

SMART PET DOOR

Artificial Intelligence Facial Recognition System

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What is this project?

AI Facial Recognition Smart Pet Door

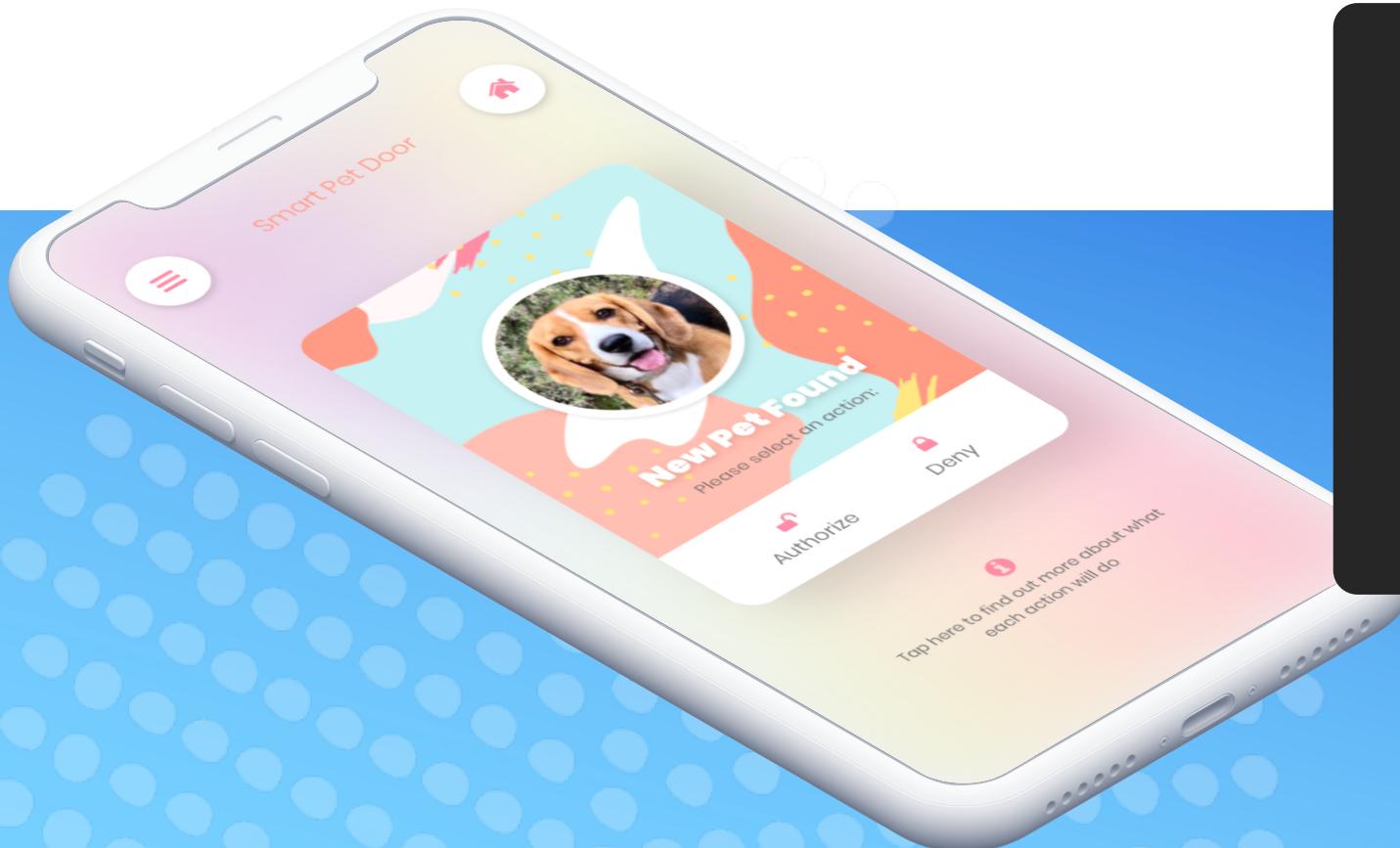
The Smart Pet Door works with a visual recognition system for authentication. Owners would only have to upload a few images of the pets during the setup (for machine learning). The camera embedded in the top of the door flap detects objects and the flap would be open to certain pets only that have already been authorized.



Image source: <https://www.surepetcare.com/en-gb/pet-doors>

Mobile app Control & Monitor

Users are able to monitor and control the smart pet door lock via our mobile app with the inbuilt camera. User can also trace back all in-and-out record with the application.



Confidence Score

There is a confidence(accuracy) score for each identification. The lock will be open automatically if the score is higher than 97%. For security purposes, users will receive notification and can decide to open or close the lock for those who is lower than 97%.

Why was the project initialized?

How many pets are there in AU?



RSPCA Australia

"Australia has one of the highest rates of pet ownership in the world. About 62% of Australian households own pets. There are an estimated more than 24 million pets in Australia."

Pets in Australia

24m

Households

62%

Owns a dog

38%



Inspiration

What was the project initialized?

"Marmaduke", a lovable yet naughty giant Great Dane named Marmaduke, always sneak out from the dog flap in the Winslow family and brought a lot of "friends" into the house.

The height of a large dog breed like Great Dane can be up to 80 cm - which is more than enough for not just animal intruders but also thieves to get into your house. Therefore, the security issue of traditional pet door has been brought to our attention.

Small Beds: Dogs and Cats up to 10kg (22lb) 55 x 65 cm (21.5" x 26")

Dachshunds
Jack Russel and Cairn Terriers
Italian Greyhounds
French Bull Dogs
King Charles Spaniels

Medium Beds: Dogs up to 20kg (44lb) 75 x 85 cm (29.5" x 33.5")

Basenjis
Viszlas
Whippets
Bull Terriers
Beagles
Bedlington Terriers
Shiba Inus

Large Beds: Dogs up to 40kg (88lb) 75 x 105 cm (29.5" x 41.5")

Dalmatians
Boxers
Greyhounds
Weimaraners

*Breed recommendations are a guideline only. Please refer to bed measurements and weight recommendations before ordering your KONA CAVE®

KONA CAVE®
dogs love it!

