Baby Health Monitoring System using Wireless and Remote Access Technology

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Abstract— In today’s working world, Sudden Infant Death Syndrome (SIDS) causes unexpected death of infants; a variety of risk factors have been detected through the years. A significant number of deaths occur when the children are being cared by non-parental caretakers. The aim of the project is to design a wearable temperature and heartbeat sensing pair of sock which eliminates the risk factors and can be constantly monitored and the gathered information of baby can be sent to the parents through a mobile application or the designed webpage. Recently the health care sensors are playing a vital role in hospitality. The baby health monitoring systems is one of the major improvement in the hospitality and lifestyle because of its advanced technology. A wireless baby health monitoring system to measure heartbeat and body temperature is being developed by using embedded and wireless technology.

Keywords— health monitoring, body temperature, heartbeat sensors, mobile application, website.

I. INTRODUCTION

In today’s world, the maximum use of resource is always complimented. So, the use of wireless technologies enhanced to meet the need of remote control and monitoring. Remote baby health monitoring is a technology that enables us to monitor the health and vital signs of the baby. It may increase access to health services and facilities while decreasing cost Remote Baby Health Monitoring reduces the anxiety and stress amongst parents, hence increasing efficiency and reliability of health services. Heartbeat and body temperature are the major signs that are routinely measured by physicians after the arrival of a patient. Heart rate refers to how many times a heart contracts and relaxes in a unit of time (usually per minute). Heart rate varies for different age groups. For a human adult of age 18 or more years, a normal resting heart rate is around 72 beats per minute (bpm). A lower heart rate at rest implies more efficient heart function and better cardiovascular fitness. Babies have a much higher rate than adults around 120 bpm and older children have heart rate around 90 bpm. The heart rate increases gradually during exercise and returns to its normal value after exercise. The rate at which the pulse returns to its normal value is an indication of the fitness of a person. If the heart rate is lower than the normal heart rate, it is an indication of a condition known as bradycardia and if the heart rate is higher than the normal heart rate, it is an indication of a condition known as tachycardia.

Like heart rate, normal body temperature also varies from person to person and changes throughout the day. The body temperature is lowest in the early morning and highest in the early evening. The normal body temperature is about 37° C or 98.6° F. However, it can be as low as 36.1° C (97° F) in the early morning and as high as 37.2° C (99° F) and still be considered normal. Thus, the normal range for body temperature is 97 to 100 degrees Fahrenheit or 36.1 to 37.8 degrees Celsius. Temperature can be measured by using different types of sensors. These sensors come in different forms such as thermocouples, resistance temperature detectors (RTD), and integrated circuit (IC)
The temperature sensor produces analog output voltage which is proportional to the temperature. The temperature sensor requires analog to digital (A/D) converter so that the analog output voltage can be converted to digital form. The output of the temperature sensor is connected to the Port of Raspberry-Pi/Arduino microcontroller through Bluetooth. The microcontroller processes this data and delivers the output on the phone application of the parents mobile as well as sends it over the internet end for displaying at the remote place. Also, the IP-Camera connected to the Microcontroller transmits live visual feeds of the baby movements continuously over the internet on the dedicated webpage.

The number of infant deaths occur due to improper care taken. Mothers with newly born baby have to stay away from their babies due to various reasons. During such situation, health status of babies is hard to detect. The sudden fall and increase in physiological parameters may cause sudden infants deaths syndrome (SIDS) and may lead to Apparently Life Threatening Events. The aim of the project is to incorporate sensory functions in the wearable hardware making it capable of measuring the physiological parameters (temperature and heart beats) accomplishing the need of continuous health monitoring. The microcontroller based hardware includes integrated sensors for the parameters heart rate, temperature. It will notify for the potential life threatening events, also recognize the development of any disease. The hardware will be able to output the analogue values of sensed data which in turn will be synchronized with cloud server via middleware architecture. Wearable hardware will communicate with middleware architecture through wireless communication. The necessary data processing on the cloud storage will identify the critical conditions as well as will create reports. The final component of the system, i.e. mobile application is featured with real-time notification, alerts in the critical situation. It will show the continuous health status. This paper describes the design of a very low-cost remote baby monitoring system which measures heart rate and body temperature of an infant and sends the data to a remote end where the data will be displayed and parents or caretakers will be able to examine him/her. This device will be much needed during emergency period or for saving life.

