Visvesvaraya Technological University
Belagavi, Karnataka-590 018

A MINI PROJECT REPORT
On

SMART CRADLE SYSTEM

Submitted
in partial fulfilment requirements for the credit of the Course
on

INTERNET OF THINGS
21CC502
by

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DEPARTMENT
OF
COMPUTER AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that **SWATHI (4NM21CM062), VYALIN BRAGANZA (4NM21CM065)** and **NEHA S NAIK (4NM21CM069)** have successfully completed the mini project work on **'Smart Cradle System'** and submitted in partial fulfillment of the requirements of the Course on **Internet of Things (21CC502)** prescribed by the **NMAMIT, Nitte** during the academic year **2023-2024**.

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ABSTRACT

The Smart Cradle System, an innovative IoT solution, integrates sensors such as PIR for motion, temperature, and moisture sensors, along with actuators like servo motors and LEDs, meticulously designed for real-time infant monitoring. Governed by the versatile Arduino Uno microcontroller board, renowned for its adaptability and computational efficiency, this system harmonizes sensor data collection and responsive actions. With 14 digital and 6 analog pins, the Uno seamlessly interfaces with sensors, enabling swift responses to changes in the baby's environment. This cohesive integration creates a nurturing and responsive space, swiftly reacting to detected motion, monitoring body temperature, and assessing diaper moisture levels to ensure the baby's comfort and safety. This blend of advanced sensor technology and the arduino's control capabilities underscores the transformative potential of IoT in enhancing infant care.

CHAPTER 1

INTRODUCTION

The Smart Cradle System utilizes the Arduino Uno, a versatile microcontroller board, as its cornerstone in establishing an intelligent and responsive environment dedicated to infant care. The Arduino Integrated Development Environment (IDE) plays a pivotal role by offering an intuitive platform for programming and managing the system's intricate components. At its core, this system integrates an array of essential sensors such as the PIR sensor for motion detection, a temperature sensor monitoring the baby's body heat, and a moisture sensor adept at detecting diaper wetness. Complementing these sensors are responsive actuators like the servo motor, gently rocking the cradle, and LEDs serving as visual cues for fever and moisture levels. This amalgamation of hardware and software embodies a comprehensive ecosystem aimed at ensuring the safety, comfort, and well-being of infants, emphasizing the potential of technology in revolutionizing caregiving practices.

1.1. Introduction to Arduino IDE

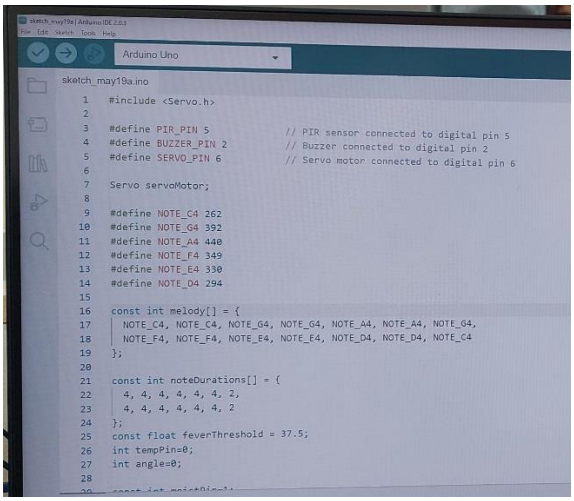

Fig 1.1 Arduino IDE

Arduino IDE stands as a robust software platform, fostering the development of code tailored to Arduino boards. Its user-centric interface streamlines the programming process, catering to individuals across skill levels, from novices exploring their first code to seasoned developers crafting intricate applications. The IDE's intuitive design integrates libraries, examples, and a simplified structure, offering a supportive ecosystem for creating code that orchestrates sensor inputs, triggers responses, and manages actuators within the Smart Cradle System.

