Research Design

The various project planning phases that were used to sequentially complete the goal and the objectives will be highlighted in this chapter. We'll list the key elements of the IoT-based Smart Pediatric Hypertension for Children alerting system and provide the circuit diagram. The approach that was used for the entire system will also be covered, along with the flowchart and algorithm that will be used for each feature. When selecting the hardware and software to be used, the following factors will be taken into consideration. Constructing an inexpensive but highly effective IoT-based Smart Pediatric Hypertension for Children alerting system.

Participants

For this study, I decided to use samples from hypertensive children between the ages of 4 and 13. We use this sampling technique when it's necessary to collect data from a large number of children on a range of topics. The aim of this study is to develop a smart system for high blood pressure in children based on the Internet of Things. Collecting samples from hypertensive children will also help the system's success. I will survey 150 children to find out how the system works and what encourages kids to use a smart system for high blood pressure in children based on the Internet of Things provided by medical institutions.

Implements

The Arduino Uno WiFi performs the same tasks as the Arduino Uno Rev3, but it has WiFi and Bluetooth® in addition to a number of other upgrades. It features the brand-new ATmega4809 8-bit CPU from Microchip as well as the LSM6DS3TR IMU, which is built-in. A self-contained SoC called the Wi-Fi Module can serve as an access point or allow users to connect to a Wi-Fi network. It has a TCP/IP protocol stack built-in. The datasheet for the u-blox NINA-W102 is available here. The Arduino UNO WiFi Rev.2 board includes six analog inputs, 14 digital input/output pins, five of which can be used as PWM outputs, a reset button, a USB port, a power jack, an ICSP header, and six analog inputs. Everything required to support the microcontroller is present. Simply use a USB cable to connect it to a computer, or power it on with an AC adapter or battery. Simply connect it to a computer with a USB cable, or turn it on with an AC adapter or battery. 2021 (Arduino, cc)

GSM/GPS tool

The A9G GSM/GPRS/GPS module by Ai-Thinker is an integrated IoT solution that supports dual-band 3 mA and GSM/GPRS networks and has a built-in GPS module. If your project requires the use of both a GSM and a GPS module, the A9G GSM GPS is a fantastic choice. The board is compact and uses a negligible amount of current. The current consumption in sleep mode is as low as 3mA thanks to energy-saving measures. It is connected to the microcontroller via the UART interface and is capable of understanding AT commands. It is also possible to use an Arduino, ESP8266, or Raspberry Pi to control the device using AT commands because of the pre-loaded G's boot loader or firmware. The technology is best suited for Internet of Things (IoT) applications such as wearable electronics, wireless location sensors, wireless location system signals, home automation, industrial wireless control, and other IoT applications. Internet-connected modules like the Raspberry Pi and Arduino can be connected using it. Additionally, it can be applied in a variety of IoT applications. (2023 for electronics).

IFTTT platform

Users can automate web-based tasks and boost productivity with the help of the free web service and mobile app IFTTT by integrating well-known apps. IFTTT, which stands for "If This Then That," is an acronym that honors programming conditional statements. Through the use of "recipes," users can define task automations so that when an event occurs in one app, it triggers a response in another. For instance, you can set up automation to send photos you share on Facebook instantly to Twitter, Instagram, Flickr, and other photo-sharing websites. (Cotriss, D, 2023).

Lithium Batteries

Consumer products that now primarily run on lithium batteries include mobile phones, kids' toys, cars, and electric bicycles. Despite their widespread use, lithium batteries are dangerous objects that present a safety risk if not packaged in accordance with transit regulations. The majority of people are unaware of this. To help with compliance, IATA has developed guidelines for shippers, freight forwarders, ground handlers, airlines, and passengers. (iata, 2022).

Blood pressure sensor

The Blood Pressure Sensor is a non-invasive sensor that was created to measure people's blood pressure. Using the oscillometric method, systolic, diastolic, and mean arterial pressure are all measured. Pulse rate is also recorded in 2023 (Vernier).