Sources: <https://www.konacave.com/>



In 2015 Australia had the 5th highest rate of burglaries in the world. The four countries with higher rates of burglary than Australia in 2015 were all located in Europe and had much smaller populations

Burgled home
20%
*2017 in Australia

Source: <https://www.budgetdirect.com.au/home-contents-insurance/research/home-burglary-statistics.html>

The problem to be solved
Home security

- In 2017 – 225,900 recorded burglaries in Australia, or one every 3 mins
- 20.3% of Australian homes have been burgled at some point
- It takes 75% of burglars less than 5 minutes to enter a property



Target Market Size

Market Research

Household owning pets 62%



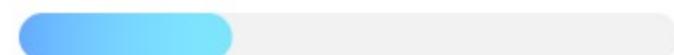
- 62% of Australian households own pets
- estimated more than **24 million pets**

Dog ownership 38%



- estimated to be **4.8 million pet dogs**
- 20 dogs for every 100 people

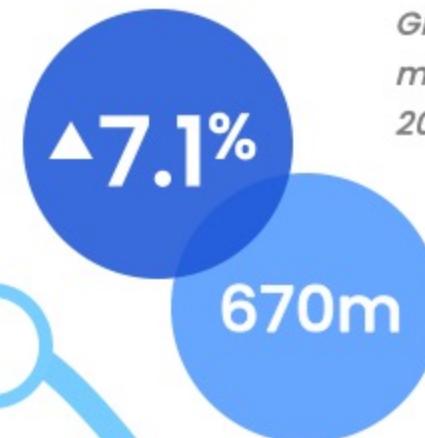
Cat ownership 23%



- 29% of households owning a cat
- estimated to be **3.9 million pet cats**
- 16 cats for every 100 people

Global Market Growth In 5 Years

Market Research



The Market Research News

"Over the next five years the Pet Doors market will register a 7.1% CAGR (Compound Annual Growth Rate) in terms of revenue, the global market size will reach US\$ 670 million by 2024, from US\$ 450 million in 2019."



“ EXISTING PRODUCTS IN THE MARKET

Market Research

SureFlap Microchip Pet Door

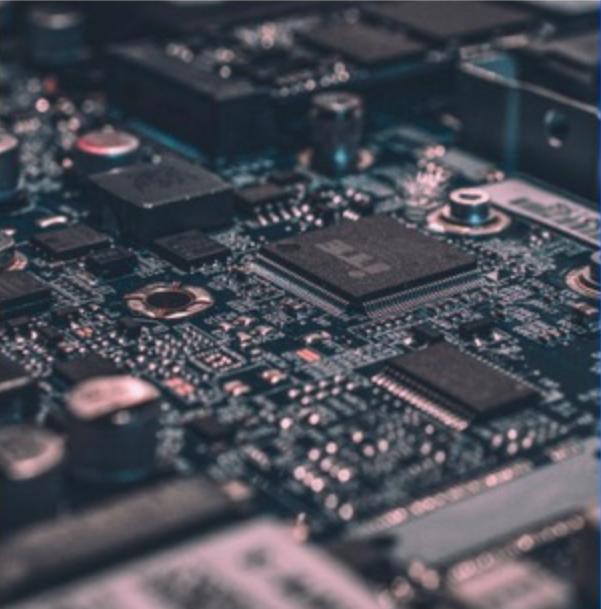
The SureFlap Microchip Pet Door is also a smart pet door, however it requires an extra microchip that is embedded in the pet's collar for authentication



Mookkie Smart Pet Feeding Bowl

The other pet product that uses Artificial Intelligence with deep neural network to identify pets

Technology Research



Artificial
Intelligence



Machine
Learning

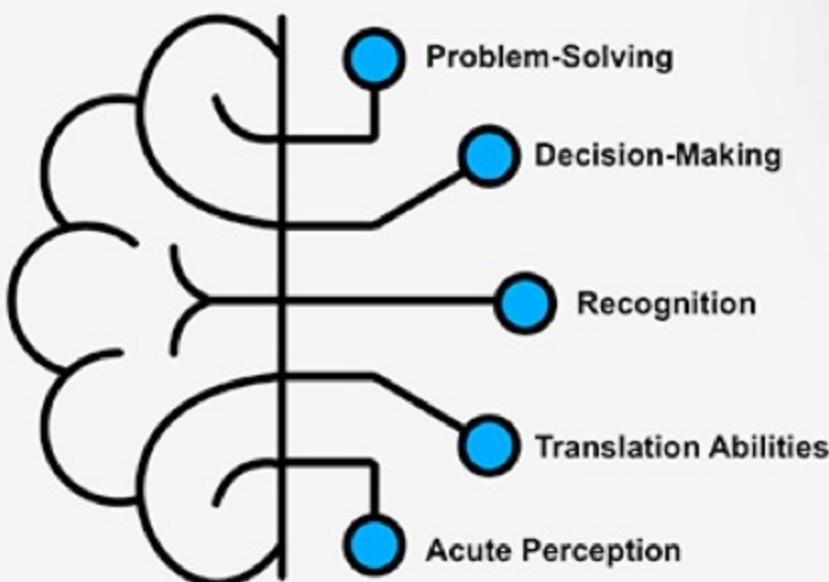


Neural
Network



What is AI - Artificial Intelligence

Technology research



A machine that is capable of imitating and performing intelligent human behavior



These tasks could include problem-solving, decision-making and recognition



A "Smart system" is equipped with AI and is trying to imitate those qualities

What is Machine Learning?

