Micro Location for Smart Buildings using IoT based smart camera

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Abstract-Today's GPS and radio-based local area positioning technologies have limited precision, with uncertainties ranging from many centimeters to several meters. Micro location creates an entirely new product category that captures millimeter-scale position and motion data at low cost, indoors and out. Smart security and remote monitoring have become vital and indispensable in recent times, and with the advent of new concepts like Internet of Things and development of advanced authentication and security technologies, the need for smarter security systems has only been growing. The design and development of an intelligent Micro Location control system using web designing for Controlling, remote monitoring of visitors and remote control of area will be implemented. The system also includes a web-based remote monitoring, and a bare-bones embedded IoT server, which monitors and control the Temperature of the area, and the owner can remotely control the person entering and exiting the area through the camera which will be fixed at the entrance and also will send the image of that person to the using SMTP server (GMAIL) and other things like Alarm by using the web page. This system finds a wide application in smart homes, buildings where the physical presence of the owner at all times is not possible, and where a remote control is desired.

Keywords- Raspberry Pi 3, Remote Control, Python, PHP, USB Camera, SMTP, Authentication, Microlocation.

I. INTRODUCTION

The Internet of Things sits at the intersection of sensors, networks, design, business models, and a wide range of industries. At its simplest, the IoT is the idea that wireless communication and digital intelligence can be embedded into everything around us, but the main disadvantage of IoT is security and privacy. Micro Location is the process of locating any entity with very high accuracy. In this project Micro location for smart building is implemented using an authenticated webpage which is being developed to secure the page and also a wireless sensor Network (WSN) is being implemented from where all the sensor values are being transmitted to the secure page and being updated. If any small micro disturbance is created that is being tracked by the sensor and the image of the area will be automatically capture and sent to the user from smtp Gmail and updated on the web page which is being developed by us. Micro location can be implemented using different protocols like NFC, RFID etc. In this project Wi-Fi 802.11 n is used to implement a Micro location for smart-buildings with secure remote control webpage and simple mail transfer protocol (SMTP) for the purpose of database.

A. Remote Monitoring & Control:

The proposed system also includes an intelligent web-based embedded server for remote authentication and control and monitor the location.

This technology plays a crucial role in enabling remote access to a person/ owner which requires the username and password if the person want to control or monitor the area from the remote area, if the person is authorized then remote controlling will be enabled and if the person is unauthorized, remote access will be disabled.

Also if any fire accident will happen it will automatically switch on the sprinkler to avoid fire accidents and also will send the mail to the owner by capturing the image and attaching it to the respected E-mail id using SMTP.This subsystem is implemented using Python programming language along with the Linux server and PHP scripts running on the Raspberry Pi 3.

II. SYSTEM DESIGN&ARCHITECTURE

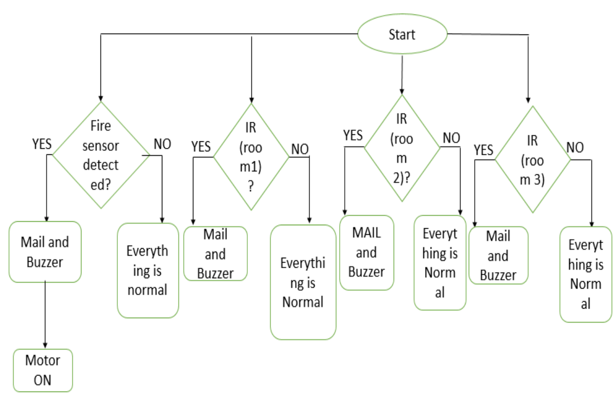

Fig.1: Flow Chart

As with any system, initial stage is to monitor the location using the specific sensor and the camera module, this can be effectively done using a flow chart, above is a flow representation of the proposed system.

