Speech Signal Processing Based on Machine learning and Complex Processors for Baby Cry Detection System

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Abstract—

Nowadays, a lot of parents has hired a maid to help them to take care of their babies because of the difficulty to take care of newborn babies. Moreover, Parents need to do housework as well as taking care of their newborn babies. However, many maids have been reported to have some adverse effect on these babies as they grow up. Furthermore, some maids may even expose these babies to too many unexpected risks that would place them at risk. In this research, a baby crying detection system is developed using a Raspberry Pi and Wireless Sensor Network (WSN). Several equipment and controls such as sound sensors, video sensors were integrated and used for baby room surveillance. The Speaking is a communication medium, and speech can be characterized by signals and signals that contain significant information and the information is in sound waveforms. Voice signal is an application of voice signal processing technology. For applications that are in digital form, they rely more on digitally processed speech signals, implement complex technologies, andThe framework was programmed using programming language Python 3.6 and Java 8.0, which was used for real-time data transmission and application signaling. Finally, the system will send the data to a remote smartphone. Moreover, the work is integrated with machine learning and IP address to boost the detection mechanism.

Keywords— Baby cry detection, Baby monitoring, Raspberry Pi, Wireless Sensor Network, Speech signal processing technology, communication medium.

1.INTRODUCTION:

The experience parents can differentiate baby crying based on experience and training. Nevertheless, hearing baby cries is challenging for young parents and for beginner childcare workers. Cry is an inherent action and is used by infants as the very begin method of communication to communicate with their parents or caretakers. The vibration of the vocal cords, that are regulated by only the Central Nervous System (CNS), creates cry vocalizations related to the expression of adults. Parents suffering from Postpartum Depression (PPD), a disorder identified by 10–15% of parents are in high-income countries, as well as up to 50% is in low and middle-income countries. The lower rate of stimulus generated by baby cry and lowers the level of sensitivity of parents to their needs of children. There are three main issues after giving birth, first is increases on hormones. Girls undergo a significant decrease in the levels of oestrogen and progesterone hormones following childbirth. Thyroid levels can also decrease, leading to tiredness and depression.The Postpartum Melancholy (PPD) is a crucial public health difficulty, with 2.6 to 35.0% of women experiencing major or minor melancholy someday inside the first 12 months after giving birth. In addition, the PPD negatively affects women's functioning, non-public relationships, and her kid's social and cognitive development Engaging in the everyday workout

and physical pastime has been confirmed as a successful treatment modality for primary and minor melancholy inside the general population, and The Physical Activity (PA) may also mean an extension of activities rather than casual ones, consisting of education, travel, treatment, and family activities. In a new meta-evaluation, PA in leisure time is the most effective solution to avoiding mental illness relative to PA in other fields of life. Equally important is the role of domain-unique PA when reading its implications in diminishing the risk of postnatal despair. Past findings of the relationship between prenatal.

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Speech processing is the study of speech signals and the processing methods of signals. The signals are usually processed in a digital representation, so speech processing can be regarded as a special case of digital signal processing, applied to speech signals. Aspects of speech processing includes the acquisition, manipulation, storage, transfer and output of speech signals. The input is called speech recognition and the output is called speech synthesis.

1.1 Research Problem

The working parents face a lot of problems in their daily lives with infant/babies. They cannot afford to pay their infant's adequate time. Infants and babies require 24 hours of care, which is extremely difficult for working parents It is uncomfortable for them to constantly look out for their baby while they're doing work or routine duties. Continuous monitoring of a new-born is a very difficult job because it is not simple for the parents to bring along their infants with them the whole time, especially when going to work The easy option for taking care baby by sending babies to day care centre or employing a caretaker to take care the babies is an option when parents are busy at home or in the workplace. But according to their requirements these two methods will not be capacious for parents.

1.1.2 Research Aim and Objectives :

The main aim of this paper is to develop the infant parenting physical cry recognize system by using raspberry pi and pyton+ Arduino. Furthermore, it will decrease the depression and anxiety of taking care baby of parent. The research consist of 3 main objectives. The first objective of this paper is to analyse the depression and anxiety of parent or childcare from baby parenting. Second objective is to reduce the time consume on taking care of babies. Finally, the third objective is to design and develop a satisfies baby crying detect system with the hardware by using Raspberry Pi.

