ECS PROJECT REPORT

TITLE:- SMART SECURITY SYSTEM FOR RESEDENTIAL COMPLEXES

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Abstract

This innovative Smart Security System revolutionizes residential security by harnessing the power of Raspberry Pi and an array of sensors to safeguard homes and provide unparalleled peace of mind. Leveraging cutting-edge technology, the system seamlessly integrates motion detectors, door/window sensors, and a high-resolution camera module with the Raspberry Pi, transforming it into a vigilant sentinel. Real-time data is meticulously analyzed locally, enabling the system to discern genuine threats from harmless disturbances, significantly reducing false alarms. This intelligent approach, powered by on-device machine learning, ensures that homeowners are alerted only when genuine threats emerge.

In the event of a perilous situation, the system swiftly springs into action, triggering a series of alarms to deter intruders and alert homeowners. Furthermore, the system seamlessly integrates with a dedicated mobile application, empowering homeowners to receive real-time notifications and monitor live camera feeds from anywhere in the world. This remote monitoring capability grants homeowners complete control over their security, enabling them to take immediate action when necessary.

The system's computational prowess extends beyond mere surveillance, venturing into the realm of proactive security measures. Utilizing the Raspberry Pi's advanced processing capabilities, the system employs on-device machine learning algorithms to analyze patterns and identify potential threats before they escalate. This proactive approach significantly enhances the system's effectiveness, ensuring that homeowners are not caught off guard.

Moreover, the system champions data privacy, meticulously safeguarding sensitive information. By processing data locally on the Raspberry Pi, the system eliminates the risk of data breaches and unauthorized access. This commitment to privacy ensures that homeowners can enjoy comprehensive security without compromising their personal information.

In conclusion, this Smart Security System emerges as a beacon of innovation in residential security, seamlessly blending advanced technology with a user-friendly interface. Its cost-effective and scalable nature makes it an intelligent, user-friendly approach to residential security, ensuring peace of mind for residents while maintaining privacy through local data processing.

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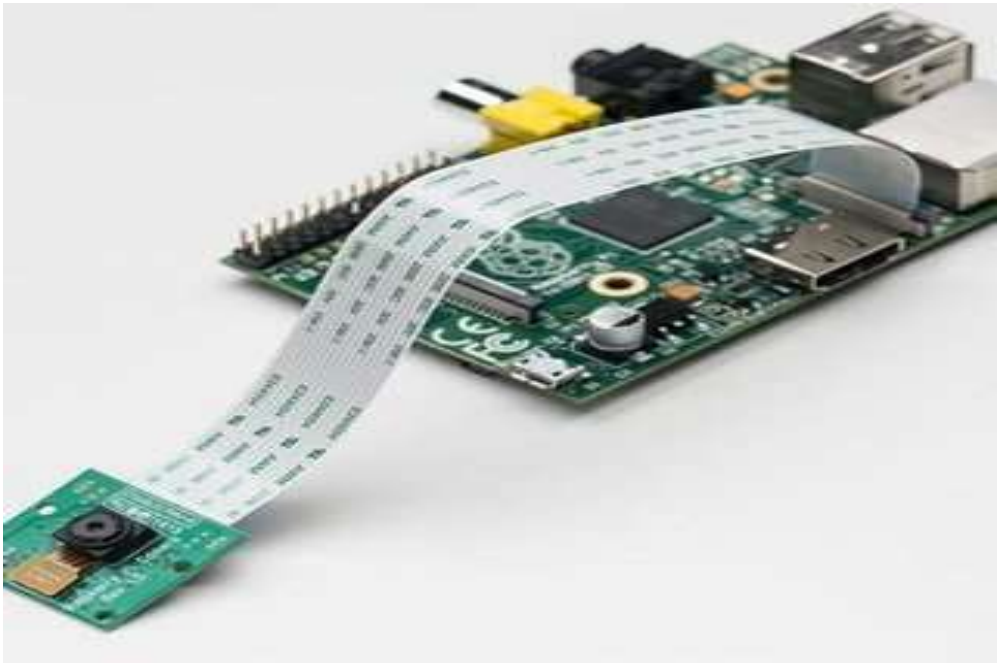
Introduction

