

IOT BASED SMART BABY CRADLE SYSTEM WITH AUTOMATED MUSIC PLAYER

Submitted in partial fulfillment of the requirements for the award of

Bachelors of Science in Computer Science

BY

LOHAR KARISHMA DILIP

(41290033)

&

SRIPRIYA S

(41290058)



**DEPARTMENT OF COMPUTER SCIENCE
SCHOOL OF SCIENCE AND HUMANITIES**

**SATHYABAMA INSTITUTE OF SCIENCE AND
TECHNOLOGY**

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A++” by NAAC

JEPPIAR NAGAR, RAJIV GANDHI SALAI, CHENNAI 600119
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **LOHAR KARISHMA DILIP (41290033)** and **SRIPRIYA S (41290058)** who carried out the project entitled **"IOT BASED SMART BABY CRADLE SYSTEM WITH AUTOMATED MUSIC PLAYER"** under our supervision from NOVEMBER 2023 TO APRIL 2024.

INTERNAL GUIDE

Dr. Rekha Chakravarthy M.E., PhD

DEAN AND HEAD OF THE DEPARTMENT

Dr. Rekha Chakravarthy M.E., PhD

Submitted Viva voice examination held on 27/04/2024

Internal Examiner

External Examiner

DECLARATION

I am, **LOHAR KARISHMA DILIP (41290033) and SRIPRIYA S (41290058)** hereby declare that the Project Report entitled “**IOT BASED SMART BABY CRADLE SYSTEM WITH AUTOMATED MUSIC PLAYER**” done by under the guidance of **Dr. Rekha Chakravarthy M.E., PhD**, Dean and head of the department. Department of Computer Science at **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY**, Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119 is submitted in partial fulfilment of the requirements for the award of Bachhelors of Science degree in Computer Science.

DATE: 27/04/2024

**LOHAR KARISHMA DILIP
SRIPRIYA S**

PLACE: CHENNAI

SIGNATUE OF THE CANDIDATE

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**LOHAR KARISHMA DILIP
SRIPRIYA S**

ABSTRACT

The standard Automatic child cradle frameworks are excessively costly and don't provide any utility. This project aims to assist mothers who are overburdened and do not have a cleaning professional or sitter to care for their children. It includes a side-to-side rocking action that relaxes and soothes the infant. Parents must use considerable effort to physically rock the cradle in order to induce swinging motion. When the infant is kept in the cradle, the parents must constantly monitor him or her to keep track of the baby's activity. The suggested concept of this smart cradle prototype will allow the cradle to be efficiently integrated. All of the sensors and hardware components will be assembled using an Arduino microcontroller. The infant within the cradle will be constantly monitored. If any action occurs, such as urinating or a baby waking up from sleep, the parents can get notified with the same using an remote server through the ESP8266 wifi module. The Smart cradle will also include other characteristics such as autonomously swaying the infant using a servo motor system. In addition, certain further features, such as a Moisture sensor for sensing moist conditions, MEMS sensor for detecting the movement of the baby, DHT 11 sensor for detecting the temperature and humidity, MIC sensor for detecting the crying of the baby and a music system with a voice recorder to soothe the baby will be included to improve the cradle's efficiency. The cradle is ideal for parents who are unable to spend their entire day at home sitting next to their newborn. This cradle may also be used in a maternity hospital as an aid to the workers who are in charge of the baby's care.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Generally, the baby cradle is used for to make sleep and soothe to baby. For example guardian has to take care of their child till as they asleep. However, conventional cradle does not electronically equipped such like battery or adapter to automate the cradle automatically. These kind of conventional cradle is used in villages areas or non-developed cities due to its low prices. But the problem of this kind of designated cradle is that you need manpower to take care of your child and your child may not be safe and feel comfortable in the conventional cradle. Thus, we need automatic cradle to take care of child which uses the battery or power source. Besides, there are extra features or function is provided by the newly automatic cradle that is beneficial for parents. Because in the present world people are very busy in their professional life so they do not get ample time to take care of their infants. It will be very difficult control the babies and if someone is hiring professional to take care of their infants. It may increase your expenses from monthly expenditure. Moreover, in today, life it is very hard to even for the homemakers to sit nearby their babies and soothe them whenever they feel uncomfortable. Though, it is automatic this application is very useful for the nurses in maternity units of hospital. Smart cradle system is an innovative IOT based project that aims to provide a more efficient and effective way to care for infants. This system utilizes various IOT components, such as sensors and microcontrollers, to monitor and control the infant's environment. For example, it can scan the baby's temperature, humidity, and movements and alert the parents or caretakers in case of abnormalities. The system can also provide soothing sounds and vibrations to help the baby fall asleep. Working parents cannot always care for their babies. They either send their babies to their parents or hire a caretaker while they are working. Some parents do not want to hire a caretaker because of safety issues and expenses. So, IOT based baby monitoring and automatic swing system that can monitor the baby's condition in real time is proposed to solve these problems.

1.2 OBJECTIVE OF THE SYSTEM

The primary objective of a Smart Baby Cradle System using IoT is to enhance the safety, comfort, and convenience of both the baby and the parents or caregivers. Here are the key objectives:

Safety Monitoring: The system aims to monitor various parameters such as the baby's motion, temperature, and heart rate in real-time. By continuously monitoring these factors, it can detect any anomalies or potential risks to the baby's well-being.

Remote Monitoring and Control: With IoT connectivity, parents or caregivers can remotely monitor the baby's status and control the cradle's functions using a smartphone or tablet. This feature provides peace of mind and flexibility, allowing caregivers to check on the baby from anywhere at any time.

Enhanced Comfort: The Smart Baby Cradle System may incorporate features to optimize the baby's sleeping environment, such as adjusting the cradle's motion, temperature, or playing soothing music or white noise to promote better sleep.

Data Insights and Analysis: By collecting and analyzing data on the baby's sleeping patterns, environmental conditions, and other relevant factors, the system can provide valuable insights to parents or caregivers. These insights can help in understanding the baby's behavior and health trends over time.

Automation and Convenience: Automation features such as automatic rocking motion based on predefined patterns or the baby's preferences can help reduce the workload on parents and provide consistent care for the baby.

Integration with Smart Home Systems: Integration with other smart home devices and systems allows for seamless operation and coordination. For example, the Smart Baby Cradle System could adjust room lighting or activate a baby monitor camera based on the baby's sleep status.

Emergency Alerts and Notifications: The system can provide timely alerts and notifications to parents or caregivers in case of emergencies or abnormal situations, such as sudden changes in the baby's vital signs or environmental conditions.

Overall, the objective of a Smart Baby Cradle System using IoT is to leverage technology to create a safer, more comfortable, and more convenient environment for both the baby and the caregivers, while also providing valuable insights and peace of mind.

1.3 COMPONENTS USED IN THE SYSTEM

ARDUINO UNO

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Most Arduino boards are designed to have a single program running on the microcontroller. This program can be designed to perform one single action, such as blinking an LED. It can also be designed to execute hundreds of actions in a cycle. The scope varies from one program to another.

Feature of Arduino UNO:

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Pin configuration of Arduino UNO:

Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

5V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as onboard components.

3.3V: This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board

GND: This pin of the board is used to ground the Arduino board.

Reset: This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5V.

Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.

Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.

External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

PWM Pins: This pins of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3,5,6,9,10 and 11 are used as a PWM pin.

SPI Pins: This is the Serial Peripheral Interface pin, it is used to maintain SPI communication with the help of the SPI library. SPI pins include:

1. SS: Pin number 10 is used as a Slave Select
2. MOSI: Pin number 11 is used as a Master Out Slave In
3. MISO: Pin number 12 is used as a Master In Slave Out
4. SCK: Pin number 13 is used as a Serial Clock

LED Pin: The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

AREF Pin: This is an analog reference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

Diagram of Arduino UNO:

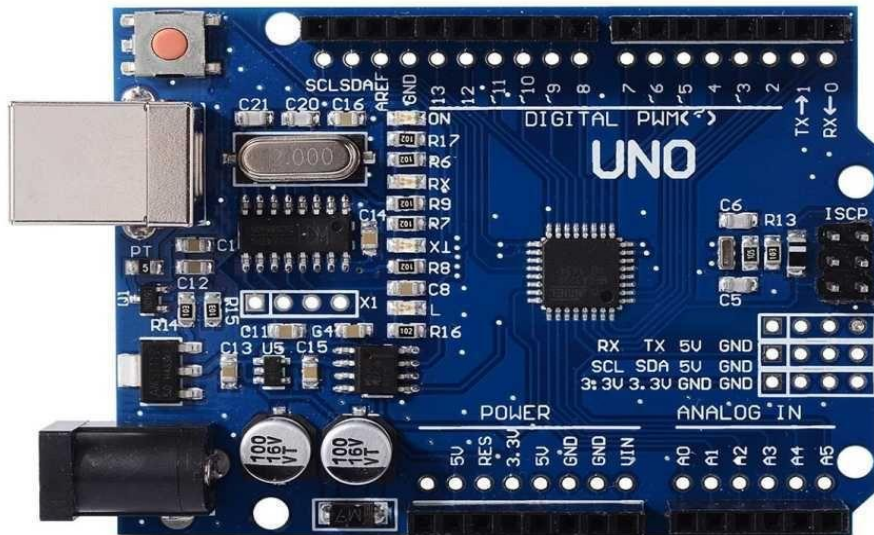


FIG 1.3.1 ARDUINO UNO

LIQUID CRYSTAL DISPLAY (LCD)

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color or monochrome.

Working of LCD:

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example, a 4K display is made up of 3840 x 2160 or 4096 x 2160 pixels. A pixel is made up of three subpixels; a red, blue and green—commonly called RGB. When the subpixels in a pixel change color combinations, a different color can be produced. With all the pixels on a display working together, the display can make millions of different colors. When the pixels are rapidly switched on and off, a picture is created. The way a pixel is controlled is different in each type of display; CRT, LED, LCD and newer types of displays all control pixels differently. In short, LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90.

