IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

Baby Monitoring System

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Abstract: *These days handling kids and being with them all the time has become a crucial task for working parents. Being attentive to the kid and being physically present with them is not possible for each working parent. Thus, an efficient solution has been encountered to take care of the child while working. A smart cradle with features like swing mechanism, Camera facility and a small toy has been implemented. ESP32 controller is used, ESP32 CAM Module, Motor Driver, & a DC Motor are the key components of the project. The project will work as a 2-way input system, i.e., the system can be controlled manually via the Blynk App. Whenever the cy is detected, swing motion will be started, even after that if the cry is detected again, then the toy will be played with the help of the Bo Motor. Thus, automatically for a time period the baby is entertained, and an attempt to sooth the baby without any personal attention will be accomplished through the prototype designed.*

Keywords: Smart Cradle, ESP32, ESP332 CAM Module, Toy, Blynk App, Swing Mechanism

I. INTRODUCTION

In the Smart Baby Cradle Monitoring System one of the important goals is to provide basic attention to the baby in absence of the parent for some time. In these current pandemic times, Work from Home facility has been enabled to the employees, while working in different room/space it will be convenient for parents to sooth the babies through our design. Through Camera Surveillance via the Blynk App, it will be easier to keep an eye on the baby while working. Instead of keeping the child in a Day-care, or hiring some nurse to attend the baby, working parents can manage to take care of their baby with the help of the smart cradle. The project implemented is under the domain 'Internet of Things' commonly known as IOT. Because of IOT many things have become easier and smarter to use in our daily life. IOT is something that allows us to exchange data collected from physical devices and send over the internet to different devices. Technology is getting updated day by day, with this updating technology human life is becoming easier & more convenient to walk upon. Using ESP32 Access point, and adding features like remote access to the system, it will be possible for a parent to access the camera, and other control buttons through anywhere in the world. Using the ESP32 Access Point with a customized website with login controls and additional features for the cradle, the prototype designed will be more advanced and suitable.

II. RELATED WORKS

2.1 Problem Statement

In this fast-paced world, it has become very difficult for new parents to nurse their child and take good care of him all the time. Since both the parents are working these days, it has become a problem to attend their child. Thus, to resolve this problem to a small extent, we have designed a "BABY MONITORING SYSTEM". This system will help parents to take care of their child, and the baby will not require 24/7 attention of the parent. Main aim of the system is to be a helping hand for the parents to nurse their baby.

2.2 Research Contributions

Baby Monitoring System is one of the handy tools for new parents. Since, parents can easily keep an eye on the baby and also control the features accumulated in the system, it becomes easier for them to handle the babies even while working. Some of the systems designed are currently being used in some of the countries. After going through some of the research papers available, different sensors and technology is used for the Monitoring System. Most of the studies collect information about the child through various sensors and notify them to parents through a web application, Mobile App

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or some other software. In [1] they have used Node MCU (ESP8266) as their microcontroller. For software purpose they have used MQTT Protocol server to operate the system manually and collect the sensor data. Sensors used are DC Motor, Temperature & Humidity Sensor, Mini Fan, Wireless Security Camera and a sound sensor for the detection of the cry. The material used for cradle fabrication is Meranti wood, which is the softest wood amongst the all. As some of them have used the web server protocol methods, [4] here, they have used the GSM Technology to notify the parents. The system implemented has an alarm and GSM Module that indicates two conditions, first when the mattress is wet and second when the baby doesn't stop within the stipulated time period. Baby's sound detection frequency and pattern is one of the important points considered here in [5] paper. Here Digital Signal Processing (DSP) has been used to amplify, filter, modulate and process the signals. Thus, baby crying detection circuit is designed and implemented depending upon the characteristics of the crying frequency. The system designed in [6] is based on Child behaviour & Health Monitoring System using Hadoop. Arduino controller is used to collect the sensor data and provide the accumulated values to Hadoop system. Ttherapeutic games are installed which are mainly used for psychotherapy and also the games to detect Attention Deficit/Hyperactivity Disorder (ADHD).

