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Design of Smart Home Monitoring System Based on IOT and AWS

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Abstract
For security-related tasks, computer vision and the Internet of Things (IoT) are becoming more and more popular. This project implements a surveillance system using a single board computer, the Raspberry Pi 3, which serves as the CPU. created utilising the OpenCV module for Python. A local database of authorised people has been created, and it contains pictures of every person who has permission to enter that secure area[1.2]. The camera will function as a computer vision system in surveillance mode, which will automatically snap six images of people and compare them to local databases to see if they match. If they do, the door will open, allowing the user to utilise AWS (Amazon Web Services) to keep track of the situation.If the person is unauthorized then it will send the image through mail[3]. This image will also be stored in the AWS S3.
Keywords - Smart Home, Face Recognition, Internet of Things, AWS, Computer Vision.

1. Introduction

The model's goal is to keep an eye on and secure a location utilising cutting-edge technologies like Amazon Web Services (AWS), Gmail, the Raspberry Pi OS, and the OpenCV module in Python, which can determine whether a user is authorised or not. With the aid of the electronic lock, the door will open if the user is authorized[5]. If the user is not permitted, it will take his picture and send it through SMTP to the mail. In this project, the automatic door is represented by hardware such as switches and a dc motor.

2. System information

The Passive Infrared (PIR) sensor is used in an existing system to determine whether or not a person is there, but it does not capture the whole image of the person because the person may be looking at the camera or not. Individual accuracy will differ[4]. We will compare the site utilising neural convolution networks, where the accuracy will be higher and the speed will also be higher. In this suggested system, as the camera is in automatic surveillance mode, the image of the person will be taken when the person approaches the camera.

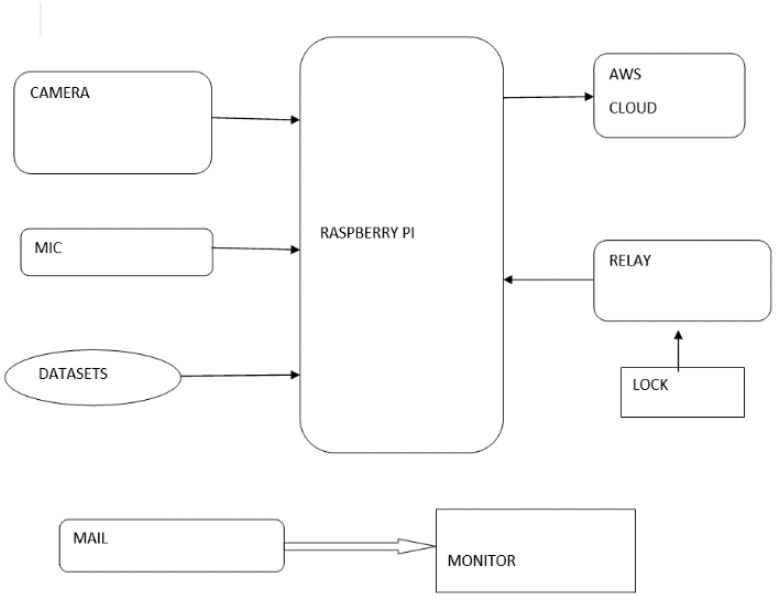

Fig 1. Block Diagram

2. Description

This project makes use of a camera that will be set to surveillance mode. The permitted individuals are put into a database. Connect the Raspberry Pi to a USB camera. Connect the Raspberry Pi's power supply[6]. Using a VGA to HDMI converter cable, connect the Raspberry Pi to the monitor using the HDMI cable. Connect the Raspberry Pi to a USB keyboard and mouse. As soon as a person is found, an image is taken and compared to the database. Door will open if it matches; otherwise, a message with the person's image attached will be delivered.

3. Components

We have used Raspberry Pi, USB Camera, Solenoid Electromagnetic Lock, Relay circuit, SD card, Monitor, Microphone as hardware components. Raspberry Pi OS, Opens ource Computer Vision, Python, Amazon Web Services, Gmail, Android MQTT as software apps and services[7].