The remaining paper is organized as follows. Section 2 discusses the related work. Section 3 elaborates the methodology of the proposed system. Section 4 explains the results and discussion of the proposed system. Section 5 concluded the paper.

2. LITERATURE REVIEW

Nowadays, it is becoming very difficult for most parents of new-born babies to care for their babies as well as to do their day-to-day activities due to a fairly busy lifestyle, as many women still participate in both domestic and income-generating duties. Therefore, mothers with new-born babies can't always be with them. Parents also have to cook, clean, do laundry and so on, but they have to either choose to complete a job or go to the baby's comfort. Sometimes maybe the parents are outside gardening or taking a shower, and can't hear the babies crying. Author [4] clarified in this regard that these babies may be exposed to so many unexpected threats that could place him/her in danger. Adding that, because of long-time abuse, such dangerous situation may come from atmosphere or stress. Furthermore, the author [5] added that, in line with all of this, many parents have to hire a maid to help them take care of their children. Some maids, however, have been reported to have some adverse impact on these babies as they grow up and some might even expose these babies to too many unexpected risks that may put them at risk [18].As most people talk of SIDS they don't know it applies to two medically defined words. First one is Sudden Unexpected Infant Death (SUID), and the second one is Sudden Infant Death Syndrome (SIDS). According to author [6], every year about 4,000 children under the age of one die from both SUID and SIDS, of which about half of the deaths come from SIDS. The causes of death most commonly include SIDS, which causes unexplained, accidental suffocation and strangulation in bed. In 2010 there were 2063 deaths from SIDS, 918 as an unexplained cause, and 629 as accidental suffocation and strangulation in bed [6]. The causes of death most commonly include SIDS, which causes unexplained, accidental suffocation and strangulation in bed. In addition, Sudden Infant Death Syndrome (SIDS) would be a sudden death of an infant under age one which

cannot be clarified despite a thorough examination and analysis, whereas sudden unexplained infant death (SUID) is a sudden and unexpected death of an infant under age one [6]. As nearly half of the deaths cannot be explained, the policy of the American Academy of Paediatrics is to include a healthy sleep atmosphere with guidelines including supine positioning, use of a firm sleeping surface, breastfeeding, room-sharing without bed-sharing, regular immunization, consideration of using a pacifier, So preventing loose bedding, overheating so exposure to smoke, alcohol and illegal drugs. The advancement of technology, nursing care as well as the remote access of physiological data has recently increased in significance. Author [6] described that monitoring the home healthcare of patients and babies. Throughout the cases of south Africa, parents care about their kids and also want to be with them often.

There are several home care services available, but much of the program is built especially for the aged and patients. Such devices can monitor their safety status, send out warning alerts automatically and also other features. The forms of treatment for children are not the same. Kids and adults need different kinds of treatment, as they are entirely dependent on someone else for their usual functions. Children can't provide any input on their concerns on pain or safety. Kids cannot articulate themselves like elderly people, example, when an child has fever, for example, the baby can only show the baby pain by weeping. Therefore, a home-care program expressly tailored for children is the need of today that would significantly lighten the burden on parents , particularly the mother. Several academic papers and patents for healthcare technology are reviewed in favour of this criteria with the goal of potential approaches to treatment for the child. A framework based on commercial GSM network had been developed by the founder [7].

Vital parameters including such calculation of temperature utilizing LM 35 [4] [7], pulse rate via IR transceivers, respiratory rate through using Piezo film sensor placed on Patient's chest that blood pressure is detected, varying gain amplified, processed and given to microcontroller. External sub-system with GSM module collects input which will then be sent via USB port to a server. The data is stored on the

server and viewed online on a web screen. In the SMS-based telemedicine network, patient heat calculated by Infrared digital temperature MLX 90614 including ECG signals obtained with PIC16F877 microcontroller-interfaced electrodes [8]. A wearable device gear is being built that records the baby's biological position including such acceleration, warmth and heart rate measurements (both optical and pressure) operated by the microcontroller and attached to the Bluetooth module that can provide enable mobile communication[9]. By using SYHS2XX series humidity sensor, a body-temperature detector, the ambient temperature-sample was also used to measure the condition around the baby and embryo humidity was controlled. Such signals are interfaced with the 18F4550 PIC microcontroller, and GSM modem is used for contact.

