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IOT POWERED SMART CRADLE FOR INFANT CARE AND VACCINATION MONITORING SYSTEM

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SUMMARY

As healthcare technology advances, there is growing enthusiasm for the Internet of Things (IoT), particularly in the era of baby health. To monitor and enhance baby health through ongoing data gathering efforts and health management features, this article presents a smart crib which integrates with Internet of Things technology. The temperature, moisture, and sound sensors are all part of the smart crib sensor network. It also continuously monitors physiological indicators like body temperature and notifies parents or other caregivers of information gathered by the moisture and sound sensors. Furthermore, the suggested system will remind families of immunization schedules and send automated reminders to parents or guardians to encourage them to follow the vaccine schedule. This Internet of Things (IoT)-based smart cradle seeks to reduce parental stress, guarantee on-time immunizations, and improve the general safety and wellbeing of infants by fusing proactive reminders with health monitoring. The suggested solution is a scalable and useful tool for contemporary childcare since it places an emphasis on data security, low power consumption, and ease of use.

Key words: *smart cradle, webpage, Thing Speak, NodeMCU, Blynk*

INTRODUCTION

The condition of technology today is developing quickly. IoT is one of the few possible integrators that could transform several tech fields and have an impact on the healthcare sector. Because of their potential to improve care for underprivileged communities, the many types of enhanced IOT smart devices are noteworthy. This could improve care for vulnerable populations, such as infants. The IoT Enhanced Smart Cradle: Infant Health Monitoring with Reminding Vaccination Schedule initiative is an illustration of an IoT-enriched innovation. Using the Internet of Things, this program aims to improve birth and infant health [1].

The suggested IoT-enhanced smart cradle uses state-of-the-art sensor technology to track vital baby health indicators, including body temperature and movement. Caretakers may get real-time information from anywhere because of the sensors embedded in the cradle, which continuously gather health data and securely send it to a mobile application. By detecting early warning signs and providing regular health updates, this system supports proactive care and can potentially reduce the risk of sudden infant health complications [3]. One of the most crucial periods of life is the transition phase, during which the developing infant's health and developmental progress (milestones) must be constantly monitored. New

parents frequently feel overburdened by the tasks involved in overseeing their baby's care, such as monitoring the child's vital signs (temperature, heart rate, and/or sleep patterns). Maintaining the recommended immunization regimens is also essential to protecting newborns from diseases that could be avoided. It is definitely simple for today's busy parents to overlook their child's health signs, as well as to forget about immunizations or test dates.

With the most recent IoT technology, the IoT Enhanced Smart Cradle brings out the best in a traditional cradle into a state-of-the-art cradle health monitoring system, thus solving the problems related to child-rearing [2]. It has in-built sensors to track an infant's parameters concerning health, temperature, and movement. One of the key attributes of the smart cradle system is the recognition and detection of limited health abnormalities associated with baby's heart rate, breath rate, and/or temperature. The smart cradle keeps record of immunization schedules as per the infant's age and medical requirements apart from constant monitoring.

It helps the parents or sommeliers to get notified instantly so that they can take fast action in case of any emergency. To begin with, real-time monitoring is required to avoid health problems in infants that might otherwise fly under the radar at such early stages, like respiratory distress or sudden changes in body temperature [31]. Along with this, this smart cradle analysis provides reports on the data examined, identifying patterns or trends in infant health, thus offering useful insights into major aspects of the baby's development over time.

The IoT Enhanced Smart Cradle not only serves as a way to address parents' concerns about infant health by delivering a complete solution, but then potentially improves the overall health outcomes of infants [4]. This type of smart cradle system easily integrates with the current technology and provides the greater satisfaction to both working parents with the sense of security. With the help of this IOT enhanced cradle system, deaths of neonates in maximum number can be decreased [5]. Educating the parents about newborn baby diseases will helps them to spread awareness among themselves. So that they can be cautious on effect that the disease may cause.so for creating an awareness we are attaching the list of most prominent diseases suffered by infants on webpage [32].

