IOT BASED SMART CRADLE FOR BABY MONITORING USING MOBILE APPLICATION

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Abstract - The Internet of Things (IoT) has completely changed how we interact with technology and opened the door for cutting-edge new uses. The creation of intelligent gadgets that can enhance our quality of life is one of the most fascinating applications of the IoT. One such device is the IoT-based smart cradle for infant monitoring. An innovative product that monitors newborn security and well-being is the IoT-based smart cradle. The device features sensors that can gauge the baby's temperature, nappy condition, and other critical parameters. These sensors allow parents to track their child's health and wellbeing in real time by sending data via the internet to a mobile application. The Smart Cradle is intended to provide parents with peace of mind and enable them to constantly keep in contact with their infant. Parents may view real-time updates on the health and safety of their kids thanks to the mobile application's intuitive interface and simple navigation. The app also notifies you if the temperature is too hot or too chilly or if your baby's diaper leaks.

***Key Words*:** Smart Cradle**,** Internet of Things**,** sensors, real-time**,** mobile application.

1.INTRODUCTION

We are all quite aware of the difficulties parents experience when trying to raise their child, particularly when both parents are employed. In such a situation, it is nearly impossible to give a 24-hour warning. An original concept known as an Internet of Things (IoT)-based smart cradle for baby monitoring combines conventional baby cradles with IoT technology to give infants a higher level of care and safety. We therefore came up with the idea to develop a Smart Cradle System that will allow parents to monitor their kids when they are away from the house and to recognize all of the baby's activities from any location.

A newborn can be effectively cared for with the help of this ingenious, intelligent, and secure cradle system. This method takes into account every single little detail required for the care and security of the infant in the cradle. IOT (Internet of Things) (Humidity & Temperature Sensing Modules, Swing Automation, Cry Detecting Mechanism, Cloud Computing (Data Storage), & User-Friendly Android Mobile Application (for User Controls) are just a few of the technologies and methodologies needed to design intelligence and innovation. Different Sensors/Modules are attached to the Cradle in order to detect each and every activity of the Baby: a Cry Detection Sensor to analyze the sound of crying which ultimately triggers the swinging mechanism, a Humidity & Temperature Sensing Module (DHT11 module) to detect Wetness of the bed and surrounding temperature, and a Module to Enable the Automated Swing Mechanism. The Arduino Mega is used to collect the data from these sensors, which is then shown on an LCD screen. The NodeMCU module (ESP8266) is then used to send the data to the cloud.

All the data collected from the sensors and modules will be kept in the cloud (Arduino cc) and periodically analyzed. The user can detect significant variables (such as humidity and temperature) and reposition the cradle using the interactive interface and mobile application that are both contained in the cloud.

The proposed solution will provide parents some downtime and enable them to worry less about their child's welfare when they are busy because they will receive updates on the condition of the child within the cradle. The other benefit is that whenever anomalous behavior is observed and picked up by sensors, alert signals will be sent out.

2. LITERATURE REVIEW

Prof. A.D. Anijkar et.al [1] Without human intervention or automatic control via sensors, the author had created an oscillating or swinging cradle. Through the employment of a revolving driving beam, the Slider-crank mechanism converts rotational motion into translational motion. battery, lead-acid Devices that detect moving objects, especially people, are called motion detectors. Decibel [dB] and adjusted decibel [dBA] sound sensors are used. The sound is measured in decibels. This paper's drawback is that it makes more noise, which disturbs the infant. The proposed system can't handle sound well enough.

Dr. Rawicz, Liu, Lu, Sri et.al [2] The prototype of the smart infant cradle is suggested to have a design specification document that details its design. The final smart baby cradle product will still adhere to the design guidelines in this document, but the electrical parts will be replaced with improved, integrated gadgets. All of the designs in this document will consider the customer and safety specifications that were stated in the functional specification. The labels for the requirements in this document match the labels for the requirements in the functional specification. The restriction is Baby's curiosity: In addition to the potential for an electrical shock, the baby could break or fall off the parts, or even try to bite or consume them. Parents' concerns: Parents are significantly more concerned with safety concerns than product features.