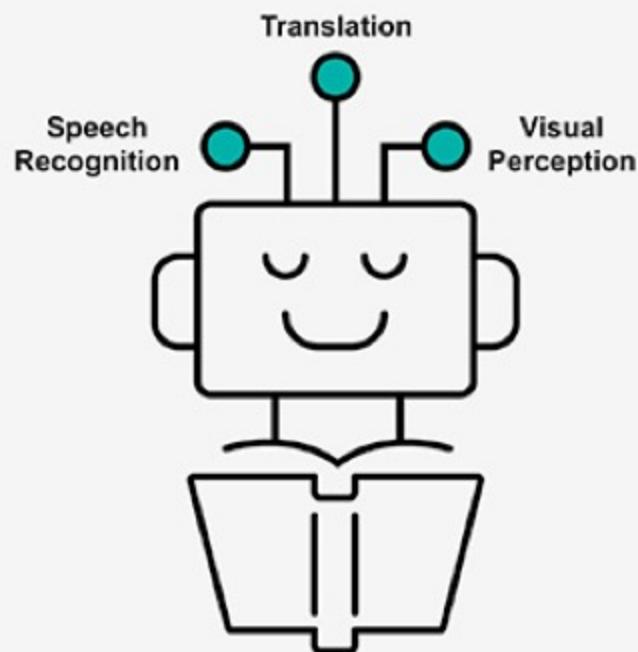
Technology research



- Machines are taught to learn from data and make decisions.
- Provide quick results for fast decision-making

Includes

- Deep Learning



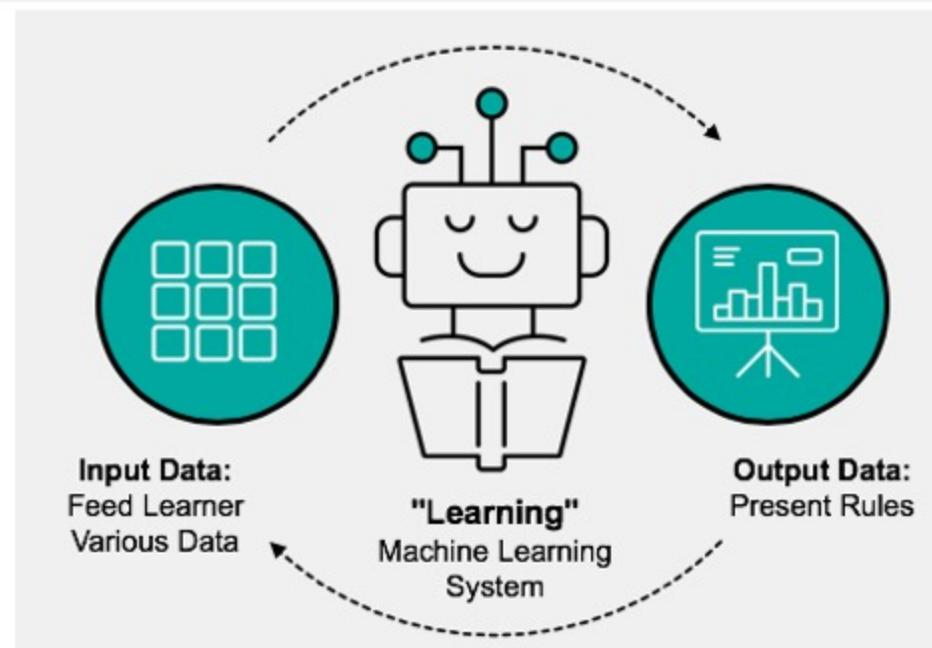
A fundamental of the Artificial Intelligence is represented by the algorithms created to improve the ability of the machine to act and make decisions, which will be able to learn from its own experience, as humans do.

What is Machine Learning?

Technology research



- Learns autonomously through a dynamic feedback loop
- Increasingly self-healing, self-organizing, and self-architecting



Supervised, unsupervised, and the semi-supervised learning model.

Supervised model is based on giving target samples to the machine, showing it the relations between input, output, and result, so that it can create rules to apply to all other cases.

What is Neural Network?

