

# AN SMART HOME ARCHITECTURE USING IOT FOR CARE OF ELDERLY PEOPLE

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**Abstract** - A System Architecture for smart homes to support the long-term care of people with special needs. Our system is designed to track and analyze the behavior of residents at multiple time scales and to provide reports and alerts by e-mail and alarm to the caregiving staff. Activity analysis is based on a heterogeneous sensor set which provides different types of information at a variety of locations in the home. The system architecture includes a smart home engine for local sensor management and alerting system and analysis plus a cloud-based analytics engine.

**Key Words:** IoT, PIR, DHT11, Email Alerts, Monitoring people, Camera, Cloud.

## 1. INTRODUCTION

The architecture of a smart home system we have implemented for the long-term care of people with special needs is explained below. People with physical and cognitive disabilities require a range of care for their daily needs. Caregivers need help in managing care and identifying important care issues. Our system is designed to analyze the activity of residents what they do and where they do it and to provide reports on their activity as well as alerts about activity of particular interest. Our analysis framework is based on our research on Bayesian models for tracking. Our system architecture is based on a smart home engine that provides local sensor management and control plus a cloud analysis engine that supports the analytics engine. This architecture is designed to be provide scalable efficiency as well as security and privacy. A smart home also referred to as a connected home or e-Home is an environment for living that has highly advanced automatic systems. A smart home appears "intelligent" because its daily activities are monitored by a computer. A smart home consists of many technologies via home networking for improving quality of living. A smart home is a place that has highly advanced automatic systems for controlling and monitoring lighting and temperature, home appliances, multi-media equipment, and security systems and many other functions. IoT [1] plays an important role in building smart home. Through IoT almost every object of our daily life in a home can be connected to the Internet. IoT allows monitoring. A smart home also referred to as a connected home or Home is an environment for living that has highly advanced automatic systems.

## 2. PURPOSE OF SMART HOME ARCHITECTURE

- Today generation have no time to take care of adult and old age people.
- We don't know any medical emergency to old age people at the time. So, can't able to help them instead of caregivers also help to old age people.
- Case of old age people using restroom – normal and regular time takes 15 min but unexpectedly taken 30 min or more. It will take serious to their life.
- They open the tap and they forget to close the tap and go to sleep there have water gets wasting.

## 3. DOMAINS AND METHODOLOGIES

### 3.1 INTERNET OF THINGS

The **Internet of things(IoT)** is the network of devices such as vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data. The IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, and tablets, to any range of traditionally *dumb* or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

### 3.2 EMBEDDED SYSTEMS

An **embedded system** is a controller programmed and controlled by a real-time operating system(RTOS) with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is *embedded* as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety eight percent of all microprocessors are manufactured to serve as embedded system component. Examples of properties of typical embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with.

#### 4. SMART HOME INSTRUMENTATION

We are designing our system in collaboration with Imagine! Colorado, a Medicaid service provider in Colorado, which operates two group homes configured as smart homes. We are in the midst of deploying our system in one of the smart homes. These homes include a variety of sensors and input devices. Sensors on each water tap to determine when the tap is being used.

- Sensors on each electrical plug.
- Electric eyes on doors.
- Pressure sensors on beds to determine when the bed is occupied.
- Computer monitors throughout the house for use by both residents and caregivers.
- A small number of cameras are installed to view some rooms in the house. RFID readers were installed in one of the houses to allow people to be tracked throughout the house but residents and staff rarely put on the tags.

