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Baby Monitoring System by using Arduino Uno

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Abstract: This paper presents the design and implementation of smart baby cradle system, a new low-cost baby monitoring system with multiple automatic functions. The system allows the cradle to swing automatically when baby cries. It has a cry analysis system which detects crying voices using sound sensor and automatically swings the cradle till the baby stops crying or zero voice detection. The system also has built-in fan that switched on when an increase in surrounding temperature is detected by DHT11 sensor. If the cradle is to be used manually, the speed of the cradle can be controlled as per the user need. Arduino Uno module is utilized in managing all the connected electronics components. This system aids parents and caretakers to look after the babies without high-demand physical attention.

Keywords: Sound sensor, DHT11, Arduino Uno, servo motor, monitoring system

1.0 INTRODUCTION

In today's fast-paced society, it is a challenge for parents to look after their children especially after lengthy working hours. Kids especially babies require full attention and monitoring most of the time including during parent's nighttime. There have been numerous advancements in infant-care technology that are intended to make it easier for parents to care for their children including the implementation of Internet of Things (IoT) into the system.[1] Specifically on cradle design, many cradles design in current market incorporates latest technology with improved effectiveness and innovation to cater this issue. Figure 1 shows different designs of the electrically controlled baby cradle available on market.

Figure 1: Baby cradle with automatic swing system

An automatic cradle designed with good characteristics will provide comfort to the baby and give good assistance to the parents or caretakers. With the information above, there are numerous components and factors to be considered when designing this smart baby cradle. This system is utilized whenever manual safety monitoring is challenging. Innovation has been made in such a way that it has reduced the complexity of human job. Along these lines, the new-born/infant care support framework has been created as an ideal option for parents or caretaker who are unable to devote enough time to their children.

There are several approach and research done by others prior to this design project. Similar concept is applied which is to give adequate assistance for infant care. Firstly, Mohamad Ishak *et al.* proposed an infant monitoring and alert system used in an incubator for neonatal intensive care unit (NICU) at hospital. The system helps the hospital personnel to monitor and record real-time conditions of the babies in NICU such as the incubator's temperature, humidity, and the baby's pulse rate. These measurement results are processed by Arduino microcontroller before being sent to PC for continuous monitoring. In case of irregularity in data readings, hospital personnel will be alerted to cater the issues. This helps in improving the productivity and efficiency in hospital.[2]

Another temperature monitoring system for baby incubator is proposed by Latif *et. al* to maintain warm temperature for baby's comfort. An LM35 temperature sensor is used in the system for temperature detection in the incubator, processed by Arduino Uno microcontroller and the data collected can be real-time displayed on a computer screen.[3] An automatic swinging cradle system has been proposed in [4]. This system contains automated swing movement of the bassinet as well as built-in alarm to alert when specific conditions are met which are (1) when the

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mattress is wet and (2) when baby does not stop crying within a set time. This proposal paper is used as main reference to design our smart baby cradle.

The smart baby cradle proposed in this paper incorporates few useful functions. First, the use of noise sensor for the detection of the child's crying activity. This will start the swinging of cradle to soothe the child. Next, the DHT sensor detects the surrounding temperature and humidity. When the detected temperature is higher than the set temperature i.e room temperature, the fan will automatically switch on. The goal of this project is to create a system that makes monitoring easy and produces good output. The suggested system prototype is built and tested to demonstrate its effectiveness in terms of cost and simplicity, as well as to assure safe operation, allowing infant-care process to take place anywhere and at any time.

2.0 MATERIALS AND METHODS

Block Diagram

Figure 2 shows the block diagram of the system. An Arduino Uno controller is used to oversee the entire system. It takes in external data and translate it into a dependable output. The sound sensor, temperature, pH, humidity sensors unit, servo motor, and fan are the sensors and control system that are connected to Arduino. The Arduino will be powered by the power supply and will collect data from the sensor's unit such as DHT11, and sound sensor. The Arduino Uno Board compiles this procedure and makes it the primary control. The suggested framework uses a passive-infrared (PIR) sensor that detects infrared light from a subject in its range of view and, as a result, detects the infant's movement. The noise sensor detects the sound of crying, while the temperature sensor detects the temperature and sends the data to the micro-controller