LITERATURE SURVEY

This paper is about monitoring the infant health condition by using an IOT-enhanced smart cradle. This cradle system will help to monitor the baby continuously. With the integration of some necessary sensors in the traditional cradle, the smart cradle has been built. These days, the majority of any industry is filled with working parents only. Whether they are experienced or started as a fresher, they need to work for a particular job to make their living. So, in their busy schedules, they don’t have time to take care of anything efficiently. Even though they have time to take care of their infant baby, that should be done with a lot of care and effort. So, this cradle system benefits the working parents by giving alerts about the baby's doing [23]. Nowadays, parents are appointing caretakers or admitting babies into caretaker centres to take care of their baby. Parents or caretakers can monitor the baby whenever they want to. So, for working parents or caretakers, these smart cradles are used. Since the smart cradles are portable and adaptable, i.e., they can be taken anywhere and adaptable to any environment condition, most of these smart cradles are used at home so that the caretakers or parents can use them effectively. This kind of smart cradle plays a vital role in creating a safer, more informed, and connected environment [7].

Consequent upon the expansion of an array of child-care options, an IoT-based baby monitoring system has been developed. These types of systems are established considering working parents, more specifically working mothers. Studies in this area draw attention to the difficulties of constant infant monitoring, especially for working ones. For more convenient baby safety measures, advanced baby monitoring systems have thus been developed. This system uses machine learning and Internet of Things (IoT) technologies to relay real-time updates about the baby's status [6]. Several studies have focused on cry detection that alarms parents when the baby is in pain and the monitoring of some critical parameters such as humidity and room temperature through sensors. A recent notable development is the recognition of facial emotions by machine learning models, thus allowing parents to remotely perceive their child's emotional states over webcams. Since an array of sensors is deployed, their signals are sent to mobile

applications for real-time monitoring through servers such as Blynk server or any other similar controller. Another key feature offered to parents is remote activation of cradle motions on crying of baby, hence promising to ease babysitting needs. This IoT-based monitoring system aims at covering baby monitoring from almost all aspects, thus making huge improvements with the support of machine learning [8].