#### 5. SYSTEM DESIGN

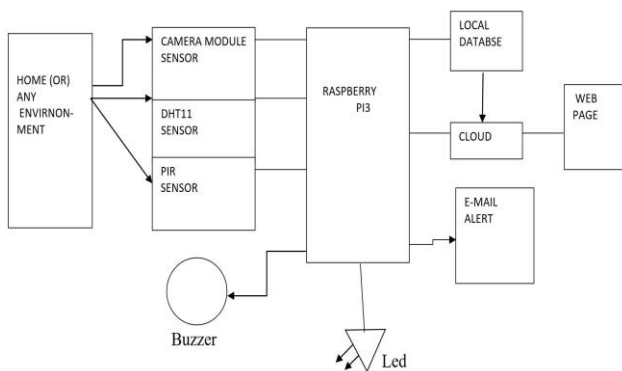


Fig -1: System architecture

#### 6. IMPLEMENTATION

##### 6.1 RASPBERRY PI 3

Raspberry pi 3 is an open source IoT platform based on easy-to-use hardware and software. It includes with on-board Wi-Fi/Bluetooth support and an 64bit improved Processor. It has been the brain of thousands of projects, from everyday objects to complex scientific instruments. Raspberry pi 3 can read inputs like light on a sensor, a finger on a button, or an E-mail and turn it into an output activating a motor, turning on an LED, publishing something online. Raspberry pi 3 can be sending a set of instructions to the microprocessor on the board. Instructions are written in python programming language for processing these instructions. In this system, Raspberry pi 3 is used as a microprocessor that can be programmed in python. It makes use of python to simplify the development process and the sensed values are send to

the Thing Speak cloud platform. It can be controlled remotely by allocating individual Ip address and connect with VNC Viewer. Raspberry pi 3 is perfect for IoT project based on sensors when the project requirements are sending sensor data to the cloud.

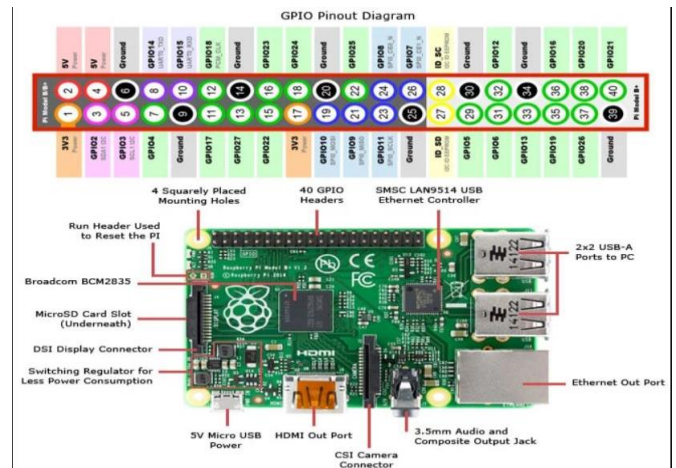


Fig -2: Raspberry pi 3 Pin Config

##### 6.1.1 RASPBERRY PI 3 - MODEL B SPECIFICATION

- Broadcom BCM2387 chipset
- 1.2GHz Quad-Core ARM Cortex-A53
- 802.11 bgn Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)
- 1GB RAM
- 64 Bit CPU
- 4 x USB ports
- 4 pole Stereo output and Composite video port
- Full size HDMI
- 10/100 BaseT Ethernet socket
- CSI camera port for connecting the Raspberry Pi camera
- DSI display port for connecting the Raspberry Pi touch screen display
- Micro SD port for loading your operating system and storing data
- Micro USB power source -5V

##### 6.2 HUMIDITY AND TEMPERATURE

DHT11 is a Temperature and Humidity monitoring sensor using digital signal acquisition technique and temperature & humidity sensing technology. This sensor consists of a resistive type humidity measurement component and an NTC temperature measurement component, connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability, low power consumption, cost-effective cheap sensor. It has following specifications humidity measuring range 20% to 90% RH with an accuracy of 5.0% RH and temperature measuring range of 0 to 50 C with an accuracy of 2.0 C.

