Smart Baby Monitoring System

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**Abstract**

At the present time, one of the major problems faced by working parents is not being able to take care of their baby. This not only affects the working adults physically but also mentally as they tend to lose focus on the job at hand thinking about their child at home. Parents also tend to choose jobs which provide them with flexible working hours so that they can take care of their child. To solve this problem, we are proposing a Baby Monitoring and Smart Cradle System that would allow the working parents to get live updates about their baby at home through a mobile application. In this work, we explain how IoT can be used to create such a system. The features of our model include, webcam to monitor the baby, audio sensors to detect when the baby cries, temperature sensors to monitor the baby’s temperature, humidity sensors to make sure the baby is not wet, playing recorded audio or music when required. The use of Node MCU will help us integrate all our sensors required. The highlight of our proposed project is to update the current status of the baby to the parents via a mobile application. This proposed baby monitoring system will help the working parents to concentrate more on their work and not have to worry about their child at home.

**Keywords [[1]](#footnote-1)**

Internet of Things, Smart Cradle System, Audio Sensor, Temperature Sensors, Humidity Sensors, Mobile App Development

# Introduction

In today’s world, the majority of the population, both men and women are working professionals and aim for an advancement in their career. One of the main factors affecting the adult's work life is having a child. Having a child negatively impacts the career of many adults in various ways. According to Uchicago News, two-thirds of the adults choose a job which is flexible enough so that they can take care of their personal requirements. This not only impacts their career path, but it also mentally affects them that peers without children have an advantage in terms of career advancements. [1]

In India, we have seen many cases where many working women leave their jobs in order to take care of their newborn child. On the other hand, working mothers who cannot leave their jobs due to other reasons, must deal with the emotions of not being able to take care of their baby.

As working parents cannot be present with them throughout the day, nowadays they tend to leave their child with babysitters to take care of their child and yet they are not satisfied with the same. This adversely affects their work performance as their minds are deviated to think about their child.

Hence, to solve this problem, availability of high-speed internet, wide use of mobile phones and popularity of IoT leads us to bring an innovative solution to help working parents so that their career isn’t affected because of having a child. One such important concept of the same is the use of mobile phones by working parents to watch the activities of the baby while at work.

This research paper aims to propose an idea to develop a system to address the challenges faced by working parents in providing adequate attention and care to their infants. The proposed project titled ‘Smart Baby Monitoring System’ will be used to monitor an infant virtually by the parents who are unable to stay with the child continuously. It deals with the health and security of the baby. The proposed system will have the following features: webcam to monitor the baby, audio sensors to detect when the baby cries, temperature sensor to check the temperature of the baby, moisture sensor to detect wetness in the cradle. All this information will be communicated to the parent (especially the mother) via a mobile application.

In today's lifestyle, it has become increasingly difficult for parents and caretakers to provide physical attention to the child whenever they cry or sleep. The cry of an infant is a biological siren to alert the caregiving environment about their needs to motivate the listener to respond. The traditional method of putting a baby to sleep, such as tying them to a saree, has been found to be uncomfortable for the child and may even cause diseases such as pneumonia, rashes, and cough. Hence the smart baby monitoring system provides more reassurance to the parents allowing them to choose what audio to play when their baby is crying and/or speak to the baby which will be played with the help of a speaker.

This system aims to be reliable and comfortable for the baby, with a GSM message being sent to the parents at every movement of the baby, such as crying or wetting of the mattress, abnormal range of humidity or temperature of the baby. In such cases, an alert is sent to the parents, or the caretaker and hence appropriate action can be taken.

Most of the time, caretakers follow strict routines to train the child for regular feeding, waking, and sleeping patterns without considering their emotional and physical needs. If a baby is not given the attention it requires, it may adversely affect the baby. Hence, we must make sure that they right amount of attention and care is given to the baby. It is essential for parents to provide adequate attention to their infant, but it can be challenging for busy parents, especially working women who must manage both home and office work simultaneously. The smart cradle system is designed to help parents and caretakers in infant care by monitoring their baby continuously with the help of a mobile application. This proposed system will benefit all the working parents and make sure they are at peace while at work.

# Literature Survey

**Smart Cradle by Using Messaging and Sensing Technology [2]**

It is quite common for infants to cry very loudly and continuously when they are hungry, sleepy or experience any physical discomforts like stomach aches. This reminds the parents that they should provide their children with constant care and attention always. Managing such situations for working parents is very hectic, in order to ease their situation this smart cradle was designed to keep an eye on the baby constantly. Audio sensors are used to detect the baby's cry, 4 seconds after which the cradle starts to swing, and music starts playing. An alarm also starts ringing. If the duration of the cry is below 2.5 minutes, only a soothing mechanism is needed. If the duration of the cry is above 2.5 minutes, the system checks the reason for the cry i.e. whether the cry is due to any wet condition or due to temperature variation.