This great innovative project was dug out of a rough idea of figuring out ways to use Artificial Intelligence, in securing large residential societies. Further, upon researching the existence of such models, we came across many research papers on this theme, along with some real-use products in the market and then, we set on the journey to know everything about such models, be it their programming languages, software models, authentication machines, the extent of the use of machine learning and artificial intelligence into such systems. We were particular, about making our model very different from the existing ones in terms of user experience, effective readiness of our system, and also cost-efficiency to build the system.

Raspberry Pi 4 Model

The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

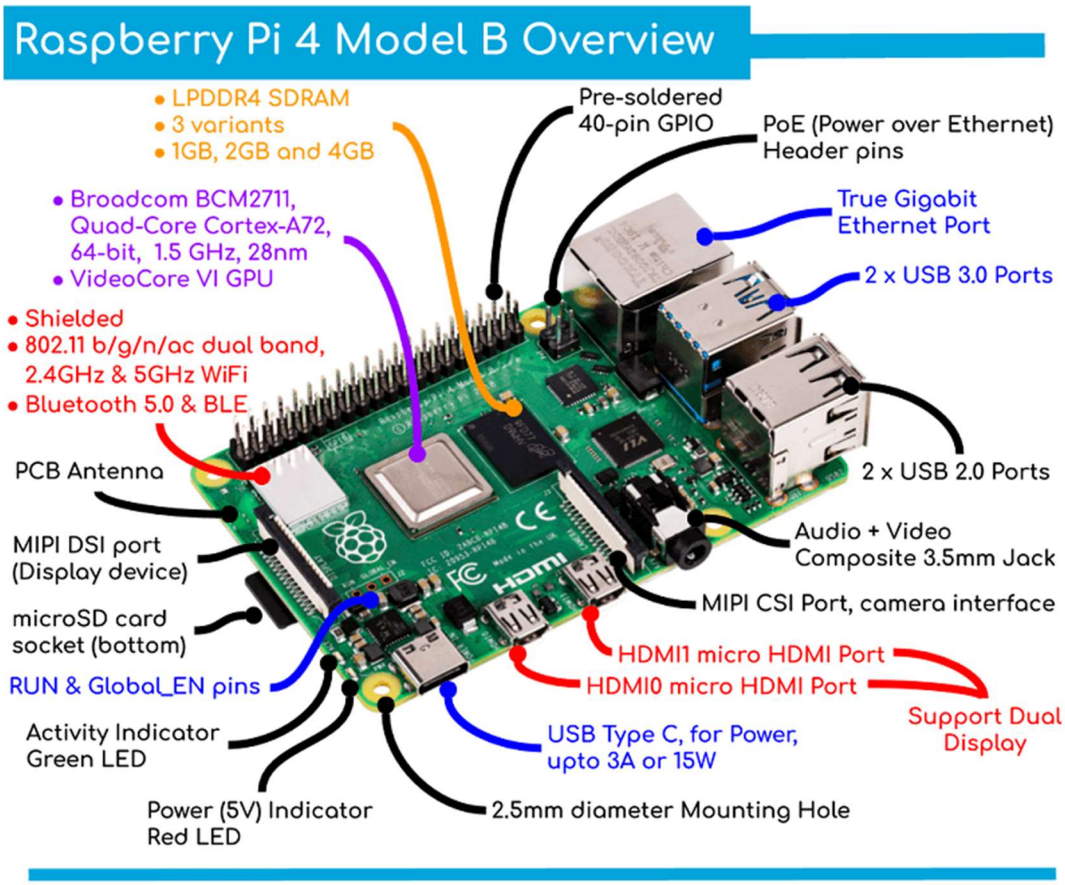


How does Raspberry Pi work?[2]

Raspberry Pi is a programmable device. It comes with all the critical features of the motherboard in an average computer but without peripherals or internal storage. To set up the Raspberry

computer, you will need an SD card inserted into the provided space. The SD card should have the operating system installed and is required for the computer to boot. Raspberry computers are compatible with Linux OS. This reduces the amount of memory needed and creates an environment for diversity.