III. METHODOLOGY

As per the problem statement mentioned in the previous section, a Smart Baby Cradle System is designed. The process started with selecting the material for cradle, keeping in mind that it should be cost-effective and comfortable for the baby. Afterwards, component selection was a crucial task, since the motor specifications were dependent on the weight of the cradle designed. Accordingly, sound sensor, microcontroller, motor driver and camera module were finalized. Testing of individual sensors was carried out, and then it was assembled as a whole system.

3.1 Component Selection

As per the cradle design and other system requirements the hardware and software components are finalized as follows-
Hardware Components:

1. ESP32 (Microcontroller)
2. ESP32 Camera Module
3. TTL to Serial Convertor
4. L293D Motor Driver
5. LM393 Sound Sensor
6. DC Motor
7. BO Motor

3.2 Software Components

Since the aim is to demonstrate the working of the system on a small-scale and it should be cost-effective. We have used the Blynk App, which is an open-source platform.

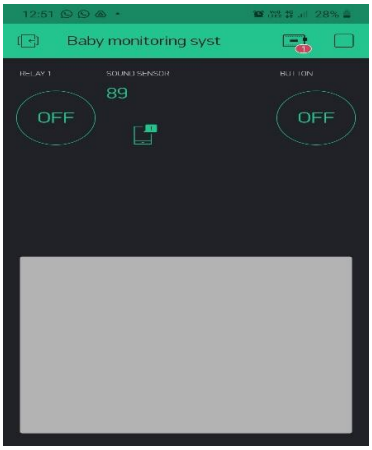

Fig1.Blynk App

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Through this platform user will be able to access the control buttons for the sensors attached in the system and will be able to view the camera window via the user-friendly GUI developed. Proteus Simulation Software is being used for the purpose of testing the sensors before actually testing it on the hardware. Arduino IDE is being used for the code development of ESP32 & ESP32 CAM Module. Before interfacing the sensors to ESP32, they were tested with Arduino, since code development with Arduino is easier than ESP32.

3.3 System Architecture

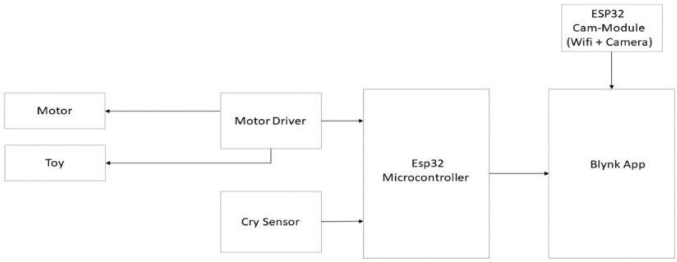

Fig 2.System Architecture

As shown in the above block diagram, the cry sensor (sound sensor) is interfaced directly to the microcontroller (ESP32). The two sensors i.e., DC motor for swing mechanism and BO Motor of the toy for entertainment of the baby are interfaced through a motor driver to the microcontroller. The ESP32 camera module will establish a connection via the ESP32.
ESP32 CAM Module can also be used as a microcontroller instead of using ESP32 as a different module. But, in future if there is any need to add some features to the system, it will be preferable that a different microcontroller is being used. Interfacing of new sensors to ESP32 will be convenient and easier in future use.

3.4 Cradle Design & Fabrication

One of the most important factors in this model would be the cradle design and its fabrication. Since all the hardware is supposed to be installed on this prototype for demonstration purpose. There are various options for the material of the cradle to be chosen such as wood, acrylic sheets, iron etc. One of the most economical and convenient material that we have chosen is “Bamboo”. Bamboo is eco-friendly, cost-effective and easy to fabricate. As, the prototype to be designed is just for the sake of demonstration purpose, most important thing to keep in mind is that it should be cost effective. Bamboo is readily available and also cheap. The cradle basket chosen is a steel structure in the rectangular form, for proper alignment. The outer cradle frame is constructed using circular bamboo sticks. Bamboo sticks can be easily attached to one by using small ropes or strings. Also, bamboo sticks can be fixed through screws. Thus, as shown in below figure, using bamboo as the base material for the cradle design, we have designed a prototype for our project.