B. System Architecture:

The proposed system is a combination of various modules namely, IR sensors at different areas to know any micro disturbance created. Also fire sensor to sense any fire incident and respond with the sprinkler automatically. The imaging module i.e. camera is responsible for capturing any micro disturbance occurred at that area by sensing it through the sensors and capturing the image while the disturbance is being created and forwarding it to user email using smtp.

The remote access is been done using the IoT networking concept to control and monitor any micro location with authenticated web page in which the status of the sensor with the image will be updated automatically.

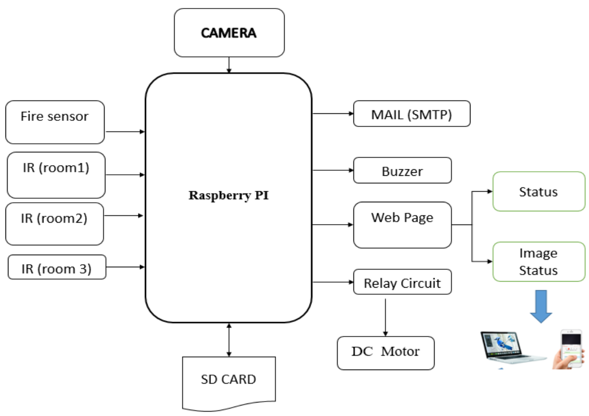

Fig.2: Block Diagram

The heart of this system is the core module which is realized using the Raspberry Pi 3, its responsibilities include, and acquiring images from the camera, processing the acquired image as required maintaining and updating the sensor information on the web page send MAIL with the attached image and switching on the required hardware automatically.

III. SYSTEM DESCRIPTION

This section gives an overview of the various concepts, components and modules of the proposed system.

A. Imaging Module

The imaging module in the proposed system is realized using a USB web Camera, the main reason behind choosing USB Camera over the Pi camera is the cost effectiveness. The camera features a high-quality CMOS sensor, with an image resolution of 25 MP (Interpolated), an adjustable lens for focus adjustment, a frame rate of 30 fps and f2.0 lens.

The USB camera also is equipped with night vision for low light photography. The camera interfaces with the Raspberry Pi via the USB 2.0 port and is responsible for capturing images when requested, the pictures are captured by using the command fswebcam.

Fig.3: USB Camera

B. Raspberry Pi Core Module

The core module of the system is realized using a Raspberry Pi 3 board; it's a $ 35 bare-bones computer designed and developed by the Raspberry Pi Foundation, the Pi 3 features a BCM 2837 System-on-Chip which includes a Quad-Core 64-Bit ARM Cortex A7 CPU clocked at 1 GHz paired with 1 GB of RAM. It also has VideoCore IV GPU for graphical processing applications, it also includes four USB ports for peripherals and 40 Pin General Purpose Input Output (GPIO) pins for interfacing the Pi with external electronic circuits, these GPIO pins are used to interface the Pi to the door lock module. The Raspberry Pi is designed to run various Linux based operating systems and has Raspbian as its official operating system and Python as its official programming language.

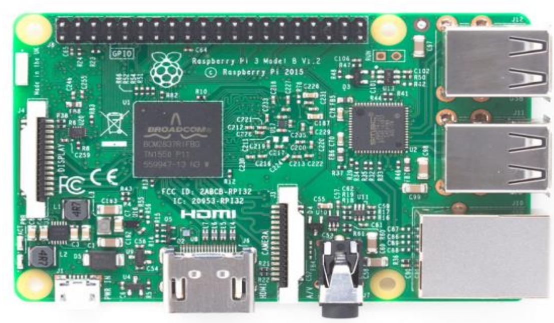

Fig.4: Raspberry Pi 3 Module

In this system the core module plays a highly pivotal role and is responsible for various functions, the core module is responsible for acquiring the images from the camera, processing and send mails. It's also responsible for maintaining the update of the location with the image capturing process. It is in charge of employing the authenticated remote access to the server with the controlling and monitoring part. It's responsible for monitoring the senor, controlling modules by sending commands using Python code via GPIO to the motor driver.