1.2. Introduction to Arduino Uno

Fig 1.2 Arduino Uno

At the core of the Smart Cradle System lies the Arduino Uno, an influential microcontroller board renowned for its versatility and reliability. With a repertoire of digital and analog input/output pins, it serves as the nerve center, efficiently processing data from sensors and orchestrating responsive actions through actuators. Its compact form factor belies its capabilities, as it navigates sensor readings from components like the PIR sensor for motion detection, temperature sensors for fever monitoring, and moisture sensors for diaper condition tracking. The Uno's processing power ensures seamless integration of these diverse inputs, empowering the system to execute precise control over the servo motor for cradle movement and LEDs for informative visual cues, encapsulating the essence of the Smart Cradle System's functionality.

1.3. Components Overview

1.3.1. Buzzer

Fig 1.3 Buzzer

A buzzer in an IoT setup serves as an audible alert system, producing sound when triggered by specific events detected by sensors. Connected to a digital pin, it generates tones through electrical signals, enabling notifications for changes in sensor readings or system status.

Control through code allows customization of sound frequency and duration, enhancing user interaction and providing real-time feedback.

1.3.2. Temperature Sensor

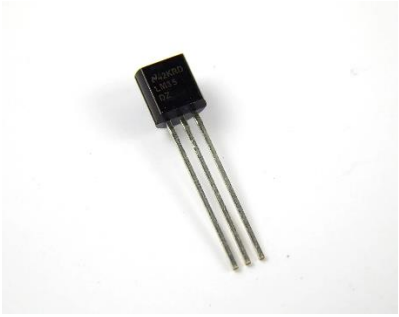

Fig 1.4 Temperature Sensor

A temperature sensor in IoT measures the ambient temperature and converts it into electrical signals for interpretation by a microcontroller. Common types include thermistors or digital sensors like the DHT series. They offer precise temperature readings for environmental monitoring, climate control, and various applications. Connected to an IoT device like an Arduino, Raspberry Pi, or microcontroller, temperature sensors provide valuable data for decision-making and automated responses, ensuring optimal conditions in smart homes, industries, agriculture, and more.

1.3.3. PIR Sensor

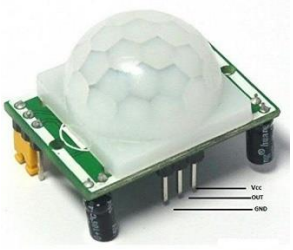

Fig 1.5 PIR Sensor

A PIR (Passive Infrared) sensor is a motion detection device used in IoT to sense changes in infrared radiation within its field of view. This sensor detects the heat emitted by objects, allowing it to identify movement or changes in thermal signatures. In IoT applications, PIR sensors are commonly employed for security systems, lighting controls, and automation. When motion is detected, the sensor triggers an electrical signal, enabling actions such as activating lights, sending alerts, or initiating other programmed responses, making it a crucial component in creating responsive and efficient IoT systems.

1.3.4. LED

Fig 1.6 LED

LEDs (Light Emitting Diodes) are connected to microcontrollers like Arduino via digital pins to control their illumination. They have polarity—longer leg (+) connects to the pin, shorter leg (-) to ground, with a current-limiting resistor (typically 220-330 ohms) in series. Using functions like `digitalWrite()`, setting the pin to HIGH (5V) turns the LED on; setting it to LOW (0V) turns it off. Always ensure the current limits for pins and LEDs are observed to prevent damage.

1.3.5. Breadboard

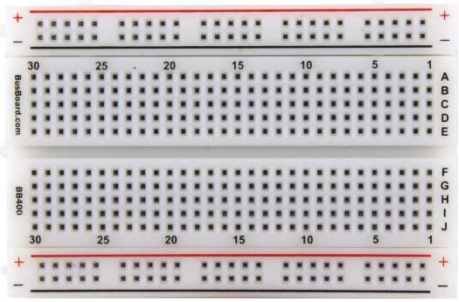

Fig 1.7 Breadboard

Breadboards are versatile prototyping tools for electronics, providing a grid of interconnected holes to easily plug in and test components without soldering. They offer an organized layout, making circuit building accessible for experimentation and rapid design iteration. While great for testing and quick setups, they have limitations in handling high frequencies or precise analog circuits due to inherent electrical characteristics.