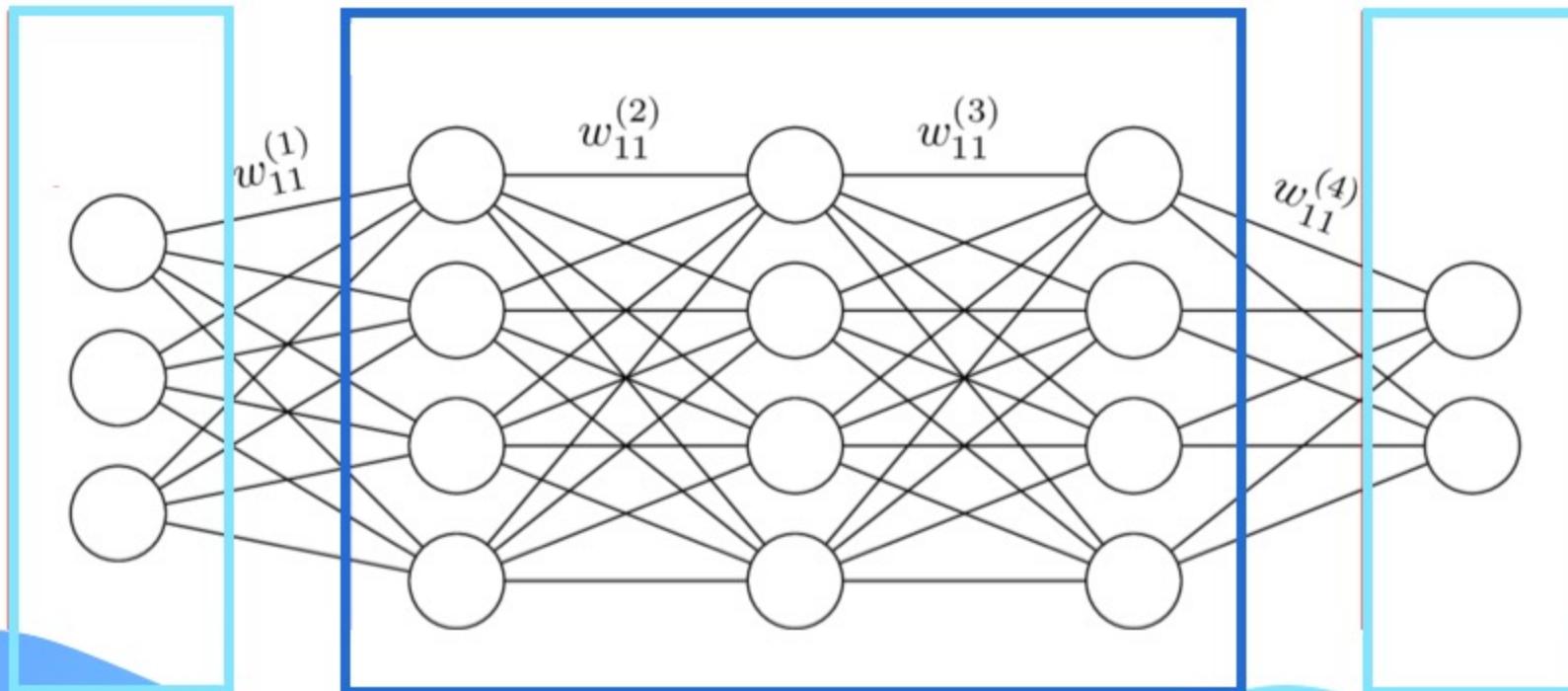
Technology research

Inspired by human brain, Artificial Neural Network is made of synapses, represented by nodes, which transform the inputs in output, following a hierarchy, so that each node can be positioned in a timeline, where the output of one is the input of the more advanced followers.

Visible input layer

Hidden layers

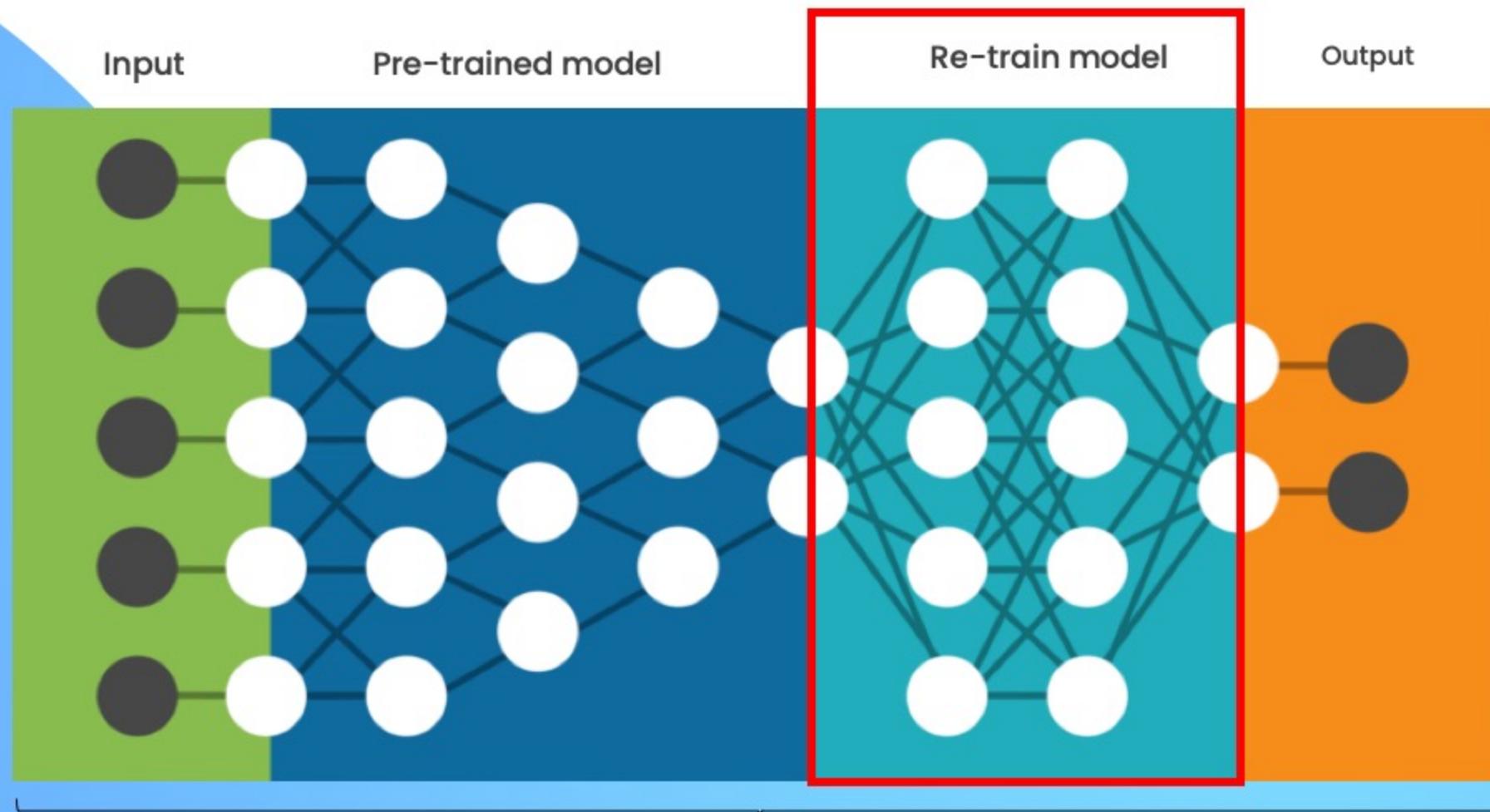
Visible output layer



The Artificial Neural Network (ANN) is the process to build the machine learning model. If an artificial neural network has more than one hidden layers, it has become a Deep Neural Network (DNN).

Transfer Learning

Technology research



Convolutional Neural Network (CNN)

What is Deep Learning?

