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Smart Baby Cradle using Sensor Technology

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Abstract: ***In today's busy world, it can be challenging for people to care for an infant around the clock, especially for working parents. As a result, many children are looked after by grandparents, housemaids, or babysitters during the day. In our research, we have proposed a highly efficient and user-friendly technology that utilizes IoT technology for detecting baby crying through a sound sensor and playing a lullaby through speakers. Additionally, an app-controlled servo motor has been integrated into the baby cradle, and a wet sensor has been used to alert parents about their baby's diaper status through in-app notifications.***
Keywords: IOT Technology, Smart Baby Cradle.

I. INTRODUCTION

The paper aims to enhance the safety and comfort of infants by using IoT technology to monitor and control the cradle's movements. Infants require a significant amount of care and attention, particularly during their first few months of life. Therefore, parents often resort to the use of baby cradles to provide their infants with a soothing and comfortable environment. However, traditional baby cradles lack advanced safety features, and parents must rely on their observation to ensure the infant's safety.

The proposed smart baby cradle uses a sensor to monitor and servo motor control the cradle's movements, providing parents with a higher degree of safety and convenience. The system consists of multiple sensors that capture data related to the infant's movements, such as a wet sensor that is used to detect urine in baby cradles and also a sound sensor, which can detect abnormal patterns and alert parents or caregivers in case of any potential risks. Facial emotions are critical in conveying a baby's feelings, such as happiness, sadness, and confidence. Our system utilizes skin color segmentation and morphological operations to recognize facial emotions accurately. The system is also eco-friendly and equipped with electronic sensors that detect various movements and activities of the child, providing real-time updates to parents. This solution is affordable for people from different backgrounds and cultures and can be marketed to a broader audience.

II. LITERATURE SURVEY

A baby monitoring system has been developed for busy parents to ensure the safety and proper care of their babies. The system can detect the baby's motion and sound, including crying, and display a video output of the baby's position on a monitor. It is capable of automatically detecting the motion and crying conditions of the baby. The hardware system is controlled by a Raspberry Pi B+ module, a condenser MIC is used for crying detection, a PIR motion sensor is incorporated for movement detection, and a Pi camera captures the baby's motion. The system provides busy parents with a convenient and easier way to take care of their babies.[1]

An enhanced noise cancelling system has been introduced for baby monitoring to overcome sound pollution and create a comfortable environment for babies. The authors have designed a low-cost, microcontroller-based system that can detect when a baby cries and automatically swing a cradle attached to the system until the baby stops crying. A camera mounted on the cradle provides video output of the baby's surroundings. Another baby monitoring system based on the GSM network has been presented by Savita P. Patil and Manisha R. Mhetre, which can monitor body temperature, moisture, pulse rate, and movement and deliver the obtained data to parents using the GSM network. However, the system presented in this paper is controlled by a Raspberry Pi instead of a microcontroller.[2]

The author has designed an automatic baby rocker with a noise sensor that detects when a baby cries. The noise sensor includes an Electret MIC with a pre-amplifier (2n3904 transistor), and the signal is fed to the microcontroller Arduino ATmega 328 to control the DC motor. Colourful LED lights are used to entertain the baby while being rocked. A Mabuchi RE-260RA DC motor with Tamiya 6-speed gearbox is used to create the rocking motion of the crib with a gear ratio of 505.9:1.[3]

The author proposed an algorithm for adjusting the swaying extent of a bassinet based on sensor signals. The bassinet includes an adaptive swaying device and other sensor networks. When the baby cries, the sensor network can detect the reason based on the detected parameters and give different signals to control the circuit. At the same time, the bassinet begins to sway slightly, and the swaying rhythm can be adjusted based on the baby's status parameters. Three pressure sensors located in the bassinet bottom, one at the center and others at the left and right, are used in the system.[4]

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The author has invented a crib that can be rocked automatically. When the crib is manually tilted in one direction and released, the locking and actuating arms operate under the biassing force of the spring in conjunction with the gear. This causes spring-loaded motors to operate and oscillate the lever arm in a back and forth movement, providing the same effect as a mother rocking the crib. The oscillation of the crib stops when the slightest resistance is encountered.[5]

The author has presented an electronic device that can be attached to a conventional pivotally mounted crib. The device is actuated by the baby's cry voice picked up by the microphone, providing short-throw rocking action to the crib, similar to a person rocking the crib by pushing and pulling on the foot or headboard. The device includes a sensitivity control so that only the baby's voice activates the rocking action, and a timer controls the duration of the rocking action.[6]

In this paper, the author proposed a baby cry recognizer that comprises of an amplifier circuit to amplify the received sound signal. A pulse generator circuit generates a pulse signal aligned with the zero crossings of the amplified sound signal. The signal recognition circuit processes this pulse signal and outputs a signal indicating the detection of a baby's cry.[7]