1.3.6. Servo Motor

Fig 1.8 Servo Motor

A servo motor provides accurate angular control through electrical pulses. It consists of a motor, gearing, and feedback mechanism, commonly used in robotics and mechanisms requiring precise movement, with different sizes offering varied degrees of rotation.

1.3.7. Moisture Sensor

Fig 1.9 Moisture Sensor

Moisture sensors can also be utilized in baby diapers to detect wetness. These sensors typically employ a similar principle of measuring conductivity or resistance changes in response to moisture. Placed discreetly within the diaper, they trigger an alert or indicator when wetness is detected, alerting caregivers to change the diaper. These sensors aim to enhance convenience and promptness in caring for infants, ensuring timely diaper changes for comfort and hygiene.

1.4. Project description

The Smart Cradle System is designed to ensure the baby's comfort and safety. When motion is detected using the PIR sensor, the system activates the cradle's rocking motion, offering a calming effect. Simultaneously, it monitors the baby's temperature and diaper moisture using sensors. If a fever or wet diaper is detected, corresponding LEDs illuminate, and a buzzer generates an audible alert. These notifications prompt caregivers to take necessary actions promptly.

CHAPTER 2

REQUIREMENT SPECIFICATION

2.1. Hardware requirements

- Arduino Uno Board
- Laptop or PC to upload codes
- Breadboard
- Jumper wires
- USB Cable
- Sensors:
    - PIR sensor
    - Temperature sensor
    - Moisture sensor
- Actuators:
    - Buzzer
    - Servo motor
    - LED (Red, Green)