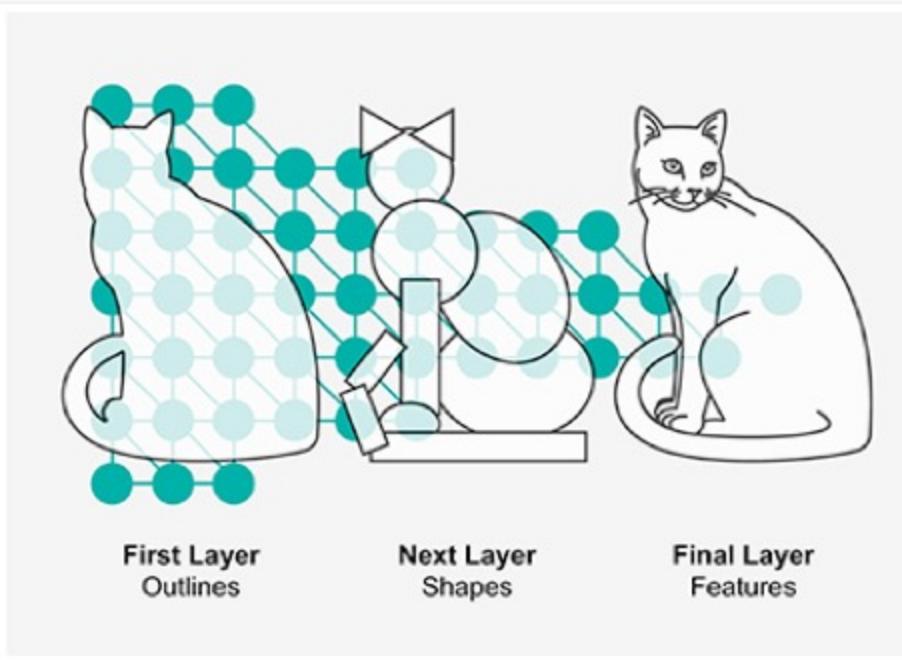
Technology research



- Learning is done in a hierarchy of layers
- Modeled after the brain's neural networks
- "Deep" describes the number of layers used

Known for

- Speech and image recognition
- Language processing

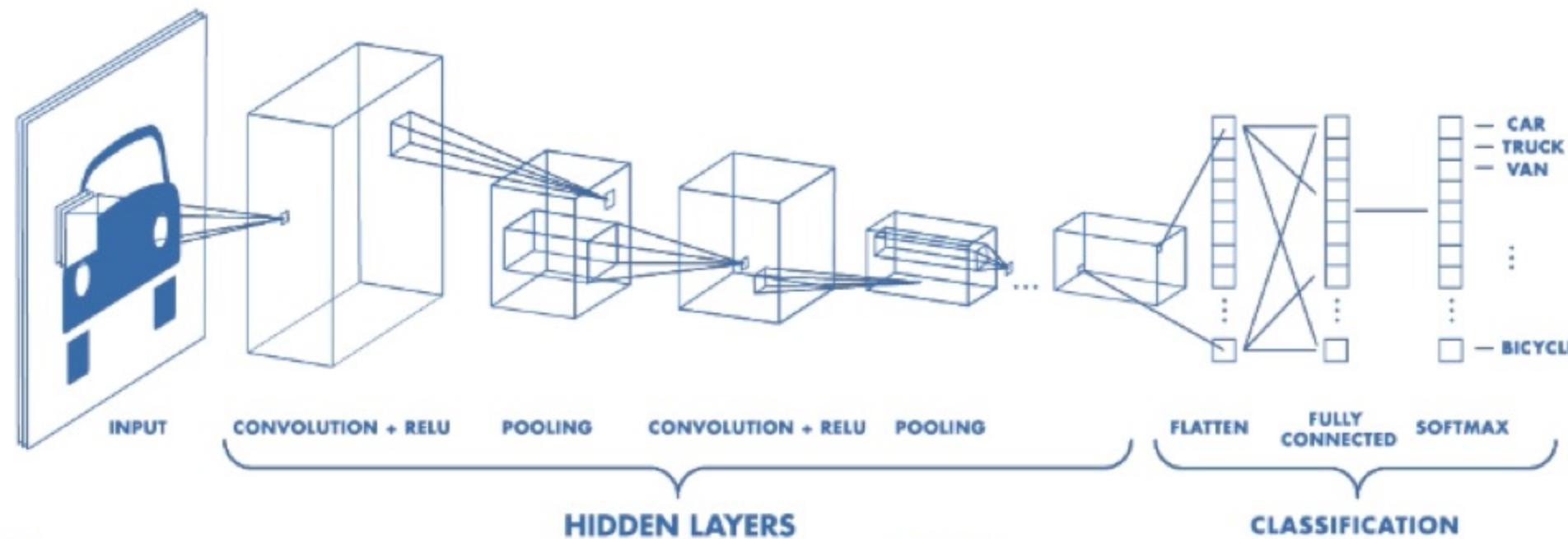


Deep Learning Algorithms can be improved and reused from learning processes, whereas the simple Machine Learning methods, can only reach a certain level of performance, and it is not possible to re-train them with new data, so the learning process is limited.

What is Convolutional Neural Network (CNN)?

Technology research

The result of the windowing is a matrix, the Feature Map, which will be smaller than the original picture, and for each layer it is possible to apply more filters, creating then more feature maps.





