

IoT Based Home Automation System for Infants and People with Special Needs

Suresh Balakrishnan, Ramaprasad Poojary

Abstract— Parenting is not an easy task. Good parenting requires the parent to quickly respond to the needs of their child. Constant monitoring of the child also becomes a necessity, especially up to an age of 18 months.

In this work, IoT based baby care and home automation care system for “Infants and special need people” has been presented. This work incorporates various features such as tracking a baby, live video streaming of baby’s activities, temperature, light and humidity control, protection from hot object hazard and design and implementation of IOS and Android based Companion App. One of the most important feature of baby care system is tracking and following a baby to ensure safety. Tracking is achieved by Pixy CMUCAM5 camera sensor which is trained to track the color of baby’s clothes. Pixy sensor is interfaced with Arduino microcontroller to drive the baby care system. Live streaming of activities of baby or people with special need is achieved with the help of video camera interfaced with Raspberry Pi Model 3B. Live streaming is transmitted through ESP 8266 WiFi module through an internet. Parents or Guardian can watch the live video streaming through a companion app. Various features of proposed work has been tested to measure the performance index.

Index Terms— Baby Care system, Home Automation, Tracking, Companion App.

1 INTRODUCTION

CHILDREN Tracking system is widely used all over the world to assure parents that their wards are safe from suspicious actions and their kid is happy in school atmosphere without crying [1,2]. Quick response to a child’s needs and their constant monitoring, up to an age of 18 months, is a prerequisite in parenting. Back in the day, parents relied on hearing the cries of child. This was fairly easy when parents were less busy and homes much smaller. A little negligence on the part of parents can cost a lot, especially since kids are known to run behind mischief [3, 4].

There have been a lot of deaths and accidents reported, in middle east as well as around the world, such as children falling off balconies, playing with guns, putting their hands into live sockets, falling into buckets filled with water and so on. These kinds of tragedies could have been avoided if there was somebody to constantly monitor the activities of the child [2].

This lead us to the development of the ‘Advanced Baby Care System’, a robotic device suitable for present times, serving as an aid in parenting for single and working parents, who find it difficult to attend to their children and engage in other activities at the same time such as cooking, household chores, office work and so on. However, it is not intended to replace the parent or baby sitter completely. Instead, it supports them [5,6].

Currently, most popular baby monitoring devices allow parents to monitor their child through motion and sound. Devices such as walkie talkies and video cameras are used for

this purpose. These are stationary devices, helpful in situations where the baby is confined to its crib, when the baby is asleep or in early stages of development.

Also, the parent has to constantly look at the baby monitor in order to know what their child is doing. There is no way of knowing if they are in danger, until it’s too late [7] ABCS is a device capable of following children who able to crawl or walk and thus helping parents keep track of them, while being engaged in their tasks. ABCS has been designed as a device which can serve as a helping hand to a parent, following the child and automatically alerting them so that the child does not wander off to unsafe zones around the house [3].

Section 2 of the paper explains the methodology of the presented work. It covers various topics such as tracking and monitoring of baby or people with special need. Generation of mobile app to keep track of various parameters such as room temperature, lighting condition and humidity.

Section 3 shows the test results such as temperature and humidity readings measured at different times. Distance vs Temperature graph has been generated to know the sensitivity of the system to hot objects.

Section 4 concludes the presented work.

2 METHODOLOGY

The whole IoT Based care system is divided into different phases according to their features. Each feature of the project is mainly designed with an IoT based system so that system becomes smarter and efficient than the earlier version of the projects. Proposed system is able to provide following features, such as:

- Tracking a baby to monitor its activities and transmit live video streaming of baby’s activities to the parents through Internet.
- Smart IOS and Android App to alert the parents when

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baby approaches dangerous zones & for the change of diaper.

- An vocal diverting system to the baby to divert it away from the unapproachable area.