2.2. Software requirements

- Arduino IDE
- Servo.h library

CHAPTER 3

DESIGN

3.1. System architecture

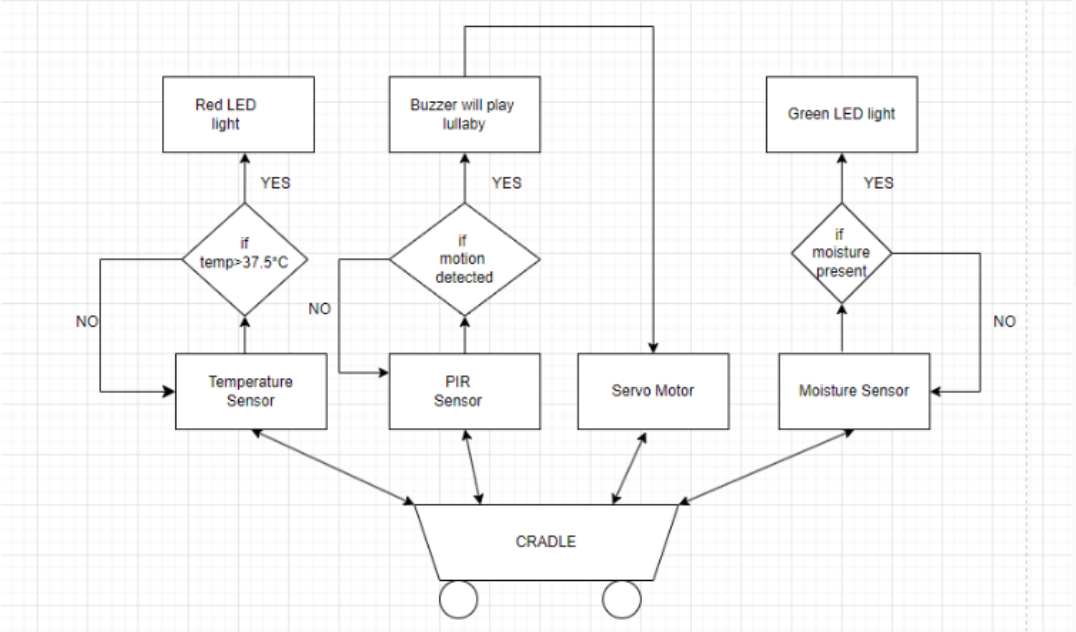

Fig 3.1 Architectural view of Smart Cradle System

You'll need an Arduino Uno board, a laptop or PC for code uploading, a breadboard, jumper wires, and a USB cable alongside sensors like a PIR sensor, temperature sensor, and moisture sensor, plus actuators such as a buzzer, servo motor, and red and green LEDs for this project.

- PIR Sensor: Detects motion within its field of view, allowing the system to respond to the baby's movements.
- Temperature Sensor: Monitors the infant's body temperature to detect fever or irregularities.
- Moisture Sensor: Identifies diaper wetness, triggering alerts for timely diaper changes.
- Servo Motor: Controls the cradle's rocking motion, providing a soothing effect to the baby.
- Buzzer, Red LED (Fever Detection), Green LED (Moisture Detection): Provide visual and audible alerts for fever or wet diaper conditions.

CHAPTER 4

IMPLEMENTATION

4.1. Circuit

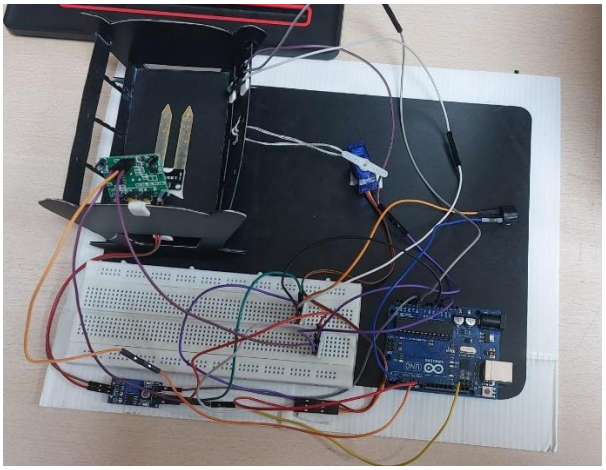

Fig 4.1 Circuit for Smart Cradle System

4.2. Procedure

1) **Hardware Setup:** Connect the PIR, temperature, and moisture sensors along with the servo motor, LEDs (both red and green), and buzzer to the Arduino Uno board using the breadboard and jumper wires.

2) **Coding:** Develop the code using the Arduino IDE, integrating sensor readings for motion, temperature, and moisture. Implement control mechanisms to activate the servo motor, LEDs, and buzzer based on sensor inputs.

3) **Upload Code:** Use the Arduino IDE to upload the developed code onto the Arduino Uno board, ensuring proper compilation and transfer for execution.

4) **Testing Motion and Sensors:** Simulate motion for the PIR sensor, vary temperature readings for the temperature sensor, and test the moisture sensor with appropriate levels of moisture to validate accurate sensor readings.3.

5) **Functional Verification:** Verify the entire system's functionality by testing various scenarios motion detection triggering the servo motor and alerting with the buzzer and LEDs, ensuring the sensors respond accurately to environmental changes.