Diagram of LCD:

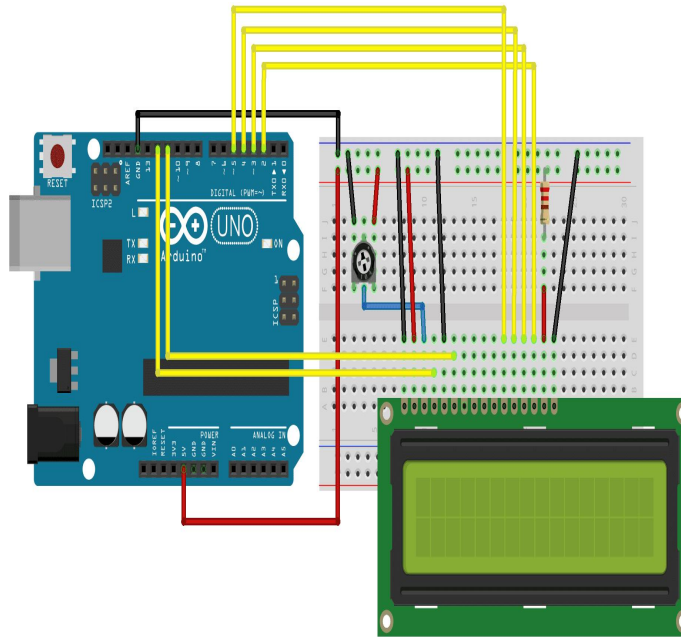


FIG: 1.3.2 LCD

RELAY MODULE

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

- A relay is an electrical switch that can be used to control devices and systems that use higher voltages. In the case of module relay, the mechanism is typically an electromagnet.
- The relay module input voltage is usually DC. However, the electrical load that a relay will control can be either AC or DC, but essentially within the limit levels that the relay is designed for.
- A relay module is available in an array of input voltage ratings: It can be a 3.2V or 5V relay module for low power switching, or it can be a 12 or 24V relay module for heavy-duty systems.
- The relay module information is normally printed on the surface of the device for ready reference. This includes the input voltage rating, switch voltage, and current limit.

Diagram of Relay module:

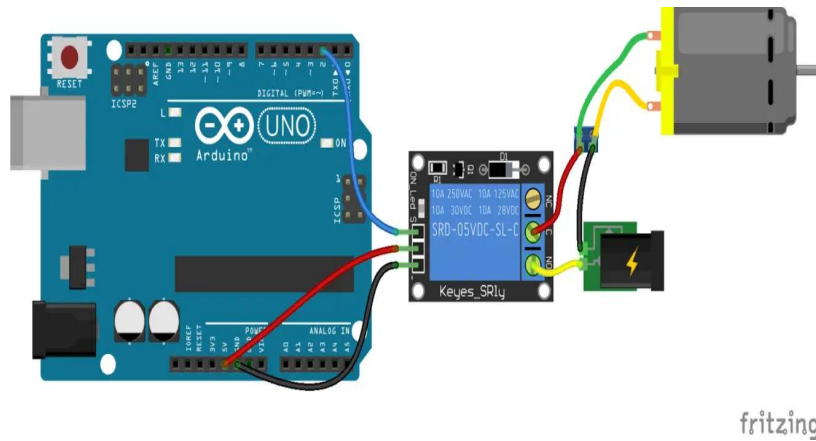


FIG: 1.3.3 RELAY MODULE

MEMS SENSOR

MEMS sensors are made up of both electronic and mechanical components. Microelectronic components handle sensing and processing of data while mechanical parts provide physical feedback – this combination makes MEMS sensors small, reliable, and cost-effective. MEMS are widely accepted in micro and nanosystems, for various applications because of their micron-scale size, low weight, smaller volume of material, less energy consumption, etc.

Whenever the tilt is applied to the MEMS sensor, then a balanced mass makes a difference within the electric potential. This can be measured like a change within capacitance. Then that signal can be changed to create a stable output signal in digital, 4-20mA or VDC. These sensors are fine solutions to some applications which do not demand the maximum accuracy like industrial automation, position control, roll, and pitch measurement, and platform leveling

Diagram of MEMS Sensor:



FIG: 1.3.4 MEMS SENSOR

DHT 11 SENSOR

The DHT-11 Digital Temperature And Humidity Sensor is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed)

DHT11 Specifications:

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: $\pm 1^\circ\text{C}$ and $\pm 1\%$

Diagram of DHT 11 Sensor:

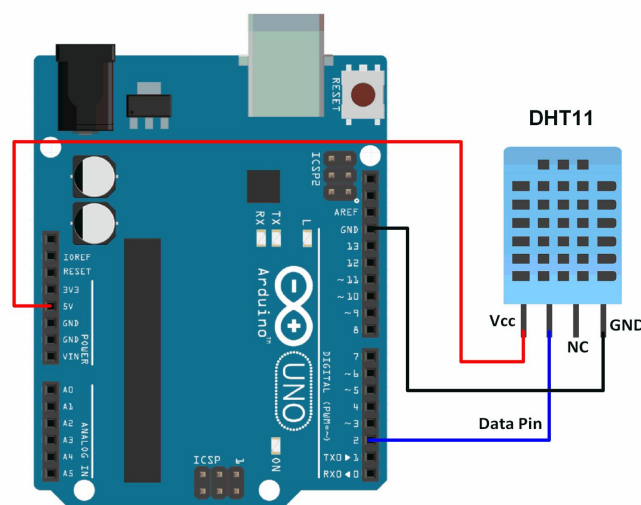


FIG: 1.3.5 DHT 11 SENSOR

MOISTURE SENSOR

A moisture sensor uses capacitance to measure dielectric permittivity of the surrounding medium. dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity. the temperature at which condensation forms on a surface. This is considered a fundamental measurement and is therefore the standard technique for high level references in metrological institutes worldwide.

Uses: Portable pin-type moisture meters feature 2-4 small steel probes, which are inserted into the material to effectively gauge the moisture level. The material probing process is followed by the circulation of current between two points, with the level of resistance translating into a moisture content value.

Diagram of Moisture Sensor:

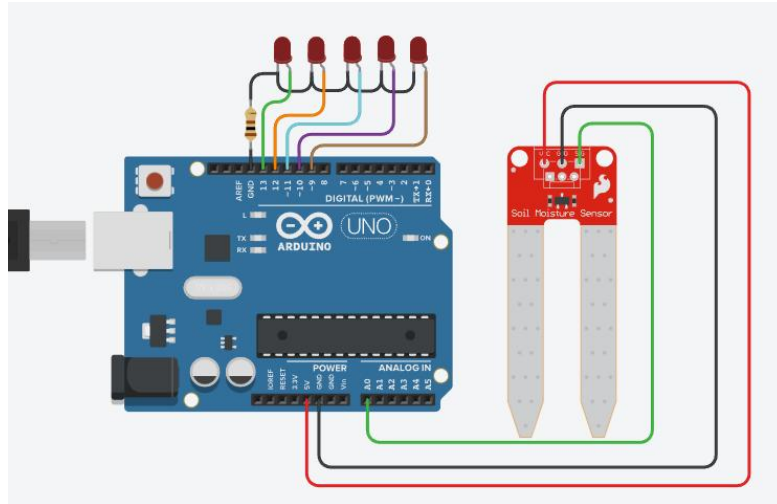


FIG: 1.3.6 MOISTURE SENSOR

MIC SENSOR

A Microphone sensor helps an electronic product capture sound waves and convert that energy into electrical energy so it can be processed and used in applications such as voice recognition in smart speakers, mobile phones and smartwatches.

It works similar to our ears. Our Ears have a diaphragm which converts the detected the vibration and converts it in the signal. Similarly, the sound sensors convert the vibration into audio signal (voltage and current proportional) with the help of a microphone.

Diagram of MIC Sensor:

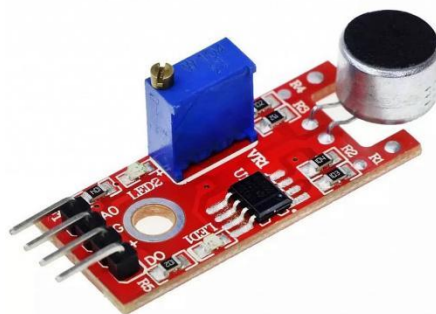


FIG:1.3.7 MIC SENSOR

ESP2866 WIFI MODULE

ESP2866 is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor.

Specifications:

- It is a powerful Wi-Fi module available in a compact size at a very low price.
- It is based on the L106 RISC 32-bit microprocessor core and runs at 80 MHz
- It requires only 3.3 Volts power supply
- The current consumption is 100 m Amps
- The maximum Input/Output (I/O) voltage is 3.6 Volts.
- It consumes 100 mA current
- The maximum Input/Output source current is 12 mA
- The frequency of built-in low power 32-bit MCU is 80 MHz
- The size of flash memory is 513 kb
- It is used as either an access point or station or both
- It supports less than 10 microAmps deep sleep
- It supports serial communication to be compatible with several developmental platforms such as Arduino
- It is programmed using either AT commands, Arduino IDE, or Lua script
- It is a 2.4 GHz Wi-Fi module and supports WPA/WPA2, WEP authentication, and open networks.
- It uses two serial communication protocols like I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface).
- It provides 10- bit analog to digital conversion
- The type of modulation is PWM (Pulse Width Modulation)
- UART is enabled on dedicated pins and for only transmission, it can be enabled on GPIO2.
- It is an IEEE 802.11 b/g/n Wi-Fi module with LNA, power amplifier, balun, integrated TR switch, and matching networks.
- GPIO pins – 17
- Memory Size of instruction RAM – 32 KB
- The memory size of instruction cache RAM – 32 KB
- Size of User-data RAM- 80 KB
- Size of ETS systems-data RAM – 16KB

Diagram of ESP2866 Wifi Module:

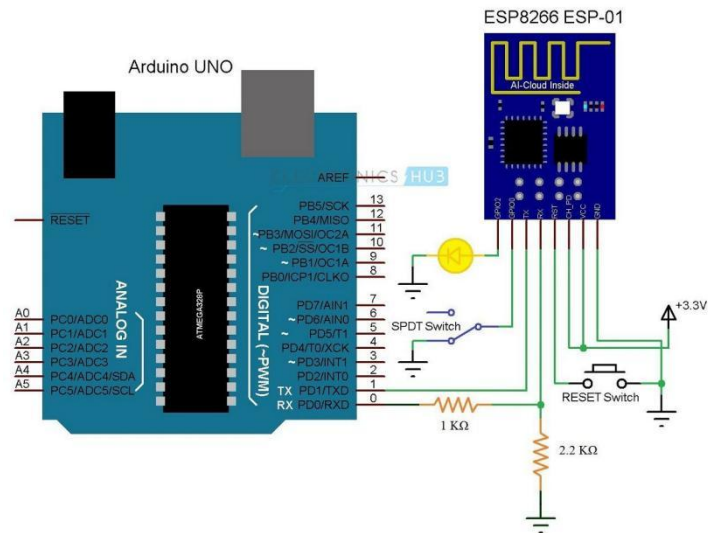


FIG: 1.3.8 ESP8266 WIFI MODULE

SERVO MOTOR

A servomotor is a closed-loop servo mechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analog or digital) representing the position commanded for the output shaft.