After setting up the OS, one can connect Raspberry Pi to output devices like computer monitors or a High-Definition Multimedia Interface (HDMI) television. Input units like mice or keyboards should also be connected. This minicomputer's exact use and applications depend on the buyer and can cover many functions.



1. Central Processing Unit (CPU)

Every computer has a Central Processing Unit, and so does the Raspberry Pi. It is the computer's brain and carries out instructions using logical and mathematical operations. Raspberry Pi makes use of the ARM11 series processor on its boards.

2. HDMI port

Raspberry Pi board has an HDMI or High Definition Multimedia Interface port that allows the device to have video options of the output from the computer displayed. An HDMI cable connects the Raspberry Pi to an HDTV. The supported versions include 1.3 and 1.3. It also comes with an RCA port for other display options.

3. Graphic Processing Unit (GPU)

This unit, GPU or Graphic Processing Unit, is another part of the Raspberry pi board. Its primary purpose is to hasten the speed of image calculations.

4. Memory (RAM)

Random Access Memory is a core part of a computer's processing system. It is where real-time information is stored for easy access. The initial Raspberry Pi had 256MB RAM. Over the years, developers gradually and significantly improved the size. Different Raspberry Pi models come with varying capacities. The model with the maximum capacity presently is the Raspberry Pi 4 with 8GB RAM space.

5. Ethernet port

The Ethernet port is a connectivity hardware feature available on B models of Raspberry Pi. The Ethernet port enables wired internet access to the minicomputer. Without it, software updates, web surfing, etc., would not be possible using the Raspberry Pi. The Ethernet port found on Raspberry computers uses the RJ45 Ethernet jack. With this component, Raspberry Pi can connect to routers and other devices.

6. SD card slot

Like most other regular computers, Raspberry Pi must have some sort of storage device. However, unlike conventional PCs, it does not come with a hard drive, nor does it come with a memory card. The Raspberry Pi board has a Secure Digital card or SD card slot where users must insert SD cards for the computer to function. The SD card functions like a hard drive as it contains the operating system necessary for turning the system on. It also serves to store data.

7. General Purpose Input and Output (GPIO) pins

These are upward projecting pins in a cluster on one side of the board. The oldest models of the Raspberry Pi had 26 pins, but most have 40 GPIO pins. These pins are pretty sensitive and should be handled carefully. They are essential parts of the Raspberry Pi device as they add to its diverse applications. GPIO pins are used to interact with other electronic circuits. They can read and control the electric signals from other boards or devices based on how the user programs them.

8. LEDs

These are a group of five light-emitting diodes. They signal the user on the present status of the Raspberry Pi unit. Their function covers:

- **PWR (Red):** This functions solely to indicate power status. When the unit is on, it emits a red light and only goes off when the unit is switched off, or disconnected from the power source.
- **ACT (Green):** This flashes to indicate any form of SD card activity.
- **LNK (Orange):** LNK LED gives off an orange light to signify that active Ethernet connectivity has been established.
- **100 (Orange):** This light comes on during Ethernet connection when the data speed reaches 100Mbps.

- **FDX (Orange):** FDX light also comes during Ethernet connection. It shows that the connection is a full-duplex.

9. USB ports

Universal service bus (USB) ports are a principal part of Raspberry Pi. They allow the computer to connect to a keyboard, mouse, hard drives, etc. The first model of Raspberry Pi had only two USB 2.0 ports. Subsequent models increased this number to four. Raspberry Pi 4 and Pi 400, much newer models, come with a mix of USB 2.0 and USB 3.0 ports.