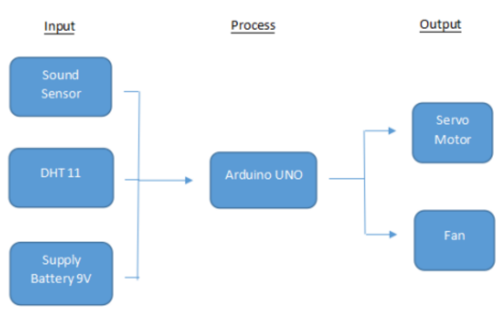

Figure 2: Block Diagram of Cradle System

Flowchart

Figure 3 depicts the flowchart implementation project, which is divided into two sections. The major element consists of software setup and hardware development, both are connected to run the system. This system's software is based on coding in Arduino integrated development environment (IDE). In addition, a sound sensor, DHT11 sensor, servo motor, and DC motor are used in this project's hardware.

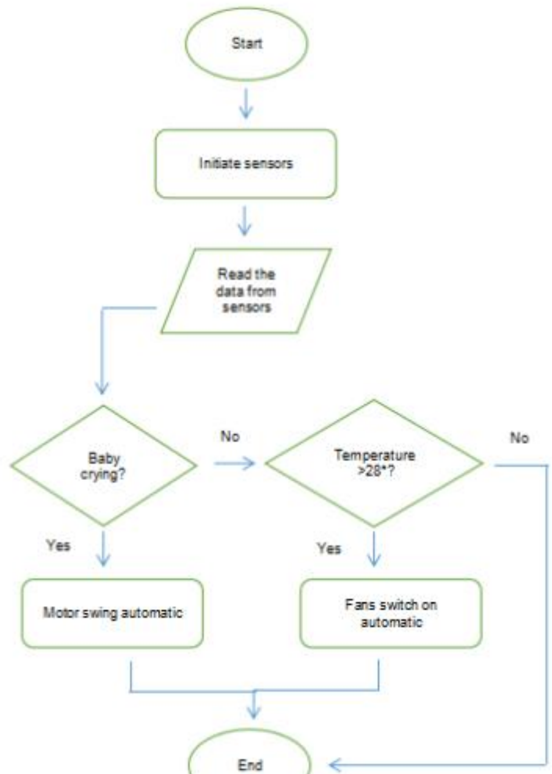

Figure 3: Flowchart of Cradle System

Circuit Diagram

Figure 4 shows the circuit diagram that has been developed project using Fritzing Software. The fully connected circuit must match the coding in the Arduino Uno controller to operate the system.

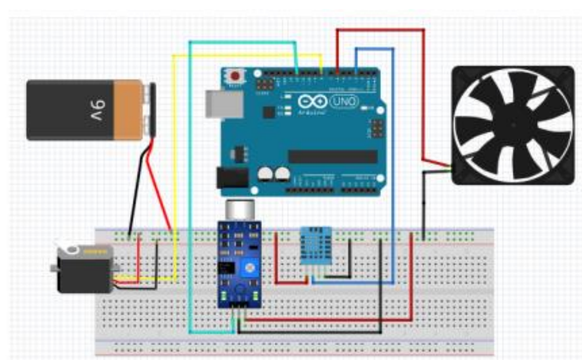

Figure 4: Circuit diagram of Cradle System

Sensors and Components

1) Sound Sensor

A KY-037 microphone sound sensor module was utilized in this project. The sensor's circuit board is made up of three key components: the sensor, amplifier, and comparator. The sensor unit, positioned at the front of the module, physically measures the area or detection before delivering an analogue signal to the amplifier. The signal is amplified by the amplifier and sent to the module's analogue output based on the resistance value of the potentiometer. The comparator turns on the digital output and the LED when the signal falls below a particular threshold. The potentiometer can be changed to change the sensitivity.