**Development of an IoT-based Smart Monitoring System with Face Recognition [3]**

The authors of this paper have identified how difficult it is for working parents to simultaneously monitor their children and work. They have developed an IoT-based system where the baby is constantly monitored. Different functionalities include the detection of the baby crying, humidity detection for the baby’s diaper and the presence of the baby in the cradle using face recognition. The authors have also developed a web page using HTML and CSS to alert the parents in case the diaper is wet or if the baby is missing. This system also detects known and unknown faces as they use face recognition to make sure only known people are there around the baby. Overall, this project is a development from the traditional methods which is beneficial for working parents.

**Automatic Cradle System for Infant Care [4]**

Traditional methods to make a baby sleep involve using a saree tied to the corners of the room to form a cradle. This might cause discomfort to the child and the mother keeps worrying if the baby will fall while swaying. The proposed system deals with an automatic baby cradle which will also detect if the baby is crying or not. It also has inbuilt sensors to see if the mattress is wet, if so it sends an alert to the parents asking them to come and change the diaper of the baby. The baby when tries to come out of the cradle, the inclination of the cradle above the specified limit blows the buzzer in the kitchen and a text message is fired to the father who is sitting in the office.

**IOT-Based Baby Monitoring System Smart Cradle [5]**

Senoj Joseph, Ajay Gautham. J, Akshaya Kumar, and Harish Baby M.K. have proposed an IOT-based baby monitoring system in order to make monitoring a baby easy for any parent. The functionalities of this proposed system are as follows, motors used for swinging mechanism, live image updation with the help of Wide Area Network (WAN), sound sensors for detecting the cry of a baby, temperature sensors etc. This proposed system gives a very detailed monitoring system for the baby as they plan to monitor the pulses, and internal heartbeat level utilizing remote innovation and sound sensor. Overall, it is a smart cradle system that is comparatively easy to use and is less expensive.

**Automatic E-Baby Cradle Swing based on Baby Cry [6]**

Currently so many modern cradles are being designed but not many families with infants are able to afford one. This paper presents the design and implementation of a new indigenous low-cost E-Baby Cradle that swings automatically when a baby cries. The cry analyzing system detects the baby's cry and will continue swinging till the baby stops crying completely. The speed of the cradle can be varied according to the situation. It also has an inbuilt alarm which rings if the mattress is found to be wet, and if the baby does not stop crying within a stipulated time, thus helping parents and nurses take care of the baby without physical attention.

**IoT-Based Smart Cradle System for Baby Monitoring and System [7]**

The authors of this paper highlight how important it is for working parents to not get distracted because of their babies at home. They have proposed an automated system where the cradle provides an incubator kind of atmosphere for the baby in the cradle. Detailed information like temperature, heartbeat, gas molecules, and the motion and position of the baby were captured and monitored. The system uses the S.ODI board which incorporates all the communication interfaces and dual controller units onboard. In this system, the recorded readings will also be shown in the mobile application. Based on the reading, necessary actions will be taken. For example, controlling the temperature, switching the fan on or off, setting up the cradle’s movement, playing music etc will be done. Altogether, this will be a system that monitors the baby with high efficiency and accuracy.

**An Intelligent Baby Monitor with Automatic Sleeping Posture Detection and Notification [8]**

The authors of this paper highlight the fact that existing systems collect and send data but no system analyzes the data. Hence this project detects the sleeping postures of the baby to make sure the baby is not suffocated or in the wrong position. This system also focuses on developing a mobile application where the different alert messages will be displayed accordingly. Detection of harmful situations such as face covered due to sleeping on the stomach, blanket removed, frequently moving etc was detected and respective alerts were sent to the mobile application.

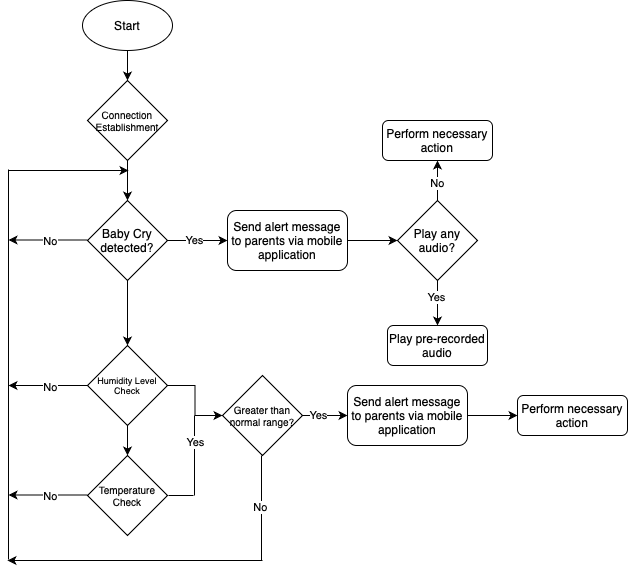
# Proposed System

In today's fast paced world,the prevalence of technology has made it difficult for people to find time outside of their work obligations, resulting in a busy and demanding lifestyle. It is difficult for working parents to babysit simultaneously. They tend to leave their child with babysitters to take care of their child and yet they are not satisfied with the same. This adversely affects their work performance as their minds are deviated to think about their child. Availability of high speed internet and wide use of mobile phones leads to the popularity of IoT. One such important concept of the same is the use of mobile phones by working parents to watch the activities of the baby while babysitting. This proposed work deals with the health and security of the infant, using various sensors to monitor the actions of the baby. This information will be sent to the parent through the mobile application.