In this paper, the author presents an approach to designing a baby cradle with a cry analyzing system that detects a baby's cry. The cradle swings based on the sound intensity, with six rocks per minute. It also has sensors like a wet sensor that detects a change in resistance and sends a signal whenever the baby wets, a temperature sensor that displays the baby's temperature, and a respiratory sensor that sends a signal during an apnea condition. Additionally, a GSM modem is used via RS232 to send a message to parents if the baby continues to cry beyond a particular time.[8]

III. METHODOLOGY

In this modern era, parents often find it challenging to provide round-the-clock attention to their infants or toddlers due to work commitments and personal obligations. To address this issue, we have proposed a Smart baby cradle using sensor technology in this paper. Our project is based on IoT and utilizes Arduino Uno as a microcontroller along with LM393 Comparator IC wet sensor to detect the baby's urine in the cradle, a sound sensor to detect baby cries, and a camera module to monitor the baby. The notification of the baby's cry will be sent to the Blynk App. Additionally, we have included a high-torque servo motor that allows the mother to move the baby cradle.

Sound sensor to detect when the baby is crying and send a signal to the Raspberry Pi. Additionally, a PIR motion sensor will be used to sense any movements made by the baby. PIR sensors can detect levels of infrared radiation, which is emitted by everything and increases with temperature. The system will also feature a Pi camera to capture the baby's facial expressions, a custom add-on for the Raspberry Pi that can take high-definition videos and still photographs.

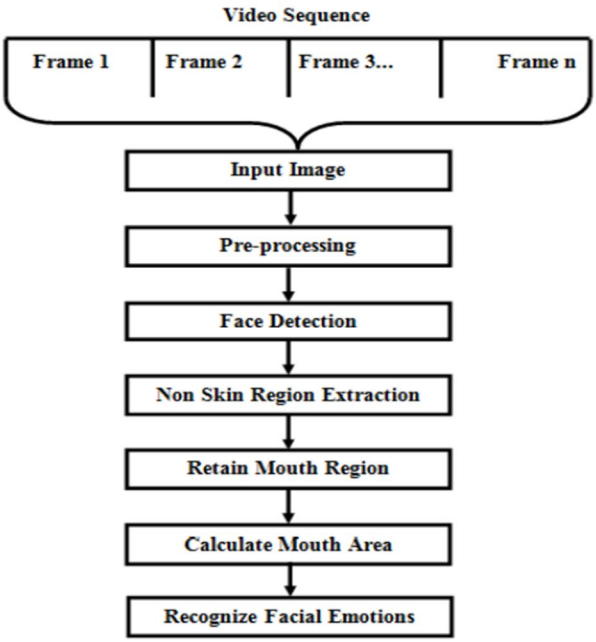


Figure 1.0

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IV. CIRCUIT OPERATION

The PIR sensor is designed to detect movement, specifically human movement within a predetermined range. Its purpose is to sense any motion made by the baby, which is then transmitted to the Raspberry Pi through the 22nd GPIO pin. The GPIO serves as an output for this purpose. When no motion is detected, the GPIO is set to a low state, and the buzzer remains inactive. On the other hand, if the PIR motion sensor detects the baby's movement, it generates a 5-volt signal to the Raspberry Pi via its GPIO, which triggers the buzzer alarm. Furthermore, the sound sensor is responsible for picking up any sound signals coming from the baby and converting them into electrical signals. The electrical signals are then transmitted through the 14th GPIO pin. If the baby is crying, the GPIO is set high, which activates the buzzer alarm. However, if the baby is sleeping soundly, the GPIO is set low, and the buzzer remains silent.

In addition to its GPIO pins, the Raspberry Pi has two high-quality connectors onboard. One is located between the Ethernet and HDMI ports, while the other is situated close to the GPIO. The connector that is closer to the Ethernet port is known as the Camera Serial Interface (CSI). This CSI is directly connected to the Raspberry Pi GPU, which enables it to process images without any intervention from the ARM processor.