A servo motor consists of three main components:

A motor: This can be either a DC motor or an AC motor depending on the power source and the application requirements. The motor provides the mechanical power to rotate or move the output shaft.

A sensor: This can be either a potentiometer, an encoder, a resolver, or another device that measures the position, speed, or torque of the output shaft and sends feedback signals to the controller.

A controller: This can be either an analog or a digital circuit that compares the feedback signals from the sensor with the desired setpoint signals from an external source (such as a computer or a joystick) and generates control signals to adjust the motor's voltage or current accordingly.

Working of servo motor:

The controller compares set point and feedback signals and calculates an error signal that represents the difference between them. The error signal is then processed by a control algorithm (such as PID) that generates a control signal that determines how much voltage or current should be applied to the motor. The control signal is sent to a power amplifier (such as an H-bridge) that converts it into an appropriate voltage or current level for driving the motor. The motor then rotates or moves according to the control signal and changes its position, speed, or torque, and sends a new feedback signal to the controller. The process repeats until the error signal becomes zero or negligible, indicating that the output shaft has reached the desired setpoint.

Diagram of Servo Motor:

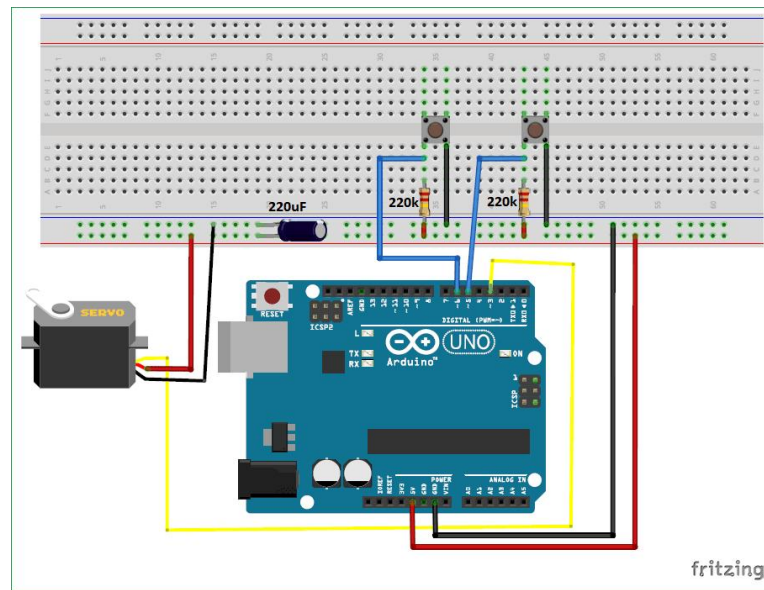


FIG: 1.3.9 SERVO MOTOR

LM324 POWER DRIVER

LM324 is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L293 motor driver IC. It can drive 4 DC motors on and off or drive 2 DC motors with directional and speed control. The driver greatly simplifies and increases the ease with which you may control motors, relays, etc from micro-controllers. It can drive motors up to 12V with a total DC current of up to 600mA. You can connect the two channels in parallel to double the maximum current or in series to double the maximum input voltage. This motor driver is perfect for robotics and mechatronics projects for controlling motors, switches, relays, etc from microcontrollers. Perfect for driving DC and Stepper motors for micro mouse, line-following robots, robot arms, etc.

Features of LM324 driver:

- Wide supply voltage: 4.5 V to 12 V.
- Max supply current: 600 mA per motor.
- Male berg-stick connectors for supply, ground, and input connection.
- Screw terminal connectors for easy motor connection.
- High noise immunity inputs

Diagram of LM324 Power Driver:

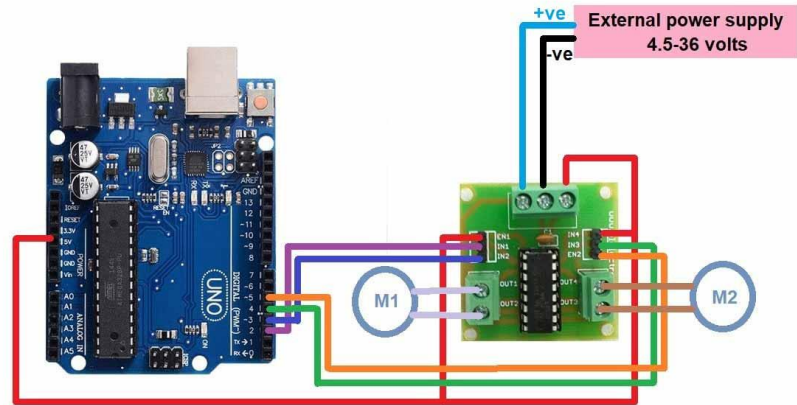


FIG: 1.3.10 LM324 POWER DRIVER

DAUGHTER BOARD

A daughterboard is type of circuit board that plugs in or is attached to the motherboard or similar expansion card to extend its features and services. A daughterboard complements the existing functionality of a motherboard or an expansion card.

Importance of daughter board :

Daughter boards play a crucial role in expanding a computer's capabilities. They provide additional features and services that are not typically available on the motherboard alone. By connecting directly to the motherboard, daughter boards can optimize performance, increase memory capacity, and enable customization for specialized tasks. These boards offer a cost-effective alternative to replacing the entire motherboard or performing major upgrades.

Diagram of Daughter Board:



FIG: 1.3.11 DAUGHTER BOARD

AMPLIFIER

An amplifier is an electronic device that increases the voltage, current, or power of a signal. Amplifiers are used in wireless communications and broadcasting, and in audio equipment of all kinds. They can be categorized as either weak-signal amplifiers or power amplifiers.

Diagram of Amplifier:



FIG: 1.3.12 AMPLIFIER

MUSIC SYSTEM (SPEAKER AND VOICE RECORDER)

Speaker is the most common type of driver, commonly called a dynamic loudspeaker, uses a lightweight diaphragm, or cone, connected to a rigid basket, or frame, via a flexible suspension, commonly called a spider, that constrains a voice coil to move axially through a cylindrical magnetic gap.

Voice recorder system in the speaker can be used to record our own voices or any of the sounds and it can be played through the means of the speaker.

Diagram of Speaker and Voice Recorder



FIG: 1.3.13 MUSIC SYSTEM

ADAPTER

An adapter or adaptor is a device that converts attributes of one electrical device or system to those of an otherwise incompatible device or system. Some modify power or signal attributes, while others merely adapt the physical form of one connector to another.

Diagram of an Adapter:



FIG: 1.3.14 ADAPTER

SERVO FAN

The fan motor is an important component in industrial facilities. Fans and their motors have become indispensable in modern industrial plants. Whether for ventilation of warehouses, cold stores for cooling or just for fresh air fan motors are everywhere.

Diagram of Servo Fan:



FIG: 1.3.15 SERVO FAN

BUZZER

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. buzzer, is a component that is used for generating sound. It is a digital component that can be connected to digital outputs, and emits a tone when the output is HIGH. Alternatively, it can be connected to an analog pulse-width modulation output to generate various tones and effects.

Working Principle:

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors. Once a potential disparity is given across these crystals, then they thrust one conductor & drag the additional conductor through their internal property. So this continuous action will produce a sharp sound signal.

Diagram of a Buzzer:

FIG: 1.3.16 BUZZER

CRADLE STRUCTURE

Cradle in furniture is an infant's bed of wood, wicker, or iron, having enclosed sides and suspended from a bar, slung upon pivots, or mounted on rockers. The rocking motion of the cradle is intended to lull the infant to sleep.

Diagram of a Cradle Structure:

FIG: 1.3.17 CRADLE STRUCTURE

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

A literature survey would involve reviewing existing research papers, articles, patents, and other sources related to similar systems. Here's a structured approach to conducting a literature survey:

Reviewing Academic Journals and Conference Proceedings:

Searching databases such as IEEE Xplore, ACM Digital Library, ScienceDirect, and Google Scholar for relevant research papers.

Looking for papers focusing on IoT applications in baby monitoring, smart cradles, healthcare monitoring systems, etc.

Paying attention to studies discussing sensor integration, data analytics, communication protocols, and user interfaces.

Exploring Patent Databases:

Searching patent databases like Google Patents or the United States Patent and Trademark Office (USPTO) for patents related to smart baby cradle systems, IoT-based baby monitoring devices, and related technologies.

Analyzing the patents to understand technological innovations, design approaches, and potential gaps in the existing solutions.

Reading Technical Reports and Theses:

Exploring technical reports and theses from academic institutions, especially those focusing on IoT applications in healthcare or smart home systems.

Looking for studies that propose novel algorithms, hardware designs, or system architectures for smart baby cradle systems.

Reviewing Industry Publications and Whitepapers:

Looking for articles, blog posts, and whitepapers published by companies or industry experts in the IoT and baby care sectors.

Industry publications may provide insights into market trends, emerging technologies, and practical considerations for implementing smart baby cradle systems.

Attend Conferences and Workshops:

Attending conferences, workshops, and seminars related to IoT, healthcare technology, or smart home systems.

Engaging with researchers, practitioners, and industry professionals to discuss the latest advancements and challenges in developing smart baby cradle systems.

Searching for Online Forums and Communities:

Participating in online forums, discussion groups, or social media communities focused on IoT, parenting, or baby care.

Engaging in discussions, ask questions, and seek recommendations from individuals who have experience with smart baby cradle systems or similar technologies.

Analyzing Review Articles and Meta-Analyses:

Looking for review articles or meta-analyses that provide a comprehensive overview of existing research and developments in the field of IoT-based baby monitoring systems.