II. EXISTING SYSTEM

There are many systems that are already being implemented. Such as-

2.1. Traditional Health Monitoring System:

- The body vitals are measured with help of the multiple individual sensors.
- These sensors are attached to different parts of the individual’s body.
- The reports of the signs are displayed on a digital display or analog display.
- If the signals deviate from the average value some buzzer goes off and the respective care takers need to address the individual.
- In other cases an SMS or Alert is dropped on the phone of the caretaker or parent.

2.1.1. Disadvantages of Traditional Health Monitoring System:

- Analog signals are generally not understood by everyone.
- It is wired and has a clumsy setup.
- Time consuming.
- Not very user friendly.
- Causes discomfort to the user wearing many sensors on the body.
- Sensors tend to be unreliable.
- Gives inaccurate results at times.
2.2. Mobile Application based System:

- This system consists of sensors attached to various parts of the baby’s body.
- The sensors sense the vital signs and transmit this information to the micro controller through bluetooth.
- The ADC action takes place and the related information is sent to the parents phones via SMS or through App.

2.2.1. Disadvantages of mobile application based System:

- Cannot provide high precision performance.
- Lack of Atomicity.
- Expensive Setup.
- No real-time continuous monitoring
- Doesn’t provide visual feeds.
- Limited scope of remote access.

III. PROPOSED SYSTEM

Our proposed system aims at monitoring the vital signs of the baby such as heartbeats and body temperature using wireless technology and textile sensors which are comfortable for the baby to wear and also accurate and precise than other sensors. We also focus on increase the scope of transmitting the information over the internet in order to provide remote access. The camera module incorporated enables displaying the visual feeds of the whereabouts of the baby and keeping an eye over their movements in a finite area. This system overcomes the drawback of the existing systems which are clumsy, less user friendly and expensive.

3.1. Advantages of Proposed system

- The staying of specialist is eliminated.
- It is a multipurpose so that overall conditions are easily measured.
- Easy to operate.
- Compare with compact sensor it gives better performance
- Reduces the tension and panic problems amongst parents.

IV. WORKING

Step 1: Reader reads values from sensors and using 10-bit ADC those values are converted into binary.

Step 2: Bluetooth Pairing is done for transmission of data with Middleware device Bluetooth listener.

Step 3: In the middleware device, after receiving, data is written in text files using writer. And then this data is further used by Middleware application for processing.

Step 4: When new data is written into the text file, system receives a function call where this function contains further processing of data. The raw data of temperature and heart rate is converted integer values and then those values are converted to standard values using functions which includes input parameters of hardware.
Step 5: While the time of first run of application, information of baby like age of baby, parent contact number and doctor information is acquired from user in the mobile application. This information is used to fetch child physiological benchmarks.

Step 6: This standard values are then compared to benchmark values of temperature and heart-rate. If then value compared is in safe benchmark limits, then the current data is stored along system time. If the value compared is not in benchmark limits, then the push notification function is called and push notification is activated on user mobile phone application.

Step 7: After value comparison, the values are synchronized with Real Time Sync function of cloud computing. Where data is stored into cloud storage. And transmitted to the monitoring devices.

Step 8: Above steps are repeated until the reader is getting data from sensors.

*:Along with the above process the camera keeps viewing in its field of vision and whenever the camera is remotely commanded through the available options it initializes transmitting.

V. MAINTENANCE

- The maintenance of the device is very essential and crucial as far as precision of the system is concerned.