C. Embedded Server & IoT

Another crucial function of the core module is to act as an embedded web server, the primary responsibilities of this server include, transmitting the visitor/ visitors images via email to the owner, look for emails to the owner and find the images of the location if any disturbance occurred.

This system employs an embedded server approach for communicating with the user and with the internet/ intranet. Python code is used to program certain aspects of this system such as sending and receiving emails. Standard Python libraries corresponding to the E-MAIL such as urlib2, cookielib, imaplib, poplib, email, SMTP, etc. for sending and receiving emails are imported and used accordingly.

This system uses web-based authenticated web page to control and monitor the area through the remote access.

The system is also configured using Apache to act as a server, which is useful to remotely monitor the conditions. The owner can log in to the server using a dedicated static IP assigned to the Raspberry Pi, another important function of this server is to provide a secure back this is a secret feature and is only accessible by the owner.

D. Micro Location disturbance:

Many kinds of wireless sensor network is used to observe and monitor the particular location or area, Here Infrared sensors are used which will detect and micro disturbance occurred and will send the information using Wi-Fi 802.11 b with the IPv4 protocol to the server and will keep on updating the sensor values, at the same time a fire sensor is also embedded to sense the any fire accident in the particular location and automation is used to automatically switch on the sprinkler around to avoid the fire accidents. The program which we are implementing is in python and the program we are making it in infinite loop so that it will keep on updating the values of the sensor. Now first according to the atmospheric conditions of the building we have to set all the sensor accordingly if any fire incident will happen it will automatically send the mail and on the Motor which represents the sprinkling of the water. Now also if any disturbance in any of the room automatically the camera will capture the image and send it to the web page and update all the Microlocation of the building. IoT is being implemented here to monitor and control the location accordingly.

Fig.5: Microlocationsmart system.

E. Authenticated web page:

Designing a web page depends on the individual web designing language skills, we will go through basic web page without any style using HTML and PHP language. Before starting with web designing, some software has to be setup and install in our raspberry OS. Ensure that you have the internet connection. Apache HTTP server: It is a server which is designed to create Web servers that have the ability to host one or more HTTP-based websites.

An authenticated web page is designed using the html and PHP web designing language. First owner has to connect to the server in order to access web page, by giving the IP address of the server it will open the authenticated webpage where the person has to enter the username and password in order to access the remote control and monitoring system.

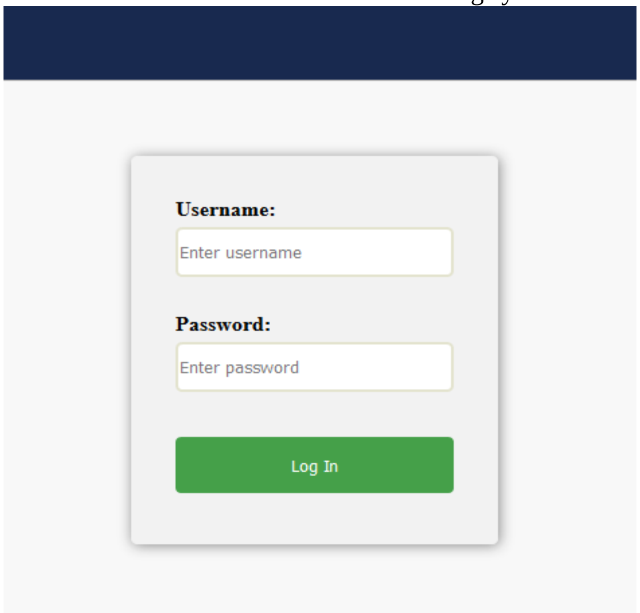

Fig.6: Authenticated web page

IV. HARDWARE IMPLEMENTATION

This section emphasizes on the actual hardware implementation of the proposed system, the various modules, components, peripherals and the interconnections between them are discussed here.