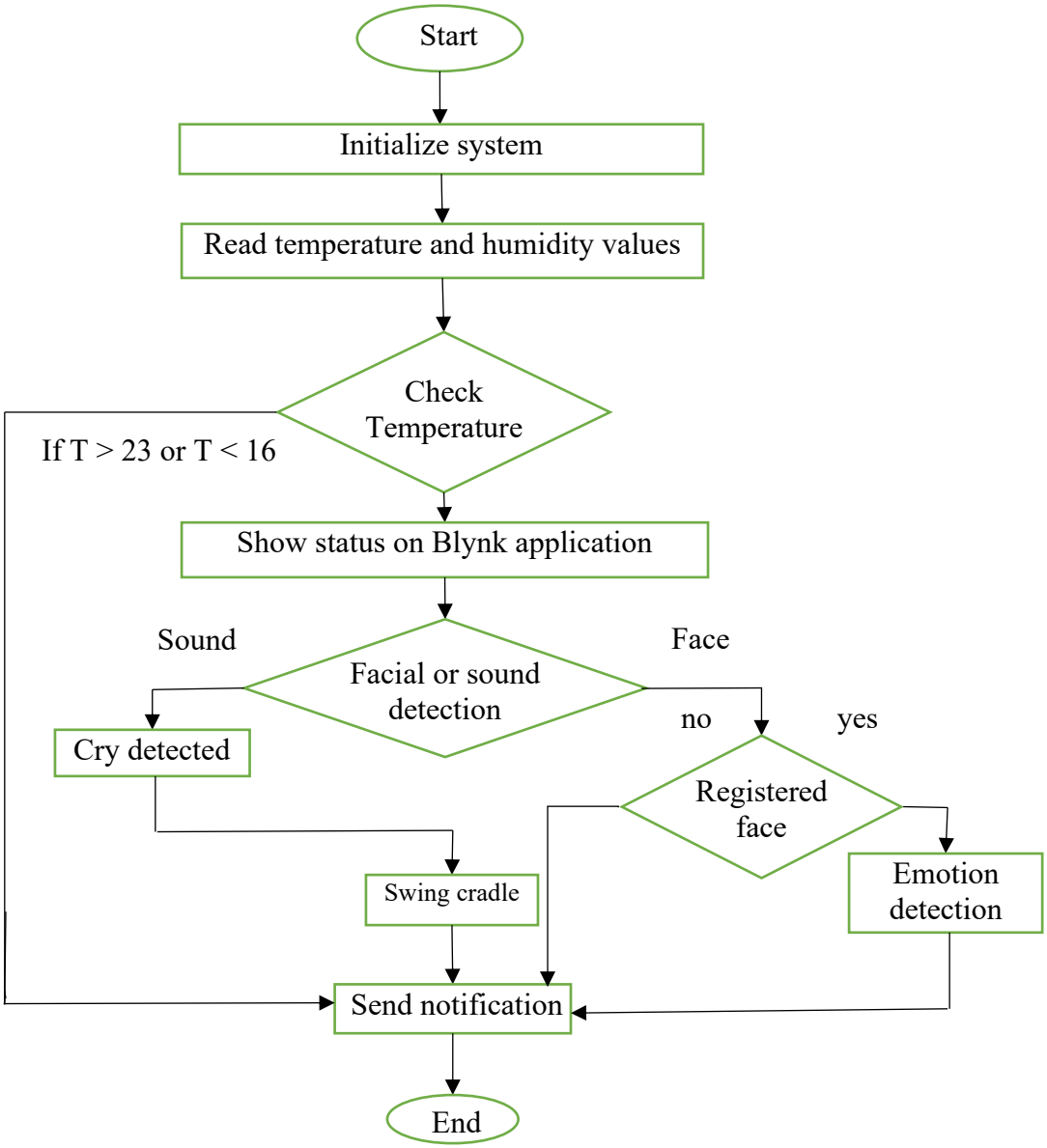

Figure 1. Flow chart of the proposed system

The discussion of baby advanced systems has received a lot of research attention and development efforts in recent years with the application of IoT. Smart cradles have been developed which offer real time monitoring of safety and health parameters of a baby using sensors and IoT platforms [33]. For example, IoT based systems with temperature and humidity sensors and movement sensors to monitor the baby's activity have been proposed [9]. In prior studies, cry detection systems and sound sensors would inform attentive guardians, number of these research projects now incorporate the Raspberry Pi as the central processing unit to interlink multiple sensors and transmit data for live access to cloud servers or mobile application, [11]. To confirm that the newborn is in a safe and harmless environment, other researchers have included temperature monitors and gas sensors to identify potentially dangerous substances in the form of flow chart shown in figure 1. Furthermore, cry pattern analysis technologies have been developed to abet parents in understanding their baby's demands [28].

IoT-based baby monitoring systems have the potential to increase child safety and make life easier for working parents, as these studies have shown [10]. However, the integration of several sensors, real-time

data storage, and the ability to regulate ambient parameters such as cradle rocking or playing music marks a considerable improvement in the sector [27]. Building on these earlier initiatives, the suggested smart cradle system provides a more complete and sophisticated means of providing real-time baby care and monitoring shown in figure 2.