Reviewing articles can help identify key trends, challenges, and future directions for research in this area.

By conducting a thorough literature survey using these methods, we can gain a comprehensive understanding of the current state-of-the-art, challenges, and opportunities in developing a Smart Baby Cradle System using IoT.

2.2 RELATED WORKS

The authors Fatih Elmas et.al, have developed the “ Rocking motion for the baby sleeping on Mothers Lap:modeling and prototyping to automotive smart cradle design” in 2015. It gives the mathematical calculation for the rotation of the cradle as sleeping pattern . The author has calculated rotational degrees between (40-140) , the speed to be bare minimum as a mother handling and all other input factor that are responsible for swing movement and given a single mathematical formula. The author has mentioned an idea to develop extra fencing for the crib to focus on security of baby. The drawback of the project are it mainly focuses on design specification and hence neglects all the other factors of the cradle [1].

The authors M. Chen, Y. Ma et.al, have developed the "Smart clothing: Connecting human with clouds and big data for sustainable health monitoring," in 2016. They have innovated the proposed system which includes various sensors such as heart rate sensors, smoke sensors, pressure sensors, weight sensors, and ultrasonic sensors. An automatic alert is sent to the nearest hospital via email if an abnormality is detected in the measured data. The system also monitors the surrounding environment or any accidental criteria and also it provides an alarm if dust or dangerous gas is detected [2].

The authors B. Steven, Richard Lam et.al , have developed the “Rock Me Baby:The Automatic Baby Rocker” on May 17, 2011. It is an automatic baby rocker with noise sensor implemented to detect baby cry. That sensor which picks the sound signal from surrounding consists of electric MIC circuit . The Signal generated from noise sensor is fed to microcontroller which was used to control the DC motor attached with rocker (the toy twirl) and few colorful lights made up of LED which were used to entertain the baby being rocked [3].

The authors Shreelatha et.al have developed the “Advanced Baby Monitor” in June 2017. They have presented a baby monitoring system based on GSM network. This system monitor’s body’s health parameters like temperature, moisture, pulse rate and movement and deliver these measured parameters on the parent’s mobile using GSM network. System presented includes reminder system as important feature in baby

monitoring activity. It conveys measurements with an alarm triggering to initiate proper actions. Using this feature, parents or caretakers can set reminder about feeding time and vaccination date [4].

The authors R. G. Babu, V. V. Natha et.al have developed the "IoT Security Enhancement with Automated Identification Device using Internet of Things based Baby Monitoring System for Smart Cradle" in 2021. They have introduced the Raspberry Pi B+ module controls the hardware of the system along with pressure sensor. The baby's movements are monitored by incorporated ultrasonic sensor. With PI 717 sensor baby's motion is captured using USB camera. Hence, the video which has been recorded of the sleeping baby is displayed on the display monitor and also it puts on alarm of beeping sound. In order to make parent alert about any accidental criteria. At last the final output which is a developed hardware, is used for detecting the baby's movements. The video of the baby is informed to parents via sms, where busy parents can find it convenient and easier for taking care of their baby [5].

The Authors P. Gopi Krishna, K. Sreenivasan Ravi et.al with MQTT protocol has proposed a design specification document that describes the smart infant prototype. This designed document will get followed to make the final smart baby cradle product which has been already proposed, although all the electronic components may be replaced with more convenient devices. All designs in this document will take into consideration of customer and safety requirements. The constraint is Baby's inquisitiveness: In addition to the risk for an electric shock, the baby could bite at or consume the parts, cause them to slip off, or break them. Which will be modified with fuse box fundamentals and better quality wires as parents are more concerned with safety issues than with product features [6].

The authors Aslam Forhad Symon et al, have developed "Design and Development of a Smart Baby Monitoring System" in 2017. The proposed system is to detect baby's activities like motion and cry sound. This system is accomplished with display unit, buzzer and camera module. Whenever baby motion or cry is detected, camera module is turned on to display baby motion on display unit and buzzer to indicate baby's cry detection and puts on continuous alarm beep sound where the System presented includes reminder system as important feature in baby monitoring activity by alerting parent to check if the infant has urinated or pooped [7].

The authors Rachna Palaskar et.al, have developed "An Automatic Monitoring And Swing the Baby Cradle for Infant Care" in Dec 2015 has provided the cradle, mechanism of automatic swinging when baby cries. To record babies temperature, to video record activities of baby, to detect facial expressions and automatically send message weather baby is safe or not. The drawbacks are it uses artificial intelligence to sense emotions hence the system cost increases and development time is more it does not contains the crib and components are mounted on the mattress [8].

The authors L Nitin Bhatnagar, Kshitij et.al, have developed "Design of Automatic & Indigenous E Cradle" in 2016. In the proposed a system when the baby cries then the cradle swings automatically, which detects the baby crying voice through microphone and the cradle swings accordingly till the baby stops crying and wet sensor is used to detect the wetness. The system was developed with an alarm that determines two conditions – first swing of cradle when baby doesn't stop crying within the time

period of 2 minute. And second if the mattress is wet, that is the important parameter to keep the baby in hygienic [9].

The authors S.Srikanth, P.R et.al have developed "Smart Baby Cradle System" in March 2018. The system proposed is designed using Raspberry PI 3, camera, wet sensors, sound sensor, PIR sensor, DC motor and SMS module. This system encloses the different features like camera monitoring, automatic swinging of cradle when baby cries, sensing the wetness of baby's bed, monitoring presence of baby in the cradle. Message about baby's cry, wetness in bed and absence of baby in the cradle are sent to parent's mobile number to intimate them about their baby [10].

2.3 BENEFITS OF SMART BABY CRADLE SYSTEM

A Smart Baby Cradle System using IoT offers several benefits for both parents or caregivers and the baby. Here are some of the key benefits:

Remote Monitoring: Parents or caregivers can monitor the baby's status remotely from anywhere using a smartphone or tablet connected to the internet.

Real-time Alerts and Notifications: The system can send alerts and notifications to parents or caregivers in real-time in case of emergencies or abnormal situations, such as sudden changes in the baby's vital signs or environmental conditions.

Enhanced Safety: Smart baby cradle systems can incorporate various sensors to monitor the baby's movement, temperature, and heart rate, among other parameters.

Optimized Sleeping Environment: The system can automatically adjust the cradle's settings, such as rocking motion, temperature, and ambient lighting, to create an optimal sleeping environment for the baby.

Data Insights and Analysis: By collecting and analyzing data on the baby's sleeping patterns, environmental conditions, and other relevant factors, the system can provide valuable insights to parents or caregivers.

Convenience and Automation: Smart baby cradle systems can automate various tasks, such as adjusting the cradle's motion or playing soothing music, based on predefined patterns or the baby's preferences.

Integration with Smart Home Systems: Smart baby cradle systems can integrate with other smart home devices and systems, such as smart thermostats or baby monitor cameras.

Parental Support: For new parents or caregivers, especially those with limited experience or knowledge about baby care, smart baby cradle systems can provide valuable support and guidance.

CHAPTER 3

ARCHITECTURE OF THE SMART BABY CRADLE SYSTEM

3.1 EXISTING SYSTEM

We already have the existing project of baby cradle system using IOT, it has some prominent features like the Temperature sensor, swing movement controller motor, moisture sensor, gas sensor, sound sensor and a web application for the parents to get notified with the activities of the baby. But we have introduced the new feature which is the sound sensor which will detect the sound of the baby according to it we have added a music system which play soothing music to pacify the baby.

3.2 BLOCK DIAGRAM OF THE EXISTING SYSTEM

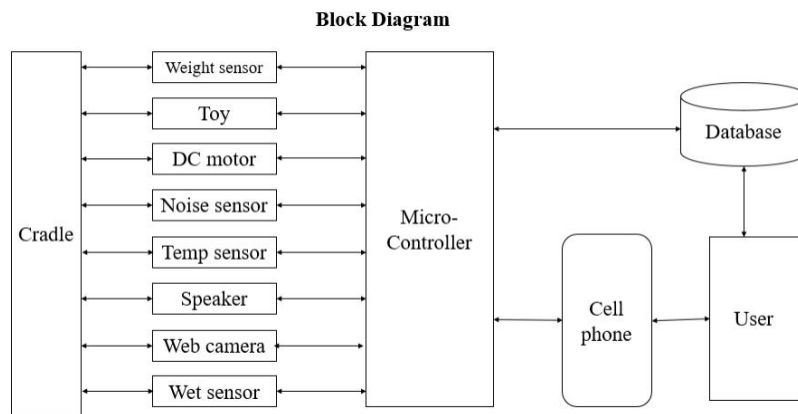


FIG 3.2.1 BLOCK DIAGRAM

A block diagram for a Smart Baby Cradle System using IoT can be structured to illustrate the key components and their interactions. Here's a descriptive breakdown of such a block diagram:

Sensor Module: This module comprises various sensors such as motion sensors, temperature sensors, and heart rate sensors. These sensors detect different parameters related to the baby's comfort and safety.

Microcontroller Unit (MCU): This unit acts as the brain of the system, processing data from sensors and controlling various components of the cradle. It manages data flow and communicates with other modules.

IoT Communication Module: This module enables the system to connect to the internet and communicate with other smart devices or a central server. It may include Wi-Fi, Bluetooth, or other communication protocols.

Mobile Application Interface: This interface allows parents or caregivers to remotely monitor and control the baby cradle using a smartphone or tablet. It provides real-time alerts and notifications.

Motor Control Unit: This unit controls the movement of the cradle. It receives commands from the MCU based on sensor inputs or user commands and adjusts the cradle's motion accordingly.

Safety Mechanisms: These mechanisms ensure the safety of the baby by implementing features such as automatic shut-off in case of emergencies or abnormal conditions.

Power Supply Unit: This unit provides power to all components of the system. It may include a battery backup to ensure uninterrupted operation even during power outages.

Data Storage and Analytics: This module stores sensor data for future analysis and generates insights into the baby's sleeping patterns, environmental conditions, etc. It may also facilitate machine learning algorithms for predictive analysis.

User Interface: This interface includes physical buttons or touch-sensitive controls on the cradle itself, allowing local operation without relying solely on the mobile application.

Cloud Infrastructure: This infrastructure manages data storage, processing, and analysis in the cloud. It enables scalability, remote access, and integration with other smart home systems.