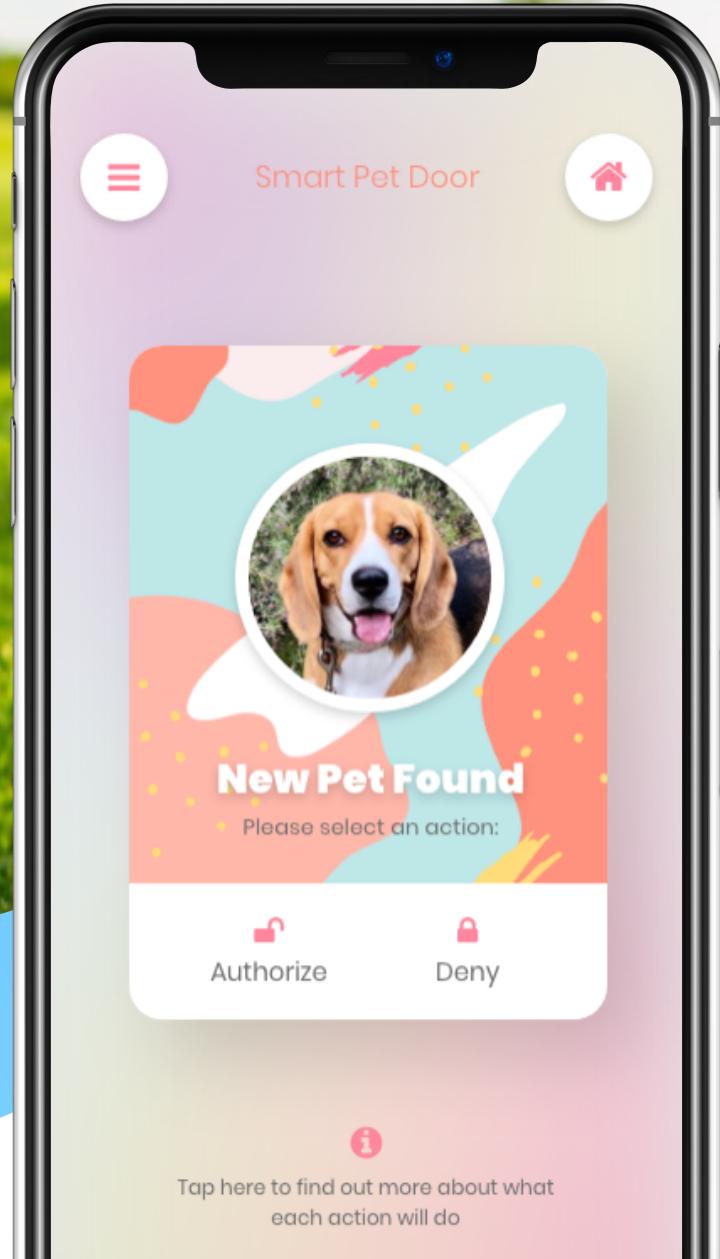
TensorFlow Deep Learning Framework

Technology research

A machine learning open source library developed by the Google Brain Team. Compared to other deep learning frameworks [see researches of other networks in Reference], TensorFlow provides higher level operations to carry out complex parallel computation that is used to build an advanced neural network model.

Its APIs are developed in several major programming languages like Python, Java, C++ and come with very comprehensive documentation, for developers' better learning and understanding.

[MORE DETAILS](#)

