SMART CRADLE WITH AUTOMATED BABY MONITORING SYSTEM

Amit,[1] Aastha Bhardwaj[2] and Kanta Malik[3]
Senior Associate, [1] Publicis Sapient, [2,3] Assistant Professor,
Vivekananda Institute of Professional Studies

Vivekananda Journal of Research
October, 2021, Vol. 10, Special Issue, Pg No. 115-120
ISSN 2319-8702(Print)
ISSN 2456-7574(Online)
Peer Reviewed Refereed Journal
© Vivekananda Institute of Professional Studies
http://www.vips.edu/vjr.php

Abstract

With enormous increase in number of working woman, handling a new born baby and infants has become a challenge especially in nuclear families. This paper endeavours to develop a system for working parents which ensures care and safety of their babies. This system comprises of smart cradle and baby monitoring system. It will provide facilities like automatic swinging of cradle, live streaming of baby's activities, notifying parents via phone or any handheld device in case baby cries or tries to come out of the cradle, etc. For providing a comfort zone to the baby in absence of parents/caretakers in the room, our system also provides features like two-way communication with baby, switching on/off of A/C if room's temperature isn't favourable, if baby is crying then lullaby would be played automatically, etc. In this system, Google Assistant would also be integrated with a view to incorporate all the above-mentioned functions via voice commands. In nutshell, besides giving a bird's eye view about baby's activities, all the functions around baby would be at the disposal of a voice command.
Keywords: *Smart Cradle, IoT, NodeMCU, Raspberry Pi, Voice assistant, Baby Monitoring System, MQTT*

1. INTRODUCTION

During the last three decades, our society has witnessed a rise in number of nuclear families and a revolutionary trend of both parents working and rise. Though with two working hands in a family, there are more earnings in families but handling newly born babies and infants is a prominent and challenging issue. IoT can very well be exploited in this direction to enable parents to work while keeping a close watch on their infants' activities in separate rooms. Internet of Things (IoT) simply refers to a network of objects that are connected to Internet. It provides devices with the ability to transfer sensor data on the Internet without requiring intervention [7], [8]. We have developed a system where in the child would be under the supervision of it and in case baby wakes up/cries, or tries to move out of the cradle then parents would be notified and a live stream would be shown on their screens. This will enable parents to work comfortably without constantly worrying about the safety of the baby. This system would also be of immense help to parents engaged in their work/household chores to use voice commands for digital assistants like Google Home, Alexa to control essential functions of the system. For example, playing a lullaby through speakers, setting the A/C mode, temperature, turning on/off the cradle swing etc. The basic idea of this paper is to transform the conventional cradles used in hospitals/homes into smart cradles and monitoring the baby's activities. The rest of this paper is structured as follows. Section II introduces the related works, Section III presents the design, architecture of proposed system followed by conclusion and future work in Section IV.

Section II: Related Work

Baby care is of utmost importance but has become one of the most difficult tasks in a nuclear especially with parents working. Thus, researchers in past have contributed by making smart systems which can help parents in distress. For example, [1] Savita et al. designed a Baby Monitoring System in which body temperature, pulse rate, moisture condition, movement of an infant and using GSM network this information is transferred to their parent. [2] P. Bhasha et al. used Node MCU microcontroller, BLYNK android application to provide functionalities like detecting the baby cry playing songs, detection of wetness and send alert messages to the parent. [3] Rudyansyah et.al used Raspberry Pi and Pi Camera Noir as image input and the DHT22 sensor as air temperature and air humidity input proof help as a monitoring security system for monitoring the baby's security. [4] Manish developed a voice-controlled home automation system where Natural language voice commands are given to the Google Assistant and with the help of IFTTT application and the Blynk application. [5] A. F. Symon et al. designed a system using Raspberry Pi B+ module to detect baby's crying sound, temperature as well as live streaming of baby position in cradle. [6] N. L. Pratap, et. al developed a system wherein parameters regarding the baby's health like temperature, heartbeat rate, dampness on the baby bed will be displayed in the mobile application. It also including capturing the motion and monitoring position of the baby.

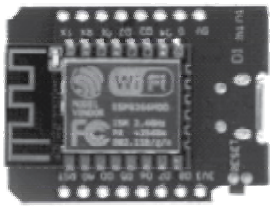
Review of existing literature reveals that IOT has been used in this direction like monitoring baby's health parameters [6], detection of baby crying [2][3][5], wetness [2][6] and subsequently playing lullaby or automatic swinging of cradle using various kinds of sensors. But there is dearth or less research in the field of enabling automation of cradles and baby safety via digital assistants. Though it's a very useful feature for parents but not much significant exploration has been done in this field.