All the above mentioned features were individually tested to meet their requirement and finally merged into a single unit. As well as this system is designed as detachable units so that it can be used as per the need and the space availability. The complete system architecture of the proposed system has been depicted in Fig. 1.

As shown in Fig 1, Baby care system comprises of two important components known as:

Tracking with Real time video streaming system & Home Automation Care Kit.

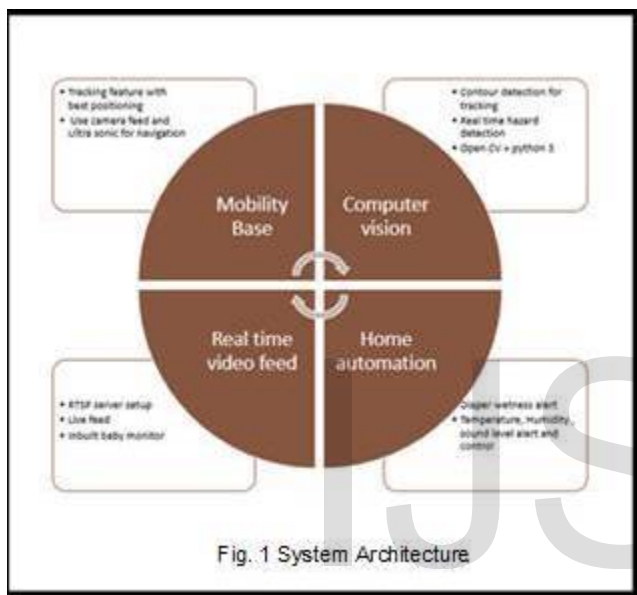


Fig. 1 System Architecture

2.1 Tracking with Real time video streaming

To monitor and track the activities of baby continuously and to follow it, Pixy camera sensor has been used. It has been trained to identify the color of baby's clothes in order to track the baby. Pixy module is interfaced with Arduino microcontroller which can help control the movement of baby care system.

Proposed system also has the feature of transmitting live video streaming of baby's activities to the parents through an App. This is achieved with the help of camera interfaced with Raspberry Pi. The Raspberry Pi camera unit captures the baby movements and transmit to the smart phone through web. A companion app has the feature of live streaming the care system at any time. The same streaming can be viewed in a TV as well as in PC by using additional interfacing unit.

The Video footage can be recorded for a specific time period on the inbuilt memory of the Raspberry Pi. Fig 2 shows the interconnection of tracking & live streaming system.

Trackg & Live streaming unit comprises of following:

- Pixy CMUCAM5 as image sensor.
- Aruidno Uno for controlling movement of baby care system.

- Raspberry Pi camera module for video streaming.
- Raspberry Pi model 3B is used for live video straming
- ESP 8266 WiFi Module for video transmission through internet.

As shown in the Fig. 3, Pixy module can be trained to recognize the different color codes. By marking unsafe areas with various color codes, vocal divert tones can be generated to keep the child away from those areas.