V. ALGORITHM

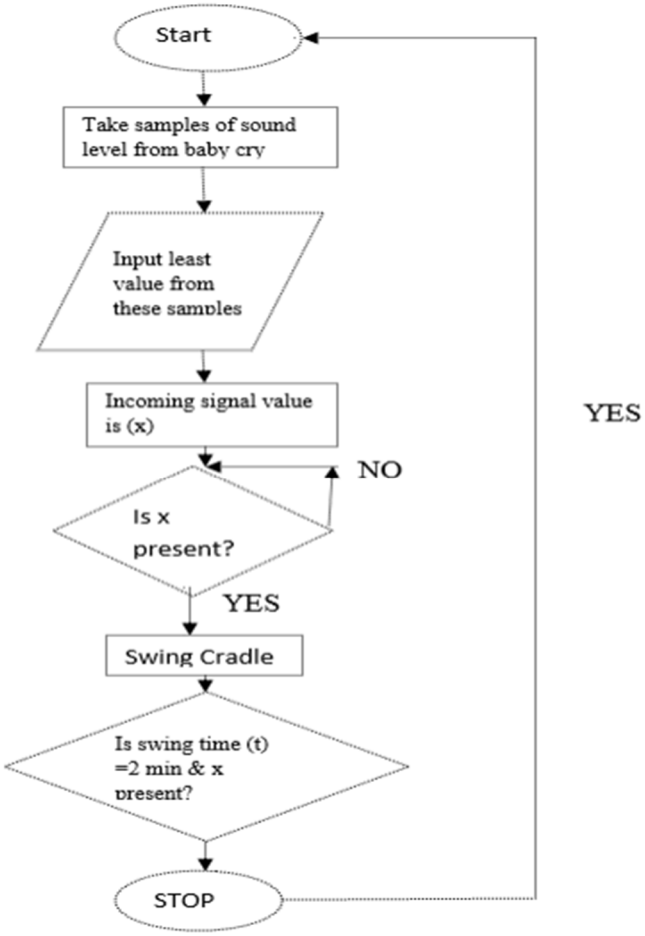


Figure 2.0

VI. BLOCK DIAGRAM

A. MIC

When a baby cries in the cradle, a microphone picks up the sound and converts it into an electrical signal that can be amplified. A condenser microphone is typically used for this purpose, which consists of two plates, one of which is extremely light and acts as a diaphragm. This diaphragm vibrates when sound waves hit it, altering the distance between the two plates and changing the capacitance, thereby generating an electrical signal.

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B. Signal Conditioning

Op-amps are commonly utilized in signal conditioning circuits to function as amplifiers. These circuits process electrical signals, such as those from microphones, and amplify them using op-amps. The amplified signals are then fed into microcontrollers for further processing.

C. Wet Sensor

This device functions as a moisture sensor with a mesh-like structure consisting of two leads. One of the leads is connected to a microcontroller via a pull-up resistor, while the other is connected to the ground. When the baby wets the mattress, the two leads come into contact, creating a short circuit which sends a signal to the microcontroller. The microcontroller then relays the signal to an alarm, ensuring that the baby is kept in a clean and hygienic environment.

D. Microcontroller

The PIC16F73 microcontroller is responsible for receiving and converting the amplified signal into a digital format. Its control over the driver circuit enables it to initiate motor movement and sway the baby bassinet in accordance with the input signal. Essentially, the microcontroller serves as the central processing unit that manages the entire system, from signal reception to motor control, ensuring that the baby is safely and comfortably cradled.

E. Alarm

There are two situations that will trigger an alarm:
firstly, when the mattress becomes wet, which serves as a signal to the parents that it is time to change the baby's clothes and mattress; and
secondly, when the baby cries continuously for a specific duration, such as two minutes while being rocked in the bassinet, the alarm will sound to alert the parents that the baby requires attention.

F. Driver Circuit

A motor driver circuit serves the crucial function of providing power to drive a motor, while also preventing electrical issues from affecting the microcontroller and other integrated circuits (ICs) in the system by isolating them from the motor's electrical disturbances.

G. Moter

A heavy-duty sewing AC motor with a speed of 8500 RPM and a voltage rating of 220 volts is being employed to sway a baby bassinet. To control the motor, a driver circuit has been integrated with a PIC microcontroller.

H. Baby Bassinet

The design of the bassinet allows for easy transport and storage.
Baby bassinets are commonly used for newborns and infants up to a certain age or weight limit.

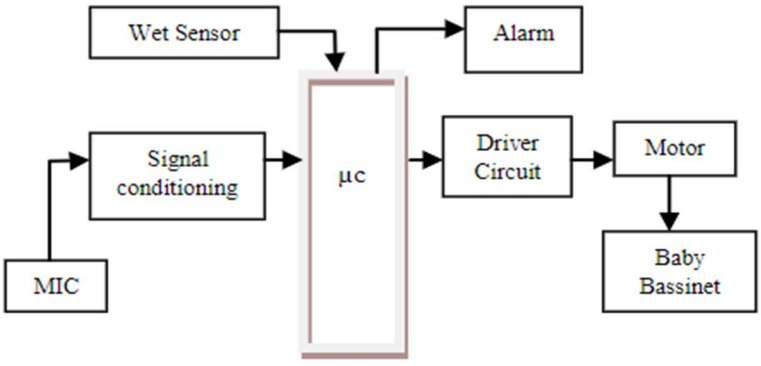


Figure 3.0

VII. SYSTEM REQUIREMENTS

A. Hardware Requirements

1) Arduino Uno
2) Sound Sensor
3) LM393 Comparator IC Sensor
4) Servo Motor
5) Camera Module