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5. Summary and comparison of papers

	Lim and Kim (2022)			(Almeida, Cortés and Other 2022)	The proposed project
	Aneroid sphygmomanometer	Hybrid sphygmomanometer	Oscillometry devices		
Method of BP estimation	Auscultation using a stethoscope to hear Korotkoff noises.	Electronic and auscultatory elements combined to produce Korotkoff sounds.	Oscillometry measures arterial flow to measure blood pressure.	Wearable Aktiia 24/7 BP monitor monitors BP readings on smartphone app. CE certified.	Arduino Nano connected to blood pressure sensor for bracelet.
Advantages	BP Inexpensive direct estimation.	No need to calibrate bias elimination for terminal digit preference.	Simple to use fewer observer mistakes suitable for screening.	Aktiia can replace ABPM for long-term blood pressure monitoring.	Notification sent to parents if child is away.
Disadvantages	Need for an expert observer Need for regular calibration.		Standard validation procedure is required. Variation among manufacturers.	Aktiia monitor only gathers PPG data when wrist is motionless.	-
Pediatric area	The best method for identifying HTN.		Sign up for 24-hour ABPM to help with difficult auscultation.	lower HR as measured by the Aktiia monitor when the user is not moving.	IoT based Smart Pediatric Hypertension for children alarming System

The comparison of the concept adopted by the authors and the proposed project

Components/project	Lim and Kim (2022)			Almeida, Cortés and Other 2022)	The proposed project
	Aneroid sphygmomanometer	Hybrid sphygmomanometer	Oscillometry devices		
Arduino microcontroller with Wi-Fi features	X	X	X	X	√
GSM/GPS tool	X	X	X	X	√
IFTTT platform	X	X	X	√	√
Lithium Batteries	X	X	X	√	√

Although accurate readings of hypertension are provided by the methods used in the aforementioned papers. The kids must hold it constantly, which is uncomfortable for them. So, only compatible and lightweight components will be used in the paper that is being presented. The entire apparatus will be a bracelet-shaped Arduino Nano with Wi-Fi capability connected to a blood pressure sensor that detects an increase in blood pressure. Every time the blood pressure rises, a notification feature will be available. The IFTTT platform and lithium batteries for the GSM/GPS module will be used to create this feature. In the event that a child is separated from his or her parents, notification of the child's location will be sent to the parents via call and message alarm.

6. Finding

The following conclusions were drawn from the analysis of the papers:

1) A few studies produced a blood pressure monitor that is inappropriate for use on children.
2) The blood pressure monitor is not of the necessary quality for use on children.
3) Because a child's hand is small in comparison to the device, the blood pressure monitor relies on the incorrect device indicators to determine whether a child's blood pressure is high or low.
4) The data gathered by blood pressure indicators and reports is insufficient to investigate a kid's situation.

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7. Conclusion

In order to enable kids with primary hypertension to move around freely and safely without parental supervision, the main objective of this research is to create a smart measurement device. Children will be able to accurately detect their elevated blood pressure without the use of conventional high blood pressure measuring equipment thanks to a smart measuring tool for the Internet of Things. The death rate of children with hypertension is decreased thanks to an IoT-based smart pediatric hypertension alarming system. Using an Arduino microcontroller, a GSM/GPS tool, a blood pressure sensor, the IFTTT platform, and lithium batteries, one can create a smart device to measure high blood pressure in children.

The goal of this project is to create an intelligent pediatric hypertension solution based on the Internet of Things that is both affordable and accessible to children with high blood pressure. It will benefit human life, safety, and economic growth. Three journal articles on the same topic will be critically examined and compared in order to determine which concept should be used. Comparisons between projects have been made to aid in the selection of components. The most important concept is that the IoT-based Smart Pediatric Hypertension for Children alerting System will be cost-effective due to the use of low-cost but effective components. This study will use samples from hypertensive children aged 4 to 13 to learn how an Internet of Things-based smart system for high blood pressure in children works. This paper proposes a bracelet made of Arduino Nano, Wi-Fi, blood pressure sensor, notification feature, IFTTT platform, GSM/GPS module, Lithium Batteries, and Lithium Batteries to provide accurate hypertension readings.

8. Recommendations for Future Research

1) The importance of conducting medical research and studies to select a device for measuring blood pressure in children and determining a device that is appropriate for the targeted children.
2) Improving the quality of the blood pressure measuring device by developing its specifications and testing it on children to see if it is appropriate for them.
3) It is necessary to select a blood pressure monitor appropriate for children so that they can walk and play freely away from their families, with a special ability to inform their parents about their situation and the ability to act in periods of troubled times.
4) That healthcare organizations seek to obtain a sufficient quantity of a device to measure blood pressure for injured children, as well as to provide offers tailored to the specific needs of each affected child in order to reduce future fatalities.

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