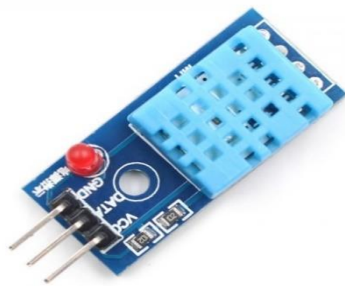


Fig -3: DHT11 Sensor

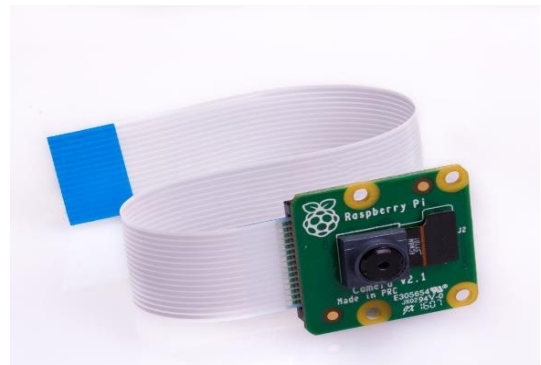


Fig -4: Camera Module

### 6.3 CAMERA MODULE

The Raspberry Pi Camera Module is an official product from the Raspberry Pi Foundation. The original 5-megapixel model was released in 2013, and an 8-megapixel Camera Module v2 was released in 2016. For both iterations, there are visible light and infrared versions.

Table-1: Camera specification

Size	Around 25 × 24 × 9 mm
Weight	3g
Still resolution	5 Megapixels
Video modes	1080p30, 720p60 and 640 × 480p60/90
Linux integration	V4L2 driver available
C programming API	OpenMAX IL and others available.
Sensor	Omni Vision OV5647
Sensor resolution	2592 × 1944 pixels
Sensor image area	3.76 × 2.74 mm
Pixel size	1.4 μm × 1.4 μm
Optical size	1/4"
Full-frame SLR lens equivalent	35 mm
S/N ratio	36 dB
Dynamic range	67 dB @ 8x gain
Sensitivity	680 mV/lux-sec
Dark current	16 mV/sec @ 60 C
Well capacity	4.3 Ke-
Fixed focus	1 m to infinity

### 6.4 MOTION DETECTION

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m. PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation. For numerous efficient projects or items that need to discover when an individual has left or entered the area. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface with. Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V.



Fig -5: PIR Sensor

### 6.5 UPLOAD DATA TO THE CLOUD

The values of the parameters in consideration will be sent to the Thing Speak cloud platform via Raspberry Pi 3. With these values a live graph is maintained by the platform for better analysis. If the cloud platform recognizes a value that is not within the optimum range, then it would send an alert through an E-mail. The user can view this mail and take the necessary actions required and Thing Speak has feature to make a Data visualization as Graph by using real time data. Using this feature user can analysis the data easily.