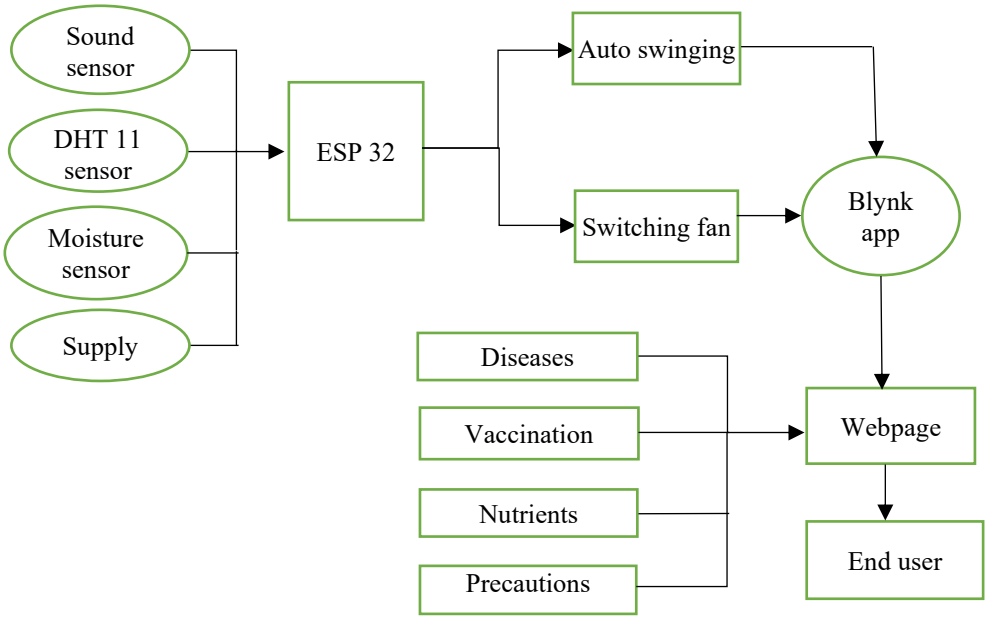

Figure 2. Block diagram of smart cradle system

Numerous studies have looked into integrating sensors with mobile platforms using NodeMCU ESP8266 or Raspberry Pi microcontrollers, which allows for continuous data transmission to cloud services like Thingspeak or Blynk [13]. In addition to cry detection methods and video monitoring, certain systems enable parents to watch out their baby's activities and react to distress signals. Recently, a lot of study has been directed towards creating IoT based applications which help working mothers monitor their children remotely because of their busy schedules [34]. The automated baby monitoring systems stem from inadequacies of traditionally assigning baby care to grandparents or caregivers with regard to constant observation [29]. A wide range of literature has proposed baby monitoring devices with sensors that monitor critical body and environmental parameters such as body temperature, heart rate, mobility, and the ambient temperature. For instance, IoT based cradles are able to monitor a baby's temperature, humidity and even gas molecules in the surrounding environment [12]. Furthermore, studies have focused on interfacing sensors and actuators in order to create a controlled incubator-like environment to help provide adequate safety for the newborn. Some prototypes are accompanied with mobile applications that enable parents to intuitively monitor essential health indicators such as heart rate, cradle moisture content, and send alerts when certain thresholds are exceeded. To provide comprehensive surveillance on the baby's posture and movement, some systems have incorporated Motion Eye OS to strengthen the systems' safety and supervision features.

Nian Li et al. "The Design and Implementation of Responsive Web Page Based on HTML5 and CSS3." These systems are very useful for working parents as they combine real-time alerts with automatic temperature control, calming movements of the cradle, and music playback. This paper illustrates how HTML and CSS can be used to design and build responsive web pages with particular notice on the execution elements of dynamic and responsive interfaces [14]. The execution covers best practices regarding optimization of multimedia content, responsive layout and design, cross-compatibility among devices and browsers, and overall branding [15]. Our research seeks to address some practical issues of responsive web programming while emphasizing the role of HTML5 and CSS5 for meeting contemporary web users' demands. These IoT-based devices are not only capable of providing round-the-clock surveillance of infants, but also pose very little risk while ensuring accurate monitoring of the children's health, thus making them highly dependable and useful in today's childcare[16].

