Smart Monitoring System for Infants with GSM Communication

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Abstract— In past few years Health monitoring is made of complex algorithms which humans find it is difficult to interpret such kind of issues make our life into critical situations for infants which we keep eye. This paper describes the design and development of a wireless based temperature, humidity, heartbeat monitoring system. This is the main use case for child incubators. Similar systems are used extensively in developed countries. But due to cost limitation in developing countries like Bangladesh such a system is not used very much, rather human monitoring of premature babies by nurse is often used which is very much prone to human errors. The proposed system saves time, cost. This is more integrated in nature and efficient in performance. The system comprises of two parts, one is transmitter and other one is receivers which are connected through GSM. It can be developed in baby care units without incurring huge cost overhead.

Keywords— Incubators, Temperature, Humidity, Heartbeat, Monitoring.

I.   INTRODUCTION

Nowadays, maintaining the quality of life and increasing the life of expectancy are highly important. Therefore monitoring patients constantly is becoming a requirement. Hence distant patient monitoring is a solution providing constant surveillance of their vital signs, in order to control efficiently their health condition and to provide urgent treatment when an emergency occurs, such an abnormal variation in heart rate. This is an integrated plan that deals with the micro controller in which all the consecutives are embedded into it. There are different kinds of Biomedical sensors (Eg., Body temperature, heartbeat, blood pressure, cardiac block, etc) WBSNs are generally used for in home monitoring or for surveillance in nursing homes avoiding unnecessary hospitalization thus reducing the general healthcare costs.

Patient monitoring involves periodic transmission of routine vital signs and alerting signals when vital signs cross a certain threshold. We assume a network of biosensors placed on or implanted in the body of patients. The biosensors send the sensed data to coordinator using LED and those data's are further transmitted via antenna.

Many challenges arise in WBSN which are the energy consumption due to periodic transmission and the huge amount of heterogeneous data captured by limited energy resources of biosensors. Another challenge in WBSN is data fusion which enables combining information from several biosensor nodes to represent the global situation of a patient leading consequently to take right decision. Our contribution is in this paper is twofold.

First, Vital signs can vary from critical signs to dynamics of the monitored conditions can slow down or speed up regarding the patient's situation.

We are specifically interested in designing the early warning systems which denotes the abnormality of heartbeat, temperature and humidity of child in incubators. So that it could be helpful in determining that baby's condition. This is designed in such a way that it endorses a BUZZER.

Our second main objective is to fuse the data and send it to outsiders via antenna, GSM. This is to give information regarding premature babies to their own relatives for their satisfaction. Main purpose is to obtain main quality and make accurate decisions about the situation of the patient based on collected data.

II.   RELATED WORK

Various aspects and needs in WBSNs have been studied and upgraded in this literature. Some of them had survey in routing protocols and scheduling data in WBSN such as [1] and [2].Others focused on analyzing and fusing the sensed data in order to

National Conference on Information, Communication, VLSI Design and Embedded system (ICVE 2K17)
(9 - 10 March 2017)

International Journal of Engineering Research & Science (IJOER)

ISSN: [2395-6992]   [Vol-3, Issue-3 March- 2017]

produce useful information[3] Y. Zhang and H. Xiao, found and analyzed the humans health monitoring of BLUETOOTH based sensor monitoring[4].H.LEE studied Health care service using ZIGBEE and mobile devices for elderly patients.

On the other hand, data fusion is used for multiple purposes depending on the aim of proposed system. In fact, some systems are designed for physical activity recognition, others for monitoring vital signs of patients using physiological parameters threshold. These work approaches feature collection, recognition and transmission of data to understand the text of the user and generate suggestions for him. Unfortunately the above [3] assume that fusing data have an energy consumption that is negligible compared to radio communication. The studies just focused on detecting for emergency cases at base station level where all the data are received from different sensors.

AP Abidoye analyzed that the transmission can be done through PPS(Personal Server)using IPDA(Intelligent Personal Digital Assistant). Huiyu Liu1[6],found that the data's collected from the premature babies are displayed in doctor's room and he can monitor via web services and also can communicate to their related persons through internet.

