

Review on Design and Development of a Smart Baby Monitoring System

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Abstract : A baby monitor, also known as a baby alarm, is a radio system used to remotely listen to sounds made by an infant. An audio monitor consists of a transmitter unit, equipped with a microphone, placed near to the child. It transmits the sounds by radio waves to a receiver unit with a speaker carried by, or near to, the person caring for the infant. Some baby monitors provide two-way communication which allows the parent to speak back to the baby (parent talk-back). Some allow music to be played to the child. A monitor with a video camera and receiver is often called a *baby cam*. This system can detect the baby's motion and sound; especially crying and video output of baby's present position can be displayed on a display monitor so that the mother or another responsible person can watch the baby while away from him or her. This baby monitoring system is capable of detecting motion and crying condition of the baby automatically. PIR motion sensor is incorporated to detect baby's movement and Pi camera is used to capture the baby's motion. A display is used to have video output of sleeping baby. Finally, the developed hardware is tested to analysis the capability of detecting the motion and crying sound of baby as well as the video output. This proposed system can provide an easier and convenient way for busy parents in terms of taking care of their babies.

IndexTerms - Baby Monitoring System, Python language, Raspberry Pi, Pi Camera.

I. INTRODUCTION

As we are very well familiar with the hurdles faced by Parents to nurture their infant and especially in case if both the Parents are working. To give 24 hours of time in such cases is next to impossible. Thus, we need to develop something unique that can help Parents to have a continuous surveillance/watch on the Baby/Infant and can notify about the same. Thus, we have come up with an idea to design a Smart Cradle System using IOT which will help the Parents to monitor their child even if they are away from home & detect every activity of the Baby from any distant corner of the world. The baby monitoring system is a kind of alarm system which can detect babies' movements and activities and can convey the message about the condition of babies to the concerned authority via a radio or mobile or even a display. Since the very beginning of humanity, families have had instincts to secure their babies from probable dangers and risk. However, the way by which parents look after their children has changed with the technological breakthroughs. They are now thinking about adopting the technological and engineering inventions for getting advantages and benefits in terms of safety issues of their babies. In this era when parents are busy with their career, a modern baby monitoring system can be a solution for handling babies properly instead of keeping them in babies' day care centers or appointing a nanny for them. Monitoring a baby continuously is really a tough job as well as it is not possible for the parents to carry out their babies all the time with them especially while working. Hiring a caregiver for the non-stop monitoring of babies is an option when parents are busy at home or in the working places or as an alternative solution is day care center. But these two methods may not be commodious for parents according to their demands. Most importantly parents do not get surety about their babies' safety in both of the cases. In this perspective, a baby monitoring device can be the best solution to remove the anxiety & stress of the parents.

II. NEED OF PROJECT

We cannot believe that nobody have come up with an innovative idea of designing better infant care systems at a reasonable cost to monitor the condition of a baby continuously and inform parents. The first baby monitor was the Zenith Radio Nurse in 1937. This Zenith Radio product was developed by Eugene F. McDonald, and designed by Japanese-American sculptor and product designer Isamu Noguchi. Some baby monitors also use a video camera to show pictures on the receiver, either by plugging the receiver into a television or by including a portable LCD screen. This type of surveillance camera is often called a baby cam. Some baby cams can work at night with low light levels. Most video baby monitors today have a night vision feature. Infrared LEDs attached on the front of the camera allow a user to see the baby in a dark room. Video baby monitors that have night vision mode will switch to this mode automatically in the dark. Some advanced baby cams now work over Wi-Fi so parents can watch babies through their smartphone or computer. Baby monitors continue to evolve and now also can utilize features such as night lights and built-in lullabies. These are not available in all monitors. Some include temperature and movement monitoring devices to sit underneath a mattress or close to the baby within a cot. A baby movement monitor uses sensor pads placed under the crib mattress to detect movement, if movement stops for more than 20 seconds an alarm will sound. There are systems to monitor, but no system completely gives the health status of baby to the parents. The solution to this problem could be design of a special monitoring system, especially for infants i.e., from (0-3) years. The system should continuously monitor the external conditions of the baby and it should be reasonably inexpensive.

- a. Save the time.
- b. Provides maximum Health security.
- c. Effortless system.
- d. Provides external safety. (Travelling, like Garden, shopping center, railway/Airlines journey etc.)

