

# IoT BASED INTERACTIVE DISPLAY UNIT USING RASPBERRY PI

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**Abstract** - In today's modern world, intelligent systems are present in smart phones and tablet-based Computers. In future, more intelligent devices will come into existence. One such intelligent device is this smart display unit. The main aim of the proposed system is to extend the availability of smart systems. The system acts as a smart display which displays date, time, temperature and humidity, recognizes face for security purpose and recognize speech to send mail, save documents and display weather report. This system is built with raspberry pi, camera, and some sensors which is perfectly suitable for smart homes. Weather reports are extracted from the IoT (weather cloud) through Application Program interfacing with the display unit. It analyzes our speech by using mobile Bluetooth and result gets displayed in display. That designed smart display has advantage of small size and less weight and more compact to use and it is suitable for families.

**Key Words:** Raspberry Pi, Linux, Interactive Display, Weather Cloud, Mobile Bluetooth, Motion sensing and Face recognition.

## 1. INTRODUCTION

Effective time management and security are essential factors in increasing production of day-to-day life. Time management is possible through Integration of technology into people's daily lives. The use of products such as tablets, PCs, and smart phones have given people access to the tools needed to be productive. However, though successful technological products have been used to increase productivity, the use of technology has become another task on everyone's daily to-do list.

Technology should mold to our schedule, not the other way around. That is where the "Smart" display unit idea originated. "Smart" display units have been envisioned for years, part of the broader trend in imbuing everyday objects with various "smarts" to improve our lives. The smart display unit idea aimed to integrate technology seamlessly into people's lives by putting it where everyone's routine eventually collides. The goal of the smart display unit is to increase a user's productivity by saving their time.

The smart display makes the smart buildings smarter. The Raspberry Pi 3 model B is used in this project. It displays the date, time temperature and humidity. The PIR sensor is used for motion recognition. When it detects any motion the camera is turned on and the image is captured.

Face recognition is done using Haar cascade algorithm. When the image is authorized, it waits for voice commands. Else the image of the unauthorized person is sent through Gmail with a alert message and a link to see what is happening in house. Speech recognition is done using mobile Bluetooth to take notes and create a document, send mail and get weather updates using weather cloud.

## 1.1 INTERNET OF THINGS

The Internet of Things (IoT) is a interrelated computing device that are provided with unique identifiers (UIDs). It has an ability to transfer data over a network without requiring human interaction. So it is mostly used in wireless technologies. Here it is used to access weather cloud and acquire weather updates. By this technology people can easily interact with the devices.

## 2. RASPBERRY PI

Raspberry pi 3 Model B, which is used here is a third generation Raspberry Pi. It is a powerful credit card sized single board microcomputer. SD card is used for storage purposes. Since there is a need for internet access to use IoT, Raspberry Pi 3 model b which has Bluetooth and Ethernet connectivity. It is 10 times faster than the 1<sup>st</sup> generation Raspberry Pi.

## 2.1 SPECIFICATIONS OF RASPBERRY PI 3

**Table -1:** Features of Raspberry Pi 3

Board	Raspberry Pi 3 Model B
Processor	Broadcom BCM2837
CPU core	Quadcore ARM Cortex-A53, 64 bit
RAM	1 GB
GPIOs	2 X 20 Pin Header
USB Ports	4 X USB 2.0
Wireless Connectivity	802.11n Wireless LAN and Bluetooth 4.1

## 3. SYSTEM DESIGN

The Interactive Display consists of Raspberry Pi 3 which is the heart of the system. Linux OS is installed using SD card. Python language is used for programming in Raspberry Pi.

PIR(Passive Infrared Sensor) sensor is used for motion analysis. It detects the moment of any human or animals. When a human passes in front of the system infrared radiation will change the output voltage and this change is considered as motion detected. Once motion is detected, the camera is turned ON. It is a method for reducing power consumption.

DHT (Digital Humidity and Temperature) sensor is connected to Raspberry Pi in order to display the current room temperature and humidity.

Mobile Bluetooth is used for giving speech input. The system acts according to the given voice input and execute a set of task like sending Gmail, creating word document, view current and forecast weather updates, etc.

API interface is used to access Gmail for authentication processes. When an unauthorized person is detected, his/her image is captured and send to the authorized person's Gmail with a link in order to see live stream. The system block diagram is shown in Fig -1.