Fig 3. Fabricated Cradle

IV. IMPLEMENTATION OF THE SYSTEM

As the cradle designed is in bamboo, the sensor which are supposed to be installed on the cradle should be light-weight and safe. There are three main components of the system i.e., sound sensor, DC motor and Camera. These three sensors are supposed to be installed on the prototype for demonstration purpose. Cradle frame has a rod fitted below the cradle

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(basket), here the DC motor is installed for the swing mechanism. The shaft of the DC Motor is attached to a string which will pull the cradle back and forth. As there is rod at the bottom, similarly one rod has been fixed at the top of the cradle (basket). On this top rod, on the right side, camera is installed. Otherwise, camera can be kept mobile as per the requirement. In the middle of the upper bamboo rod, a toy is attached to the BO Motor for the baby to rejoice.

4.1 Flowchart

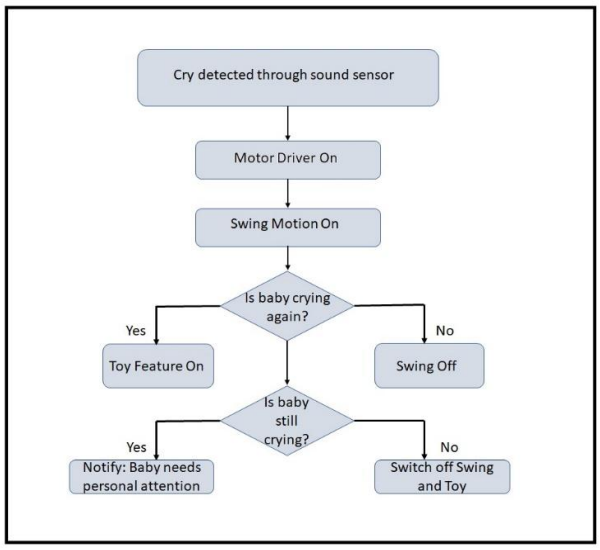

Fig 4. The above flowchart describes the control flow of the designed system

4.2 Working

The main aim of the system is to entertain and sooth the baby without human presence for some time period. As the cry of the baby will be detected through the analog pin of the LM393 sound sensor, it will turn on the Toy Motor through the L293D motor driver. The audio detected through the sensor will have a fixed value. So, once the sound frequency goes beyond the fixed value it will send a signal to the motor driver and the toy motor will be turned ON through motor driver. After a delay of some seconds, even if the sound detected is in between the range of the fixed value, then the toy motor and the DC motor for swing mechanism will be started simultaneously.

At the top of the cradle in the right-hand side there will be a camera module installed to keep a watch on the baby and monitor his actions. This camera will be connected to the parent's mobile phone through the Blynk App. By clicking on the camera button on the GUI of the App, a camera window will pop-up. On detection of the cry the swing mechanism of the cradle and the toy will be turned on automatically. These controls can also be controlled manually through the Blynk App. As per requirement, after seeing the camera window through the App, parents can turn ON/Off the swing mechanism of the cradle and the toy interfaced to it accordingly.

V. RESULTS & CONCLUSION

After studying multiple research papers and projects, the model of our project was designed. The components were chosen considering the requirement of the project. The devices were assembled individually and the working was observed. Various revisions and tests were performed for the development of the code. The unique aspect of our project over other similar versions is that we have tried to monitor various sound inputs of the baby's cry and have specified a certain range for the detection of cry so that other sounds would be eliminated. Along with this we have a camera surveillance module to monitor the baby. All these features could be operated through the mobile as well. Moreover, the cradle is made up of bamboo which is an ecofriendly and economic material and hence could be afforded by people of all spectrum. This project is not limited up to these features only, the further scope of this project could be creating a full fledge software application or including audio and video processing using new-age technologies like AI and ML. Also, by making use of

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the ESP 32 access point, remote control can be made passible, so that parents can access the app from anywhere.

ACKNOWLEDGMENT

We would like to thank my guide and all other departmental teachers who have contributed in my project. The constant support from the college faculty and required attention from the guide was very helpful during the implementation of project. Additionally, we would also like to thank the people who have supported directly/indirectly for this project.

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