III. LITERATURE SURVEY

[1] Soukaina Bangui, Mohammed El Kihal and Yassine Salih-Alj.

This system is proposed to provide an enhanced noise canceling system to overcome the Sound pollution in order to make babies' monitoring rooms more comfortable. The author Have Designed a low-cost baby monitoring system which can detect sound when a baby cry And is attached to a cradle which swings automatically once the system detects a sound and The Cradle does not stop until the baby stops crying. A camera is also mounted on the top of The Cradle to get the video output of the surroundings of the baby.

[2] Savita P. Patil, Manisha R. Mhetre based on GSM network.

This system can monitor body temperature, moisture, pulse rate and movement of a baby And deliver the obtained data to the parents using the advantage of GSM network(mobile) However, this system is controlled by microcontroller whereas Raspberry - Pi is used for Controlling purpose of the system that has been presented in this paper.

[3] Ziganshin E. G., Numerov M. A., Vygolov S. A. have proposed a baby monitoring system Using ultra-wideband (UWB) technology. This system is developed mainly with a purpose of diagnosis of obstructive sleeping disorders of babies which are known as sleep apnea.

IV. RESEARCH METHODOLOGY

A baby movement monitor uses sensor pads placed under the crib mattress to detect movement, if movement stops for more than 20 seconds an alarm will sound. Baby monitors generally use wireless systems, but can also use wires or may operate over existing household wiring such as X10. Wireless systems use radio frequencies that are designated by governments for unlicensed use. For example, in North America frequencies near 49 MHz, 902 MHz or 2.4 GHz are available. While these frequencies are not assigned to powerful television or radio broadcasting transmitters, interference from other wireless devices such as cordless telephones, wireless toys, computer wireless networks, radar, Smart Power Meters and microwave ovens is possible.

Digital audio wireless systems using DECT, are resistant to interference and have a range up to 300 m. Analog audio transmissions can be picked up at a distance from the home by a scanner receiver or other baby monitor receivers, and so present a risk to privacy as long as the transmitter is switched on. Digital transmission such as Frequency-hopping spread spectrum provides a level of protection from casual interception. Some wireless baby monitors support multiple cameras on one handheld monitor-receiver. These systems are even compatible with a standard wireless security camera. FM transmitters, paired with a microphone can be an inexpensive solution to a DIY baby monitor, since clock radios can also be used as one. Smartphone apps allow a user to monitor a camera-equipped device, such as another smartphone or a tablet. Alternatively, Wi-Fi or Bluetooth can link a camera to a dedicated app on a smartphone or tablet. This means a smart device doesn't need to be left in the baby's room. Portable battery-operated receivers can be carried by the parent around the house. The transmitter stays near the infant crib and is usually plugged into a socket. Some baby monitor packages include two receivers. Baby monitors may have a visible signal as well as repeating the sound. This is often in the form of a set of lights to indicate the noise level, allowing the device to be used when it is inappropriate or impractical for the receiver to play the sound. Other monitors have a vibrating alert on the receiver making it particularly useful for people with hearing difficulties. Systems with several transmitters can monitor several rooms in the home at once. Transmitters with movement sensors such as a pressure-sensitive mat placed beneath the child's mattress give additional warning of restless activity by the infant.