Patents are still being applied to find innovation in the control system for infant care. In architecture a device is being built to control breathing, temperature and infant sleeping duration in the crib. There is a package that has three sensors mounted to the diaper. Such signals are generated, sent by transmission so then a receiver also at remote station, an amplifier that adds this signal to the audible beep in order to warn parents to take suitable response. A.S. Patent No.6,043,747 (Altenhofen), Where a parent group will record signals which can then be shown to the baby unit to relax or soothe the baby [12]. The baby package includes a microphone which is capable of communicating sounds to the user. Nonetheless, to diagnose a concern with the infant, the parent must continuously track the sounds from the baby unit. America's First Patent No. 6,450,168 B1 [13], contains a baby's sleep bed sheet or clothing given either as a sleeping bag or as a sleeping jacket, based on the child's age. The bag for new-borns without arm holes, except for older babies with arm holes except sleeves

A. **Review On Existing System**

Several experiments have conducted with various approaches to explore the implications of automatic baby cradles. A baby management system was proposed in [14], in which an improved noise cancelation system was recommended which controls the baby and prevents noise exposure. The system's primary aim is to reduce the disruption that would interrupt the infant by playing soothing music.

With the aid of a light sensor this device can also change the light intensity of the room. The device does have more sophisticated functionality, though, such as enabling real-time tracking over the IoT environment and tracking vision via web camera[19][21].

Goyal and Kumar[15] developed an E-baby cradle which can wave continuously once it hears crying and once the crying starts swinging. The frequency for the swinging cradle are being adjusted according to the needs of the parents. Does have an alarm installed in the device which alerts the user when there were two situations. The first one is the surface is damp the alert will go off signalling that the bed must be adjusted. Secondly, the warning warns people to come to their baby if the baby does not stop screaming after a given amount of time. Nevertheless, it is not useful if parents are next to the baby, as it requires only a buzzer warning, the sound of which may scare the infant. A similar automated control device for babies was suggested by author [16]. The author have built a low-budget device that moves the cradle after identification of the crying tone, and the cradle ceases once the baby starts crying. The built-in sirens went off in one of the following conditions: the bed is damp, or after a certain time, the infant doesn't really stop screaming. To track the baby a video camera is positioned over the cradle. The guardians, nevertheless, can only collect the warning message via SMS, so they cannot monitor the device. The device introduced in the current study is also more sophisticated, as it uses an IoT platform to track and manage the smart cradle built anywhere and anywhere in real time.

3. METHODOLOGY:

This sections provides a basic voice identification system that can effectively be linked to the design of a gadget capable of recognizing the cry of a baby and automatically switching on baby rest music. The model contains voice recognizer and other electronic gadgets connected to Raspberry Pi. The music devices run with sensor and processor synchronization. The baby parenting is a kind of alert system that can identify the cry condition of infants. It can relay the babies status message [34] to the person worried via a wireless or telephone. Speech recognition is the process of translating spoken words into a computer-

readable format, which clearly meant translation into a binary language. Converting speech into on-screen text or computer commands requires the computer to go through several complex steps. When a person speaks, he vibrates in the air, which is essentially analog. Analog-To-Digital Converters (ADC) convert this analog waveform into computer-understandable digital data. To do this, use an accurate measurement of the waves to digitize the sample or sound at frequent intervals. For process audio, the system sometimes separates into different frequency bands and filters the digitized sound to remove unwanted noise. It also normalizes the sound and adjusts it to a constant volume. You can also align the time

Baby crying alert system architecture will be developed based on the Rapid Application Development (RAD) model in which this platform is considered to rely on an agile approach. RAD approach is suitable to be applied in this project because it is actually facing a time-limiting challenge with the goal of producing a fast outcome. RAD model also focuses on more customer interaction to gain product input and specifications. The RAD model explicitly allocates a certain amount of time for each step, over a limited time span to guarantee that the research will be complete on time. Figure 1, shows the rapid application development processes.

Figure 1: Rapid Application Development Processes

3.1   Requirements Planning:

Requirement preparation is the first step of the RAD approach where engineers and stakeholders have to consult frequently with each other in order to understand the system 's specific specifications and prepare how the negotiated task is to be carried out [35]. The specifications, goals and priorities are explicitly identified by the customer and the contractor in order to provide a shared vision of how it can be accomplished with as few capital as possible within a limited period of time.

3.2   User Design:

Each process is based on using multiple concept experimentation to construct the interface experience. This process reflects the central and critical component of the RAD technique. During this step, the customer and the developer will continuously collaborate and ensure that all the specifications and goals are fulfilled according to the previously defined criteria (process) that it is much like customizing the specification according to the needs of the client.