Security Module: This module ensures the security and privacy of data transmitted between the cradle, mobile application, and cloud servers. It may include encryption, authentication, and access control mechanisms.

Alerting System: This system notifies parents or caregivers of any abnormal events or emergencies such as sudden changes in the baby's vital signs or environmental conditions.

By illustrating these components and their interactions, the block diagram provides a comprehensive overview of the Smart Baby Cradle System using IoT.

3.3 PROPOSED SYSTEM

In the proposed system Arduino is main heart of this project and it will read all sensors and controls the swinging of the cradle . When the Baby cries, the MIC sensor will identify it and gives signal to Arduino and the speaker will be automatically turned on to soothe the baby. We can also record our voices on to the voice recorder. Arduino send PWM pulses to servo motor to swing cradle. MEMS sensor is attached to the cradle to monitor the movements of baby. When baby moves fan will be turned ON. If baby urinates then buzzer will be ON. Arduino reads the datas from all the sensors and display it on the LCD. Also, it sends sensor's data to IOT cloud server through ESP8266 wifi module. We can monitor the baby's conditions when baby is in the cradle from a remote server. We already have the existing project of baby cradle

system using IOT with some prominent features like the Temperature sensor, swing movement controller motor, moisture sensor, gas sensor, sound sensor and a web application for the parents to get notified with the activities of the baby. Through this project, we have introduced the new feature which is the MIC sound sensor which will detect the sound of the baby crying according to it we have added a music system which will play soothing music to pacify the baby.

3.4 ARCHITECTURE DIAGRAM OF THE PROPOSED SYSTEM

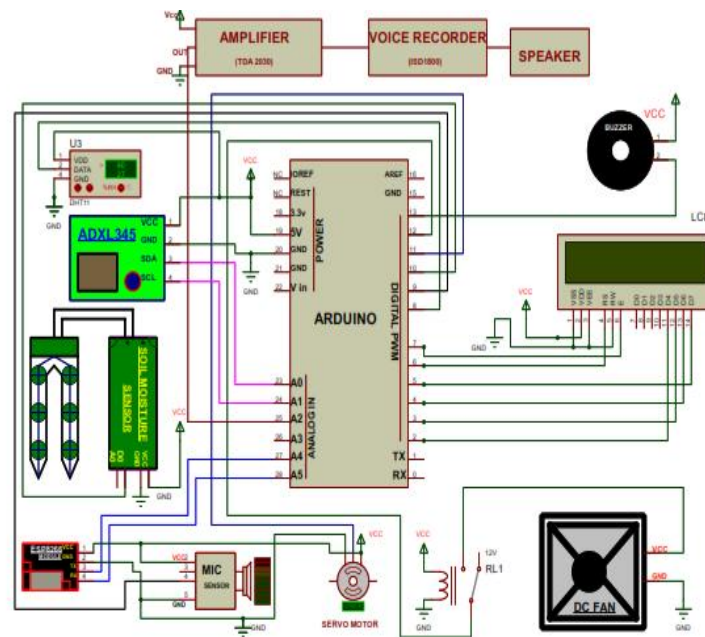


FIG: 3.3.1 ARCHITECTURE DIAGRAM

3.5 HARWARE REQUIREMENTS

Microcontroller	:	Arduino Uno
Crystal	:	16 MHz
LCD	:	16X2 LCD
Temperature Sensor	:	DHT11
Humidity Sensor	:	DHT11
Sound Sensor	:	MIC sensor
IOT Module	:	ESP8266
Wet Detection Sensor	:	Moisture sensor
Baby Moment Sensor	:	MEMS Sensor
Fan	:	12V DC Fan
DC Gear Motor	:	10 R.P.M
H-Bridge	:	L293D
Buzzer	:	5V DC
Power Source	:	12V 2 amp Adaptor

3.6 SOFTWARE REQUIREMENTS

Arduino IDE and DHT 11 Sensor Library

CHAPTER 4

WORKING OF THE COMPONENTS

ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328 running at 20 MHz. Most of its pins are connected to the external headers, however some are reserved for internal communication with the USB Bridge coprocessor. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It gets activated by simply connecting it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Overall, the Arduino Uno serves as the brain of the smart cradle system, integrating sensors, processing data, executing control logic, facilitating communication, and ensuring the safety and comfort of the infant. Its flexibility and programmability make it a versatile platform for creating customized smart cradle solutions tailored to specific needs and preferences.

Features:

- ATmega16U2 Processor: 8-bit AVR RISC-based microcontroller
- Power: 2.7-5.5 volts
- Security: Power On Reset (POR)
- Brown Out Detection (BOD)
- Memory: 16 KB ISP Flash 512B EEPROM 512B SRAM

LCD :

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example, a 4K display is made up of 3840 x 2160 or 4096 x 2160 pixels. A pixel is made up of three subpixels; a red, blue and green commonly called RGB. When the subpixels in a pixel change color combinations, a different color can be produced. With all the pixels on a display working together, the display can make millions of different colors. When the pixels are rapidly switched on and off, a picture is created. The way a pixel is controlled is different in each type of display; CRT, LED, LCD and newer types of displays all control pixels differently. In short, LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90.

Features:

- 5x8 dots with cursor
- 16 characters * 2 lines display
- 4-bit or 8-bit MPU interfaces
- Built-in controller (ST7066 or equivalent)
- Display Mode & Backlight Variations
- ROHS Compliant

RELAY MODULE:

A power relay module is an electrical switch that is operated by an electromagnet. The relay module receives an input signal, typically a low-voltage electrical signal, from the microcontroller. Inside the relay module, there is an electromagnetic coil. When the input signal is applied to the coil, it energizes the coil, creating a magnetic field around it. The magnetic field produced by the coil attracts an armature or an iron core within the relay module. As the armature moves it sets relatively normal open or normal close. This movement is typically spring-loaded in one direction. thereby opening or closing a circuit in response to an input signal.

Features:

- Operating current capacity: 10 A
- Resistance: 100m(ohm)
- Voltage capacity: 30VDC
- Operation time: 10s

MEMS OR TILT SENSOR:

MEMS sensors are used to detect the movement of the cradle . Deflection of the cradle is measured by using a differential capacitor that consists of independent fixed plates attached to the cradle . The acceleration value that the sensor is designed to detect would depend on the expected range of motion and the sensitivity required for the application. The sensing element converts the physical input varies (force, pressure, acceleration) from minor movement to half oscillation into an electrical signal that can be measured and processed. The processed electrical signal is then transmitted to the microcontroller for further display on LED . Then the automatic servo motor fan will be turned ON after the signal is received.

Features:

- Power supply : 3V -5.5V
- Current : 300pA-500pA
- Frequency bandwidth range: 0.5 Hz to 1600 Hz for the X and Y axis
- 0.5 Hz to 550 Hz for the Z axis.
- Accelerometer: +/-2g, +/-3g , +/- 5 g , where +/-1g =9.8m/s
- Capacitor : 10pF , where bandwidth is 500Hz

DHT 11 TEMPERATURE AND HUMIDITY SENSOR:

The DHT11 sensor is a basic, low-cost digital temperature and humidity sensor. Its working mechanism is relatively simple. Single-bus data format is used for communication and synchronization between MCU and DHT11 sensor. When MCU sends a start signal, DHT11 changes from the low-power-consumption mode to the running-mode and will wait for the MCU to complete the start signal. Once it is

completed, DHT11 sends a response signal of 40-bit data that include the relative humidity and temperature information to MCU. Once data is collected, DHT11 will change to the low- power-consumption mode until it receives a start signal from MCU again.

Features:

- Power supply: 3V – 5.5V
- Current : 0.5mA -2.5mA
- Time period: 1s
- Humidity measurement count: 20-90% RH
- Temperature measurement count : 0-50 degree Celsius

MOISTURE SENSOR:

The moisture sensor is used to detect if the baby has urinated. The moisture sensor consists of two or more conductive probes that are embedded in or coated with aluminium foil which acts as an electrode. The resistance between these electrodes changes with the moisture content of the cradle bed. The resistance between the two probes is measured using an ohmmeter. The resistance reading obtained from the sensor can be converted to signal waves through the magnetic field created because of the change in the resistance. The signal will be sent to the microcontroller for the display on the lcd. Then the buzzer will also be turned on.

Features:

- Large DC voltage gain 100 dB
- Wide bandwidth (unity gain) 1 MHz (temperature compensated)
- Wide power supply range: Single supply 3V to 32V or dual supplies $\pm 1.5V$ to $\pm 16V$
- Very low supply current drain (700 μA)—essentially independent of supply voltage

MIC SENSOR:

Sound detection sensor module for arduino detects whether sound has exceeded a threshold value which more than 500 which is set on the code. Sound is detected via microphone and fed into an LM393 op amp. The sound level set point is adjusted via an on board potentiometer. When the sound level exceeds the set point, an LED on the module is illuminated and the output is set low.

Features:

- Large DC voltage gain 100 dB
- Wide bandwidth (unity gain) 1 MHz (temperature compensated)
- Wide power supply range: Single supply 3V to 32V or dual supplies $\pm 1.5V$ to $\pm 16V$
- Very low supply current drain (700 μA)—essentially independent of supply voltage

ESP8266 WIFI MODULE :

It is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor.

Features:

- It is a powerful Wi-Fi module available in a compact size at a very low price.
- It is based on the L106 RISC 32-bit microprocessor core and runs at 80 MHz
- It requires only 3.3 Volts power supply
- The current consumption is 100 m Amps
- The maximum Input/Output (I/O) voltage is 3.6 Volts.
- It consumes 100 mA current
- The maximum Input/Output source current is 12 mA
- The frequency of built-in low power 32-bit MCU is 80 MHz
- The size of flash memory is 513 kb

SERVO MOTOR :

The servo motor would be programmed to produce a gentle rocking motion to soothe the baby through the received input signals. When the baby is crying the sound gets detected from mic sensor attached. Then the analog signal is transmitted to the Arduino uno to fetch the input signal. Then the analog signal is converted to digital signal to display on LED and send message to the parent on web application simultaneously. The microcontroller signals the motor to move back and forth from 40° to 120° with a operating speed of 0.17 s/60° (4.8 V), 0.14 s/60° (6 V) to soothe baby. A servo motor includes a feedback system that provides information about the motor's current position or speed. This feedback allows the control system to adjust the motor's behavior to achieve the desired motion.