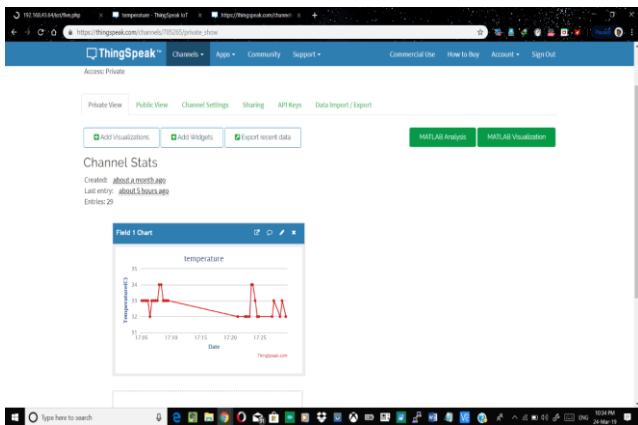


Fig -6: Temperature Cloud data with analysis visualization

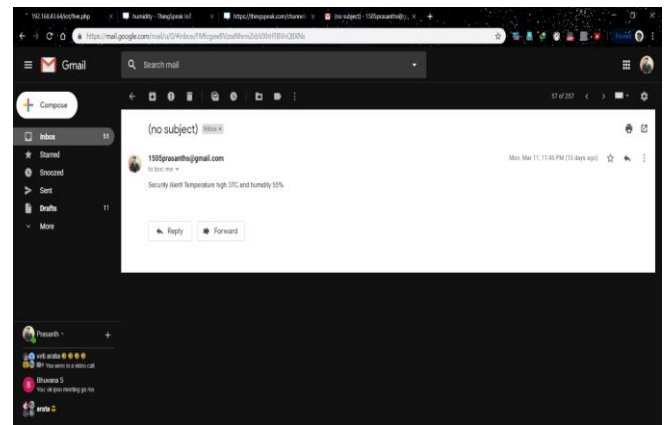


Fig -9: Temperature alert with realtime data on E-Mail alert

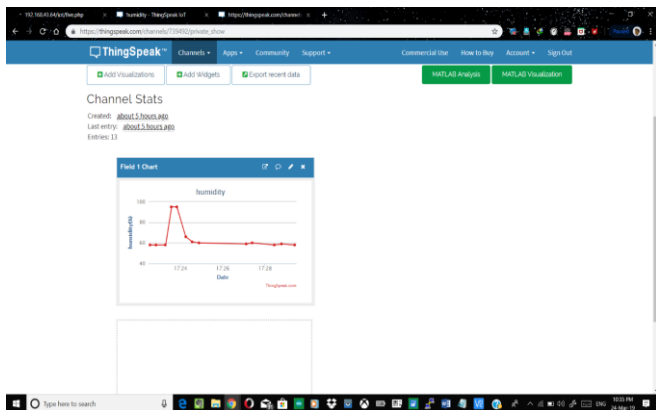


Fig -7: Humidity Cloud data data with analysis visualization

### 6.7 WEBPAGE TO VIEW REAL TIME DATA

In this webpage using php with Apache webserver can be host anywhere using Ip address and login with securely, then user can view and monitor the real time sensor data and can view the database.

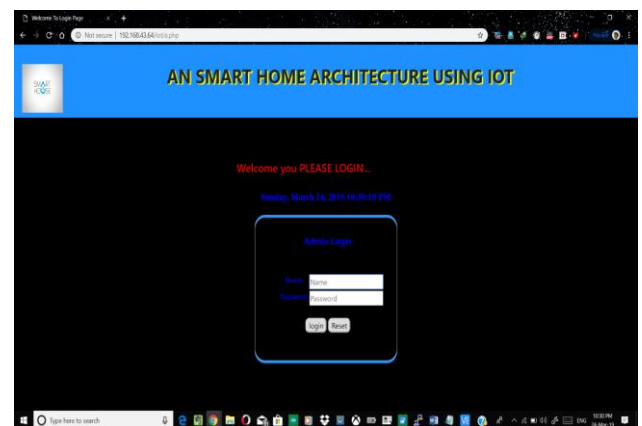


Fig -10: Login verifies authorization of the user to enter into webpage for access the data

### 6.6 SENDING ALERTS TO THE CARE TAKER

If the cloud platform recognizes a value that is not within the optimum range, then it would send an alert through an E-mail. The user can view this mail and take the necessary actions required.

