

**Vigillant Cradle Using**

**Voice Recognition Signals**

Educational Technology (EdTech)

Senior Project

By

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Chapter 1 System Requirements and Technical Specifications

1.Introduction to “Vigillant Cradle”



The Vigillant Baby Cradle The Vigillant Baby Cradle is an innovative project aimed at providing parents with convenience and peace of mind by automatically responding to their baby's needs. This system integrates several components, including a sound sensor, servo motor, speaker, and an MP3-TF-16P SD card module, all managed by an ESP32 microcontroller. The cradle detects when the baby cries, initiates a gentle swinging motion, plays soothing music, and sends alerts to the user's smartphone. Additionally, it notifies the user when the baby laughs, ensuring prompt attention and care.

Components :

* Sound Sensor: Detects the baby's cries and laughter, providing input signals to the microcontroller.
* Servo Motor: Controls the swinging motion of the cradle, ensuring a gentle and soothing movement.
* Speaker: Plays calming music in response to the baby's cries, helping to soothe the baby.
* MP3-TF-16P SD Card Module: Stores and plays audio files, allowing for a variety of soothing sounds or music.
* ESP32 Microcontroller: Manages the operation of the entire system, including processing sensor input, controlling the servo motor and speaker, and communicating with the user's smartphone via Wi-Fi.

Functionality:

* Cry Detection and Response:

1. When the sound sensor detects the baby's cry, the ESP32 activates the servo motor to initiate a gentle swinging motion of the cradle.
2. Simultaneously, the ESP32 triggers the speaker to play soothing music from the MP3 audio files stored on the SD card.
3. An alert is sent to the user's smartphone via ESP32, notifying them of the baby's crying.

* Laughter Detection and Notification:

1. When the sound sensor detects the baby's laughter, a notification is sent to the user's smartphone indicating the baby's joyful state.

System architecture



Chapter 2 Sound Sensor Overview





Introduction a sound sensor is a critical component in the Smart Baby Cradle, designed to detect the baby's cries and laughter, thereby triggering appropriate responses from the cradle system. This sensor essentially acts as the system's "ears," converting sound waves into electrical signals that can be processed by the microcontroller.

Functionality and Working Principle:

Detection of Sound:

The sound sensor captures sound waves in the environment, such as a baby's cry or laughter. It typically consists of a microphone that converts these sound waves into corresponding electrical signals.

Signal Amplification:

The raw electrical signals produced by the microphone are usually weak and need to be amplified. The sound sensor includes an amplifier circuit to boost these signals to a level that can be processed by the microcontroller.

Analog-to-Digital Conversion:

Many sound sensors have a built-in Analog-to-Digital Converter (ADC) that converts the analog electrical signals into digital data. This digital data is easier for the ESP32 microcontroller to interpret and process.

Threshold Detection:

The sensor can be configured to detect sound levels above a certain threshold. This threshold can be adjusted so that the sensor only triggers responses when it detects sounds within the specific range of a baby's cry or laughter, filtering out background noise.

Key Features:

* Microphone Element: The primary component that detects sound waves and converts them into electrical signals.
* Amplifier: Boosts the weak electrical signals from the microphone to a usable level.
* ADC (Analog-to-Digital Converter): Converts analog signals to digital data for the microcontroller.
* Sensitivity Adjustment: Allows tuning the sensor's sensitivity to detect the desired range of sound levels, ensuring accurate detection of baby cries and laughter.

Integration with the Smart Baby Cradle:

* Connection to ESP32 Microcontroller: The sound sensor is connected to the ESP32 microcontroller via its output pins. The ESP32 reads the digital signals from the sensor to determine if the baby is crying or laughing.
* Signal Processing: The ESP32 processes the input signals from the sound sensor to differentiate between different types of sounds (e.g., cry vs. laughter) based on predefined thresholds and patterns.
* Triggering Actions: Upon detecting a cry, the ESP32 activates the servo motor to initiate cradle swinging and plays soothing music via the speaker. When laughter is detected, it sends a notification to the parent's smartphone.

Types of Sound Sensors:

* Analog Sound Sensors: Provide raw analog output signals. They require the ESP32 to use its built-in ADC to process the signals.
* Digital Sound Sensors: Have a built-in ADC and provide digital output signals, which can be directly read by the ESP32.