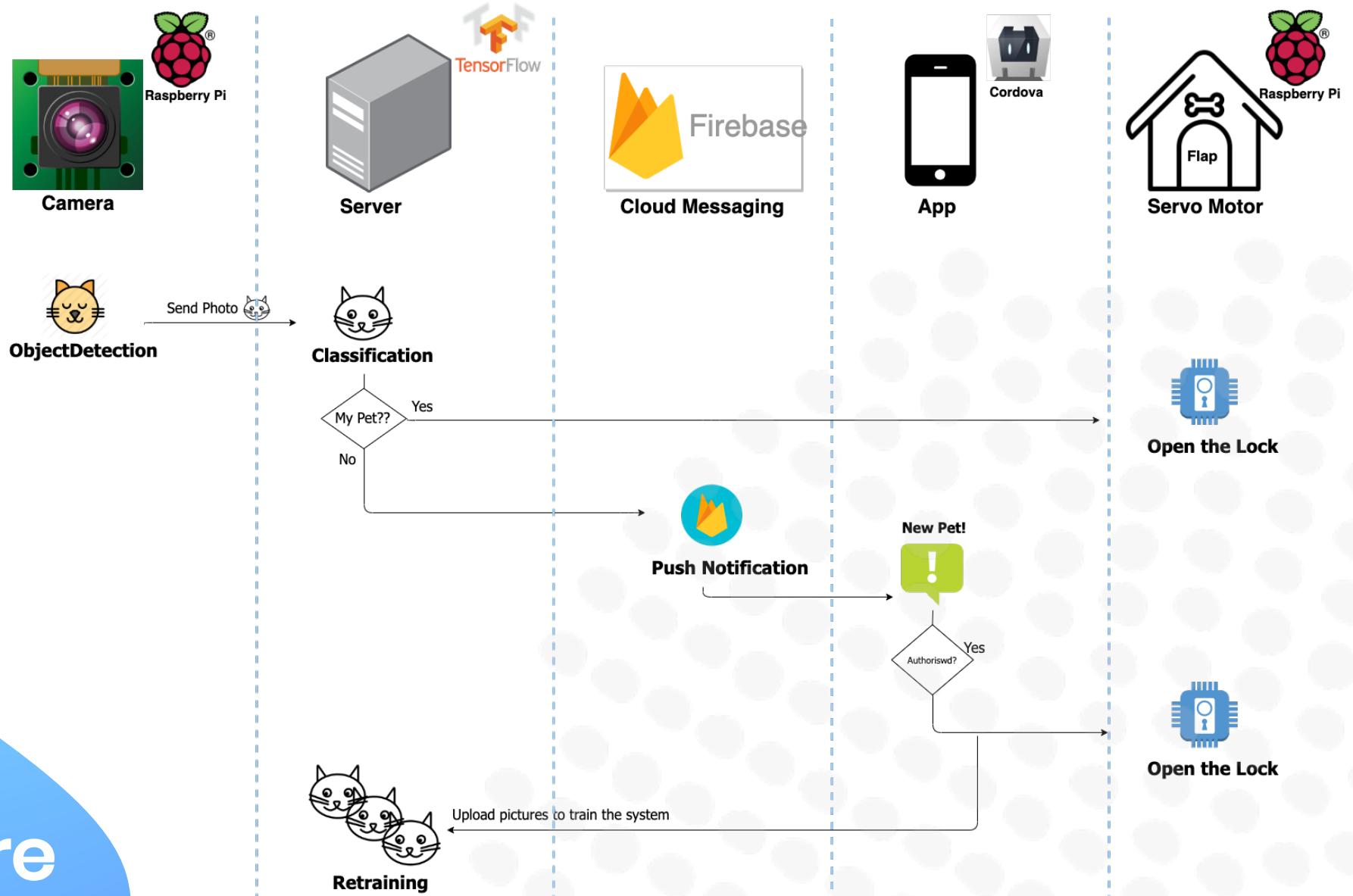


Project Implementation

The Smart Pet Door

System Architecture

The Smart Pet Door



The Smart Pet Door
Product Prototype

Camera

To detect objects in front of
the Smart Pet Door



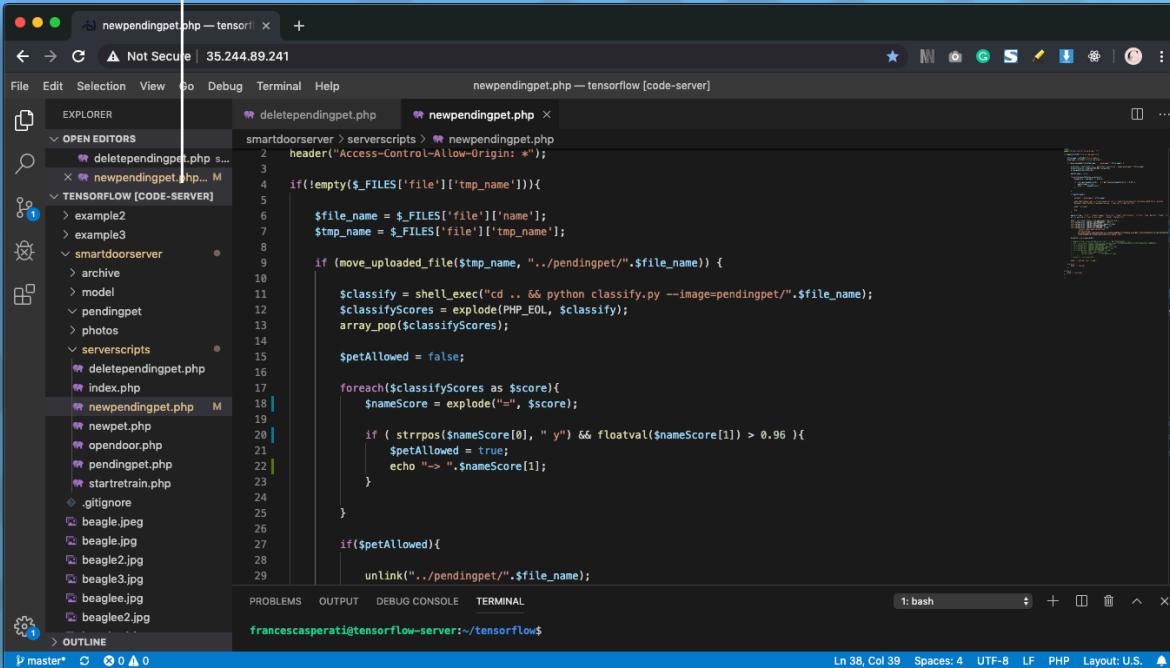
Raspberry Pi

Door Flap

Remain close or open for
authorized pets

The Smart Pet Door Project Components

Server



```
newpendingpet.php — tensorflow < Not Secure | 35.244.89.241
File Edit Selection View Go Debug Terminal Help newpendingpet.php — tensorflow (code-server)

EXPLORER
    deletependingpet.php
    smartdoordata > serverscripts > newpendingpet.php
        header("Access-Control-Allow-Origin: *");
        if(!empty($_FILES['file']['tmp_name'])){
            $file_name = $_FILES['file']['name'];
            $tmp_name = $_FILES['file']['tmp_name'];

            if (move_uploaded_file($tmp_name, "../pendingpet/".$file_name)) {
                $classify = shell_exec("cd .. && python classify.py --image=pendingpet/".$file_name);
                $classifyScores = explode(PHP_EOL, $classify);
                array_pop($classifyScores);

                $petAllowed = false;

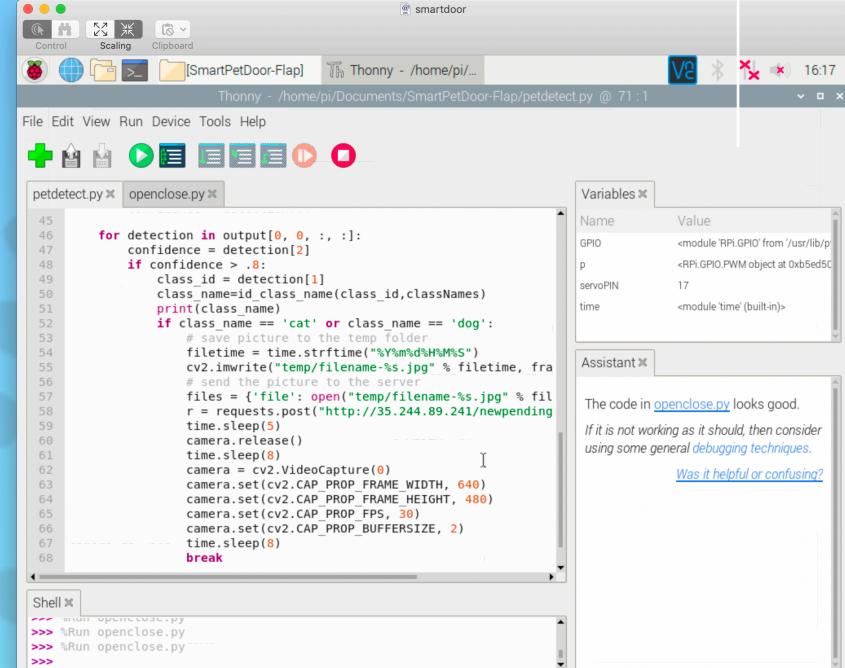
                foreach($classifyScores as $score){
                    $nameScore = explode(":", $score);

                    if ( strpos($nameScore[0], " y") && floatval($nameScore[1]) > 0.96 ){
                        $petAllowed = true;
                        echo "-> ".$nameScore[1];
                    }
                }

                if($petAllowed){
                    unlink("../pendingpet/".$file_name);
                }
            }
        }
    }

