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IOT BASED SMART CHILDCARE MONITORING SYSTEM

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ABSTRACT

This paper proposes an efficient wearable health monitoring system for babies using IoT technology. The system is developed including a fully integrated sensor for identifying the breathing pattern, bed or crib exiting, temperature and humidity changes, crying and unusual high frequency motions of the child. If the system detects any unusual activities or risky behavior of the subject it gives out an alarm to the parents or any authorized persons via message triggering mechanism. Parents can also monitor the current conditions and get live updates of the baby through a dashboard. As both parents nowadays, work outside and it is not always possible to monitor the baby in-person, it is necessary to make use of modern technologies. It will be beneficial for the parents to readily track the health of the infant and getting updates in necessary conditions. The main aim of the system is to prevent risky situations and mishappenings to the child by providing alerts and updates to the parents at right time. This can be achieved using an IOT enabled childcare monitoring system. The project uses ESP8266 Wi-Fi module which is very cost effective. DHT22 sensor helps to measure the exact temperature and humidity values of the child and the surroundings. For detecting the movements and crib excitementsan accelerometer is used. Cry and noise detection is enabled by using a microphone.

I. INTRODUCTION

IoT or the Internet of things is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Introducing Iot concept in childcare monitoring will help to connect the system and its components through internet and provides better performance and global accessibility.

Childcare is one of the major challenge faced by the parents today, where most of the parents are working persons. So they cannot be around their child all the time [12]. Hence most of the time, the child is kept either in a daycare or a maid is kept at home for taking care of the child. Recently lots of newspaper articles have

been reported about incidents on child abuse, mostly in daycarefacilities or by maids at home [7]. Therefore, the requirement for remote child monitoring system is the need of the hour. In case of traditional method of childcare it requires direct supervision from parents [1].

The costs for infant care are high due to highly intensive labor [4]. Therefore, by developing a system which is capable of giving updates about their babies during illness or normal days would help the parents to work peacefully [2]. A conventional approach does not efficiently provide the real-time updates of these baby health parameters. Also, this approach avails parents to constantly monitor the parameters of a baby to ensure their health [5]. Most of the babies have respiratory problems and troubles in maintaining body temperature[3].The aim of IoT based childcare monitoring system is to monitor the activities of the baby and to identify a threat at its earliest stage would be the best way to avoid any hazards caused by it.Since the system provides necessary alerts to the parents regarding risky situations of their child, they can take appropriate steps accordingly[5].The monitoring parameters are compared with preset values or under control parameters in order to detect any unfavorable condition of the baby. Whenever a parameter rises above the threshold, parents are informed with an SMS or email notification [5].

The first step is to identify the necessary conditions which may signal such a situation. Some of the main factors that need to be measured and monitored are respiratory rate, heart rate, motion, bed or crib exiting, temperature changes, crying and unusual high frequency motion. The most critical time when infants may need to be monitored is during the sleep, in case of birth defects and in times of illness. A number of infant deaths occur due to improper care taken [8]. Since babies requires constant attention and care a distant monitoring system is essential for protective childcare [12].

The female participation in labor force in the industrialized nations has increased tremendously, subsequently infant care has become a greater challenge to many families in their daily life [2]. In that scenario women have to take care of their baby and at the same time need to handle the work pressure [5]. This system will help the parents to take care of their child not only when they are at home but also when they are at the office or outside their home [5]. The sudden fall and increase in physiological parameters may cause sudden infants deaths syndrome(SIDS) and may lead to apparently life threatening events [8].

Sudden Infant Death Syndrome (SIDS) is one of the most critical problems needed to be addressed and it requires a great deal of care labor. SIDS is defined as any sudden and unexplained death of an apparently healthy infant aged from one month to one year [4]. Traditional monitoring techniques are difficult to wear for long periods of time and may cause discomfort to the infant. If a system is

developed which continuously gives updates about their infants during illness or during normal routine then it will be of great help to such members as they can work in stress less environment [13]Wireless and wearable sensors provide more convenient and long term monitoring[1].In order to make parents easy access to monitor their children and prevent misapplication by unauthorized people, the system can be accessed online through the website which have authentication feature[13].The main drawback of the existing system is that it is embedded with Bluetooth technology for communication. So very short range communication can be achieved. It may be around ten meters [8]. There are increasing demands for improving the efficiency and productivity in health and child care domain [6].

These systems provide a sense of security and assist parents in monitoring a child [10]. Still there is hardly any system which measures vital signs of babies and delivers the information to parents in an intelligent way [8]. Live video based monitoring is one among the basic childcare application [9]. But it may cause privacy issues. The cost is one important factor to be considered. So a cost effective and reliable child monitoring system becomes a vital requirement today. A major disadvantage of a general surveillance system is that they can only monitor a limited area in room and hence creates blind spots [7]. Child care monitoring using sensor technology provides the quite unique and flexible solution to overcome the causes of health monitoring.it will reduce the issues related to health of child [11].

II.RELATED WORKS

In the recent years, many efforts have been taken to improve the existing childcare monitoring devices. Many home-care systems are available but majority of this system are specially designed for the aged people and patients.