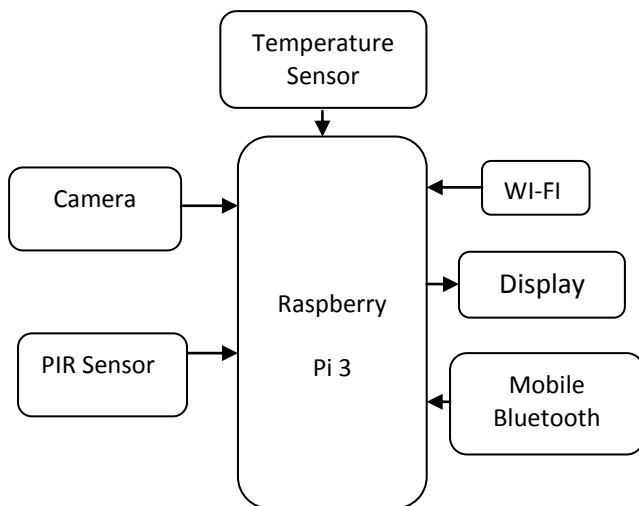


Fig -1: System Block Diagram

#### 4. DESIGN OF SYSTEM HARDWARE

As shown in Fig-2, the hardware components are connected to the GPIO (General Purpose Input Output) pins of Raspberry Pi 3. It consists of four supply pins, eight ground pins and others are the general purpose pins

In PIR Sensor, the supply, Gnd and Vcc are connected to the corresponding GPIO pins. In Temperature sensor, the data pin, Vcc, ground are connected to the left out corresponding GPIO pins.

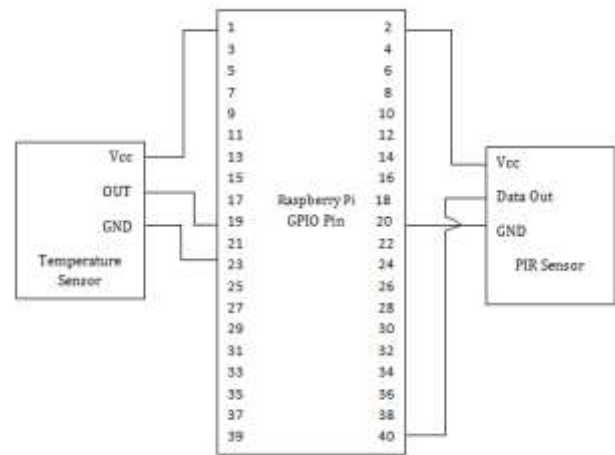


Fig - 2: Pin Diagram

#### 5. AUTHENTICATION PROCESS

In authentication, the human face is recognized using Haar cascade algorithm. If it is unauthenticated, it send a alert mail with a link to watch the live happenings. It can be used for security purposes.

##### 5.1 Haar Cascade algorithm

Haar cascade algorithm is a machine learning based approach. The cascade function is trained from a positive and negative images. The algorithm has four stages,

- Haar Feature Selection
- Creating Integral Images
- Adaboost Training
- Cascading Classifiers

The first step is to create a dataset in the name of an authorized person which consists of his/her images. When the camera is ON, the captured image gets compared with the images in dataset.

In Haar feature selection, the image is divided into multiple windows. These images are converted into a matrix based on gray scale intensity. The faced and unfaced images are separated using Adaboost training. Cascading classifiers are used to select the unique features in the face for speeding up the process.

Each saved feature in the data set is compared with the feature of the current image. If more number of features are similar then that dataset name gets displayed in the screen.

If the features are not recognized, then it is considered to be an unauthorized person. Automatically the device sends the person's image through Gmail.

### 6. FLOW CHART

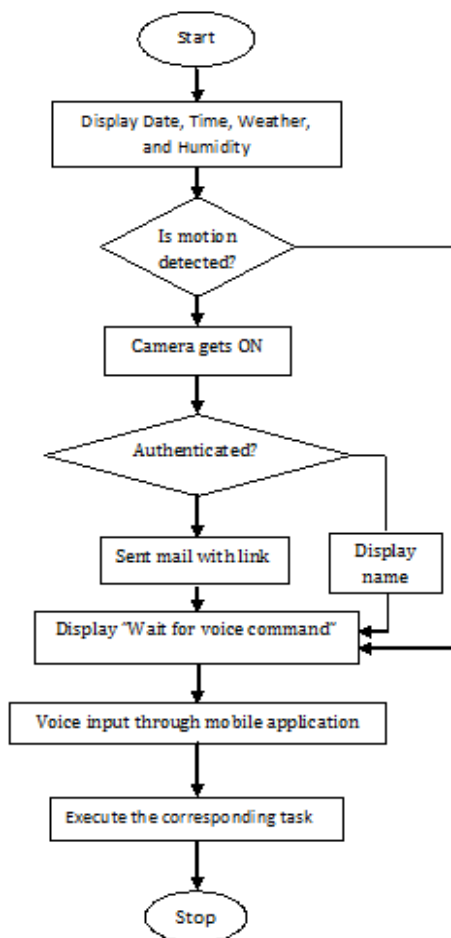


Fig -3: Process Flow

When the device is ON, the default parameters like date, time, temperature and humidity gets displayed. If motion is detected by the PIR sensor, authentication process is carried out.

In case of authorized person, the name of the person is displayed and it waits for the voice commands displaying “waiting for voice command” as shown in Fig-4.