3.3 Construction

This process converts the concept into a perfect working model, where both the context and specifications are transformed into a full production model. The developer should assume less errors and problem in this process because most of the problems and bugs with in earlier phase were resolved. In this step, the user also has to provide in to their choice to further develop the application and suit the applicant's unique needs. Another process will concentrate on the back end of the system because the user interface was already addressed with the customer in the earlier phase, and this step will just help enhance device performance.

3.4 Transition (Cutover)

It is the last step of RAD in which the project must continue in this process. In this step, all specifications such as data transfer, checking, and transitioning to the new system must experience along with the user's training in using the system. This stage is also recognized as the phase of testing which decides the functionality and reliability of the system. This process checks all system components to ensure the system is in complete operating order and is necessary to report any defects or unusual phenomena inside the system to the manufacturer. Each process will be exposed to several test series including unit checking, configuration checking, device testing and, lastly, user experience testing the research methodology is divided into two phases. Phase one is on study of literature and phase two is interview.

Table 1: Baby Crying Noise With Negative Emotional Feeling

Question	Level of Agree	Frequency	Percentage
A1. Do your partner has helped you to take care your baby	1 Strongly Agree	5	5%
	2	50	50%
	3	0	0%
	4	45	45%
	5 Strongly Disagree	0	0%
A2. Have you face anxiety while baby is crying	1 Strongly Agree	30	30%
	2	70	70%
	3	0	0%
	4	0	0%
	5 Strongly Disagree	0	0%
A3. Can the music able to calm down the baby while baby is crying	1 Strongly Agree	0	0%
	2	32	32%
	3	48	48%
	4	10	10%
	5 Strongly Disagree	10	10%

In the Table 1, the data of A1 has represent the respondent partner helped to take care their baby the group of agree (5%+50% = 55%) are get helped. There are 45% are not agree their partner are helping them for taking care their baby. Furthermore, in this question we can know, the respondent's partner helping are almost half compare to entire result.

Table 2: Baby Monitoring and Time

Question	Answer	Frequency	Percentages
B1. Average per day, how much time you have sleep while taking care your baby?	below 8 hours	100	100%
	More than 8 hours	0	0%
B2. Have you ever owned a baby monitoring system?	Yes	13	13%
	No	87	87%
B3. How much time spend to relax the crying baby	10 - 30 minutes	32	32%
	31 – 60 minutes	68	68%

Table 2 shows the baby monitoring and time by using Hypothesis 2. In the Table 2 the data showing 100% of respondent are not having time to reach the exactly 8 hours rest time. The baby monitoring system are not reached the trending level there are only 13% of respondent has used the baby monitoring system. the time spend for calm a baby down until not crying 32% of respondent can finish within 30 minutes. However, 68% are within 31 to 60 minutes.

Table 3: User Satisfaction Updates

Question	Answer	Frequency
C1. Which are the most important features for you while considering owning a baby monitoring system? (can select more than 1)	Music to relax baby	44
	Crying Alert	87
	Security Features	0
	Easy to set up	33
	Wi-Fi - connectivity	10
	Smartphone Access	75
	Wearable	2
	Video Monitoring	100
C2. Did you own any following device	Phone	100
	Tablet	22
	Pc/ Laptop	61

Question	answer	Frequency	Percentages
	Yes	67	67%

C3. Would you like to be considered for this testing opportunity	No	2	2%
	Maybe	21	21%
C4. User Satisfaction	Yes	70	77.7%
	No	20	22.7%

Table 3 is showing the user satisfaction updates by using Hypothesis 3. To conclude the Table 3, the system can exclude the features of security features (0%) and wearable (2%). Additionally, the most concern features are crying alert (87%), video monitoring (100%), and smartphone access (75%) for the music to relax and ease to set up features we will set as optional features.

