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IoT-based infant health monitoring system

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Abstract: It is difficult to grasp the behavior of infants since their parents cannot understand what the infants want to express. In today's world, some parents are too busy to take care their children all the time. In such case, Sudden Infant Death Syndrome (SIDS) may occur on the infants. SIDS has been continuously leading cause of death for infants aged between 1 month and 1 year in developed countries [1]. Because infants have more vulnerable cardiopulmonary fitness and weaker resistance than adults, it is necessary to continuously monitor their physical condition to be aware of bad signs as early as possible. This paper proposes an IoT-based infant health monitoring system, which continuously monitors the infant's temperature and heart rate using sensor and wireless communication technology.

Keywords: IoT, infant health monitoring, wireless communication, temperature sensor,

1. Introduction

It is hard for the parents of an infant to know whether the infant is in a serious health condition or not because the infant cannot express itself [2]. Since infants are tiny and sensitive, they are vulnerable and are at high risk of death. In 2017, there were about 1,400 infants died from SIDS in the United States [3].

There is a large need for monitoring infant's health, especially for infants born prematurely or with congenital diseases. There are many developments of infant monitoring system, ranging from incubator to wearable devices that can be used by infants.

In this paper, we design a prototype for IoT-based infant monitoring system, which monitors the temperature and heartbeats of infants. The system will also send an alert message to the parents and the doctor if the infants are found abnormal. The system can be built in low cost by using only general products.

2. Related work

There have been traditional infant monitoring systems for health professionals in the hospital or clinic [4].

But it wired and has a clumsy setup，too many contact points will make infants uncomfortable and the analog signal is incomprehensible for ordinary people.

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Many researchers propose several systems to use wireless incubators to monitor infants, but they require special devices in high cost，and also need large space to be installed.

3. Proposed system

3.1 System architecture

The overall system architecture is shown in Fig.1. It consists of the following main components:

1. Wearable devices, which collect data on the infant's temperature and heartbeat.
2. Server, which is for body data analysis, data storage and generation of notification.
3. Alert system in the server, which sends an alert message to both the parents and the doctor if it find that the infant is in an abnormal situation.
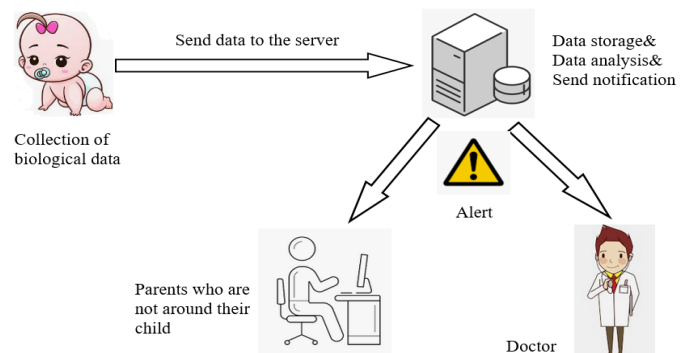

Fig.1.Architeceure of the system

3.2 Prototype and architecture

This system consists of temperature sensor, heartbeat sensor, Arduino Gemma, Raspberry pi, and a cloud server. It continuously monitors the infant's temperature and heartbeat, and it sends an alert message to the doctor and the parents when it judges the infant is in a designated dangerous situation.
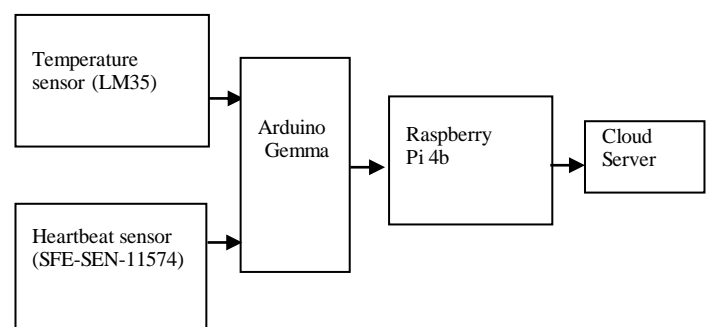

Fig.2. Block diagram of the system

Since every infant has different physical condition,

before the system start monitoring, doctors will input criteria based on the disease and the basic physical condition of the infant to be monitored.

The Fig.2. shows the block diagram of the system. At first, the data are obtained from the sensors, these data are then sent to the cloud server at a certain interval. It will be processed and compared with the criteria the doctor set. If the data are judged to be normal, these data are automatically stored in the cloud database, and parents can request to show whether their infant is in good condition or not. If the data are judged to be abnormal but not serious, the system generates an alert message only to the parents to check if the infant is really in danger or not.

Moreover, all the data will be stored as an electronic medical file, the file will have great benefits for the future treatment of some diseases, especially for chronic disease.

However, in extremely serious situations which need emergent treatment, such as when the heart rate continues to be zero or the body temperature continues to be too high or low, the system will send an alert message to not only the parents but also the doctor.
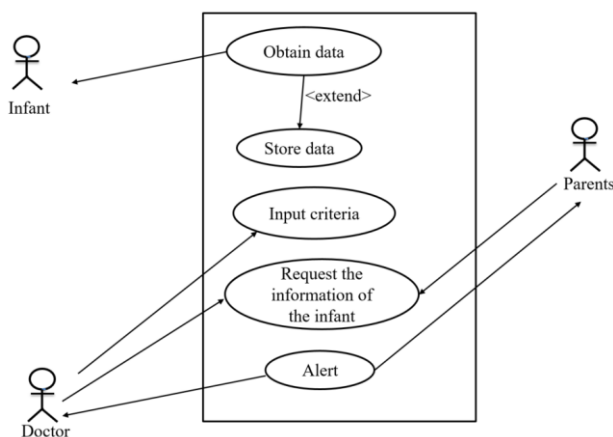
3.3 Use Case Diagram

Fig.3. Use Case of the system

In the above use case diagram, there are three actors named "infant", "parents" and "doctor". There are five use cases that represent the specific functionality of the infant monitoring system:

A. Obtain data
Temperature sensor and heartbeat sensor collect two biological data during the period when the infant is wearing the device.

B. Store data
All the biological data are stored in the database as an electronic medical file.

C. Input criteria
The criteria are manually input by the doctor after medical diagnosing the infant.

D. Request the information of the infant
Both doctor and parents login the web page to check the infant's biological data. And the parents can also input the basic information of the infant, such as the name, age and the date of birth.

E. Alert
If the data is judged to be abnormal, the system sends an alert message to the parents and/or the doctor to check the condition of the infant.

4. Results and Future Plan
In this paper, an infant monitoring system is proposed, which uses sensors and wireless communication technology, to keep body temperature and heartbeat under monitoring continuously, greatly reducing parents' anxiety and infant's risk coefficient.

In the future, with the improvement of sensor technology and wireless communication technology, infant remote monitoring systems can be made more reliable and stable. Artificial intelligence analysis of data also can be added to the system.

5. References
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