The first stage of the implementation is to prepare the Raspberry Pi 3 module for its first boot; this is done by downloading the latest version of the Raspbian operating system from the official Raspberry Pi website. A microSD card is the formatted using SD Formatter; it's then flashed with the Raspbian OS using Win32 Disk Imager. The first boot is then completed on the Raspberry Pi connecting the required peripherals, such as power supply, keyboard, mouse, Ethernet cable, etc.

The Raspberry Pi for optimal operation requires a quality power supply; the Pi can be driven by using any Micro USB based mobile phone chargers with a good current rating, and this system is powered by a 5V 2.5A power bank for uninterrupted operation.

Since the Raspberry Pi 3 has inbuilt Wi-Fi and Bluetooth is used for connectivity; the Pi also has an Ethernet port which can be used to gain wired internet access.

Using Python programming language preinstalled on Raspbian the source codeof the system is provided and tested appropriately. The USB Camera is interfaced, the GPIO pins are programmed using commands in Linux and Python in this stage. The camera is interfaced to the Pi via the USB port and the door lock module is interfaced via the GPIO pins on the Pi.

V. EXPERIMENTAL RESULTS

This section emphasizes on the final results of the proposed system, the system has WSN (Wireless sensor Network) which will send the sensor data to the server and keep on updating the values, If any micro disturbance is been done in that area automatically the camera will take the image of the area and send it to the person using email with the buzzer alert at the location. The system correctly recognizes any kind of disturbance occurred and will intimate to the user

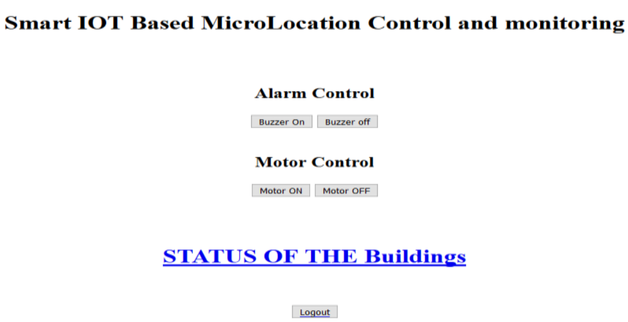

Fig.7: Control Web Page

With an alert section and send the image of the area using SMTP mail. Also the main part of this project is IoT which will give the owner to access the micro location through the remote area by connecting to the server using IPv4 protocol which is an authenticated web page with a username and password to make it more secure and also it forwards the images to the mail.

The owner now has provide the username and password to authenticate to monitor and control the location.

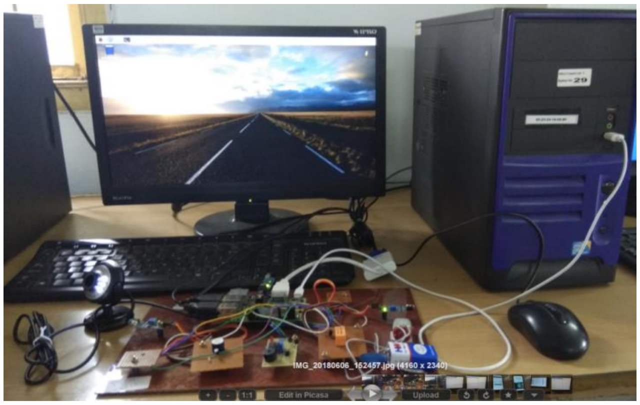

Fig.8: Final Setup

VI. CONCLUSION

This paper presents the design and implementation of a Smart Micro Location intelligent security system using a robust, low-cost, low power single chip approach with the Internet as its backbone. This paper also explores the immense potential of Internet of things in monitoring a location using the WSN. The versatility and prowess of Linux operating system, the Python programming language, and the web page design for secure web page authentication have also been explored, in depth.

VII. REFERENCES

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