Since this has a great impact on web services this cannot be effectively used by many people. Unfortunately in all afformentioned work, the data fusion process is to identify either the emotional state of the user (stressed, relaxed, feelings, etc.,)or to identify the activity being performed using a set of recognized activities y the system.

III.   IMPACT ON CHILD INCUBATORS

In past few decades, female participation in the labour force in the industrial nations has greatly increased in present society. Subsequently, infant care has become a major challenge to many families in their daily life. As we seen in India both the parents need to work and look after their babies/infants, so more workload and stress is there on such families especially on female counterparts. If a system is developed which continuously gives updates about their infants during illness then it serves as a great help to work in stressful environment with fruitful output.

This paper presents a design of baby monitoring system based on the GSM network. A prototype is developed which gives a reliable and efficient baby monitoring system that play a vital role in providing better infant care. This system monitors vital parameters such as temperature, moisture, heart rate. This can be done under risk conditions and using GSM network the data are transferred to their parents. The other advantage is the programmability of alarm conditions can alleviate any inaccuracy through a normal sensor. Communication is done through GSM interface in which short messaging service (SMS) is fundamental part of original GSM system and its progress.

In this way just by an infant's few biomedical parameters parents get information about their health.

IV.   SYSTEM ARCHITECTURE

The architecture of the system consists of both hardware and software. The code is written in Embedded
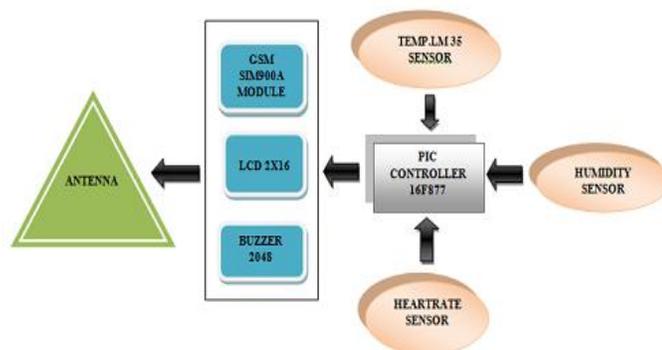

FIG.1 BLOCK DIAGRAM

National Conference on Information, Communication, VLSI Design and Embedded system (ICVE 2K17)
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International Journal of Engineering Research & Science (IJOER)

ISSN: [2395-6992]   [Vol-3, Issue-3 March- 2017]

4.1   GSM Interfacing Module

TTL Modem is sim900A.This is a Quadband GSM which operates at frequency 850MHZ.The Baud rate can be configurable 9600-115200bps through AT(Attention)Commands.It is suitable for SMS as well as data transfer application to mobile phone and mobile phone interface.The modem can be interfaced via USART(serial communication).

4.1.1   SIMCom SIM900A GSM

This is actual SIM900 GSM module which is manufactured by SIMCom. Designed for global market, SIM900 is a quad-band GSM/GPRS engine that works on frequencies GSM850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900 features GPRS multi slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 andCS-4.

With a tiny configuration of 24mm x 24mm x 3mm, SIM900 can meet almost all the space requirements in User's applications, such as M2M, smart phone, PDA and other mobile devices.

The GSM/GPRS Modem is having internal stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS; attend the incoming calls and internet etc through simple AT commands. The cellular modems particularly, USB stick ones are now at affordable prizes however it is limited; they are explicitly designed for internet connections. So you cannot use it as normal modem and implement for an example point to point data link communication with them. The GSM modem that allows this is quite rare and so we create and offer you one that is a device for PC with ISB interfaced with "VOICE".

The modem is manufactured with automatic Pick and place machine with high quality standard. The Onboard low dropout 3v power supply allows us to connect wide range of unregulated power supply (5-12v).Using this modem we can make audio and video calls, send and receive SMS, attend the incoming calls and get internet connectivity using simple AT commands.