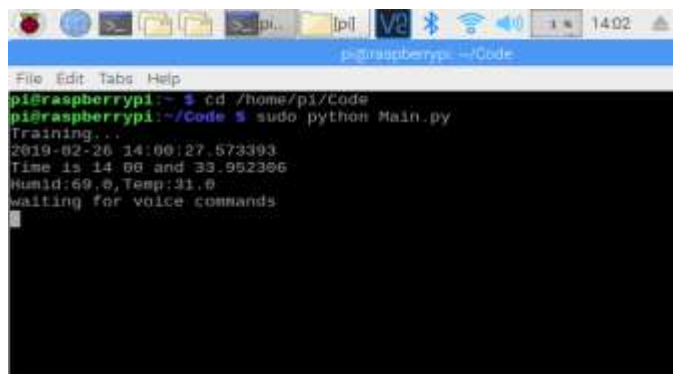


Fig -4: Displayed Parameters

The processes like sending mail, creating word document, getting weather reports can be executed using voice command through mobile Bluetooth. One such execution is shown in fig -5.

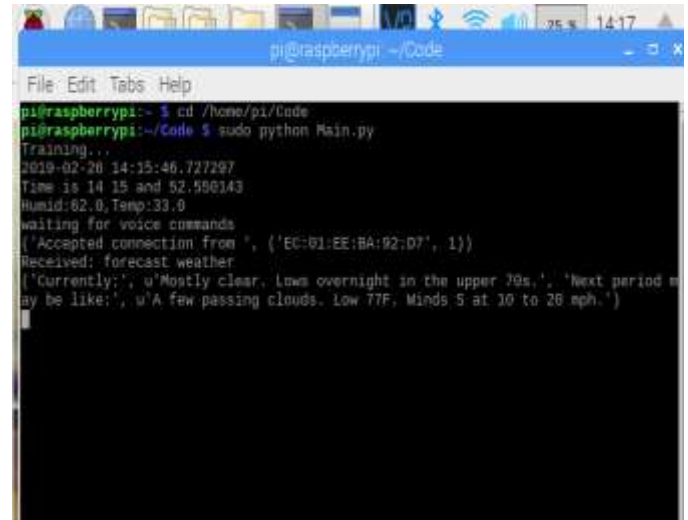


Fig -5: Weather Report

For emergency purposes, instead of creating the word document, we can give voice input which can be converted into text document as shown in Fig-6 and Fig -7. Through the same voice input, the document can be sent to any e-mail ID.

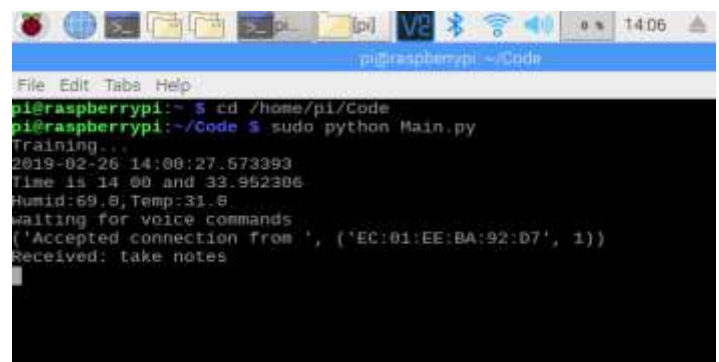


Fig -6: Taking notes

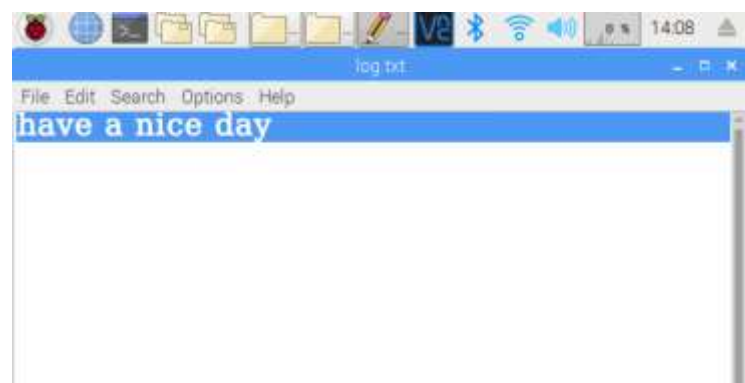


Fig -7: Created Text Document

If the authentication fails, the person's image is sent to the registered Gmail through API interfacing. The mail also includes a link to see what is happening in live stream.

## 7. CONCLUSION

The smart display developed by a host Raspberry Pi, a Single board computer which is connected to the network via Wi-Fi, weather information obtained through API of weather cloud, date, time, room temperature will gets displayed in the smart display unit. The user can interact mobile through APP and user can communicate through voice synthesis module. Thus the system could also be extended with voice controls and GPIOs. And the display will respond according to the user. Images are captured based on motion detection and sent to the server where gets subjected to a face recognition procedure. Thus, it suggest that the developed recognition procedure is able to achieve a accuracy on the dataset. This shows a feasibility of the system as a low cost component for home automation. The system also contributed to a higher level of security. Smart display design which has enough advantages like simple to use, small size, user friendly and it suitable for family homes.

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