4.3. Code

```
#include <Servo.h>
#define PIR_PIN 5            // PIR sensor connected to digital pin 5
#define BUZZER_PIN 2         // Buzzer connected to digital pin 2
#define SERVO_PIN 6          // Servo motor connected to digital pin 6
Servo servoMotor;
#define NOTE_C4 262
#define NOTE_G4 392
#define NOTE_A4 440
#define NOTE_F4 349
#define NOTE_E4 330
#define NOTE_D4 294
const int melody[] = {
  NOTE_C4, NOTE_C4, NOTE_G4, NOTE_G4, NOTE_A4, NOTE_A4, NOTE_G4,
  NOTE_F4, NOTE_F4, NOTE_E4, NOTE_E4, NOTE_D4, NOTE_D4, NOTE_C4};
const int noteDurations[] = {
  4, 4, 4, 4, 4, 4, 2,
  4, 4, 4, 4, 4, 4, 2
};
const float feverThreshold = 37.5;
int tempPin=0;
int angle=0;
const int moistPin=1;
int led_moisture=12;
int led_fever=13;
void setup() {
  pinMode(PIR_PIN, INPUT);
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(SERVO_PIN, OUTPUT);
  pinMode(led_moisture,OUTPUT);
  pinMode(led_fever,OUTPUT);
  servoMotor.attach(SERVO_PIN);  // Attaching the servo motor to the pin
  Serial.begin(9600);
}
void playSong() {
  for (int i = 0; i < sizeof(melody) / sizeof(melody[0]); i++) {
    if (melody[i] == 0) {
      delay(noteDurations[i] * 100);
    } else {
      tone(BUZZER_PIN, melody[i], noteDurations[i] * 100);
      delay(noteDurations[i] * 110);
      noTone(BUZZER_PIN);
    }
  }}
void loop() {
  int motionDetected=0;
  motionDetected=digitalRead(PIR_PIN);
  int moisture;
  moisture=analogRead(moistPin);
  float moisture_percentage;
  moisture_percentage=(100-((moisture/1023.00)*100));
```

```
  float temp;
  temp=analogRead(tempPin);
  temp=temp*0.48828125;
  if (motionDetected==HIGH) { // Check if motion is detected
    playSong();
    Serial.println("motion detected");
    for(angle=45;angle<90;angle++)
    {
      servoMotor.write(angle);
      delay(5);
    }
    for(angle=90;angle>45;angle--)
    {
      servoMotor.write(angle);
      delay(5);
    }
    servoMotor.write(180);  // Move the servo motor to 180 degrees position
    delay(100); // Delay to avoid continuous triggering
    servoMotor.write(90);   // Return the servo motor to 90 degrees position
    delay(100); // Delay to avoid re-triggering immediately
  }
  if (moisture_percentage>10) {
    Serial.println("Moisture detected - Change the diaper!"); // Prompt for diaper change
    digitalWrite(led_moisture,HIGH);
    delay(1000);
    digitalWrite(led_moisture,LOW);
  }
  Serial.print("Temperature: ");
  Serial.print(temp);
  Serial.println("*C");
  if (temp>feverThreshold) {
    Serial.println("Fever detected!");
    digitalWrite(led_fever,HIGH);
    delay(1000);
     digitalWrite(led_fever,LOW);
  }
  delay(1000);  // Adjust the delay as needed
}
```

CHAPTER 5

RESULT

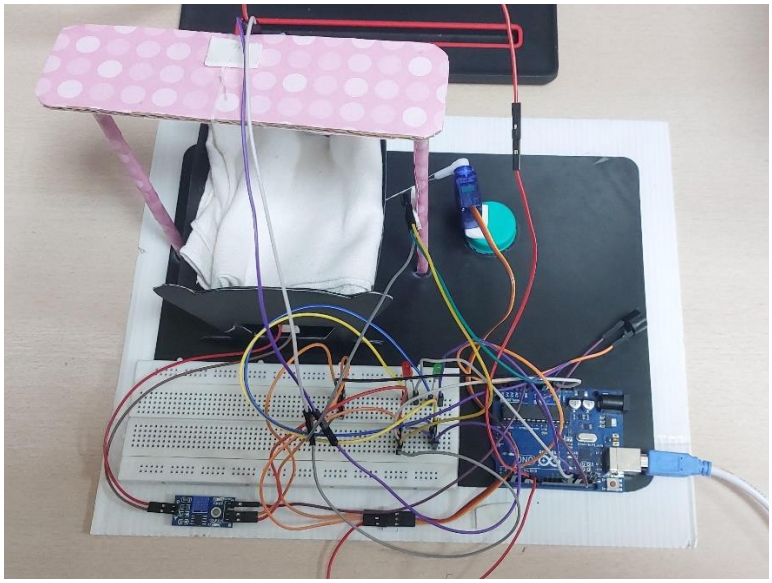

Fig 5.1 Working model of Smart Cradle System

Fig 5.1 represents the working of the Smart Cradle System .When motion is sensed, the system plays a melody through a buzzer and simulates cradle rocking using a servo motor.