3.5 Speech Processing Using Machine Learning

In machine learning, the most basic thing to get satisfactory results is to have a good understanding of the algorithms used and problem constraints. Also, all machine learning algorithms and methods are somewhat different. For example, fewmethods are designed based on certain assumptions or other types of data inapplicablefor the specific type of data that makes them. This is why the number of applicants in learning data may have multiple machine learning methods.super-connected society.Here, speech recognition represents the development of flexible piezoelectric materials, self-powered sensors, machine learning algorithms and speaker recognition.
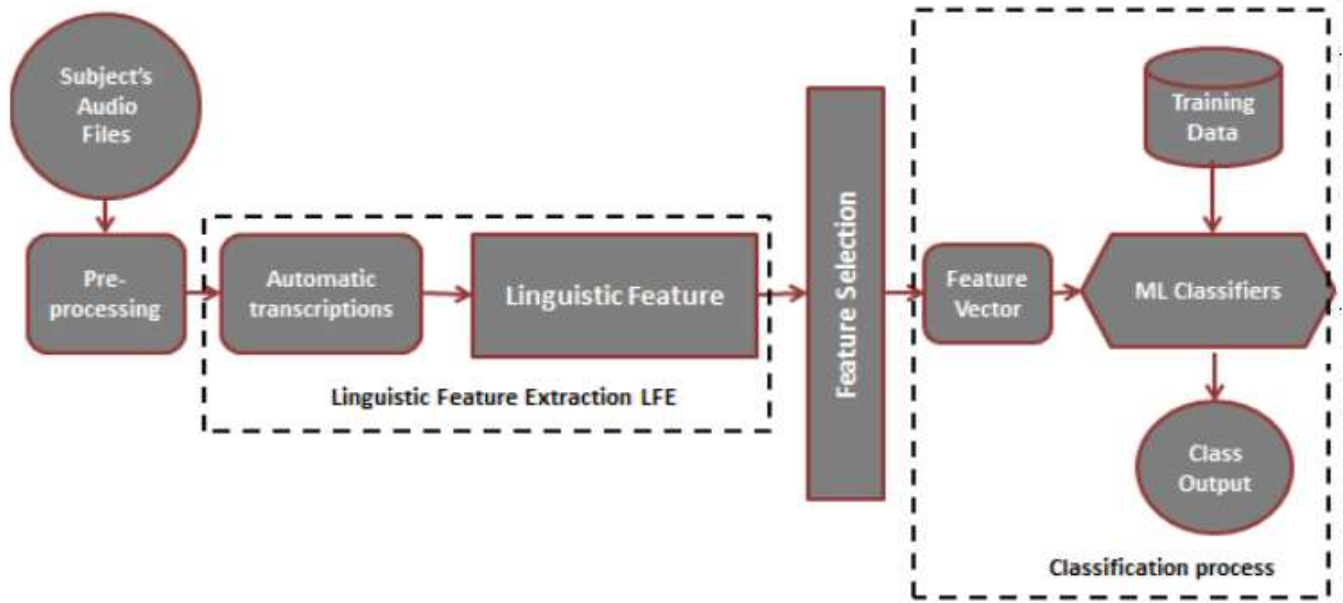
Figure 2: Speech processing architecture

4.Result and Discussion

Design infant monitoring program functions The Raspberry Pi B+ package will act as the main control unit. The Raspberry Pi is a low-cost microcontroller measured by credit cards that could generate data when connected into a monitor
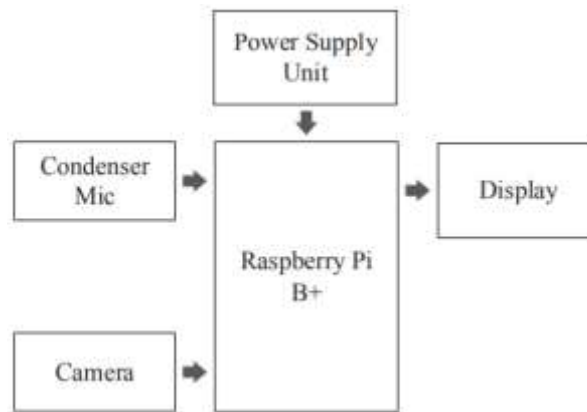
Figure 3 : Infant Monitoring Program Functions

Condenser MIC will be included with this design to monitor the baby crying which to offer the Raspberry Pi's alert. A Pi camera that would be another defining aspect of this device. It will also be installed on the machine to get the immediate video output of the location where the baby is located. The Raspberry Pi Camera Module is a special mechanism that insert-on the Raspberry Pi.