In next section, we are going to explain the in-depth system design catering to the above problems.

Section III: Proposed System

Our system comprises of following components:

1. WeMos D1 Mini



The WeMos D1 Mini is a development board based on ESP8266 and has 11 digital input/output pins, and a Micro USB connection for programming.

2. DHT-22



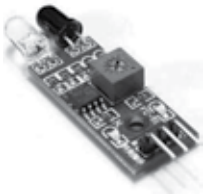
The DHT-22 is a digital temperature and humidity sensor. A capacitive humidity sensor is used to measure the surrounding air, and spits out a digital signal on the data pin.

3. ISD 1280



ISD1820 Sound/Voice Recorder Playback Module with on-board Microphone is based on ISD1820, which a multiple-message record/playback device.

4. Infrared (IR) Proximity Sensor Module



IR Sensor module has a pair of infrared transmitter and receiver tube. When the Transmitter emit a certain frequency and encounters an obstacle, infrared reflected back to the receiver tube completing the circuit for processing.

5. Raspberry Pi



In this paper, Raspberry Pi 4 hosts the Automation scripts for various scenes which have been discussed earlier. This mini-computer is a better alternative since it is both energy efficient and cost effective. It provides faster networking as it comes with a Gigabit Ethernet and onboard wireless networking along with better Bluetooth connectivity.

6. 5A Relay Module



Relays are simple electronics components that allow us to switch a high load using only a single pin on our board.

7. 12V DC Stepper Motor



A stepper motor provides maximum torque at low speeds. We used this 10Kgcm Stepper Motor that has a step angle of 1.8 Â° per step. This will aid in great positioning and precise control for the cradle swing action.

8. Camera



The camera platform is a generic IP camera allows us to integrate into Home Assistant. It also supports 2-Way Audio communication through the camera's built-in speaker and microphone. Notifications are sent to configured mobile devices when the camera detects baby crying or other abnormal sounds.

9. Virtual Assistant



The Virtual Assistant is a voice-controlled digital assistant. It has a software that can perform various tasks and service on the voice commands. Any virtual assistant like Google Home Mini, Alexa etc. can be used, in fact one can use his/her smartphone phone if he/she doesn't want to purchase a separate hardware.

Figure 10 shows the circuit diagram of the proposed model. All the components of the system interface with each other based on the I/O pins as shown in the figure.