Anritha, Anupreethi et.al [3] Anritha Ebenezer offers a design strategy for a baby cradle that includes a cry-analyzing device that can identify newborn cries. Cradle swings based on sound intensity. Six rocks are produced per minute. It has a wet sensor to show when the infant wets; when the baby wets, the resistance changes, sending a signal. Other sensors include breathing sensors that send signals in cases of apnea and temperature sensors that display the baby's temperature. In the event that the infant does not cease crying within a specific amount of time, a GSM modem connected to an RS232 port will send a message to the parents.

Harper, Mirada, Blea et.al [4] The first automatic rocking cradle was created by Marie R. Harper and Maxine R. Blea. It swings side to side on a horizontal axis to mimic human oscillation of the cradle. To give the cradle oscillatory motion, spring motors are used. To the cradle or cradle are attached spring motors that create motion similarly to human efforts. A very safe gadget for use with young children or newborns is provided with a spring motor this means it is readily halted when the tiniest resistance or opposition to its movement is encountered. The benefits of this technique include affordability and safety for young babies due to a mechanism that prevents the cot from swinging whenever there is resistance.

Durga, Itnal, Soujanya, Basha and Saxena et.al [5] They created a system that employs sensors to track the baby's movements and vital indicators, such breathing and heart rate, and transmits this information to a cloud-based platform. Parents or other carers can access the data using a smartphone application and keep an eye on the baby's health in real-time.

Saude and Vardhini et.al [6] Proposes an Internet of Things (IoT) and Raspberry Pi B+-based smart infant cradle solution. The device is intended to keep an eye on the baby's movements, temperature, and humidity levels and notify the parents if any unusual conditions are found. Sensors that are linked to the Raspberry Pi B+ make up the smart baby cradle system. There are four different types of sensors in this system: temperature, humidity, ultrasonic, and vibration. Because the Raspberry Pi B+ is also connected to the internet, the system can notify the parents' smartphones if any unusual conditions are found.

3. DESIGN AND SPECIFICATION

The figure 1 and 2 shows the design of the cradle prototype that has been built for this research. The main component used to build this prototype is foam board having thickness of about 5mm.

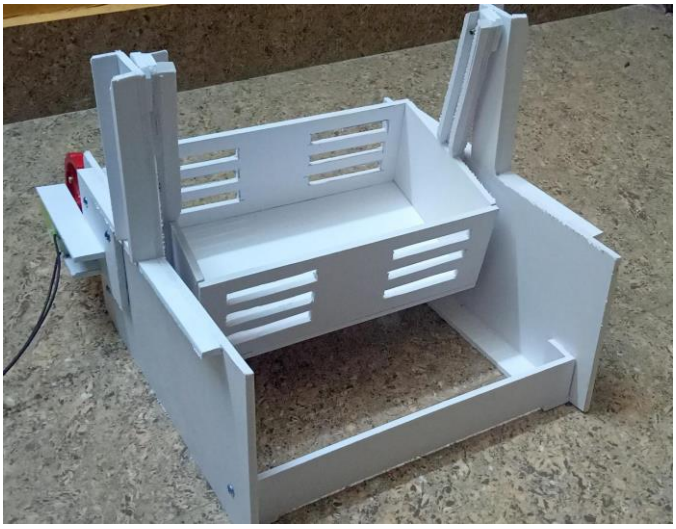

Figure 1: Front view of the cradle prototype

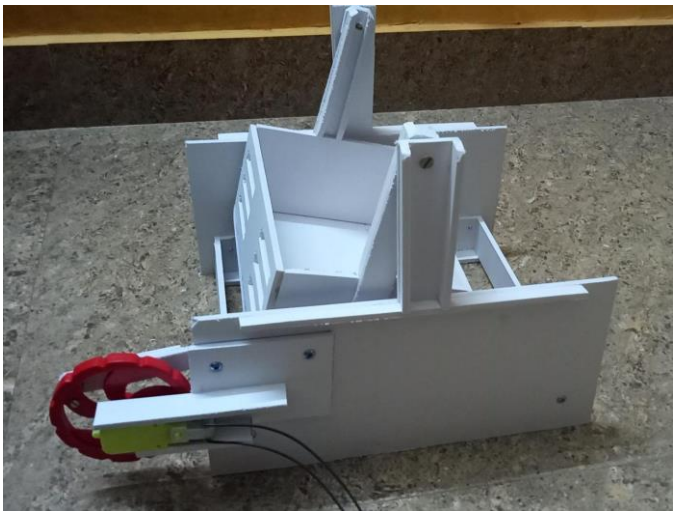

Figure 2: Side view of the cradle prototype

The overall weight of the prototype is approximately 650 gms. The length and width of the Cradle box is about 20 cm and 12.5 cm respectively. The height of the build comes around 8 cm. Overall the total length and width of the entire build is 41 cm and 31 cm along with a height of 20 cm. The build prototype can support up to 287 gms of load.