- The device we have created is built to last long but due to rough usage and external physical force it may be damaged. To prevent this it is essential to handle the device with care.

- The maintenance and upgrading of the mobile application and server will carried out by our technical team.

- The wearable sock is not waterproof, so avoid submerging the device into water.

- Dry Wash of the device is recommended.

- In case of any technical faults and shortcoming, please consult our tech support.

- If the temperature sensor gives abrupt reading try restarting the system because it is possible that the sensors are drawing more current than usual.

- In case of the heart rate monitors giving wrong readings make sure to introduce moisture to the ambient region.

- For a quick reboot interchange the battery polarity or remove connections and restore them.

- In case of poor transmission check the connectivity of the Bluetooth transmitter by searching for Bluetooth network using mobile phones.

- Replace/ Recharge the battery at regular intervals of time.

- With the changing physical features of the child the threshold values must be changed by Reprogramming the Module as per the given chart.
### Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Normal Temperature</th>
<th>Fever temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armpit</td>
<td>35.5 - 37.0° C</td>
<td>&gt; 38.5° C</td>
</tr>
<tr>
<td>Skin</td>
<td>29.0 - 34.0° C</td>
<td>&gt; 35.2° C</td>
</tr>
</tbody>
</table>

### Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Normal heart rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>100 – 160 BPM</td>
</tr>
<tr>
<td>0 – 5 Months</td>
<td>90 – 150 BPM</td>
</tr>
<tr>
<td>6 – 12 Months</td>
<td>80 – 140 BPM</td>
</tr>
<tr>
<td>1 – 3 years</td>
<td>80 – 130 BPM</td>
</tr>
</tbody>
</table>

### VI. Use Case Diagram

THE ACTORS ARE:

- Health monitoring system
- Server
- Parents or caretaker
The health monitoring system (HMS) system consists of temperature, heart-rate and camera module. The health monitoring system makes the use of the sensors to monitor the vitals of the baby. This information is stored on the cloud server and is kept ready for access. The parents or caretaker do login to the system and enter the threshold values based on the knowledge base with them. The server validates the user. It then compares the values received from the HMS, if it exceeds or drops below the threshold, an alarm is raised and notification is sent to the user on their mobile phone application on form of alarm.

VII. ACTIVITY DIAGRAM

Health monitoring system (WEARABLE DEVICE)
Record management system (CLOUD STORAGE)
Parents or Caretaker (MOBILE APPLICATION)
The health monitoring system takes the new entries into the system using the heart rate, temperature sensors also the camera. This information is provided to the user through the app. The vital signs are checked for comparison and the health monitoring system requests threshold value from the record management system. The record management system provides the details to the health management system and it checks for the RISK conditions based on the parameters provided to the system. If there is a risk detected the health monitoring system sends an Alert to the Caretaker or parent (MOBILE APPLICATION).

VIII. CONCLUSION

Thus, the proposed system for "Baby Health Monitoring System using Wireless and Remote Access Technology” will be a more helpful to all those parent those are working and becomes convenient to observe each and every movement of baby along with their health. Because we are overcoming all the drawbacks of existing system parent are able to track the current location and remote access is done over long range. The proposed system will thus be much more efficient than the existing system.

IX. ACKNOWLEDGEMENT

The project synopsis “Baby Health Monitoring System using Wireless and Remote Access Technology” was successfully represented with the help of our project guide and project coordinator Prof. Rahul Patil. We would like to thank him for providing us appropriate guidance whenever necessary and are also heartily thankful for allotting his precious time for our report. We express our gratitude to our Head of Department Dr. D. R. Ingle for providing timely assistant to our query and guidance that he gave owing to his experience in the field for past many years.

We express our gratitude to Principal Dr. M. Z. Shaikh for his coordination and obliging us with his great knowledge. We would also like to thank Mr. Anurag Agnihotri for helping us implementing this idea and providing us necessary guidance.

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