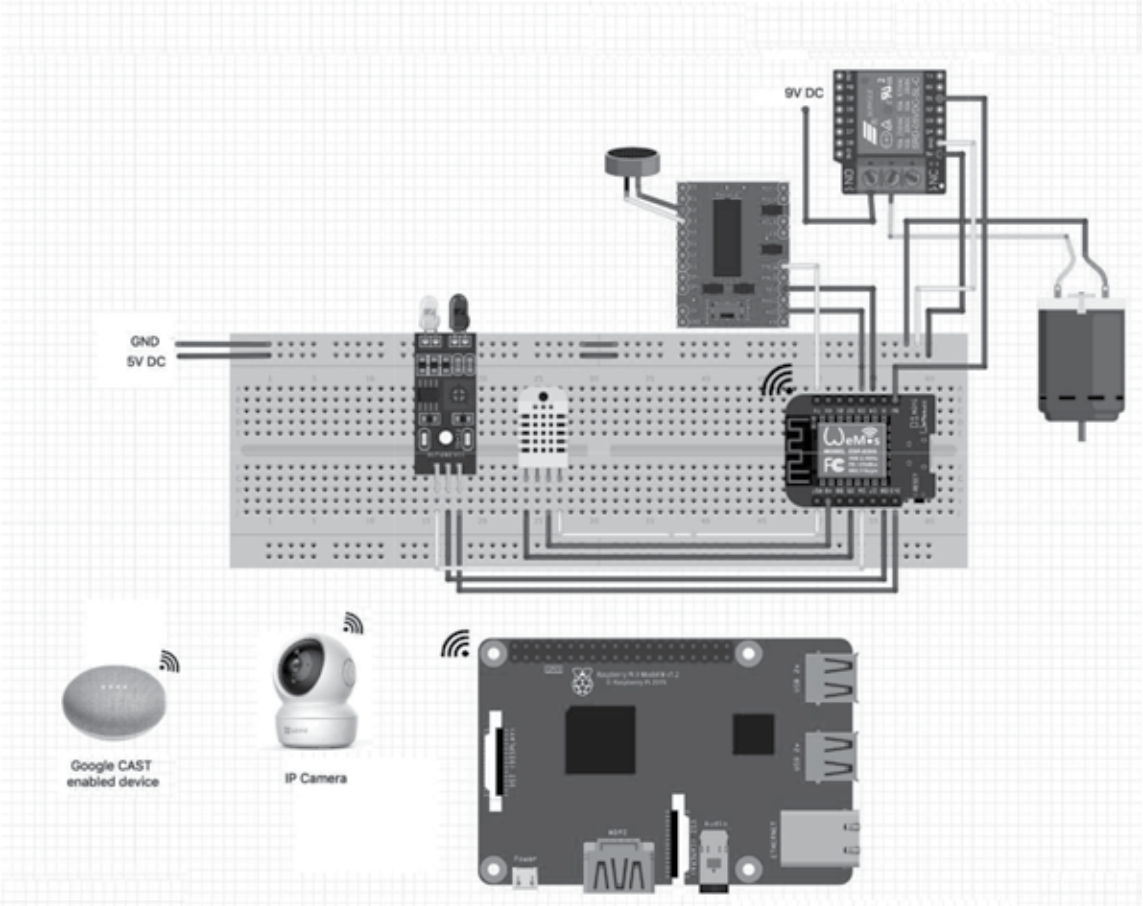


Figure 10 Circuit Diagram of the system

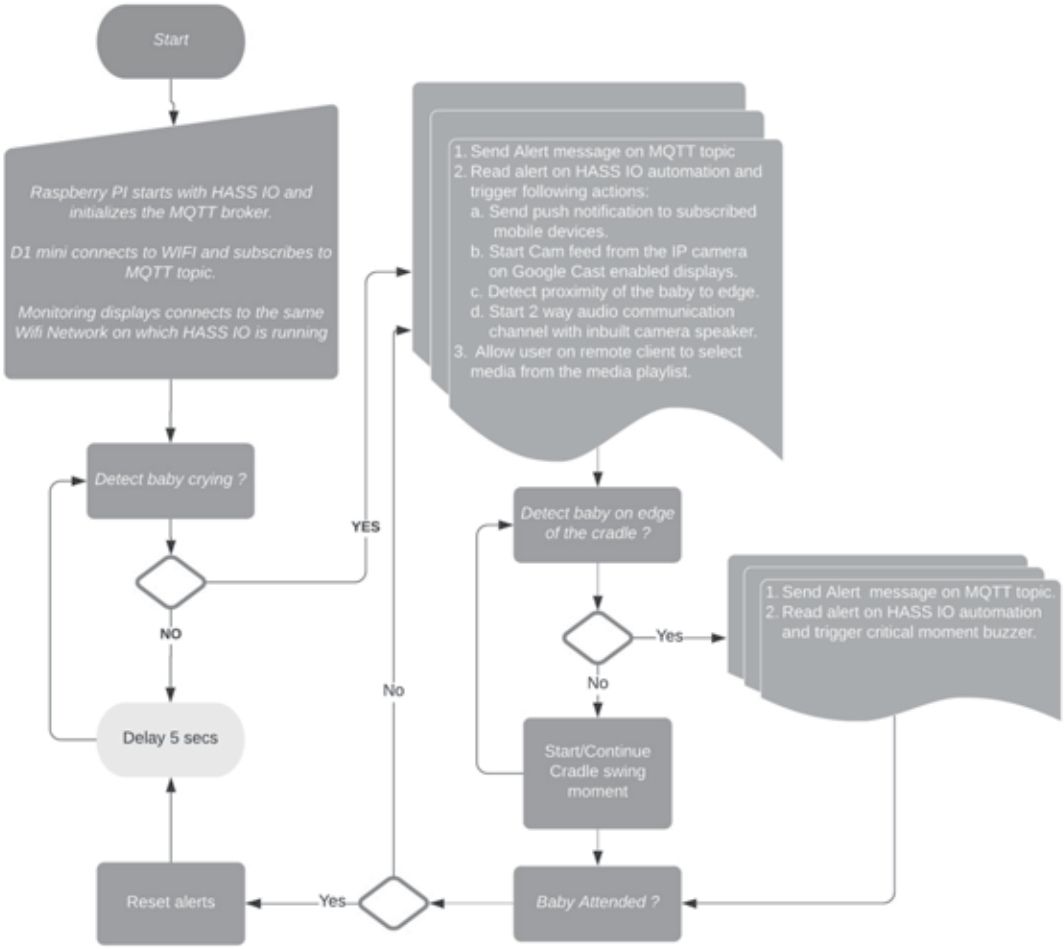


Figure 11 Process flow diagram of the system

Figure 11 shows the process flow of the system. The system bootstraps with setting up the communication channel between the connected components viz. WeMos D1 Mini, Raspberry Pi running HASS IO and MQTT broker to setup the message topic for various sensors to emit the event messages. Installed sensors like Audio sensors, IR Proximity sensor, DHT-22 temperature and humidity sensors collect data from surroundings of the cradle and generate MQTT messages. These messages are being processed by the HASS IO scripts to further perform corresponding automations.

The system also provides live feed of the baby camera on demand where parents/guardians can see anytime what babies are doing in cradle.

If there is any unusual behaviour like crying, manoeuvring out of the cradle then parents would be notified on their phones, pads and other handheld devices. Smart TVs (Google cast enabled devices) can be configured to show the live telecast of baby on occurrences of such events. Similarly, AC mode can be set to ON when room temperature rises beyond certain set threshold. The inbuilt camera speakers or the Google Home speaker can play lullaby to distract the baby from crying. Parents can also have a two-way communication with their babies to soothe them when they feel alone.

Section IV

Conclusion and Future work

A smart cradle equipped with Baby Monitoring System integrated with Virtual Assistants was designed and implemented to ensure baby safety and giving a comfort zone to both baby and the parents. The biggest advantage of this system is that it is very user friendly and its of great utility for parents who are busy in their work/household chores and can't spend much time to constantly monitor the baby's activities. It also makes it convenient to control the cradle's actions like swinging, playing lullaby or baby rhymes on speakers, control room AC and lights by just using a voice command.