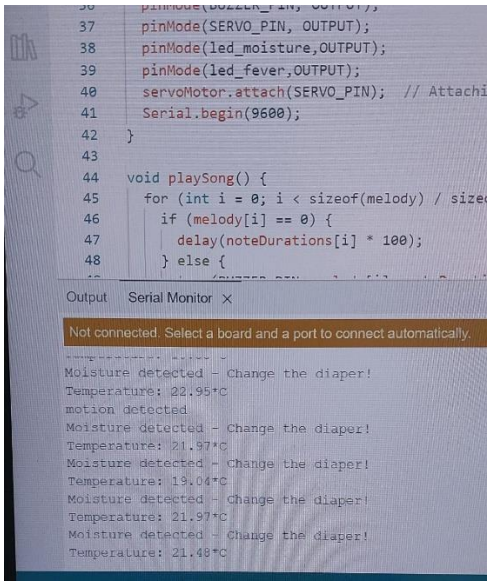

Fig 5.2 Output of a scenario

Fig 5.2 represents the code continuously monitors these parameters, reacting to changes in motion, diaper moisture, and temperature readings.

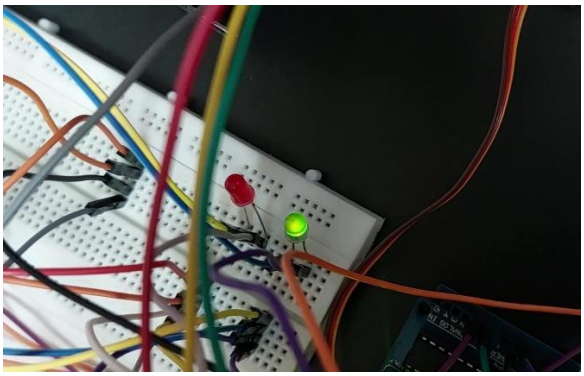

Fig 5.3 Output of Moisture detection

It reads and displays the temperature. If it's above 37.5°C, it indicates a fever by briefly lighting another LED (Red). And if diaper moisture exceeds 10%, it prompts a diaper change message and briefly lights an LED (Green) as in Fig 5.3.

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENTS

6.1. Conclusion

The Smart Cradle System embodies a holistic approach to infant care, leveraging advanced sensor technology and the versatile Arduino Uno microcontroller. Its ability to monitor motion, temperature, and diaper moisture levels while providing responsive actions like gentle rocking and visual alerts demonstrates the potential of IoT in enhancing infant safety and comfort. By combining hardware and software seamlessly, it showcases the transformative role technology can play in caregiving.

6.2. Future Enhancements

- Wireless Connectivity: Implementing wireless communication (like Wi-Fi or Bluetooth) would enable remote monitoring and control via smartphones or dedicated applications, providing caregivers with real-time updates and control over the system from a distance.
- Machine Learning Integration: Integrating machine learning algorithms could enable the system to learn and adapt to the baby's patterns, allowing for predictive analysis of behavior or health, offering proactive care and insights.
- Camera Integration: Adding a camera for visual monitoring could enhance the system's capabilities, allowing caregivers to remotely view the baby's activities and well-being in real-time.
- Enhanced Notification Systems: Expanding the notification capabilities beyond LEDs and buzzers to include SMS alerts or voice notifications could offer more comprehensive and accessible alerts for caregivers.

These enhancements would further elevate the Smart Cradle System, enriching its capabilities and functionalities to provide even more comprehensive care and convenience for caregivers while ensuring the utmost comfort and safety for infants.

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