The proposed system deals with solving the problem mentioned above, which is a baby monitoring system having inbuilt features to monitor the baby continuously whilst providing additional information on fever, and any other abnormalities to the parents. Additionally, the live data about the child will be sent to the parent via a mobile application, where the parents can keep an eye on the baby and monitor its activities on a daily basis.

A sound sensor will be attached to cradle in such a way that it will take input sound of baby only, and it will conclude the activity to be performed as per the range of sound in decibels, if the sound is more than certain amount then system will automatically start playing the recording of the mother. If the baby is still crying then alert will be sent to the parents/caretakers. Motion sensor that is PIR (Passive Infrared) sensor will detect the motion which is used for security purpose and in point of view of any danger, if there is too much motion detected, then an alert will send to the parents. Wet sensor is used to check if the mattress is wet. If any kind of wetness is detected it will send the alert message to the parents. There will be two temperature sensors used here which are DHT11 and LM35, DHT 11 that will check the temperature of the whole room and LM35 sensor will measure the temperature of the baby, and it will alert the parent if there is a huge change. The proposed system will decrease the difficulty of these hurdles, and release the stress of the parent and most importantly the baby will be safe, healthier and will sleep without any discomfort.

# Block Diagram



**4.1. Node MCU (ESP8266)**

It is an open source development board based on the ESP8266 Wi-Fi module. It allows for easy programming and prototyping of IoT projects with Wi-Fi connectivity. Node MCU controls the whole system using an Arduino platform. The MCU comes with an inbuilt Wi-Fi and uses embedded C. It is also adaptable with most sensors.

**4.2. PIR Sensor - Motion Detection**

A motion detection may detect moving objects,particularly people. For detecting an object PIR sensor is used. Here it performs a task like it checks the presence of a baby in the cradle. The motion detector is mainly used for security purposes. It alerts the parents when the baby is not found in the cradle, by sending SMS to parents.

**4.3. Raspberry Pi 3** - **General Purpose Input/output(GPIO)**

Raspberry Pi 3 present near the child has a mic plugged with it. Zebronica Mic present near the raspberry pi is connected to a 7 channel USB sound card. The main function of it is to record the audio signals and these audio signals are stored in the form of buffers in the raspberry pi. These are sent to the raspberry pi present in the signal processing unit through UDP protocol. That means the raspberry pi present near the child acts as a transmitter and the one present in the signal processing unit acts as a receiver. This will receive the signal and extract features by applying signal processing techniques on them. It first detects if the signal is a cry signal or not. Once, if it confirms it to be the child's cry signal, it will send alerts.

**4.4. DHT11 - Temperature and Humidity Sensor**

The temperature sensor measures the temperature around the cradle and if the temperature is more than 39◦C with respect to the room temperature, it alerts the parent. Another DHT11 sensor is placed inside the cradle very close to the baby in order to check if the baby has a sudden change in body temperature. The temperature change around the cradle or in the room is one of the reasons the baby might be disturbed. Once the abnormalities are detected, both the parents will receive an alert.

**4.5. APR Module - Voice Recording Module**

The APR is a voice Recording Module. This is used so that a melody, ie. the mothers voice recording where she is speaking in a loving and soothing voice to the infant is played on loop till the baby stops crying completely.

**4.6. Microphone - Audio Detection**

Phase 1: Infant Cradle Monitoring System - When a baby cries in the cradle, the microphone detects it and converts the sound signal into an electrical signal. The electrical signal is then fed into an amplifier. A condenser microphone is used to detect the baby cry.

Phase 2: Real-Time Infant Monitoring and Cry Detection

**4.7. Speaker**

When the microcontroller unit receives the information from the microphone, that frequency is checked and if the frequency is matched to the baby crying frequency then automatically a song is played.

**4.8. Wet Sensor**

The wet sensor detects the wetness of the baby and alarms the parents to change the cloth of the baby.

# Conclusion

By using the proposed system, working parents with a very tight and hectic schedule can monitor their baby without compromising on their job. They can be fully focused on their work when they are away from their child as any important updates like fever or a continuous cry by the baby, will be alerted automatically to the parents. Our model is specifically designed to help busy mothers avoid anxiety about their baby and stay calm and composed. Any wetness detected on the mattress is also signaled to the parents, thus it helps in maintaining the hygiene of the baby. When the baby starts crying, the mothers soothing voice recording is played, which ensures the baby that someone is constantly there for the baby, and is never left unattended. This creates a healthy environment for the child, amidst the parents’ busy work schedule.

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