10. Power source

Raspberry Pi has a power source connector that typically uses a 5V micro USB power cable. The amount of electricity any Raspberry Pi consumes depends on what it's used for and the number of peripheral hardware devices connected.

Working of the model

1.It activates its modules when **PIR sensor** is active .

2.After that the pie module camera detects the common objects captured in the frame using **tensor flow module**, this is a basic training model which is having **pre trained library** for common objects around us also the **coco files** contain the list of common objects defied to it recognize the objects define to it.

3. After this if there is a person in front of the camera the image classification file **"pyshotscam.py"** captures the person and checks for the persons image within the folders of data set and images inside the **train model.py file**.

4. Upon recognizing the person, pi will initiate a command to open the main gate of the society for the recognized person and in case of unrecognized person it will take **at least 2 pictures of the person for entry** and also allow him to enter through the gate.

5. Inside the personal flats there are PIR sensors to regulate the gas and **smoke sensor mq135** and also the microphone module for the screen detection and will on active mode **until 15 minutes of entry of any unknown person** or can remain active throughout the time it will install.

6.After which if there is any detection through the above said sensors the whole module would get activated and work accordingly and initiate a notification for the problem detected on our website with the **image of the last person entered irrespective of known or unknown person**.

7. The whole process is controlled majorly by **Raspberry pi4 model B as the core CPU** along with different sensors and primarily relaying upon the PIR sensors for its activation.

Background

Security is a major require of almost everyone in the society. The major challenge is for those with Senior Citizens or infants, as physical security deployment may not always be effective and sure to protect the assigned person. Thus, we came up with the solution of providing security using our system, with full surety to the owners with promise.

The demand for security system with modern technology, is still quite unimaginable for many of us. This greater need of such system made us innovate in this field to meet the supply.

Definition of the problem :

Security is a major require of almost everyone in the society. The major challenge is for those with Senior Citizens or infants, as physical security deployment may not always be effective and sure to protect the assigned person. Thus, we came up with the solution of providing security using our system, with full surety to the owners with promise.

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Objective

- Secure the owner from any kind of threat perception,
- Systematically, ensuring security in cases of accidents too
- Managing, main gate entry and exit list, with record of unknown persons' entry along with images of the person while waiting at the main gate
- Ensuring, the theme of sustainable environment by promoting right use of resources
- Providing, immediate medical or police assistance in cases of grieve need, in real time

Procedure

The “Smart Security System for Residential Complexes” is a visionary tool comprising of software and hardware components, in place to fully adapt to its environment and thereby, protect the person’s within its range from any kind of direct or indirect attacks. The tool is greatly, made of combinations of various sensors deployed to take care of threats to its owners. It is capable of assessing even gas or chemical attacks and even sense danger from your voice, even if you are not in a position to directly call out for help. The system is taking care of everything inside the residential complex right from a person’s entry from main gate. The pi module camera’s at the main gate records itself the entry of any known person and also captures any unknown persons, random images, while he/she is waiting at the main gate for authenticated entry. Then as the person is inside the premise, on the way to a personal flat and the flat owner has recognized or has already allowed him/her as their guest, only then the flat gates are to be opened. If the person, is instantly admitted by the owner while waiting outside the personal gate, then also he/she can be granted access to enter the personal flat. There are Passive infrared sensors installed right above the entry door of a flat, which is glows light upon any movement, thereby signaling entry of any person. Then, eventually all the sensors are placed at their best fit locations, for maximum utilization of their outputs for safeguarding the members of the flat. Thereby, securing the whole complex with programmed sensors and cameras. The whole of the project is skillfully displaying its readiness and effective working in providing security to the residents and also, at the same time showcasing its social responsibility of environment friendly nature. The whole system works on the theme of “SAVE ELECTRICITY” from

the entrance itself, where every part of it is off until the main gate cameras detects any person. So, providing round the clock security from all possible threats.