Features:

- Operating voltage: 4.8 V a 7.2 V
- Running Current 500 mA – 900 mA (6V)
- Stall Current 2.5 A (6V)
- Dead band width: 5 μs
- Stable and shock proof double ball bearing design
- Temperature range: 0 °C – 55 °C

LM324 POWER DRIVER:

LM324 is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular LM324 motor driver IC. It can drive 4 DC motors on and off or drive 2 DC motors with directional and speed control. The driver greatly simplifies and increases the ease with which you may control motors, relays, etc from micro-controllers. It can drive motors up to 12V with a total DC current of up to 600mA. You can connect the two channels in parallel to double the maximum current or in series to double the maximum input voltage. This motor driver is perfect for robotics and mechatronics projects for controlling motors, switches, relays, etc from microcontrollers. Perfect for driving DC and Stepper motors for micro mouse, line-following robots, robot arms, etc.

Features:

- Wide supply voltage: 4.5 V to 12 V.
- Max supply current: 600 mA per motor.
- Male berg-stick connectors for supply, ground, and input connection.
- Screw terminal connectors for easy motor connection.
- High noise immunity inputs

DAUGHTER BOARD (5V/12V POWER) :

Daughterboard is a circuit board that plugs into and extends the circuitry of another circuit board. Daughter boards play a crucial role in expanding a computer's capabilities. They provide additional features and services that are not typically available on the motherboard alone. By connecting directly to the motherboard, daughter boards can optimize performance, increase memory capacity, and enable customization for specialized tasks. These boards offer a cost-effective alternative to replacing the entire motherboard or performing major upgrades.

Features:

- 32 bit RISC processor with 128K ROM and 32K SRAM
- USB programmable with boot loader
- 5 x E-blocks ports, 32 I/O lines
- Compatible with most downstream boards
- Native USB and SPI buses
- Removable crystal

AMPLIFIER :

Amplifier is an electronic device that increases the voltage power of a sound signals. Amplifiers are used in wireless communications and broadcasting, and in audio equipment of all kinds. Amplifier in the smart cradle system is connected along with the music system to amplify its sound for a better reach.

Features:

- Output power 18 W at $V_S = 16 \text{ V} / 4$ with 0.5% distortion

- High output current
- Very low harmonic and crossover distortion
- Short-circuit protection
- Thermal shutdown

SPEAKER AND VOICE RECORDER :

Speakers are used for broadcasting the soothing sounds for the baby. It will get turned on as soon as the mic sensor will detect the crying sound of the baby. The voice recorder is used for recording songs or the voice of the mother. Which will record a song or a voice for upto 15 secs with a 3mb of memory.

Features:

- Memory capacity for the voice recorder: 3 Mb
- Time period for the voice recording: 15s
- 0.5 μ A standby current
- On-chip 8 Ω speaker driver
- On-chip oscillator
- Single +3 volt power supply

DC FAN :

A mechanical fan has been fixed along with the cradle which will get turned on automatically if the MEMS sensor detects any movement of the baby.

Features:

- Operating Temp.: -10°C~70°C
- Storage Temp.: -40°C~70°C
- Weight : 40g

BUZZER :

The working principle of a buzzer depends on the theory that, once the voltage is given across a piezoelectric material, then a pressure difference is produced. A piezo type includes piezo crystals among two conductors. Once a potential disparity is given across these crystals, then they thrust one conductor & drag the additional conductor through their internal property. So this continuous action will produce a sharp sound signal.

Features:

- Operating Voltage: 4 to 8V DC
- Rated Current: ≤ 30 mA Sound Output at 10cm: ≥ 85 dB
- Resonant Frequency: 2300 $\pm$ 300Hz
- Operating Temperature : -25°C to +80°C Storage
- Temperature: -30°C to +85°C

CHAPTER 5

SOFTWARE COMPONENTS SPECIFICATIONS

5.1 INTRODUCTION TO C++

enhancement of the C language to include object-oriented paradigm. It is an imperative and a compiled language.

1. C++ is a high-level, general-purpose programming language designed for system and application programming. It was developed by Bjarne Stroustrup at Bell Labs in 1983 as an extension of the C programming language. C++ is an object-oriented, multi-paradigm language that supports procedural, functional, and generic programming styles.
2. One of the key features of C++ is its ability to support low-level, system-level programming, making it suitable for developing operating systems, device drivers, and other system software. At the same time, C++ also provides a rich set of libraries and features for high-level application programming, making it a popular choice for developing desktop applications, video games, and other complex applications.
3. C++ has a large, active community of developers and users, and a wealth of resources and tools available for learning and using the language. Some of the key features of C++ include:
4. **Object-Oriented Programming:** C++ supports object-oriented programming, allowing developers to create classes and objects and to define methods and properties for these objects.
5. **Templates:** C++ templates allow developers to write generic code that can work with any data type, making it easier to write reusable and flexible code.
6. **Standard Template Library (STL):** The STL provides a wide range of containers and algorithms for working with data, making it easier to write efficient and effective code.
7. **Exception Handling:** C++ provides robust exception handling capabilities, making it easier to write code that can handle errors and unexpected situations.

Overall, C++ is a powerful and versatile programming language that is widely used for a range of applications and is well-suited for both low-level system programming and high-level application development.

C++ is a middle-level language rendering it the advantage of programming low-level (drivers, kernels) and even higher-level applications (games, GUI, desktop apps etc.). The basic syntax and code structure of both C and C++ are the same.

Some of the features & key-points to note about the programming language are as follows:

- **Simple:** It is a simple language in the sense that programs can be broken down into logical units and parts, has a rich library support and a variety of data-types.
- **Machine Independent but Platform Dependent:** A C++ executable is not platform-independent (compiled programs on Linux won't run on Windows), however they are machine independent.

- **Mid-level language:** It is a mid-level language as we can do both systems-programming (drivers, kernels, networking etc.) and build large-scale user applications (Media Players, Photoshop, Game Engines etc.)
- **Rich library support:** Has a rich library support (Both standard ~ built-in data structures, algorithms etc.) as well 3rd party libraries (e.g. Boost libraries) for fast and rapid development.
- **Speed of execution:** C++ programs excel in execution speed. Since, it is a compiled language, and also hugely procedural. Newer languages have extra in-built default features such as garbage-collection, dynamic typing etc. which slow the execution of the program overall. Since there is no additional processing overhead like this in C++, it is blazing fast.
- **Pointer and direct Memory-Access:** C++ provides pointer support which aids users to directly manipulate storage address. This helps in doing low-level programming (where one might need to have explicit control on the storage of variables).
- **Object-Oriented:** One of the strongest points of the language which sets it apart from C. Object-Oriented support helps C++ to make maintainable and extensible programs. i.e. Large-scale applications can be built. Procedural code becomes difficult to maintain as code-size grows.
- **Compiled Language:** C++ is a compiled language, contributing to its speed

Applications of C++:

C++ finds varied usage in applications such as:

- Operating Systems & Systems Programming. e.g. Linux-based OS (Ubuntu etc.)
- Browsers (Chrome & Firefox)
- Graphics & Game engines (Photoshop, Blender, Unreal-Engine)
- Database Engines (MySQL, MongoDB, Redis etc.)
- Cloud/Distributed Systems.

Sample code in C++:

```
// Your First C++ Program
#include <iostream>
int main() {
    std::cout << "Hello World!";
    return 0;
}
```

FIG: 5.1.1 SAMPLE C++ CODE

Output:

```
Hello World!
```

FIG: 5.1.2 OUTPUT OF C++ CODE

5.2 ARDUINO IDE PLATFORM

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

The Arduino IDE will appear as:

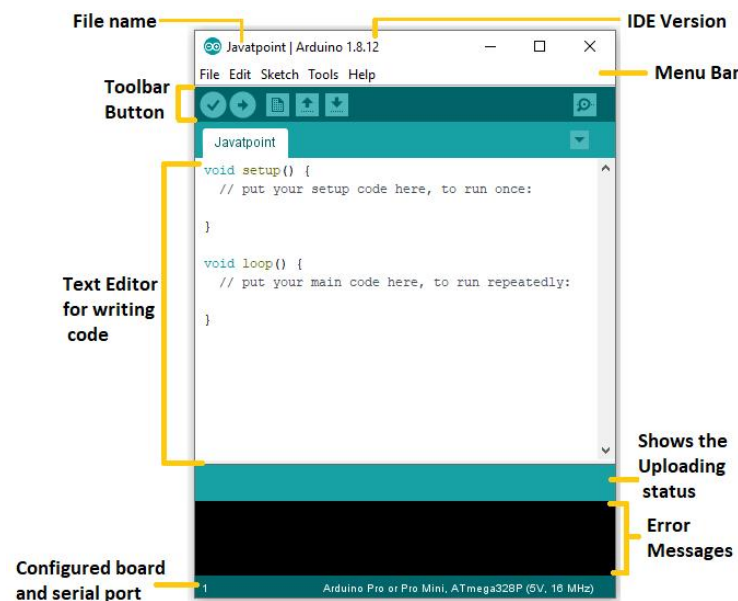


FIG: 5.2.1 ARDUINO IDE

The important features of the IDE are mentioned below.

- Easy to use.
- Supports multiple libraries.
- Support cross platform.
- Open source software.
- Highlights syntax errors.
- Provides reference examples

5.3 DHT SENSOR LIBRARY

An Arduino library for the DHT11 temperature and humidity sensor. This library provides a simple and easy-to-use interface to read temperature and humidity data from a DHT11 sensor. To use this library, open the Library Manager in the Arduino IDE and install it from there.