4.1.2   Visualization Terminal

Here SMART PHONE is adopted as hardware for visualization terminal. This makes it convenient for users to observe their own status. Even when the patient is involved in outdoor activities, he/she can easily observe physical signs of patients and location via smart phone.

The user can have a clear understanding about his/her status and the surrounding environment. On the screen HR, PR and TR i.e., heart rate, pulse rate, temperature respectively. The received data can be saved by smart phone so that the previous dynamic curves can be queried and analyzed. Once vital sign is beyond the normal range, the smart phone will immediately send out an alarm message and buzzer helps with a sound.
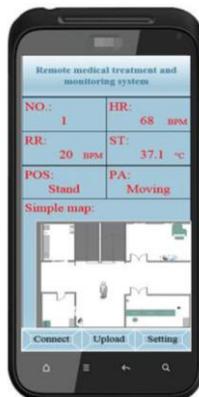

FIG.3 HEALTH STATUS AND ENVIRONMENT

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International Journal of Engineering Research & Science (IJOER)

ISSN: [2395-6992]   [Vol-3, Issue-3 March- 2017]

4.1.3   PIC Controller

PIC(Peripheral Interface Controller):It is a 8bit controller, which means CPU can process 8bit data at a time.PIC 16F877 is a family of Harvard architecture. This is 0-7Bit ie.,8Bit ADC. It is of 1024 bytes resolution.ie.,8bit.

4.1.4   Overview of PIC16F877

PIC16F877 is one of the most advanced micro controller of microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality and ease of availability.It is a deal for machines such as machine control devices and measurement applications,study purpose and so on. The PIC16F877 features all the components which modern controllers normally have.

4.1.5   Heart Beat Sensor

Are you wondering how a heart beat sensor is able to detect and measure your heart rate. Heartbeat sensor works basically on a principle of Optoelectronics. All it takes to measure is a pair of LED and Microcontroller. What we do to measure our heart rate is first we will detect heartbeat count the pulses for one minute to get the beats per minute. So inorder to detect the pulse we will pass the light from one side of the finger and measure the intensity of light on the other side of the finger. Whenever the heart pumps the blood more light is absorbed by increased blood cells and we will observe the intensity of light received using LDR.As a result the resistance of the LDR increases. This variation in resistance is converted into voltage using a signal conditioning circuit usually an OP-AMP.   The target rates for people aged between 20-70.For 25-year old the range is 140-170bpm while for 60-year old it is typically between 115-140bpm.
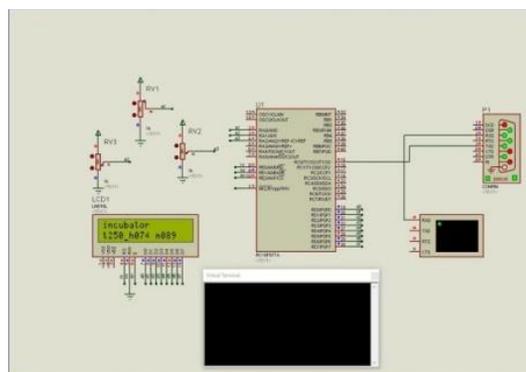
4.1.6   Early Warning Score System

An early warning score system (EWS) is a guide used by emergency medical services staff in hospitals to determine the degree of critically of patient situation. A EWS is used as a systematic protocol to measure simple physiological parameters in all patients to allow early recognition of those presenting an acute illness or who are deteriorating. For each vital sign, a normal healthy range is defined. Measured values outside of this range are allocated a score which is weighted and colour coded on the observation chart according to the magnitude of deviation from the normal range.

4.1.7   Data Wrapping

Several approaches for energy saving in WSN are proposed in this literature. However, the majority of these works consider the data sensing and processing have energy consumption that is negligible compared to data transmission. Consequently these approaches try to minimize the networks communications. However the assumptions is not always correct especially when the sensors collect data and communicate it through GSM to the outsiders made an cost effective approach. In this way the data has been wrapped in very effective way such that the sensors work effectively on child monitoring and also it could help for monitoring the health of normal patients in practice..