Example of a Common Sound Sensor:

* KY-038 Sound Sensor Module:

1. Equipped with a microphone and an adjustable sensitivity knob.
2. Provides both digital and analog outputs.
3. Easy to interface with microcontrollers like the ESP32.

* Calibration and Testing:

Sensitivity Adjustment: During setup, the sensitivity of the sound sensor needs to be adjusted to accurately detect the specific sound levels of a baby's cry and laughter while ignoring ambient noise.

Testing: Extensive testing is conducted to ensure the sensor accurately detects the baby's sounds and triggers the appropriate responses from the system without false positives.

Chapter 3 Implementation and Functionality Overview

Implementation and Functionality Overview of the Viggilant Cradle Cradle

Implementation:

1. Hardware Setup:

Component Assembly:

* Securely mount the sound sensor, servo motor, speaker, and MP3-TF-16P SD card module onto the baby cradle.
* Connect these components to the ESP32 microcontroller using appropriate wiring and connectors.

Power Supply:

Ensure a stable power supply for the ESP32 and other components, either through batteries or an external power adapter.

Circuit Design:

Design and implement the circuitry to interconnect all components, including the power supply circuit, sensor input lines, and control lines for the servo motor and speaker.

2. Software Development:

* Microcontroller Programming:
* Write code for the ESP32 microcontroller to handle various tasks:
* Read input from the sound sensor.
* Process and differentiate between the baby’s cry and laughter.
* Control the servo motor to initiate and regulate the swinging motion.
* Manage audio playback using the MP3-TF-16P SD card module.
* Establish Wi-Fi communication to send alerts and notifications to the parent's smartphone.

Sound Detection and Processing:

* Implement algorithms to analyze sound sensor data and identify specific sound patterns corresponding to crying and laughter.
* Servo Motor Control:
* Develop routines to control the servo motor, ensuring smooth and gentle swinging of the cradle.
* Audio Playback Management:
* Program the ESP32 to select and play appropriate audio files from the SD card via the speaker in response to the baby’s cry.
* Wi-Fi Communication:
* Use Wi-Fi libraries to connect the ESP32 to the internet and send notifications to the parent's smartphone using services like Blynk or Firebase.

3. Testing and Calibration:

Sound Sensor Calibration:

* Adjust the sensitivity of the sound sensor to accurately detect the baby’s cries and laughter while filtering out background noise.
* System Testing:
* Conduct thorough testing to ensure each component works correctly and the overall system functions as intended.
* Simulate various scenarios to verify the system’s response to different sounds and its ability to send notifications.

Refinement:

Make necessary adjustments based on testing results to improve accuracy and reliability.

Functionality:

1. Cry Detection and Response:

Sound Detection:

* The sound sensor continuously monitors the environment for sound.
* When it detects a sound, it sends a signal to the ESP32 microcontroller.
* Signal Processing:
* The ESP32 processes the signal to determine if the sound matches the pattern of a baby’s cry.
* Swing Activation:
* Upon confirming a cry, the ESP32 activates the servo motor, causing the cradle to swing gently.
* Music Playback:
* The ESP32 triggers the MP3-TF-16P SD card module to play a soothing audio file through the speaker.
* Smartphone Notification:
* Simultaneously, the ESP32 sends an alert to the parent's smartphone, notifying them that the baby is crying.

2. Laughter Detection and Notification:

Sound Detection:

The sound sensor detects laughter and sends the signal to the ESP32.

Signal Processing:

The ESP32 processes the signal to confirm that it matches the laughter pattern.

Smartphone Notification:

A notification is sent to the parent's smartphone, informing them of the baby’s joyful state.

3. Continuous Monitoring and Adaptation:

* The system continuously monitors the environment, ensuring prompt detection and response to the baby’s needs.
* Adjustments can be made to the sensitivity and response parameters to optimize performance based on real-world usage and feedback.

Conclusion the Smart Baby Cradle offers a seamless solution for parents, allowing them to attend to their baby's needs promptly while providing peace of mind. By integrating advanced technology with essential baby care functionalities, this project aims to enhance the parenting experience and promote the well-being of both the baby and the parents. This intelligent cradle not only responds to the baby's immediate needs but also provides valuable notifications to parents, ensuring that they are always informed and able to provide timely care.