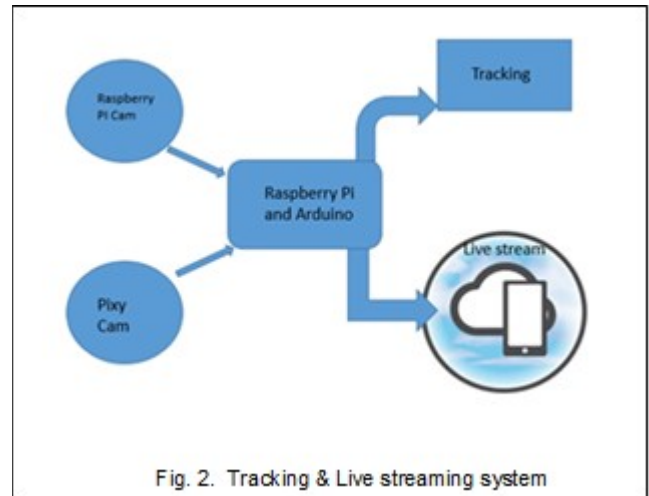


Fig. 2. Tracking & Live streaming system

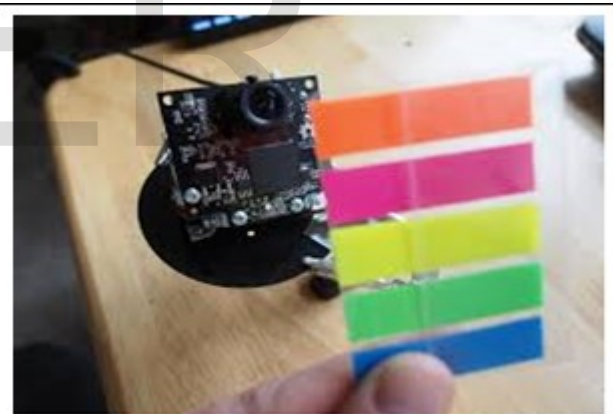


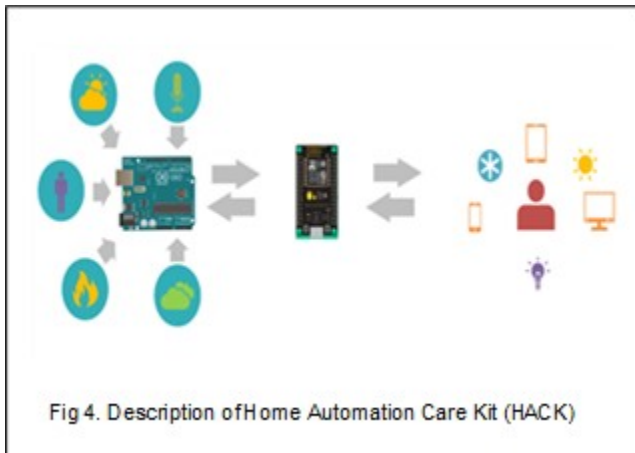
Fig.3 A color code detection by PixyCMUCAM5

2.2 Home Automation Care Kit (HACK)

The living environment is very important for the baby, people with special needs, aged people and people who are under medical care. Hence maintaining the temperature, humidity, light intensity and sound level are most important. Second system of the proposed work shown in Fig 4. handles IoT based home automation which takes care of above mentioned parameters.

- The temperature of the room is sensed by a digital temperature sensor DS18B20. The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements

and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that requires only one data line (and ground) for communication with a central microprocessor. It has been interfaced with Arduino Uno [9]. The Humidity of the room is observed by DHT11 sensor. Which is compatible with Arduino Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration.



Above information will be made useful to parents through an App. ESP 8266 WiFi module has been used for the communication. In addition to monitoring of temperature & humidity, Parents also will be able vary the above parameters if needed through a feedback mechanism with the help of an App.

In addition to above features, HACK system will be able to alert the parents during following three cases:

- The Care system alerts the parent when a child approaches hot objects. Hot objects are detected by using a non-contact IR temperature sensor which has been used for this purpose. The thermal sensor chosen for this application is the Melexis' MLX90614ESF-BAA [10, 11].

- The diaper wetness detection and indication is specially designed for babies. Irrespective of baby tracing system this can be used as an autonomous unit. The wetness of the diaper is sensed by a copper contact outside layer of the diaper. The status will be transmitted to the Care unit through the 433Mhz transmitter module. The information will be received by the Receiver unit on the Care unit, and the same information will be transmitted to the smart phone via wifi. The parent will get the immediate alert about the diaper change notice.