Result and Discussion

Review on Security in Smart Home Development by Rosslin John Robles and Tai hoon kim

Details :

Smart Home is a residence that uses a Home Controller to integrate the residence's various home automation systems. The most popular Home Controllers are those that are connected to a Windows based PC during programming only, and are then left to perform the home control duties on a stand-alone basis. Integrating the home systems allows them to communicate with one another through the home controller, thereby enabling single button and voice control of the various home systems simultaneously, in preprogrammed scenarios or operating modes. Security has been an important issue in the smart home applications. In this paper, they have discussed smart home and security, we also review the tool related to smart home security.

Design and Implementation of Smart Home Security System by Md. Kamal Hossain **and** Prodip Biswas.

Details :

It has been seen that the prototype model works without any basic error. So it can be implemented in the practical field. Besides the cost of the project is not too much. Here it has provided utmost security so, it is quite impossible to any burglar to enter the room without concern of owner. If available financial and technical support from the concerned Govt. section and organizations it is found that, then it will be possible to commercialize the proposed lock for the benefit of the people of our country. Some feature has been added to
make the project more efficient. It could be implemented it by GSM based home security system. For this when a burglar enters the room without the concern of owner a sms will be sent to the user. Then it will take precautionary measure. It may be used another technique called biometrics which is more prominent and a recognized means of positive identification. Some new technologies such as fingerprint scanning, retinal scanning and iris scanning, and voiceprint identification also can be inserted. Moreover it could be useful for various sensors such as gas sensor, fire sensor for more improvement of the security of home.

Enhanced Intelligent Smart Home Control and Security System Based on Deep Learning Model by Olutosin Taiwo, **Absalom E. Ezugwu**, Olaide N. Oyelade, and Mubarak S. Almutairi

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Improved convenient living, a healthy lifestyle, comfortability, and home security are areas of interest and development. The elderly, handicapped, and sick need to reduce daily activities that can stress them and negatively impact their health. To end this, a smart home automation system that can facilitate local and global monitoring, control, and safety of the home was developed. This work contributes to the existing research in home automation with the design and development of a multifunctional Android-based mobile application for the smart home automation domain. It has proposed an approach to enhance home security using the CNN deep learning model to classify and detect intruders in the home. The detection is based on the identification of motion in the home environment. Using this method shows that users will have enhanced security of their houses while having minimal disturbance from notifications.

The proposed method intends to eliminate frequent notifications and false notifications in a smart home automation system. The drawback of our proposed method is the detection of multiple movements at a time. The training and classification models were based on the movement of a person at a time.

- **"A Smart Security System for Residential Complexes Using Machine Learning"** by researchers at the Indian Institute of Technology Madras. Their paper proposes a smart security system that uses machine learning to identify threats in residential complexes. The system uses cameras to collect data on the activity in a residential complex. This data is then used to train a machine learning model to identify suspicious behavior.

- **"A Smart Security System for Residential Complexes Using IoT"** by researchers at the Indian Institute of Science Bangalore. This paper proposes a smart security system that uses the Internet of Things (IoT) to collect data from a variety of sensors in a residential complex. This data is then used to create a real-time picture of the security situation in the complex.

- **"A Smart Security System for Residential Complexes Using Blockchain"** by researchers at the Indian Institute of Management Ahmedabad. This paper proposes a smart security system that uses blockchain to secure data in residential complexes. The system uses blockchain to create a tamper-proof record of all security events.

These are a few research papers and their work overview on the theme of "Smart Security system for Resedential Complexes".

Things that can be added in the device in future to make it more useful

- **Drones and yard detection**

The first line of defense in protecting your home is no longer going to be your front door. Futuristic polymer-coated fences will be able to detect when someone attempts to climb over them, and alert the rest of the security system that an intruder is present.