IoT (Internet of Things) enabled the interplay and control of numerous objects resulting into the

transforming concept of smart homes. The remote monitoring and controlling of home functions such as appliances, lights, security, and temperature control is at the fingertips of every user, owing to the advancement in IoT Technologies and the rising demand of automation, convenience, and energy efficiency [35]. The use of Internet of Things technologies facilitates smart homes by enhancing the integration between systems and devices for the proper use of the resources available in living spaces [17]. Ubiquitous computing has been profoundly changing how people use their homes. Hence, the idea of accomplishing automation in tasks like temperature and climate control, energy management, lighting, and security makes technology-enabled homes smarter. Blynk is widely known as a powerful, easy, and versatile tool for monitoring IoT based smart home systems in real time, thereby making it one of the most used platforms for developing smart home systems [18].

Smart home systems began with early home automation technologies, which were primarily limited to controlling simple appliances like lights and thermostats [19]. With the onset of IoT, smart home systems evolved to equip all kinds of sensors, actuators, and networked devices amenable to remote control through mobile applications. Being flexible, the Blynk IoT platform can be turned into a great candidate for any smart home application, thanks to its easy-to-use graphical interface and compatibility with a varied set of microcontrollers and sensors [20]. With Blynk, one can simply use the smartphone to check and control the home system from anywhere, also customizing and monitoring the environment in real time. Cloud services also made a strong case for smart homes, making them more efficient and giving remote access to the users from anywhere in the world. Other main features of the Blynk platform include providing a real-time interface for monitoring and controlling IoT devices. Research by claims that Blynk allows users to monitor data from connected devices in real-time, offering benefits like energy consumption tracking, lighting control, and remote security system management [30]. Additionally, the platform allows users to set up alerts and notifications, which enhances the user experience in general and ensures that critical systems always function as intended as shown in below figure 3.

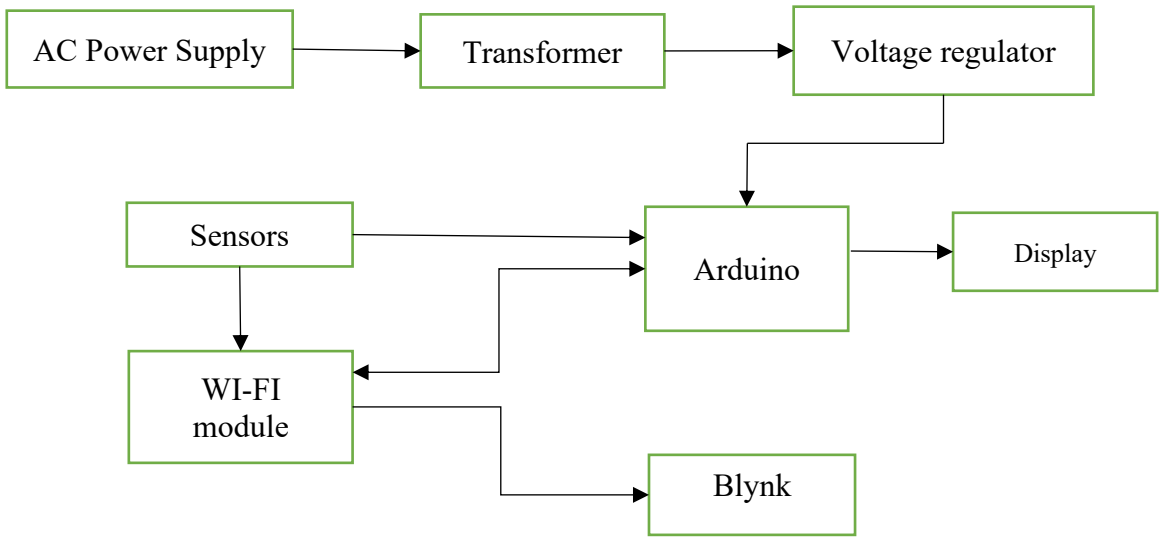

Figure 3. Block diagram of the smart cradle using Blynk

EXPERIMENTAL RESULTS

The IoT-enhanced smart cradle was tested to monitor infants' health parameters and remind caregivers about vaccination schedules.