A. Webcam

Web cameras are video cameras that stream or broadcast images or videos in real time via a computer network, such as the Internet. Web cams typically come in the form of small cameras that are incorporated into hardware, mounted to a user's monitor, or placed on a desk. A video chat with two or more individuals using live voice and video can be conducted using webcams.

B. Raspberry Pi

A line of tiny single-board computers (SBCs) known as Raspberry Pi was created in the UK by the Raspberry Pi Foundation in collaboration with the Raspberry Pi project, which was

first designed to support computer science education in schools and underdeveloped nations. proved more well-liked than anticipated, selling to customers outside of its intended market to be used as robots. Due to its inexpensive cost, versatility, and open design, it is frequently utilised in numerous fields, including climate monitoring. Its HDMI and USB gadgets are widely utilised by computer enthusiasts and electricians.

C. Solenoid Electric Lock

Electric lock and opening latch are described as solenoid locks. It can be selected selectively in cases and is available in unlock mode on open power mode, lock and storage in power switch mode, and both modes on closed power mode. Only when the solenoid is turned on is it possible to open with the power opening type[8]. As a key and a key system, solenoid door locks employ electromagnetic force and a movable piston or plunger. A battery or other low-voltage DC power source is typically used in the system. Electrical energy travels to the coil that opens the electric magnet when the controller is set up as a control device or remote control.

D. Relay

An electrical switch is a relay. includes a group of terminals for the insertion of one or more control signals and a group of active communication terminals. In most contact forms, such as contacts, cut contacts, or customised combinations, the switch can have any amount of connections[9]. Relays are employed when several circuits need to be controlled by a single signal or when an independent low power signal needs to control a circuit. Relays were first utilised as signal multipliers in long-distance telegraph lines, reviving the signal entering from one circuit by passing it to another. Relays are a common component of modern telecommunication systems and the first practical computer.

E. Microphone

A transducer, sometimes known as a microphone or mike, is a device that transforms sound into an electrical signal. Telephones, hearing aids, public speaking programmes for music halls and public events, motion picture production, live audio and recording engineering, audio recordings, dual-radio, megaphones, and radio and television broadcasts are just a few examples of the various uses for microphones. Additionally, they are utilised by computers for speech recognition, VoIP, audio recording, and other functions like compression or ultrasonic sensors.

F. Raspberry Pi Operating System

A Raspberry Pi application built on Debian is called the Raspberry Pi OS (formerly known as Raspbian). Since 2013, the Raspberry Pi Foundation has formally introduced it as the foundational operating system for the Raspberry Pi line of single-board computers.

G. Open Source Computer Vision

We can create real-time computer vision applications using the multi-platform package OpenCV. With capabilities like face detection and object detection, it focuses on image

processing, video recording, and analysis. Depending on the structure of the current scene, computer vision may be thought of as a manual that teaches how to disrupt, rebuild, and interpret 3D space from its 2D photographs. It functions by simulating and reproducing a person's vision using hardware and software from computers.

H. Python

Python is a very advanced, well-translated, and heavily written programming language. Its design philosophy places a strong emphasis on the utilisation of crucial retreats and the readability of the code. Python is created at random and stored in trash. Python was created by Guido van Rossum in the late 1980s to replace the ABC programming language, and it was first made available in 1991 as Python 0.9.0. New capabilities including list recognition, cycle-based garbage collection, reference computations, and Unicode compatibility were added to Python 2.0 in 2000. When Python 3.0 was introduced in 2008, it underwent a significant upgrade. By 2020, Python 2 had reached version 2.7.18.

I. Amazon Web Services

Amazon Web Services, Inc. (AWS) is part of Amazon that provides the required cloud platforms and APIs for individuals, companies, and governments, with a limited payment base. These cloud computing web services enable distributed computer processing and software tools across AWS server farms.

J. Gmail

Google offers Gmail as a free email service. There are 1.5 billion people that are actively using it as of 2019. Typically, users access Gmail using a web browser or the official mobile app. Through POP and IMAP agreements, Google also enables the usage of email clients. The Google mail servers automatically analyse emails for a number of things, such as viruses and spam.