It's likely that a combination of low-flying drones and chemical-marking yard sprayers will help to halt any interlopers before they've even made it to your back door. When a trespasser is present, they will immediately be doused in a difficult-to-remove chemical marker, and a drone will be launched from your roof that will follow – and film – their attempted escape.

In some instances, the drones themselves may be able to release a marking spray as well, making it impossible for even the best getaway car to elude detection.

- **Automated neighborhood watch**

Technology is going to take this community awareness a step further by equipping the next generation of intelligent alarm systems with the ability to communicate with other systems in the neighborhood. If ever a suspicious person were to enter the neighborhood, the program will immediately alert all the other homes and will collectively begin gathering important data.

Everyone wants to feel safe in their own home and know that their possesses are protected when they are away. With the future of smart home protection just around the corner, you'll have all the security you need, without feeling like you live in a bunker.

- **Energy Efficiency:**

Smart homes will continue to serve in enhancing energy efficiency. Smart thermostats, lighting, and appliances are interconnected to minimize energy consumption resulting in reducing utility bills.

- **Technology Advancements:**

Technology is rapidly growing, which makes smart home solutions more affordable and accessible. With more awareness of technology in society, it will become the standard rather than the exception.

- **Aging Population:**

To help senior citizen maintain their independence by doing their work themselves without the help of others there is a need for its solution.

A smart home provides a comfortable and secure environment for the world's population that is aging with time.

References :

https://www.researchgate.net/publication/228416463_A_Review_on_Security_in_Smart_Home_Development

https://www.researchgate.net/publication/293173717_Design_and_Implementation_of_Smart_Home_Security_System