3.1 Block and Circuit Diagram

A self-regulating baby rocker containing noise sensor for determining the cry of the baby is proposed. Audio or noise sensor contains electronic MIC having a pre-amplifier that amplifies the input sound signal which is in turn passed to Arduino atmega328 microprogrammed control unit to supervise dc motor for swinging. Few beautiful LED lights are used to engage the baby while the swing is set. [4] A self-regulating automatic baby cradle for cry detection was proposed which involves use of microcontrollers. Micro controller converts sound to electrical signals. It controls the output signal and output is sent to DC motor that makes the cradle to start swinging. The model has wet sensor to demonstrate baby's wetness situation, at the point newborn child wets, resistance value would change subsequently sending a signal. Distinctive sensor like respiratory sensor is used to monitor apnea condition and temperature sensor to indicate temperature around the infant. GSM modem has been utilized to send the SMS to the parent if infant is constantly crying. [5] Computation of adjusting the cradle affecting degree by the sensor signal is proposed. The cradle is comprised of an adaptable affecting device and distinctive sensor framework. A calculation for modifying the support influencing degree by the sensor sign is proposed. Whenever the baby is crying, the sensor framework can survey the cause as demonstrated by recognizing the important standards, offering the unmistakable hints to control circuit. Meanwhile, the cradle possibly starts to impact. The affecting mind-set can be adjusted as demonstrated by the parameters from status of the toddler. They utilized 3 wet sensors arranged in the base of the cradle, one at the concentration and second at left and third at the right of the base. [6] The Slider-crank mechanism has been proposed which is applied to change rotatory movement into translatory movement with the help of a rotating driving beam that has been proposed in the framework which includes utilization of sensors. Motion detector is an apparatus that identifies moving articles, especially individuals. Sound sensors distinguish both balanced decibel [dBA] and decibels [dB]. Decibel is an estimation of sound weight. Primary constraint of this proposed system is that it makes greater commotion because of which child gets aggravated. The proposed framework isn't sufficiently talented for taking care of sound and giving solace to the child. [7] Andrew et. al. proposed to make a Cradle that ought to be controllable by an advanced cell which transmits information for example, video/sound stream. The proposition for keen support framework was made. It ought to have a programmed approach to comfort the infant if the guardian cannot get to the child immediately. The proposed arrangement concocted a few highlights. They have utilized an embedded controller or microprogrammed control unit, wireless internet access module shield, router, speaker, stepper engine, electronic mic.

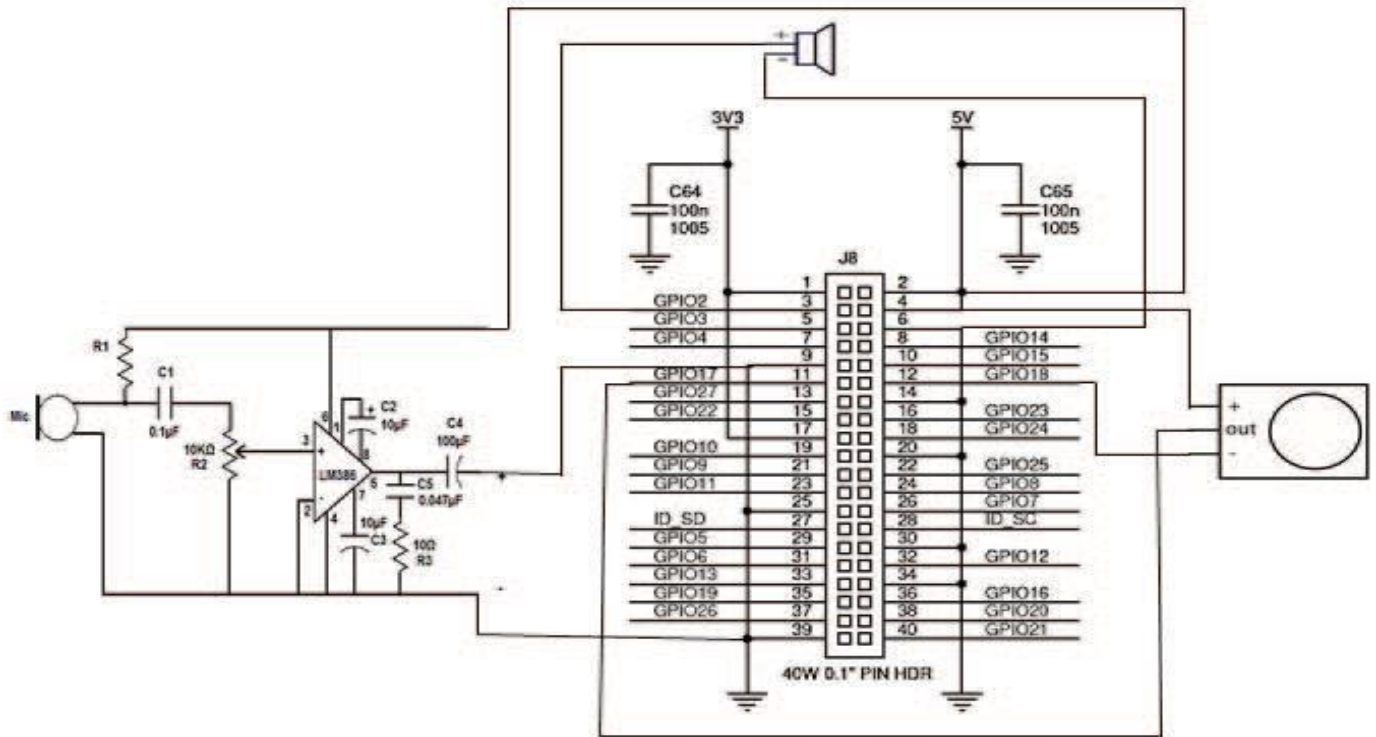


Fig1. Circuits diagram of Baby monitoring systems

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market.