Figure 4: Raspberry Pi Alert Command

4.1 Circuit Design

Figure 4 shows the circuit diagram of a baby crying detection system which comprises Raspberry Pi Model 3B+ (v1.2), condenser MIC (LM393) and Raspberry Pi Camera Rev 1.3. The Raspberry Pi Model B+ board contain a 40-pin expansion header labelled as 'J8' providing access to 28 GPIO pins with 8 ground pins and 4 power pins. The output of condenser microphone relates to 17 number GPIO pin the output of PIR Sensor related to 27 number GPIO pins of Raspberry Pi. The Output buzzer relates to GPIO pins of Raspberry Pi.
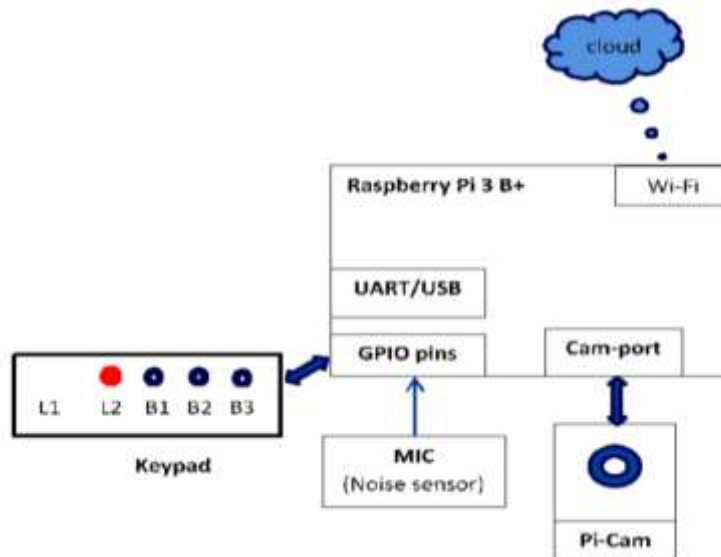
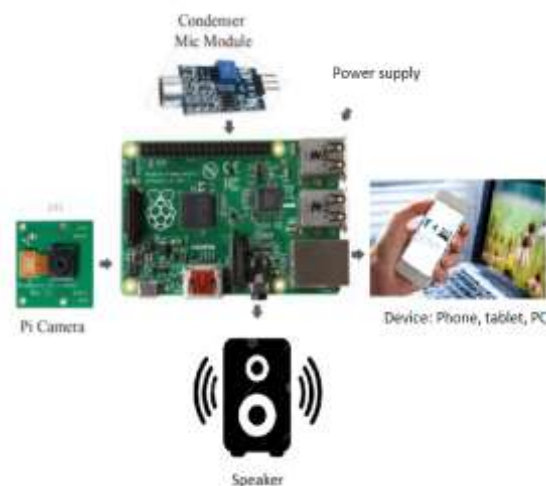Figure 5: Circuit Diagram for baby Crying Detection System

Figure 6: Overview of baby Crying Detection System

Python language is a programming language which has been applied to configure Raspberry Pi after installing the Raspbian Operating System in the SD card. To make eligible, the Raspberry Pi uses Pi camera. In addition, the library files of Pi camera have been installed into the system. After starting the operating system, the Raspberry Pi will be powered up. And it will initialize the python script. The General-Purpose Input/Output (GPIO) port will then activate to operate.
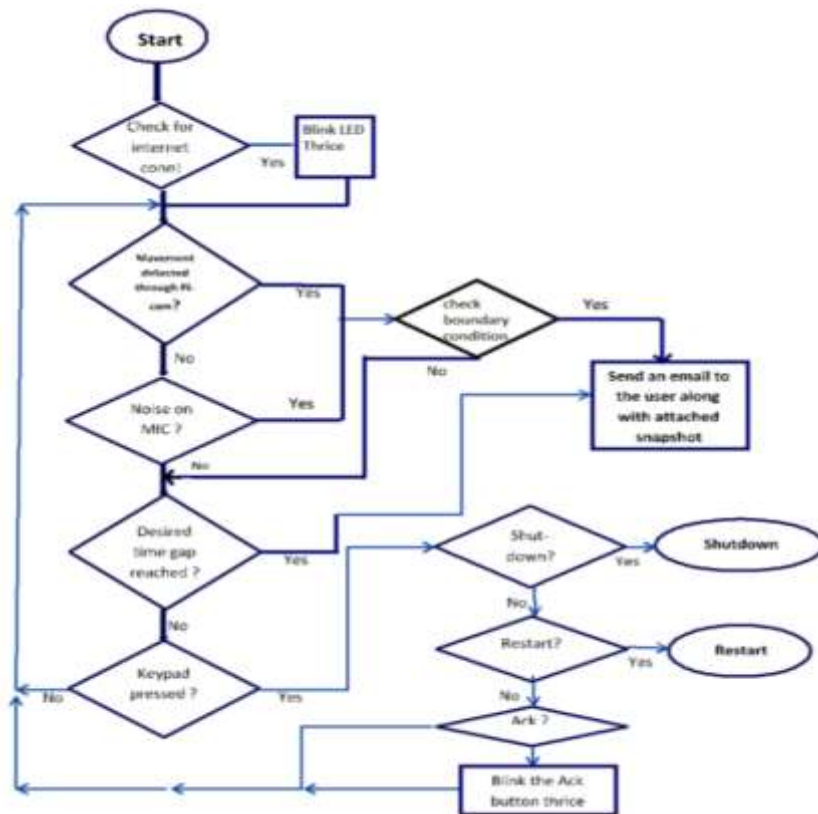
Figure 7: Baby Crying Detection System Process