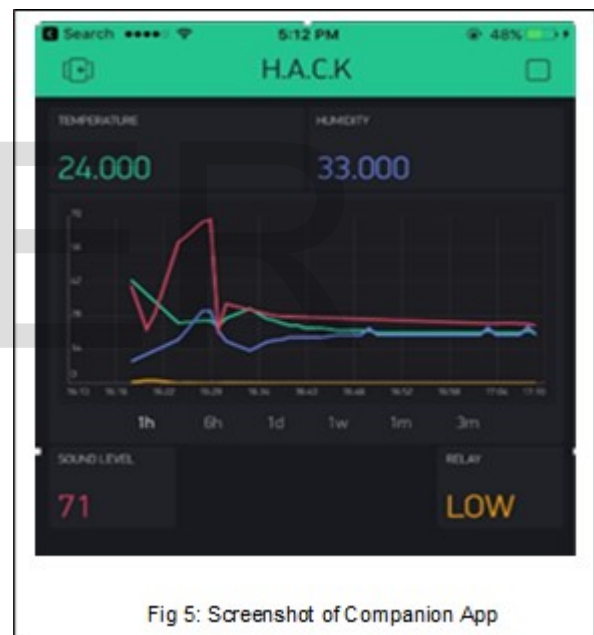
- A PIR (Passive Infra-Red) Motion Sensor has been used to alert the parents when baby wakes up from sleep. This is very important in situations where the child wakes up without crying and wanders off, without knowledge of parents, which can lead to accidents. A sleep mode is implemented in the system to capture the continuous movement of the baby and the same information will be transmitted through WiFi and made useful to parents through a mobile App.

All the above features are made available to parents through a mobile "Companion App". An IOT application

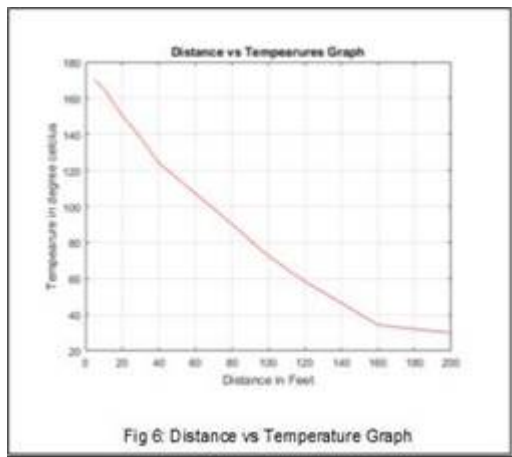
compatible with IOS and Android with the ability to connect to the Home automation care system through the web as well as off an offline server locally hosted by an electronic device. The application is capable of provide monitoring of various parameters, notifications on the smartphones using the smartphones inbuilt system to draw attention. The option to operate on a web server gives caretakers the ability to monitor the person to be cared for from anywhere with an internet connection. All data can be logged and mailed to the caretaker's email ID at the end of each day. The caretaker can access the data/reading of a particular room at any given moment via the companion application.

3 RESULTS & DISCUSSIONS

Fig 5 shows the screenshot of IOS and Android based mobile "Companion App" designed to help parents track the activities of baby or people with specials needs. Figure shows the temperature and humidity readings of the room which can be adjusted through the help of an App if needed.



Home Automation Care Kit also takes care of thermal hazard detection. Purpose of this detection unit is to detect if baby is in the vicinity of hot objects. In such cases, through an alarm baby will be diverted away from those areas and Parents will be alerted through a tone by Companion App. Once the reading from the temperature sensor is exceeding the safe value the controller will send a signal via wifi unit, so the parents will get the emergency notification on companion app in the mobile phone. At the same time a diverting audio tone will played in the system to divert the baby's movements. The temperature vs distance reading can be observed from the given graph in Fig 6.



4 CONCLUSION

This project is designed for the current generation. When both parents are working, it becomes difficult for them to manage their children and accomplish other tasks at the same time. This paper presented a smart, IoT based baby care and home automation system which can independently assist the parent or guardian about the activities of Infants or people with special needs. Various features have been tested and yielded fruitful results. IOS and Android based mobile app has been designed and implemented to keep track of various parameters such as room temperature, lighting condition and humidity of the room. App also helps controlling these parameters if needed.

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