Specification of Raspberry Pi:

- CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz.
- GPU: 400MHz Video Core IV multimedia.
- Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
- USB ports: 4.
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack.
- Network: 10/100Mbps Ethernet and 802.11n Wireless LAN.
- Raspberry pi board adapter 5v / 2A – Power Supply of Raspberry pi.

Flow Chart:

The flow chart of of monitoring system is shoen below in that we can see that start with operating system followed by python script then initializing G PIO on board after that scan the G PIO system if motion is detected then buzzer is on and system is work successfully.

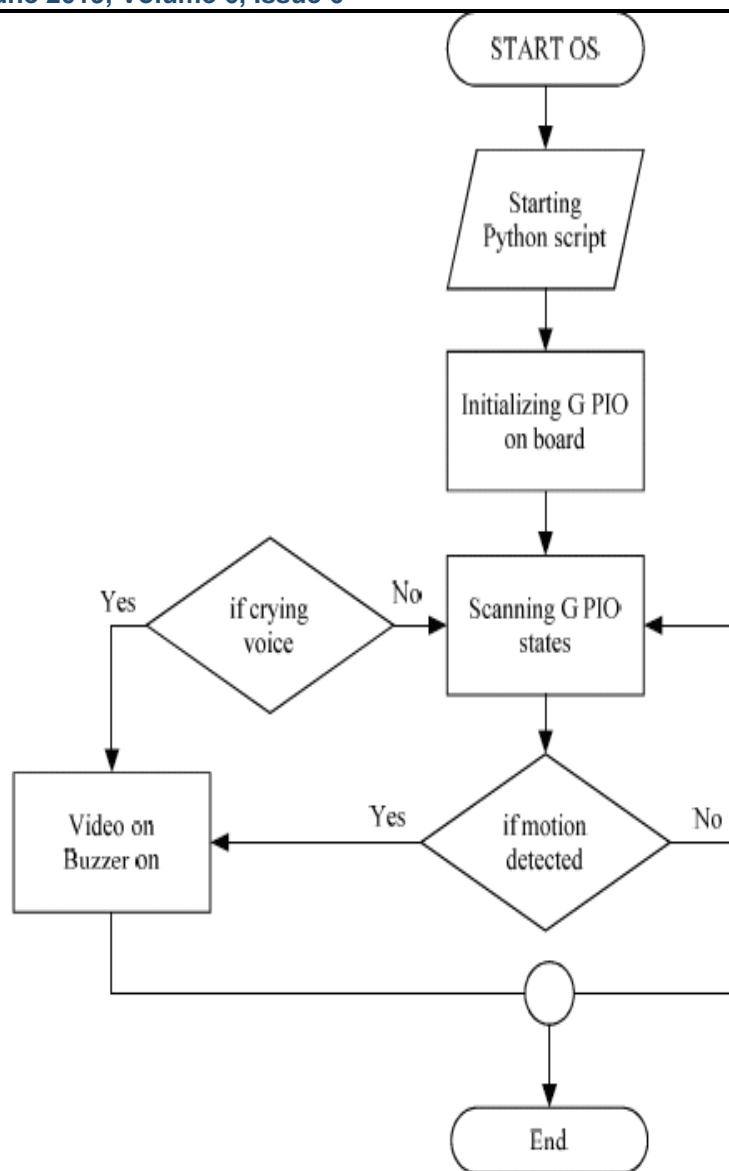


Fig.2 Flow chart of system

The PIR sensor senses motion and always used to detect human movement within predetermined range. At first, the PIR sensor senses the baby motion and then the information is passed through the 22 number GPIO pin of Raspberry Pi. The GPIO is used as an output. When there is no motion detected, the GPIO is set low, and the buzzer gives no alarm. If the PIR motion sensor detects the baby motion, it outputs generates a 5- volt signal to the Raspberry Pi through its GPIO and the buzzer gives an alarm. Similarly, the condenser MIC picks up sound signals from baby and transforms them into electrical signals. The signal is passed through 14 numbers GPIO pin. If the baby is crying, the GPIO is set high and the buzzer gives the alarm. If the baby is sleeping, the GPIO is set low and the buzzer remains silent. Raspberry Pi shows up with two first-rate connectors on board. One is in between Ethernet and HDMI, another is close to GPIO. The one, which is nearer to Ethernet connection, is Camera Serial Interface (CSI). This CSI is directly attached to the Raspberry Pi GPU that can process images devoid of ARM intervention.

The functions of the sensors implemented are as follows: Noise sensor: The noise sensor is used to detect the sound level of the baby's cry and if the sound level is higher than the threshold value, an amplified signal is sent to the servo motor for automatic swinging of the cradle. DHT sensor: DHT sensor is used to measure the temperature and humidity of the cradle. The main aim of using DHT sensor is to get the current temperature of the atmosphere around the baby. For instance, the temperature is above 22 degree it causes a discomfort to the baby that time the parent can pay attention to the baby by swinging the cradle through the mobile application. PIR sensor: PIR sensor is used to detect the movement of the child inside the cradle. In the proposed model two PIR sensors are used which are placed in the extreme two opposite corner of the cradle for more accurate data. When the child turns to right or left the current status is sent to the mobile application. If the baby is uncomfortable inside the cradle the movement of the baby inside the cradle will be changing continuously. Wifi Module: A Wifi module is used to connect the sensors of the cradle system to the Blynk cloud services via Arduino. Arduino: Takes the signal from the Wifi module sends the data to the Blynk cloud. The Blynk Cloud sends the data of the sensors to the mobile application. Camera module: The parent will be able to speak to the child through the mobile application which is connected to the camera. The parent will be able to see the child live on his/her mobile application.