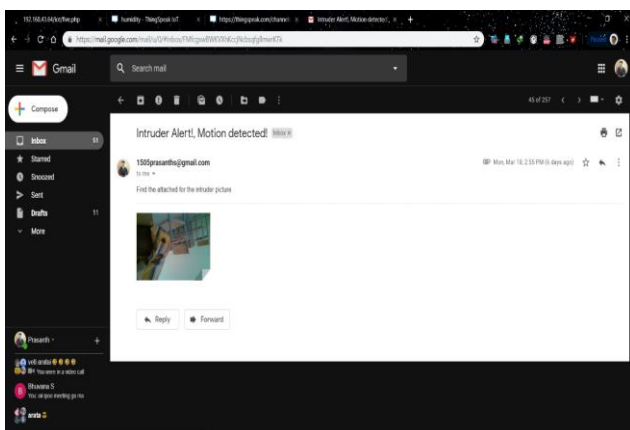


Fig -8: Motion sensor alert with Picture using camera module on E-Mail alert

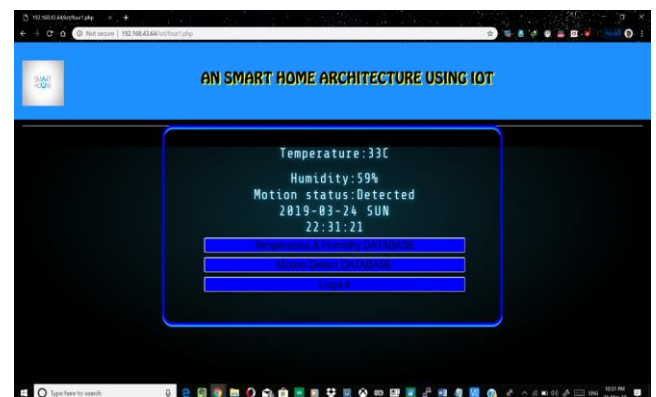


Fig -11: Realtime Data to be view on webpage

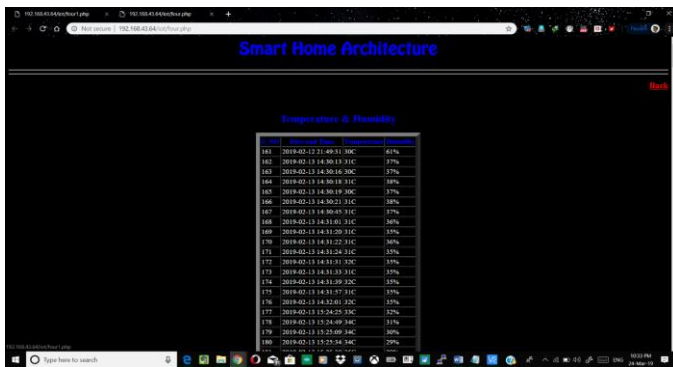


Fig -12: Local Database data of DHT 11 Sensor on webpage

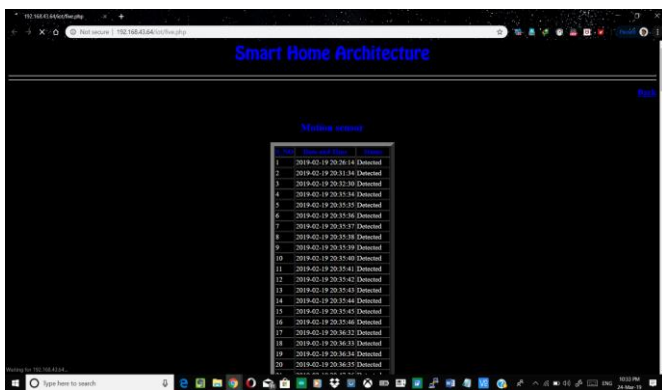


Fig -13: Local Database data of PIR Sensor on webpage

### 6.8 HANDS ON PROJECT

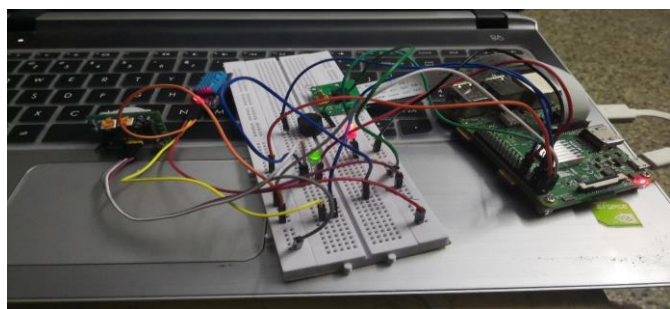
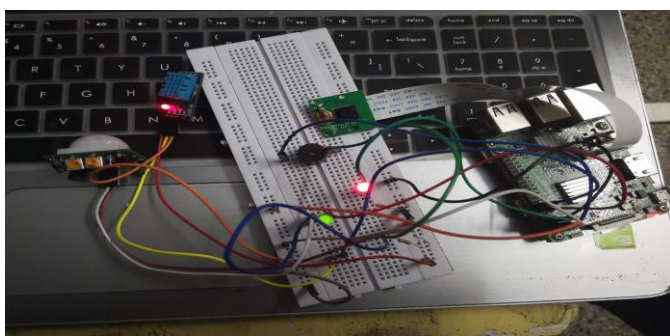