4.2   Circuit Diagram

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The circuit diagram comprises of virtual terminal and LCD as the major components in which the it has the major role and effective functioning. The PIN Diagram comprises of pins that is responsible for Analog to Digital conversion and further processing to GSM which allows communicating to the outsiders. It also has the 24/7display by means of LCD in the monitor control room which the doctors can always keep an eye on it.

4.3   Flow Chart

The micro controller is the major component which is the heart of this process. The sensors which we use are connected via this controller. Every sensor has certain criteria to be satisfied. If this condition is satisfied this goes to the micro controller else if not satisfied i.e., if it becomes abnormal or below the range the signal arrives to the GSM module to communicate to the outsiders.

This flowchart shown below describes clearly about the process and components with their functionality in its own manner. The software used here is PIC CCS Compiler and the simulation is done through PROTEUS.
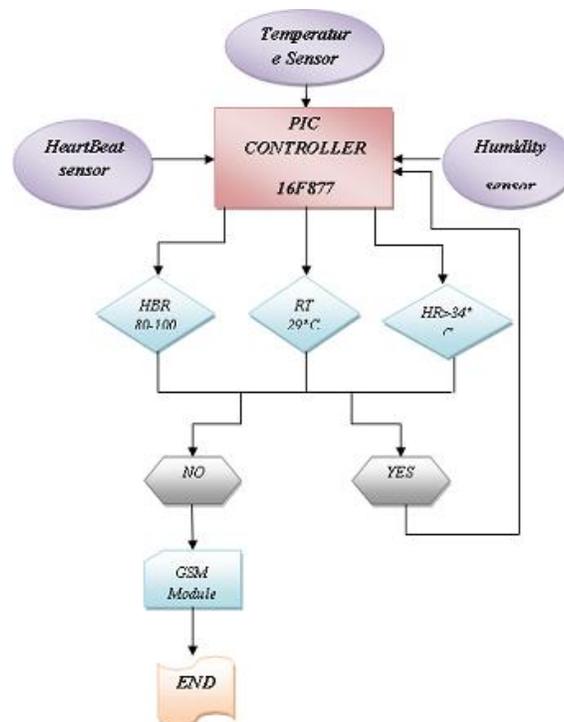

FIG.5 PROCESS AND FUNCTIONALITIES FLOWCHART

V.   COMPARISON OF BASIC DATA FUSION APPROACH

We have constructed an advanced approach that reduces complexity. The decision is made by simply testing and comparing with the previous technique which uses data fusion and DTT approach. Since DTT approach is used previously it results in high cost which leads to complex process. The existing system has certain limitations that it covers only small distance, less accuracy, low sensitivity of sensor and less efficiency. Since ZIGBEE is used to communicate it becomes less efficient and results very heavy calculations and derivations in which only experts can do it. Therefore a decision is taken only to reduce such calculations and complex algorithms. The results shows that it is 98% successful when compared to data fusion.

VI.   CONCLUSION

In this paper, we have proposed a new frame work for the data management and processing in WBSNs. We have conducted a series of simulations on real medical data recordings to show the effectiveness of our approach. The results show that our approach reduces considerably the sensed and the transmitted data and the energy consumption while maintaining data integrity

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and decision accuracy. The main focus of our paper is to keep an eye contact always on our child health from their birth by continuous monitoring. Nowadays most of the child our kept under the observation in incubator at ICU. In such cases we also can keep a touch of our child health details by using this GSM module. This might happen to reach the emergency core of our infants. This is the effective approach which reduces complexity, cost. We have overcome the drawbacks of the existing system that this is replaced the transmission module with GSM. In earlier system zigbee is very effective but it covers only short range of distance. So people who are in long distance cannot communicate. So we introduce GSM MODULE for long distance communication, the controller read the ADC value and send alert message to the receiver. This deals in monitoring the babies pulse variation which makes this paper more effective.

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