B. Software Requirement

1) Blynk App
2) Proteus
3) Arduino IDE

VIII. ACKNOWLEDGEMENT

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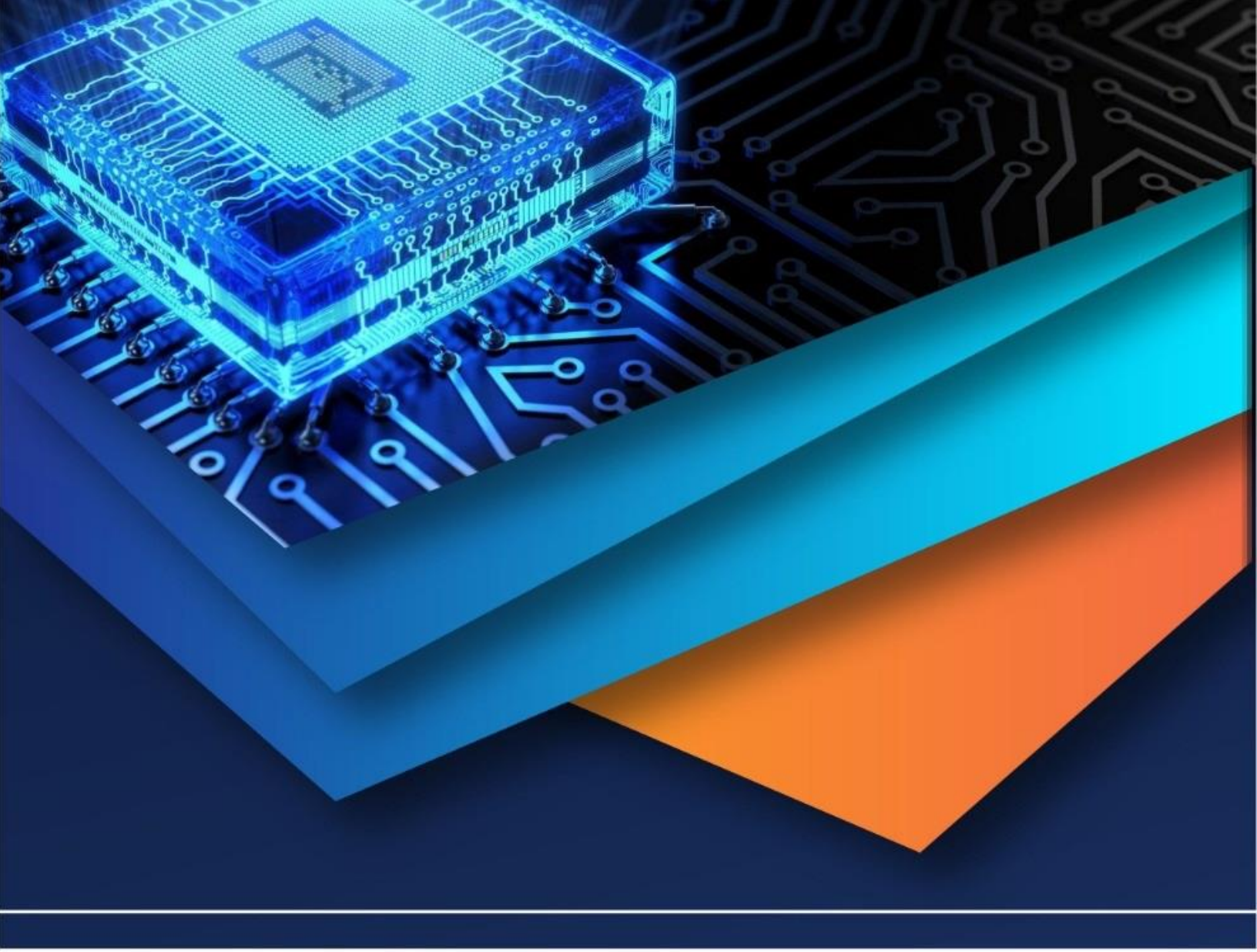
IX. CONCLUSION

The smartness of devices has been enhanced with the advent of the Internet of Things. We have developed and built a smart cradle integrated with an IoT-based baby monitoring system to keep track of a baby's crucial parameters, including crying condition, humidity, and ambient temperature. With an increase in the information that can be transmitted over the internet, remote access has become possible. A camera module attached to the cradle allows for continuous monitoring of the baby's movements within a limited area. Our study employs IoT technology to monitor the baby's movements and sends related notifications to mobile applications.

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