4. METHODOLOGY

A. Connecting and working DC motor with Arduino

Because they are quite effective, powerful, and their parameters are easily adaptable to user needs, such as speed, dc motor motors are used to produce oscillation motion. Dc motor motors can be controlled by sending pulses across the signal

lines continually. For regulating the movement of the motor, the relay connects the motor to the Arduino.

B. Temperature and humidity sensor working with Arduino

We are using the DHT11 sensor for obtaining both the temperature and humidity values. The data pin of this sensor is connected to the breadboard and through this linked to both Arduino mega and NodeMCU module. The Arduino mega uses this data to display the values oh lcd screen (16x2 display) and NodeMCU data sends this data to Arduino IOT cloud to be displayed on the dashboard.

C. NodeMCU module working with Arduino

NodeMCU contains the ESP8266 WIFI module which is used to send the data to the Arduino cloud. This module contains a data pin which is linked to Arduino mega through breadboard. Arduino mega reads the values and displays them on the lcd screen (16x2 display) and since Arduino mega is linked to NodeMCU, these values are sent to the Arduino cloud and displayed on the dashboard.

D. A custom sound sensor to detect baby's cry.

This custom sensor is used to detect the baby's cry which is connected to both NodeMCU and Arduino Mega via a relay board. This sensor has a LM741 IC called as the amplifier stage that contains a microphone along with some resistors and capacitors. Output relay slot of this sensor is used to connect the relay board. In its amplifier stage, a sound signal when detected is converted to electrical signal, which is then amplified. This Output is fed to the Latching circuit (LC), which in turn feeds it to the relay drive circuit. Then based on this Output, relay is activated or deactivated.

5. RESULTS

Using sensors and other connected devices, an IoT-based smart cradle keeps track of a baby's movements, cry patterns, and other vital signals. In order to enable parents or other carers to remotely check on the baby's health and well-being, the data gathered is sent to a mobile application.

IoT-based smart cradle for baby monitoring contains certain main features that include:

1. Monitoring of temperature: The cradle can keep track of the baby's environment's temperature and notify parents or other carers if it gets too hot or cold.
2. Monitor Diaper Status: The cradle can keep track of the baby's diaper status and notify parents or other carers if it requires to be changed or not.
3. Sound monitoring: The cradle can pick up on sounds like crying or fussing and alert parents or other carers so they can take immediate action.
4. Integration with mobile applications: It enables parents or other carers to remotely check on a baby's health and well-being using the information the cradle collects and transmits to a mobile application.
5. Controlling the cradle: Cradle can be controlled via mobile application using the ON/OFF switch.

The mobile application can send appropriate notifications to parents or carers based on temperature, humidity and sound sensor readings as shown in below Figure 3,4 and 5.

Temperature(C)	**Message**
<20	Cold
28-34(current season)	No Message
>34	Too Hot

Figure 3: Temperature analysis with message

Humidity (%)	**LED**	**Message**
50-65	OFF	No Message
>65	ON	Diaper has to be changed

Figure 4: Humidity analysis for Diaper status with message

Sound sensor	**LED**	**Cradle status**	**Message**
300Hz-600Hz	ON	ON	Baby is crying, Cradle is running.
0-299Hz	OFF	OFF	No Message

Figure 5: Sound sensor analysis with message

6. CONCLUSIONS

The pace of technological advancement is quickening. Given how far technology has come, society can profit from it in many different ways. Automated cradles are the best. a circumstance in which working parents must care for the infant while already having a lot on their plates. The cradle system gives them peace

of mind knowing their child is secure and protected inside the cradle. Cradle that is more robust, has more features, and costs less. Considering that parents are constantly worried about their newborn baby's wellbeing. That cradle system was developed to make the baby healthier. This motorized baby cradle allows the working lady to care for the child while performing household tasks.

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