CHAPTER 6

APPENDICES

6.1 CODING

```
#include <LiquidCrystal.h>
#include <stdio.h>
#include <Wire.h>
#include "dht.h"
#include <Servo.h>
Servo myservo;

LiquidCrystal lcd(6, 7, 5, 4, 3, 2);

#include <SoftwareSerial.h>
SoftwareSerial mySerial(A4,A5);

#define dht_apin 8
dht DHT;

int mic    = 9;
int mos    = 10;
int relay  = 12;
int buzzer = 13;

int music_play = A2;

int pos=0;
int cnt=0;
int tempc=0,humc=0;

int memsx=0,memsy=0;

int sti=0;
String inputString = "";    // a string to hold incoming data
boolean stringComplete = false; // whether the string is complete

char res[130];

void serialFlush()
{
  while(Serial.available() > 0)
  {
    char t = Serial.read();
  }
}
```

```

void myserialFlush()
{
    while(mySerial.available() > 0)
    {
        char t = mySerial.read();
    }
}

char check(char* ex,int timeout)
{
    int i=0;
    int j = 0,k=0;
    while (1)
    {
        sl:
        if(mySerial.available() > 0)
        {
            res[i] = mySerial.read();
            if(res[i] == 0x0a || res[i]=='>' || i == 100)
            {
                i++;
                res[i] = 0;break;
            }
            i++;
        }
        j++;
        if(j == 30000)
        {
            k++;
            j = 0;
        }
        if(k > timeout)
        {
            return 1;
        }
    }
    if(!strncmp(ex,res,strlen(ex)))
    {
        return 0;
    }
    else
    {
        i=0;
        goto sl;
    }
}

char buff[200],k=0;
void upload(unsigned int s1,unsigned int s2,unsigned int s3);
char readserver(void);

```

```

void clearserver(void);

const char* ssid = "iotserver";
const char* password = "iotserver123";

void swing()
{
    for(pos=10;pos<180;pos++)
    {
        myservo.write(pos);delay(2);
    }
    delay(900);
    for(pos=180;pos>10;pos--)
    {
        myservo.write(pos);delay(2);
    }
    delay(900);
    for(pos=10;pos<180;pos++)
    {
        myservo.write(pos);delay(2);
    }
    delay(900);
    for(pos=180;pos>10;pos--)
    {
        myservo.write(pos);delay(2);
    }
    delay(900);
    digitalWrite(11, LOW);
}
void beep()
{
    digitalWrite(buzzer, LOW);delay(2000);digitalWrite(buzzer, HIGH);
}
void setup()
{
    Serial.begin(9600);//serialEvent();
    mySerial.begin(9600);

    myservo.attach(11);
    myservo.write(10);

    pinMode(music_play, OUTPUT);
    pinMode(buzzer, OUTPUT);
    pinMode(mic, INPUT);
    pinMode(mos, INPUT);
    pinMode(relay, OUTPUT);

    digitalWrite(buzzer, HIGH);
    digitalWrite(relay, LOW);
    digitalWrite(music_play, LOW);
}

```

```

//63. IOT based advanced smart cradle for baby monitoring system
lcd.begin(16, 2);lcd.cursor();
lcd.print("IOT Based Advanced");
lcd.setCursor(0,1);
lcd.print("Smart Cradle For");
delay(2000);
lcd.clear();
lcd.print(" Baby Monitoirng");
lcd.setCursor(0,1);
lcd.print("   System   ");
delay(2000);

wifiinit();

lcd.clear();
lcd.setCursor(0,0);
lcd.print("T:");//2,0
lcd.setCursor(8,0);
lcd.print("H:");//11,0
digitalWrite(11, LOW);
}

int sts1=0,sts2=0;
char urines[20]="Baby-No_Urine";
char cryings[20]="Baby-No_Crying";
char tilts[20]="Baby-No_Tilt";

void loop()
{

    DHT.read11(dht_apin);

    tempc = DHT.temperature;
    humc = DHT.humidity;

    lcd.setCursor(2,0);convertl(tempc);
    lcd.setCursor(10,0);convertl(humc);

    memset(urines,'\0',strlen(urines));
    if(digitalRead(mos) == LOW)
    {
        lcd.setCursor(0,1);lcd.print("Urine ");
        strcpy(urines,"Baby-Urine");
        digitalWrite(buzzer, LOW);
        sts1++;
        if(sts1 >= 2){sts1=2;}
        if(sts1 == 1)
        {
            upload(tempc,humc,urines,cryings,tilts);

```

```

    }
  }
  if(digitalRead(mos) == HIGH)
  {
    lcd.setCursor(0,1);lcd.print("    ");
    digitalWrite(buzzer, HIGH);
    sts1=0;
    strcpy(urines,"Baby-No_Urine");
  }

  memset(cryings,'\0',strlen(cryings));
  if(digitalRead(mic) == LOW)
  {
    lcd.setCursor(8,1);lcd.print("Crying  ");
    strcpy(cryings,"Baby-Crying");
    digitalWrite(music_play, HIGH);
    swing();
    upload(tempc,humc,urines,cryings,tilts);
    lcd.setCursor(8,1);lcd.print("    ");
    delay(1500);
    digitalWrite(music_play, LOW);
  }
  if(digitalRead(mic) == HIGH)
  {
    lcd.setCursor(8,1);lcd.print("    ");
    strcpy(cryings,"Baby-No_Crying");
  }

  memsx = analogRead(A0);delay(100);
  memsy = analogRead(A1);delay(100);

  //lcd.setCursor(0,1);convertrl(memsx);
  //lcd.setCursor(8,1);convertrl(memsy);

  memset(tilts,'\0',strlen(tilts));
  if((memsx > 290 && memsx < 390) && (memsy > 290 && memsy < 390))
  {
    lcd.setCursor(8,1);lcd.print("    ");
    strcpy(tilts,"Baby-No_Tilt");
    digitalWrite(relay, LOW);
    sts2=0;
  }
  else
  {
    lcd.setCursor(8,1);lcd.print("Baby Tilt");
    strcpy(tilts,"Baby-Tilt");
    digitalWrite(relay, HIGH);
    sts2++;
  }

```

```

        if(sts2 >= 2){sts2=2;}
        if(sts2 == 1)
        {
            upload(tempc,humc,urines,cryings,tilts);
        }
        //lcd.setCursor(8,1);lcd.print("      ");
    }
}

char bf2[50];
void upload(int s1,int s2,const char *s3,const char *s4,const char *s5)
{
    delay(2000);
    lcd.setCursor(15, 1);lcd.print("U");
    myserialFlush();
    mySerial.println("AT+CIPSTART=4,\"TCP\", \"projectsfactoryserver.in\",80");

    delay(8000);
    memset(buff,0,strlen(buff));
    sprintf(buff,"GET
http://projectsfactoryserver.in/storedata.php?name=iot758&s1=%u&s2=%u&s3=%s&
s4=%s&s5=%s\r\n\r\n",s1,s2,s3,s4,s5);

    myserialFlush();
    sprintf(bf2,"AT+CIPSEND=4,%u",strlen(buff));
    mySerial.println(bf2);
    delay(5000);
    myserialFlush();
    mySerial.print(buff);
    delay(2000);
    mySerial.println("AT+CIPCLOSE");
    lcd.setCursor(15, 1);lcd.print(" ");
}

char readserver(void)
{
    char t;
    delay(2000);
    lcd.setCursor(15, 1);lcd.print("R");
    myserialFlush();
    mySerial.println("AT+CIPSTART=4,\"TCP\", \"projectsfactoryserver.in\",80");

    delay(8000);
    memset(buff,0,strlen(buff));
    sprintf(buff,"GET http://projectsfactoryserver.in/last.php?name=iot4L\r\n\r\n");
    myserialFlush();
    sprintf(bf2,"AT+CIPSEND=4,%u",strlen(buff));
    mySerial.println(bf2);

    delay(5000);

```

```

    myserialFlush();
    mySerial.print(buff);

while(1)
{
    while(!mySerial.available());
    t = mySerial.read();
    if(t == '*' || t == '#')
    {
        if(t == '#')return 0;
        while(!mySerial.available());
        t = mySerial.read();
        delay(1000);
        myserialFlush();
        return t;
    }
}

    delay(2000);

    mySerial.println("AT+CIPCLOSE");
    lcd.setCursor(15, 1);lcd.print(" ");
    delay(2000);
return t;
}

void clearserver(void)
{
    delay(2000);
    lcd.setCursor(15, 1);lcd.print("C");
    myserialFlush();
    mySerial.println("AT+CIPSTART=4,\"TCP\", \"projectsfactoryserver.in\",80");

    delay(8000);
    memset(buff,0,strlen(buff));
    sprintf(buff,"GET
http://projectsfactoryserver.in/storeddata.php?name=iota4&sl0=0\r\n\r\n");
    myserialFlush();
    sprintf(buff2,"AT+CIPSEND=4,%u",strlen(buff));
    mySerial.println(buff2);

    delay(5000);

    myserialFlush();
    mySerial.print(buff);

    delay(2000);
    myserialFlush();

    mySerial.println("AT+CIPCLOSE");

```

```

        lcd.setCursor(15, 1);lcd.print(" ");
        delay(2000);
    }

void wifiinit()
{
    char ret;
    st:
    mySerial.println("ATE0");
    ret = check((char*)"OK",50);
    mySerial.println("AT");
    ret = check((char*)"OK",50);
    if(ret != 0)
    {
        delay(1000);
        goto st;
    }

    lcd.clear();lcd.setCursor(0, 0);lcd.print("CONNECTING");
    mySerial.println("AT+CWMODE=1");
    ret = check((char*)"OK",50);
cagain:

    myserialFlush();
    mySerial.print("AT+CWLAP=\"");
    mySerial.print(ssid);
    mySerial.print("\",\"");
    mySerial.print(password);
    mySerial.println("\");
    if(check((char*)"OK",300))goto cagain;
    mySerial.println("AT+CIPMUX=1");
    delay(1000);

    lcd.clear();lcd.setCursor(0, 0);lcd.print("WIFI READY");
}

void converts(unsigned int value)
{
    unsigned int a,b,c,d,e,f,g,h;

    a=value/10000;
    b=value%10000;
    c=b/1000;
    d=b%1000;
    e=d/100;
    f=d%100;
    g=f/10;
    h=f%10;

```

```
a=a|0x30;  
c=c|0x30;  
e=e|0x30;  
g=g|0x30;  
h=h|0x30;
```

```
Serial.write(a);  
Serial.write(c);  
Serial.write(e);  
Serial.write(g);  
Serial.write(h);  
}
```

```
void convertl(unsigned int value)  
{  
    unsigned int a,b,c,d,e,f,g,h;
```

```
    a=value/10000;  
    b=value%10000;  
    c=b/1000;  
    d=b%1000;  
    e=d/100;  
    f=d%100;  
    g=f/10;  
    h=f%10;
```

```
    a=a|0x30;  
    c=c|0x30;  
    e=e|0x30;  
    g=g|0x30;  
    h=h|0x30;
```

```
    lcd.write(a);  
    lcd.write(c);  
    lcd.write(e);  
    lcd.write(g);  
    lcd.write(h);  
}
```