Fig -14, 15: Hands on Smart Home Architecture Using IoT for Care of Elderly People

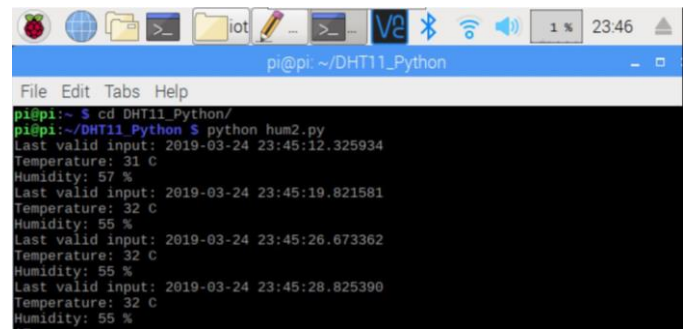


Fig -16: Start the Program of DHT11 using VNC Viewer on mobile

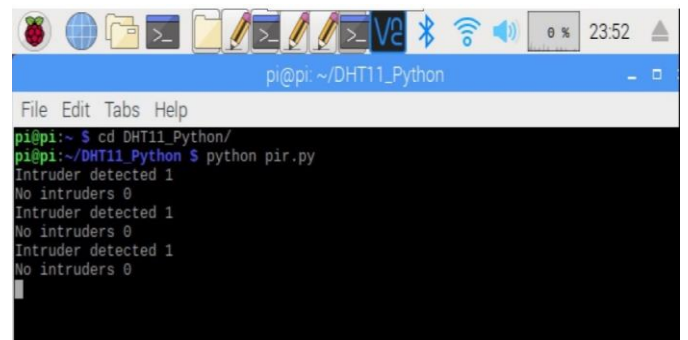


Fig -17: Start the Program of PIR using VNC Viewer on mobile

### 7. APPLICATION

The term special needs cover a broad range of physical and cognitive disabilities; these disabilities can also exhibit themselves in many combinations. People with special needs require help with basic life tasks [2]: eating, dressing, toileting, etc. Dukakis [3] describes the importance of caregivers. The United States has moved to community-based care for adults with special needs: group homes, semi-independent apartments, or individuals living with a caregiver. This model often provides a richer life and has been shown to be less expensive than institutional care. But it also places greater burdens of care and management on families and service agencies: 87% of adults with special needs in the U. S. do not live-in professional care facilities. Daily care is provided outside the medical system---long-term care is provided by families, adult foster care providers, and group homes. IoT can be used to provide unobtrusive yet continuous monitoring of residents and provide alerts and reports on their condition---care givers, loved ones, and medical staff all require succinct, actionable data [4]. Given the broad range of special needs, monitoring methods need to be applicable to people with many types of conditions---developing systems one diagnosis at a time is too costly and time consuming and completely fails in the case of multiple involvements [5]. Our goal is to analyze the daily activity of residents [6]. We want to infer their movement around the house and their activities during the day. Our previous work [1] developed algorithms to track the movement of people

using cameras with non-overlapping fields of view. We are extending that work to combine observations from cameras with observations from less powerful sensors, such as electric eyes. A camera provides an appearance model that can be used to disambiguate the identity of a subject, sensors such as electric eyes only record the presence of a person, not their identity.

## 8. CONCLUSION AND SCOPE FOR FUTURE

The sensors and Raspberry pi are successfully interfaced with the cloud. The data is stored successfully and can be accessed remotely. All observations and experimental set up prove that this is a complete solution to monitor the home for care of people. User can have access to the data and can know if there are any deviations with respect to temperature, humidity, motion detection and camera. Implementing this system will allow users like caretakers to monitor and improve the security and overall protection of elderly people. Future works will include notifications of the techniques and expanding the area under monitor to some extent by including different type sensors like IR, Heart Rate, etc... then some automations in home for easy accessibility to Elderly people.

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