4.2   Result

The Raspberry Pi camera is established so that the baby face and body can be filmed accurately. It shown in the Figure 7. Moreover, When the baby has start crying. The condenser mic is detected the baby is crying and the mic received input. Once received the input by the MIC then it will send signal to the Raspberry Pi. Then the soothing baby music will be activated and start playing from the speaker. At the same time the picture processing is used to see the baby instantly from devices when the Pi camera activates. The image is shown in the Figure 8,

Finally, the system clicking on the snap and giving the parents the boundary warning by mail. The email has successful send to the user email address with baby cry alert. The image shown in the Figure 9. In comparison, Raspberry Pi is a low-cost chip that can make the device cheaper than other existing devices. This system can simultaneously provide the audio and video output.

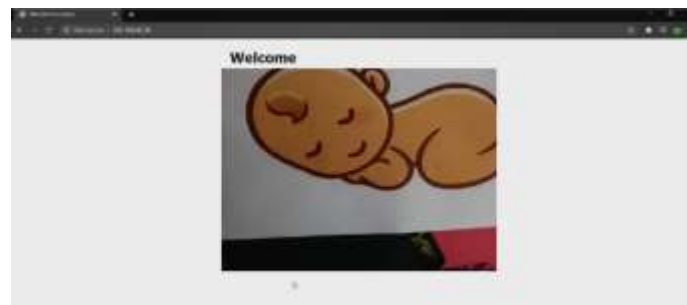Figure 8: Crying Sound Alert Detected Interface
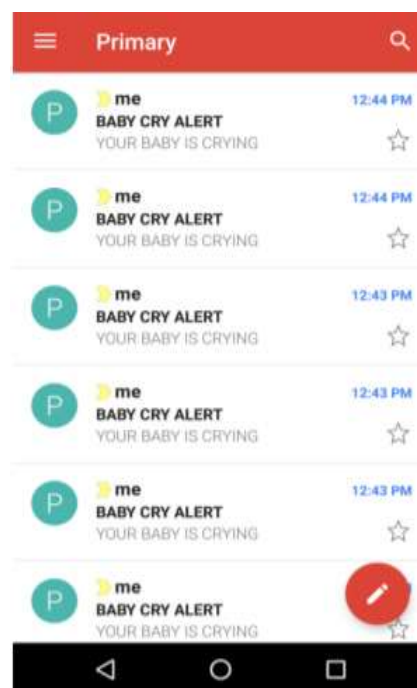
Figure 9: Cameras captured Image

Figure 10: Baby Crying Alert Email

5.CONCLUTION

An automated baby tracking device is the perfect way parents will watch their babies during this busy period. This is simply an method to taking advantage of new technologies that has little impact on the parents' everyday activities. the goal is to establish a tracking program. From the above tests, this proposed baby tracking device can be seen to have a much better performance. As we know the speaking is a communication medium, and speech can be characterized by signals and signals that contain significant information as sound waveforms. Voice signal is an application of voice signal processing technology. This machine is built using module Raspberry Pi B+ which is a microcomputer with a credit card size which has significant advantages over Microcontroller or Arduino. In comparison, Raspberry Pi is a low-cost chip that can make the device cheaper than other existing devices. This system can simultaneously provide the audio and video output. The information gathered is reviewed by numerous literature and user expectation about the system. the questionnaire distributed the understanding of user requirement from the system. the system offering the soothing baby music to bring the baby more calming.

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