Naveen Krishna and Jayanthy, has proposed Beaglebone Black Webcam Server for Security [12], in this project they implement BeagleBone Black to do video streaming and video is saved in the server and the client can download the video using proper authentication. But, this project does not have a motion detection feature [13]

Abhishek Basak and three others published a paper in IEEE International Conference in the year 2011 on “Kids' Health Monitoring System”- It uses wearable sensors and vocabulary-based acoustic signal processing. System detects activities and audio signals such as cry, cough, sneeze etc. Consist of wearable body temperature and pulse rate sensors. It also operates on Bluetooth technology provide only timely based alerts [14].

Sushma Chowdary et al. [4] implemented an Infant Monitoring System using Multiple Sensors. The system consistsof sensors for measuring ECG, temperature and CO2 level around the infant’s crib. This system can provide continuous monitoring of the infant’s

vital parameters and can be used in Neonatal Intensive Care Units (NICU) and at home. The main drawback of this system is the use of Bluetooth for connectivity and several CO2 sensors are needed for continuous monitoring of exhaled air [1].

Savita P.Patil, and Manisha R. Mhetre also proposed an Intelligent Baby Monitoring System using GSM module. System is an inexpensive and simple to use, which can improve the quality of infant-parent communication. It allows constant capturing of multiple biological parameters of the baby and analysis of the overall health. But the main demerit of the GSM technology is that the transmission can encounter interference due bandwidth lag [2].

Sakuntala et al. [12] designed A Novel Concept for Remotely Monitoring Babies. The proposed system consists of an array of membrane switches connected on the top of the mattress of the crib, under the top cloth cover of the mattress.The switches will detect the position of the subject and produce a signal and indicate the movements of the baby. Since the system is placed under the bed there are chances that the switches being pressed when baby moves within the crib. So it may result in unwanted notification of baby's slight usual movements.

Krishana Tupe and four others implemented a Child health care monitoring using sensor technology. This framework uses two sensors one is Heart Rate and second one is body temperature. Heart rate sensor provides the Heart Beats of child's per minutes and Body Temperature sensor gives the output of temperature in Celsius of child. One of the main drawback of this system is, without internet connection parent can't get the information. [11].

Sagar Dhumal et al. [8] in the year 2016 published their paper regarding wearable health monitoring system for babies. Device is designed like a hand gloves and the parameters like temperature and heart rate can be easily monitored on the hand of baby. Since babies are restless they always move their hands and lick them all the time. So it will make discomfort for the babies and hard to monitor the parameters [13].

III.PROPOSED SYSTEM

The proposed work is an Infant Monitoring System based on IOT. This system helps to detect any movement or position of the baby and measure accurate temperature of the baby as well as the humidity of surroundings, also detects when baby cries or if any other noise is interrupted. Allthese activities are measures on real-time basis. The proposed system is built on Iot technology for connecting the hardware and user device to the cloud server. Rather than Bluetooth technology, system is using Wi-Fi technology, hence wide range can be achieved.

This system is performed by using low cost ESP8266-12e Wi-Fi Module. ESP8266-12e is a low cost module and its additional

memory space is used to store programs, therefore no need of separate micro controllers like Arduino or Raspberry pi. It consists of accelerometer, DHT22 sensor, microphone, ADCand fewsimple components. An accelerometer is used to identify the position or movement of the baby. DHT22 sensor is used to measure the accurate temperature and humidity of the baby as well as the surrounding. Cry detection is done by using a microphone. It can effectively monitor the activities and movements of the baby and inform parents through sms or email via SMS Triggering technique.

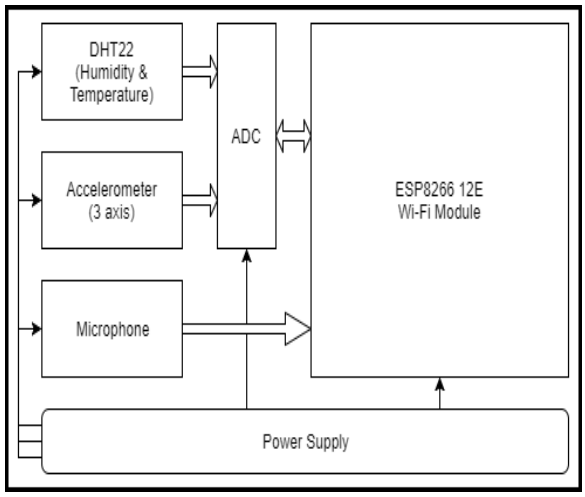

Fig.1 System Architecture

Fig.1 explains the architecture of the system. The accelerometer, DHT22 sensor and the microphone are associated with an analog to digital converter to connect with the ESP8266-12e Wi-Fi module which enables the transfer of data to the cloud server. Then from the server the alerts regarding the conditions of the baby is sent to the parents or authorized persons in a real time base.