2) DHT11 Sensor

The DHT11 is a basic digital temperature and humidity sensor with a modest price tag. It measures the ambient air with a capacitive humidity sensor and a thermistor. Then, it gives out a digital signal output on the data pin (no analogue input pins needed). It is also simple to use. One of the drawbacks of this sensor is, data collection needs careful scheduling.[5]

3) Servo Motor

SG90 Micro Servo Motor used in this system is a small and light server motor with a high output power. The servo can rotate 180 degrees in total with 90 degrees at two opposite directions. This is to allow swinging movement to the cradle. It functions in the same way as regular servos but in a smaller size. To control these servos, a servo code or library is required.[6]

4) DC Motor (Fan)

Fan is powered by using a DC motor with a fixed voltage potential, such as the voltage of a battery. DC motor fan is typically considered to be the most energy efficient. It uses a fraction of the energy that AC motor fans do . DC motor fan uses up to 75% less energy to create the same amount of output as standard AC motor fan. This means a 25-watt DC motor fan produces the same energy efficiency as a 100-watt AC motor fan.

3.0 RESULTS

Analysis Result

This chapter's analysis was based on the system analysis that looked at the results of a sound sensor that detected a sound or noise from the baby and a DHT11 sensor that detects temperature and the environment surrounds the baby. This project required a few tools and components, including a servo motor, a sound sensor, a moisture sensor, a DC motor, and an Arduino Uno. The complete prototype of this project is shown in Figure 5. The data extraction from the system will be explained in the next sections.

Figure 5: Front view of the Cradle System

Analysis of sound detection

Table 1 shows the sound sensor's responses; before and after it detects a noise. When it is unable to identify a sound, the sound sensor's LED will not light up (green circle). The LED will light up (blue circle) as an indication of sound/noise detection and it will send signal to the server. The shaft of the electric driven motor will actuate the links, and the links will actuate the bed at a consistent speed, which is connected to the carriage.

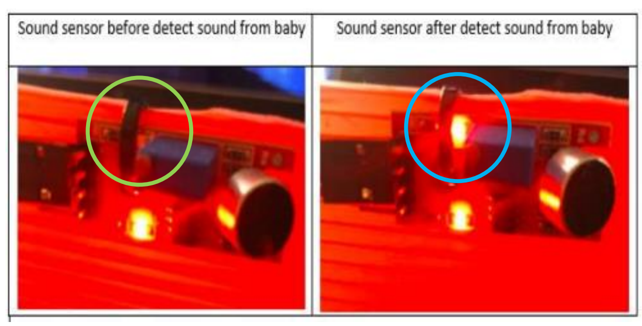

Table 1: Detection of sound sensor

Analysis of temperature and humidity detection

Figure 6 shows the reading record for sensing both temperature and humidity from the surrounding of the cradle. The temperature sensor can detect the room temperature, and if it is too hot, the fan will automatically switch on. The temperature value is converted into a suitable number in the Celsius scale using the sensor's output. Pulse-width modulation (PWM) signals are used to control the fan speed. Finally, the system displays humidity and temperature on the Arduino IDE while the fan runs.[7]

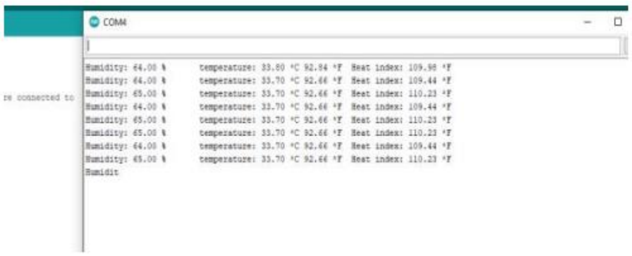

Figure 6: DHT11 sensor reading

4.0 DISCUSSION

Analysis of overall system

According to the findings, the output of the sensors detection, as well as the production of the prototype with system that is stimulated by the sensors, are demonstrated. All sensors are functioning, and data provided is tally with the intended outcomes. According to this study, the sensors must first be constructed by supplying the appropriate information in the coding to be transferred to the microcontroller before the sensor can run efficiently based on the data provided.

5.0 CONCLUSION

A smart baby cradle system is intended to solve the problem that parents, babysitters, and anybody else with a baby face when caring for their child. This project made it easier for individuals to look after their children, especially for working parents, or even while they sleep at night. It is no longer necessary for parents to go to their children to swing the cradle. The project reduces human effort and the stress of parents during working hours. A motor, sensors, and an oscillating carriage are the components needed for a baby care equipment. The overall mechanism is movable, allowing for easy transfer between rooms too. The benefit of this system is that it has a low initial cost and allows for minimal operational costs. The technology has a lot of room for improvement and operational efficiency, to be commercially viable and appealing.

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