K. Android MQTT

Originally known as MQ Telemetry Transport, the MQTT protocol intended for a portable, lightweight machine network. designed to connect to distant places with equipment that has a constrained network or service bandwidth. It must make use of a transport protocol, typically TCP/IP, that offers a structured, non-lost, two-way connection. The message vendor and customer number are the two types of network transactions that the MQTT Protocol defines. A server known as a MQTT broker is one that receives all messages from clients and distributes them to the appropriate local clients. Any device that runs the MQTT library and communicates with the MQTT vendor across a network qualifies as a MQTT client, from a tiny controller to a fully complete server.

4. Working

Assuming that it is put up in front of the home, the complete configuration is fixed. When a person or item is spotted, the camera takes a photo of it and sends it to the user inside the house using the SMTP protocol of the Gmail application. Python and Open CV are both used

to script the code base. In addition, the photos are kept in an AWS S3 bucket, which use AWS Rekognition to identify a returning user. Additionally, we have a solenoid EM cabinet lock door lock system that uses an Android MQTT application to open and lock the door. All of these are included, as well as microphone instructions to turn on/off the camera when someone approaches the door.This is one of the feature which we included for recognition as shown in Fig2.

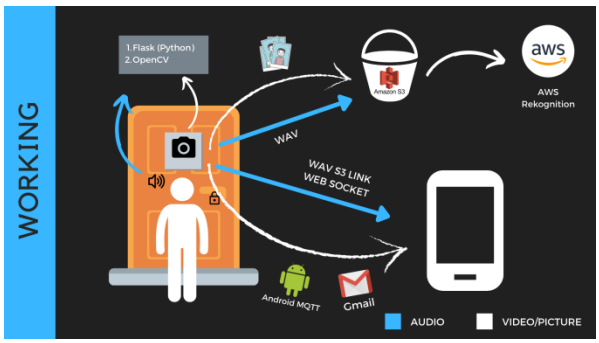

Fig 2. Workflow

5. System architecture

L. System Architecture for Smart Home

The system architecture for a smart house must be able to analyse instrumented data, monitor home appliances, and measure interior conditions. Our method makes use of microcontroller-enabled sensors to gauge the state of the house and microcontroller-enabled actuators to keep an eye on the front-end appliances. For data processing, our method makes use of cloud computing's PaaS (Platform as a Service) and SaaS (Software as a Service). Sensors with microcontroller support measure the circumstances in the house while the microcontroller analyses and processes the instrumented data. Actuators with microcontroller capabilities get instructions from the microcontroller to carry out certain tasks. The relationship between the microcontroller and cloud services determines how the commands are given. a database or data store that acts as a command queue for actuators, storing data from microcontroller-enabled sensors and cloud services for data processing and visualisation Between the back end and the front end, there is a server/API layer that makes it easier to handle sensor data and store it in databases. In order to operate the actuators, it also accepts commands from the web application client, which it then records in a database. Through the serer, the actuators send requests to consume commands from the database. Measure, visualise, and operate equipment via a mobile device thanks to a web application providing cloud services (e.g., smart phone).

Fig 3. System Design

6. Code Base

As seen in Fig. 4, the Code is carried out and the camera is activated using voice command. The current user is identified, and the photos of the incoming users are scrutinised and taught using several datasets to comprehend their look. Python is used to build the majority of the code base, and Amazon Web Services S3 Bucket is where the object pictures are kept.

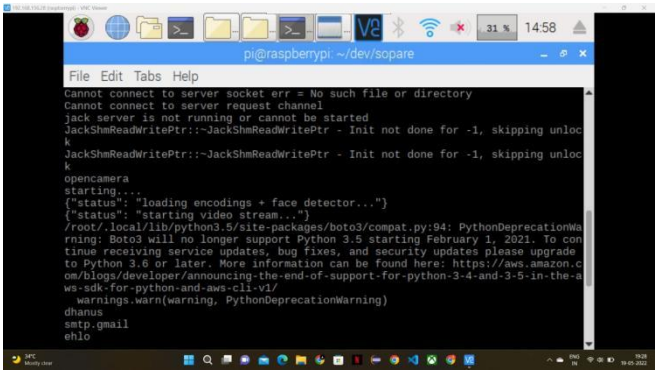

Fig 4. Execution

As can be seen in Figure 5, all of the photographs that were taken are saved in Amazon Web Services.