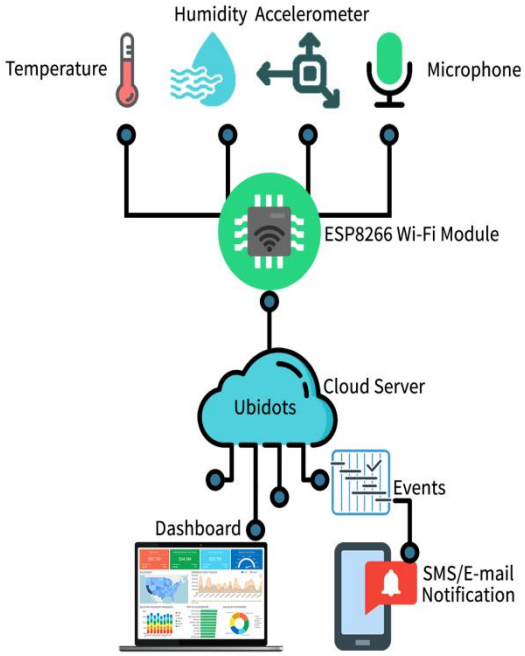

Fig . 2 Flow Chart

The Fig.2 explains the detailed flow chart of the proposed prototype. It consists of an accelerometer to detect the position or any movement of the baby, a DHT22 sensor to sense accurate temperature and humidity of the baby as well as the surroundings, and a microphone to detect baby's cry or any other interrupted noises. The whole values from these sensors would get transferred to the Home Network and then to the cloud server, there, the values are compared with the preset values. In case if any emergency situation occurs, the parents would get notified through sms or emails via sms triggering technique.

A. Accelerometer

An accelerometer is a device used for measuring the proper acceleration of the subject. The acceleration of anybody in its on rest frame is not same as the coordinate acceleration. These has broad range of applications in industry and science. To detect

the magnitude and direction of the proper acceleration both Single- and multi-axis models of accelerometer are available. Conceptually, an accelerometer behaves as a damped mass on a spring. When the accelerometer experiences an acceleration, the mass is displaced to the point that the spring is able to accelerate the mass at the same rate as the casing. The displacement is then measured to give the acceleration.

B. DHT22

Digital-output relative humidity & temperature sensor also named as AM2302.It is used to measure the relative humidity and temperature. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability. Its sensing elements is connected with 8-bit single-chip computer. DHT22 is outstanding long-term stability, long transmission distance and low power consumption. It does not require any extra components. Small size and low power consumption and long transmission distance(20m) enable DHT22 to be suited in all kinds of harsh application occasions.

C. Microphone

An electret microphone is a type of electrostatic capacitor-based microphone. It uses a permanently charged material and there by eliminates the need for a polarizing power supply. It is a stable dielectric material with a permanently embedded dipole moment. Electrets are commonly made by first melting a suitable dielectric material such as a plastic or wax that contains polar molecules, and then allowing it to re-solidify in a powerful electrostatic field. There are mainly three types of electret microphone viz Foil-type or diaphragm-type, Back electret, Front electret. Electret microphone requires no polarizing voltage while others need additional polarizing voltage.

D. ESP-12E Wi-Fi module

ESP-12E Wi-Fi module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. It is best suited for highintegration wireless applications, designed for space and power constrained mobile platform designers. It has the ability to embed Wi-Fi capabilities and to function as a standalone application, with the lowest cost, and minimal space requirement. It also offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application. It is integrated with an inbuilt cache memory to improve the performance of the system in such applications. Supports Smart Link Function for both Android and iOS devices. This module is mounted with a four MB external SPI flash to store user programs. If larger definable storage space is required, a SPI flash with larger memory size is preferred. Theoretically speaking, up to 16 MB memory capacity can be supported.

E. ADC IC

The ADS7924 is used as an analog to digital converter. It converts the analog values in to digital values. It has a dedicated data registers and onboard programmable digital threshold comparators for each input. It contains very low-power ADC core, and support for low-supply operation, and a flexible measurement sequencer that essentially eliminates power consumption between conversions. It is applied in portable and Battery-Powered Systems as well as in energy harvesting systems. The ADS7924 offers multiple operating modes like idle mode, awake mode, auto scan mode etc. to support a variety of monitoring needs.

IV. RESULTS AND DISCUSSION

This IOT based automated streetlight system is very cost effective. The project aim is the effective child monitoring to reduce the risks and dangers to the babies mainly when their parents are not around. It can also efficiently inform the parents about the current status and wellbeing of their babies. The notifications are send to the parents or any authorized persons as and when any risky situation is encounteredby the system. Parents can view and understand the conditions and activities of their child via a dashboard.

V. CONCLUSION

A major challenge of child monitoring can be solved with help IoT based Smart Childcare Monitoring System. System detects the movements, activities and parameters like temperature, humidity, audio signals such as cry, cough, sneeze and automatically send out emergency signals to parents. Also urgent situation condition can be quickly be noticed and handled within less time. proposed system is using Wi-Fi technology rather than Bluetooth, hence wider range can be achieved. Therefore, parents can access the updates and conditions of the child event when they are not at home. SMS triggering option is included to alert the parents or care takers whenever the baby need attention. SMS alerts can have more than one recipient.

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