CODE

```
import cv2
from subprocess import call

def open_py_file():
        call(["python3","facial_req.py"])



#thres = 0.45 # Threshold to detect object

classNames = []
classFile = "/home/ecs2023/Downloads/ecs2023imagerecog-main/coco.names"
with open(classFile,"rt") as f:
    classNames = f.read().rstrip("\n").split("\n")

configPath = "/home/ecs2023/Downloads/ecs2023imagerecog-main/ssd_mobilenet_v3_large_coco_2020_01_14.pbtxt"
weightsPath = "/home/ecs2023/Downloads/ecs2023imagerecog-main/frozen_inference_graph.pb"

net = cv2.dnn_DetectionModel(weightsPath,configPath)
net.setInputSize(320,320)
net.setInputScale(1.0/ 127.5)
net.setInputMean((127.5, 127.5, 127.5))
net.setInputSwapRB(True)



def getObjects(img, thres, nms, draw=True, objects=[]):
```

```
    classIds, confs, bbox = net.detect(img,confThreshold=thres,nmsThreshold=nms)
    #print(classIds,bbox)
    if len(objects) == 0: objects = classNames
    objectInfo =[]
    if len(classIds) != 0:
        for classId, confidence,box in zip(classIds.flatten(),confs.flatten(),bbox):
            className = classNames[classId - 1]
            if className in objects:
                objectInfo.append([box,className])
                if (draw):
                    cv2.rectangle(img,box,color=(0,255,0),thickness=2)
                    cv2.putText(img,classNames[classId-1].upper(),(box[0]+10,box[1]+30),
                    cv2.FONT_HERSHEY_COMPLEX,1,(0,255,0),2)
                    cv2.putText(img,str(round(confidence*100,2)),(box[0]+200,box[1]+30),
                    cv2.FONT_HERSHEY_COMPLEX,1,(0,255,0),2)

    return img,objectInfo


if _name_ == "_main_":

    cap = cv2.VideoCapture(0)
    cap.set(3,640)
    cap.set(4,480)
    #cap.set(10,70)


    while True:
```

```
success, img = cap.read()
result, objectInfo = getObjects(img,0.45,0.2, objects=['person'])
#print(objectInfo)
cv2.imshow("Output",img)
cv2.waitKey(1)

if getObjects(img,0.45,0.2, objects=['person']):
    print("Person Detected")
    #cv2.destroyAllWindows()
    #vs.stop()
    #open_py_file()
```

```
# import the necessary packages
from imutils import paths
import face_recognition
#import argparse
import pickle
import cv2
import os
from subprocess import call

# our images are located in the dataset folder
print("[INFO] start processing faces...")
imagePaths = list(paths.list_images("dataset"))

# initialize the list of known encodings and known names
knownEncodings = []
knownNames = []

# loop over the image paths
for (i, imagePath) in enumerate(imagePaths):
        # extract the person name from the image path
        print("[INFO] processing image {}/{}".format(i + 1,
                len(imagePaths)))
        name = imagePath.split(os.path.sep)[-2]

        # load the input image and convert it from RGB (OpenCV ordering)
        # to dlib ordering (RGB)
```

```
        image = cv2.imread(imagePath)
        rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

        # detect the (x, y)-coordinates of the bounding boxes
        # corresponding to each face in the input image
        boxes = face_recognition.face_locations(rgb,
                model="hog")

        # compute the facial embedding for the face
        encodings = face_recognition.face_encodings(rgb, boxes)

        # loop over the encodings
        for encoding in encodings:
                # add each encoding + name to our set of known names and
                # encodings
                knownEncodings.append(encoding)
                knownNames.append(name)

# dump the facial encodings + names to disk
print("[INFO] serializing encodings...")
data = {"encodings": knownEncodings, "names": knownNames}
f = open("encodings.pickle", "wb")
f.write(pickle.dumps(data))



def open_py_file():
    call(["python3","facial_req.py"])
```

```
open_py_file()
from gpiozero import LED
from gpiozero import MotionSensor
import time

green_led = LED(17)
pir = MotionSensor(4)
green_led.off()

while True:

    print("Scanning")
    if pir.wait_for_motion():
        print("Motion Detected , Switching on Lights")
        green_led.on()
        time.sleep(5)
        green_led.off()
        print("No Motion for 5 sec , Switched off Lights")
        time.sleep(2)
import cv2

#thres = 0.45 # Threshold to detect object

classNames = []
classFile = "/home/pi/Desktop/Object_Detection_Files/coco.names"
with open(classFile,"rt") as f:
    classNames = f.read().rstrip("\n").split("\n")
```

```
configPath = "/home/pi/Desktop/Object_Detection_Files/ssd_mobilenet_v3_large_coco_2020_01_14.pbtxt"
weightsPath = "/home/pi/Desktop/Object_Detection_Files/frozen_inference_graph.pb"

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                    cv2.FONT_HERSHEY_COMPLEX,1,(0,255,0),2)
                    cv2.putText(img,str(round(confidence*100,2)),(box[0]+200,box[1]+30),
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    cap.set(4,480)
    #cap.set(10,70)



    while True:
        success, img = cap.read()
        result, objectInfo = getObjects(img,0.45,0.2, objects=['cup'])
        #print(objectInfo)
        cv2.imshow("Output",img)
        cv2.waitKey(1)
import cv2
from picamera import PiCamera
from picamera.array import PiRGBArray

name = 'name' #replace with your name

cam = PiCamera()
cam.resolution = (512, 304)
cam.framerate = 10
rawCapture = PiRGBArray(cam, size=(512, 304))

img_counter = 0
```

```
while True:
    for frame in cam.capture_continuous(rawCapture, format="bgr", use_video_port=True):
        image = frame.array
        cv2.imshow("Press Space to take a photo", image)
        rawCapture.truncate(0)

        k = cv2.waitKey(1)
        rawCapture.truncate(0)
        if k%256 == 27: # ESC pressed
            break
        elif k%256 == 32:
            # SPACE pressed
            img_name = "dataset/"+ name +"/image_{}.jpg".format(img_counter)
            cv2.imwrite(img_name, image)
            print("{} written!".format(img_name))
            img_counter += 1

    if k%256 == 27:
        print("Escape hit, closing...")
        break

cv2.destroyAllWindows()
```

THANK YOU !