Babies cannot convey their emotions or discomforts whether they are feeling bored or hungry or even having a fever. They can only express their problems by crying. However, according to research babies do express their concerns by creating different types of sounds and poses. Our future work would be to train machine Learning model with new born reflexes and behaviour and analysing various baby's sounds. It would include sentiment analysis by using machine learning models trained with baby's expression for example: if he is making particular suckling expression in sleep which would mean he is hungry so notification of hunger would be sent to parents.

References

[1] Savita P. Patil and Manisha R. Mhetre,"Intelligent Baby Monitoring System", ITSI Transactions on Electrical and Electronics Engineering, volume 2, Issue 1, pp.11-16, 2014.

[2] Bhasha, Pydala & Kumar, T. & Baseer, K. & Jyothsna, V.. (2021). An IoT-Based BLYNK Server Application for Infant Monitoring Alert System to Detect Crying and Wetness of a Baby. 10.1007/978-981-33-6176-8_7.

[3] Rudyansyah, Aldy & Spits Warnars, Harco Leslie Hendric & Gaol, Ford & Matsuo, Tokuro. (2020). A prototype of Baby Monitoring Use Raspberry Pi. 1-4. 10.1109/ICISS50791.2020.9307586.

[4] Gupta, Manish Prakash. "Google Assistant Controlled Home Automation." International Research Journal of Engineering and Technology 5.5 (2018).

[5] A. F. Symon, N. Hassan, H. Rashid, I. U. Ahmed and S. M. Taslim Reza, "Design and development of a smart baby monitoring system based on Raspberry Pi and Pi camera," 2017 4th International Conference on Advances in Electrical Engineering (ICAEE), 2017, pp. 117-122, doi: 10.1109/ICAEE.2017.8255338.

[6] N. L. Pratap, K. Anuroop, P. N. Devi, A. Sandeep and S. Nalajala, "IoT based Smart Cradle for Baby Monitoring System," 2021 6th International Conference on Inventive Computation Technologies (ICICT), 2021, pp. 1298-1303, doi: 10.1109/ICICT50816.2021.9358684.

[7] W. A. Jabbar, M. H. Alsibai, N. S. S. Amran, and S. K. Mahayadin, ''Design and implementation of IoT-based automation system for smart home,''in Proc. IEEE Int. Symp. Netw., Comput. Commun. (ISNCC), Jun. 2018, pp. 1–6.

[8] Y. Lu and J. Cecil, ''An Internet of Things (IoT)-based collaborative framework for advanced manufacturing,'' Int. J. Adv. Manuf. Technol., vol. 84, nos. 5–8, pp. 1141–1152, May 2016.