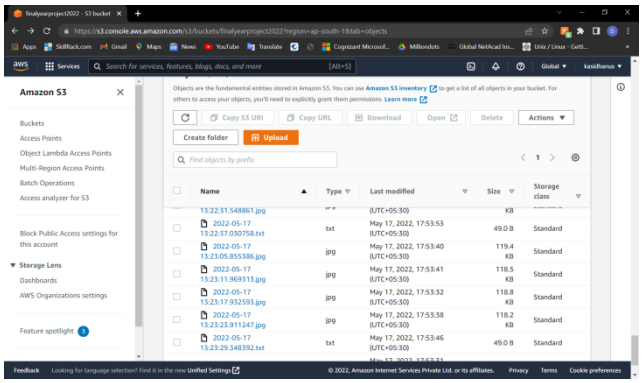

Fig.5.Amazon Web Services

MQTT Android Application used to open/ lock the door automatically via the “door open” command and publish it.

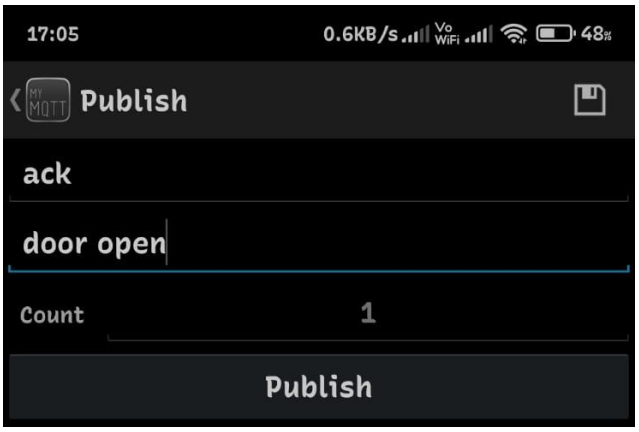

Fig 6. MQTT Application

7. USE CASES

This section provides use cases, such as regulating appliances, restricting access, and monitoring house conditions.

7.1 Monitoring Conditions at Home

This use case demonstrates the AWS infrastructure-hosted cloud service for monitoring residential conditions. The measurement service enables the user to visualise and preserve data on home conditions so they may be viewed anywhere, at any time[10]. The following sensor modules were utilised in this use case to measure the home's temperature, humidity, ambient light, and proximity. This display displays the measurement service's user interface.

7.2 Measurements for Home Appliances

The cloud service for managing home appliances that will be hosted on AWS infrastructure is being developed using this use case. The management service will provide the user control over the smart actuators connected to their household appliances' outputs[11]. Devices like valves and switches that may be programmed to do tasks like turning things on or off or modifying an operating system are known as smart actuators. Actuators offer a variety of capabilities, including emergency shutdown (ESD), on/off valve service, positioning to % open, modulating to regulate variations on flow conditions, etc. In this instance, we provided On/Off functions to control home appliances including lights, lamps, and fans using Relay SPDT Sealed actuators. Using a digital write, an actuator is activated.(ESD), on/off valve service, positioning to % open, modulating to regulate variations on flow conditions, etc[12,13]. In this instance, we provided On/Off functions to control home appliances including lights, lamps, and fans using Relay SPDT Sealed actuators. Using a digital write, an actuator is activated.The actuator needs to be given instructions. The following JSON

message informs Arduino board 3 to change pin number 4 to high, i.e., turn on the corresponding actuator, and is an example of the user interface of the monitoring service: "destination": "3", "source": "1", "commands": "4": "H"

8. Result & Conclusion

Using online services and cloud computing, this article investigates the idea of the smart home. In order to link intelligent items, we used technology. We also used cloud services to make it simple to communicate with intelligent objects from multiple places. Finally, we used JSON notation to increase the efficiency of data interchange. Home access control, home appliance monitoring, and home renovation services have all been successfully demonstrated using this technique. Other apps may adopt or be compatible with infrastructure.

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