```

Raspberry Pi



```
smartdoor
File Edit View Run Device Tools Help
petdetect.py openclose.py

for detection in output[0, 0, :, :]:
    confidence = detection[2]
    if confidence > .8:
        class_id = detection[1]
        class_name=id_class_name(class_id,classNames)
        print(class_name)
        if class_name == 'cat' or class_name == 'dog':
            # save picture to the temp folder
            filetime = time.strftime("%Y%m%d%H%M%S")
            cv2.imwrite("temp/filename-%s.jpg" % filetime, frame)
            # send the picture to the server
            files = {'file': open("temp/filename-%s.jpg" % filetime, 'rb')}
            r = requests.post("http://35.244.89.241/newpending")
            time.sleep(5)
            camera.release()
            time.sleep(8)
            camera = cv2.VideoCapture(0)
            camera.set(cv2.CAP_PROP_FRAME_WIDTH, 640)
            camera.set(cv2.CAP_PROP_FRAME_HEIGHT, 480)
            camera.set(cv2.CAP_PROP_FPS, 30)
            camera.set(cv2.CAP_PROP_BUFFERSIZE, 2)
            time.sleep(8)
            break

Variables
Name Value
GPIO <module 'RPi.GPIO' from '/usr/lib/python3/dist-packages/RPi/
p <RPi.GPIO.PWM object at 0xb5ed5c
servoPIN 17
time <module 'time' (built-in)>

Assistant
The code in openclose.py looks good.
If it is not working as it should, then consider using some general debugging techniques.
Was it helpful or confusing?

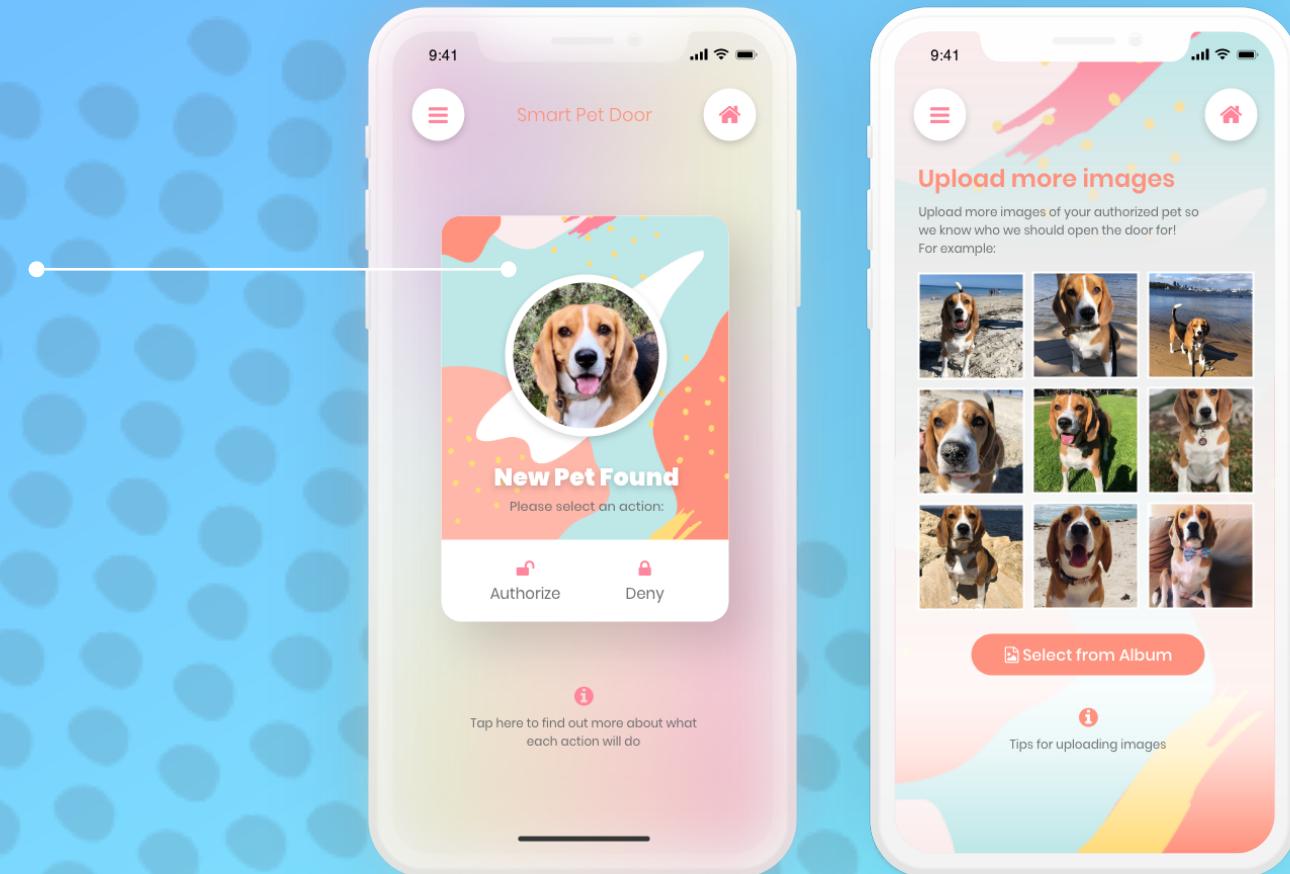
Shell
>>> smartdoor openclose.py
>>> %Run openclose.py
>>> %Run openclose.py
>>>
```

The Smart Pet Door

Project Components

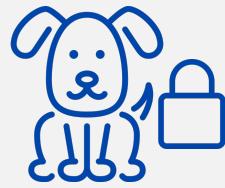
Mobile App

Receive notifications,
control door open and
upload images for new pets



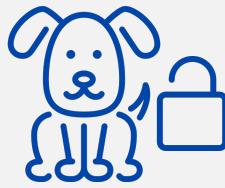
The Smart Pet Door

User Scenario **Demonstration**



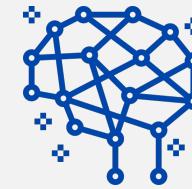
1. Deny Pet

When the door detected stranger pets. User can deny pet from the app to remain door close



2. Authorized Pet

When the door detected authorized pets and open the door, no notification sent



3. Add a New Pet

When user would like to authorize a new pet and open door

The End

Thank you for your attention