Real-Time Monitoring

Smart cradle is incorporated with the sensors called sound sensor, moisture sensor, DHT11 sensor. The main function of these sensors are, when any sound like crying is detected from the baby then the cradle automatically swings to soothen the baby. Sound is detected through microphone which is present in sound sensor. DHT11 sensor mainly used to determine the temperature and humidity around the baby. If the temperature exceeds threshold value then automatically fan rotates to give comfort to the baby.

Moisture sensor is used measure whether the baby wets his or her pants. And the wetness is also measured with certain values. Here the data from the sensors are monitored at each and every time.

Alerts for Caregivers

The real time data from the sensors are sent directly to the Blynk application which acts as a cloud to store the data. Blynk application is designed to decrease the stress caused by the babies to parents or caretakers. With the help of Blynk app parents can know about current status of the baby. Blynk also have a special feature to provide notifications directly to the mobile phone. It sends message to the mobile when moisture is detected, high temperature is detected.

Vaccination Reminders

Working parents are busy with their work. In their busy schedule the chance to remember everything about baby is less so this webpage is created to remind every details of baby to parents. Webpage is created about vaccination schedule and most common diseases occurs to the baby. Login credentials are given to the each parent so that they can check about the disease stored in webpage. Vaccination reminder is to remind parents about the vaccination to be taken by the baby.

The smart cradle which is incorporated with sound sensor, DHT11 sensor, and Moisture sensor having a microcontroller of NodeMCU. The cradle is up of acrylic sheets of 5mm so that when sound sensor captures baby noise it can perform well by swinging. When there is sudden increment in temperature which greater than threshold value of 20 degrees (from code) the fan will rotates shown in below figure 4.

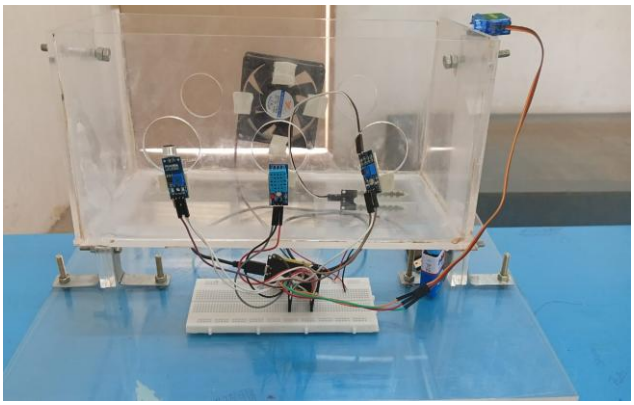

Figure 4. Smart cradle

CONCLUSION

To sum up, the smart cradle is a huge innovation that helps working parents with their problems by giving them a practical, easy-to-use, and less stressful way to keenly observe their baby's health. This technology converts the conventional cradle into a smart one and provides parents with real-time health status updates, increasing their awareness and responsiveness [21]. Through the NodeMCU microcontroller's integration with Thingspeak, the smart cradle uses a variety of sensors including sound, temperature, and moisture sensors connected to an Arduino microcontroller to carry out particular tasks [22]. For example, the temperature sensor regulates a DC fan to keep the room comfortable, while the sound sensor hears out neonate crying and causes the crib to swing. As an instructional tool, the companion website gives parents vital details about diseases, their effects on newborns, and the precautions that must be taken, such as immunization schedules. The vaccination reminder helps the approach to ensure kids get vaccinated on time, thereby avoiding potential health issues. Therefore, the smart cradle helps society as it supports health care measures apart from aiding parents in managing their work and childcare needs [24]. Parents with modern parenting methods will improve their child's health and also be able to manage time with technology in childcare through the smart cradle [25]. The IoT-enabled smart cradle combines health monitoring and vaccination scheduling to address two major challenges in infancy care, thus relieving particularly cumbersome tasks from the caregiver and providing them with a lot of convenience and peace of mind [26]. This method, apart from encouraging child safekeeping, also reveals the

flexibility of the Internet of Things in healthcare applications.

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