IV. CONCLUSION

4.1 Features:

- Portable battery-operated receivers can be carried by the parent around the house.

- The transmitter stays near the infant crib and is usually plugged into a socket. Some baby monitor packages include two receivers.
- Baby monitors may have a visible signal as well as repeating the sound.
- This is often in the form of a set of lights to indicate the noise level, allowing the device to be used when it is inappropriate or impractical for the receiver to play the sound.
- Other monitors have a vibrating alert on the receiver making it particularly useful for people with hearing difficulties.
- Systems with several transmitters can monitor several rooms in the home at once.
- Transmitters with movement sensors such as a pressure-sensitive mat placed beneath the child's mattress give additional warning of restless activity by the infant.

4.2 Application and Advantage:

- Application of this device is good for security reasons.
- Military people can also make use of it, especially during night time.
- Some of the other places where the PIR sensor can be used are parking area, supermarket, library, hospital, grocery stores, garden and many such public places
- In this globalization world save electricity is the important fact and PIR sensor looks after it effectively.
- It can make use of these detectors in equipment as well as appliances
- It is a good source of saving energy
- Evaluation of moving object becomes easy due to the intensity of infrared lights.
- You can also adjust it according to the outside changing temperature.
- You don't have to get dependent on exterior sources of energy as electricity gets produced from infrared lights.
- Spotlight of IR light is possible because of lenses present in PIR sensor.
- It responds aptly to living beings (human, animals) motion and can get adjusted to body temperature.
- It can make use of it on DVDs or television sets or VCRs.

4.3 Disadvantage:

- PIR sensors have a property of only receiving infrared light and cannot emit it like other types of infrared sensors.
- They can be expensive to purchase, calibrate and install.
- The chances of not covering the entire room. So multiple sensors have to use
- The chances of triggering the motion detector then you don't want to
- If the outside detector is placed or mounted too close to a light that stays on at night then it will be triggered continuously by bugs.
- Some of the things like direct wind from the cooler/ air conditioner, fire places or heater can affect because it actually detects the change in the IR energy. To specifically the heat energy emitted by a normal human skin temperature.

4.4 Future scope:

- Analysis of Infant Activities.
- Video Enhancement.
- Instant Mobile App Notification.
- Better Monitoring of Baby.
- Automation of System.
- Real-Time Database.
- Accurate Sensors.
- Cry Analysis Pattern.
- Analog to Digital Conversion.

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