6.2 SCREENSHOTS

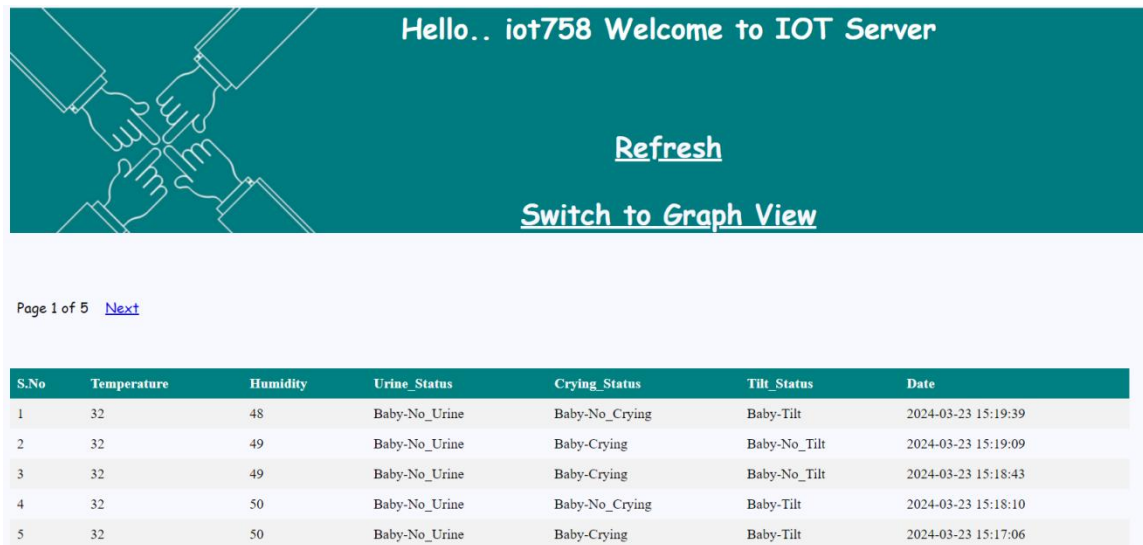


FIG: 6.2.1 SAMPLE OUTPUT (1)

S.No	Temperature	Humidity	Urine_Status	Crying_Status	Tilt_Status	Date
1	32	48	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:19:39
2	32	49	Baby-No_Urine	Baby-Crying	Baby-No_Tilt	2024-03-23 15:19:09
3	32	49	Baby-No_Urine	Baby-Crying	Baby-No_Tilt	2024-03-23 15:18:43
4	32	50	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:18:10
5	32	50	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:17:06
6	31	49	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:16:33
7	31	48	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:15:55
8	31	47	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:15:30
9	31	47	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:15:05
10	30	45	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:13:05
11	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:04:39
12	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:04:16
13	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:03:58
14	31	55	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:03:32
15	31	56	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:03:00

FIG: 6.2.2 SAMPLE OUTPUT (2)

6	31	49	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:16:33
7	31	48	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:15:55
8	31	47	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:15:30
9	31	47	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:15:05
10	30	45	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:13:05
11	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:04:39
12	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:04:16
13	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:03:58

FIG: 6.2.3 SAMPLE OUTPUT (3)

13	31	54	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:03:58
14	31	55	Baby-No_Urine	Baby-Crying	Baby-Tilt	2024-03-23 15:03:32
15	31	56	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:03:00
16	31	56	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:02:37
17	31	57	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:02:17
18	31	58	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:01:57
19	31	59	Baby-Urine	Baby-No_Crying	Baby-No_Tilt	2024-03-23 15:01:30
20	31	57	Baby-No_Urine	Baby-No_Crying	Baby-Tilt	2024-03-23 15:01:03

FIG: 6.2.4 SAMPLE OUTPUT (4)

SNAPSHOTS OF THE MODEL:



FIG: 6.2.5 MODEL (1)

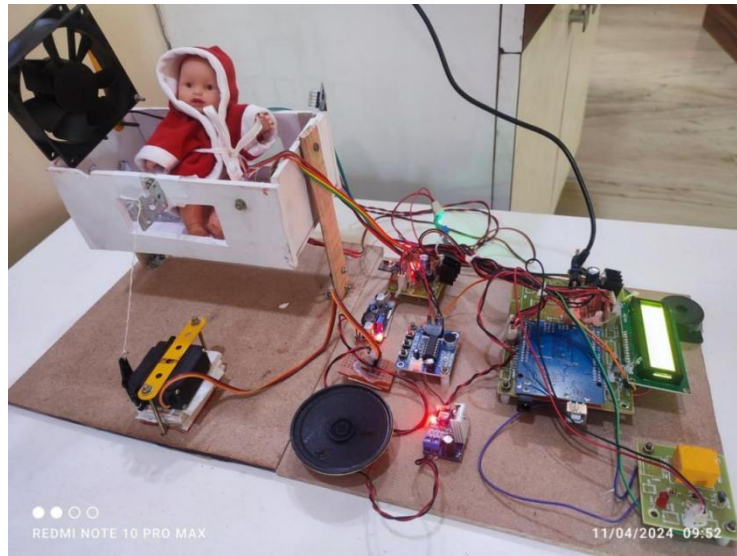


FIG: 6.2.6 MODEL (2)

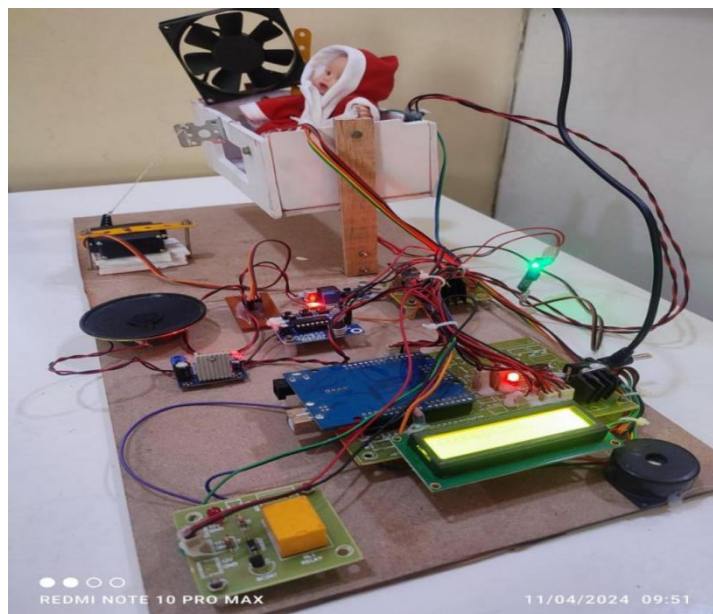


FIG: 6.2.7 MODEL (3)

CHAPTER 7

CONCLUSION

Implementing a smart baby cradle system using IoT technology offers numerous benefits for both parents and infants. By incorporating sensors, actuators, and connectivity features, this system can monitor and adjust various aspects of the cradle's environment in real-time, providing a safer and more comfortable experience for babies while offering peace of mind for parents.

In conclusion, the smart baby cradle system leverages IoT to enhance childcare by:

Real-time Monitoring: Parents can remotely monitor their baby's sleeping environment, including temperature, humidity, and movement, through a smartphone application or web interface.

Automated Adjustments: The system can automatically adjust the cradle's rocking motion, music, and lighting to soothe the baby back to sleep without requiring direct intervention from parents.

Safety Features: Integrated sensors can detect potential hazards such as overheating or sudden movements, triggering alerts to parents and taking corrective actions to ensure the baby's safety.

Data Insights: The system collects data on the baby's sleep patterns and environmental conditions over time, providing valuable insights to parents and healthcare professionals for optimizing sleep routines and detecting any anomalies.

Convenience: With remote access and automation capabilities, parents can manage the cradle's settings conveniently from anywhere, allowing for greater flexibility and peace of mind.

Overall, the smart baby cradle system revolutionizes childcare by combining advanced technology with essential caregiving needs, ultimately promoting better sleep quality and safety for infants while offering convenience and support for parents.

FUTURE WORK

The future of the smart baby cradle system using IoT holds immense potential for further innovation and enhancement. Some potential avenues for future work include:

Enhanced Sensing Capabilities: Integrate additional sensors to monitor vital signs such as heart rate, breathing patterns, and oxygen levels, providing more comprehensive health monitoring for infants.

AI-Powered Sleep Analysis: Implement machine learning algorithms to analyze the collected data and provide personalized insights into the baby's sleep patterns, preferences, and developmental milestones.

Integration with Smart Home Ecosystems: Enable seamless integration with other smart home devices and platforms, allowing for coordinated actions based on broader environmental factors and user preferences.

Biometric Authentication and Security: Incorporate biometric authentication features to ensure secure access to the cradle's controls and data, safeguarding against unauthorized access or tampering.

Remote Caregiver Integration: Facilitate communication and collaboration between parents, caregivers, and healthcare professionals through the system, enabling remote monitoring and support for infant care.

Customizable Sleep Programs: Develop customizable sleep programs tailored to individual babies' needs and preferences, incorporating adaptive algorithms to optimize sleep quality and promote healthy development.

Environmental Control Optimization: Utilize advanced control algorithms to optimize environmental parameters such as temperature, humidity, and noise levels based on real-time feedback and predictive analytics.

Energy Efficiency and Sustainability: Implement energy-efficient designs and renewable energy sources to minimize environmental impact and reduce operating costs over the system's lifecycle.

Voice and Gesture Control: Integrate voice and gesture recognition technology to provide hands-free control and interaction with the cradle, enhancing usability and accessibility for parents.

Global Accessibility and Affordability: Develop cost-effective and scalable solutions to make smart baby cradle systems accessible to a wider range of parents, including those in underserved communities and developing regions.

By pursuing these avenues for future work, the smart baby cradle system using IoT can continue to evolve as a valuable tool for improving infant care, promoting parental well-being, and advancing our understanding of early childhood development.

CHAPTER 8

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