

Cloud Based Pet Detection System

Under Guidance of Prof. Dr. Christian Baun

Presented By (Group 4)

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1. Introduction

6. Sensor Node

2. Tools and Hardware

7. WebApp (REST API)

3. Architecture

8. Data Storage

4. Sequence Diagram

9. Frontend

5. Detection Model Creation

10. Kubernetes and Apps Deployment

1

Image Detection

Training a model that can detect Cats and Dogs

- Used Yolo v5 Model for the training
- Used X images as training data
- Used
- Used

2

Sensor Node

Sensor Node should be able to detect cats and dogs and should only send image of cat or dog to the backend server

- Device preparation (OS installation, Camera setup)
- Load the trained model weight
- Create a script in Python that will detect the image and send the data using RESTful APIs.

2

kubernetes cluster

Create a Cluster and install all required backend and frontend application to get image data and represent the data in User interface (here frontend web page)

- K3S cluster setup
- Image Storage System
- Data Storage System
- Backend API service
- Frontend Web app

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7. WebApp (REST API)

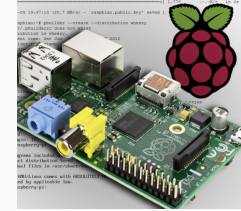
8. Data Storage

9. Frontend

10. Kubernetes and Apps Deployment

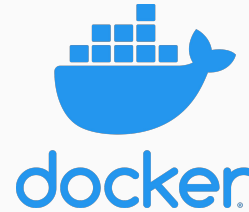
Hardware:

- Raspberry Pi4
- 4 Raspberry pi3
- Raspberry pi Camera Module v2
- TP Link Switch



Tools Used:

- Python & JavaScript
- FastAPI
- Docker
- Kubernetes (K3s)
- MinIO
- Pytorch
- Yolo v5





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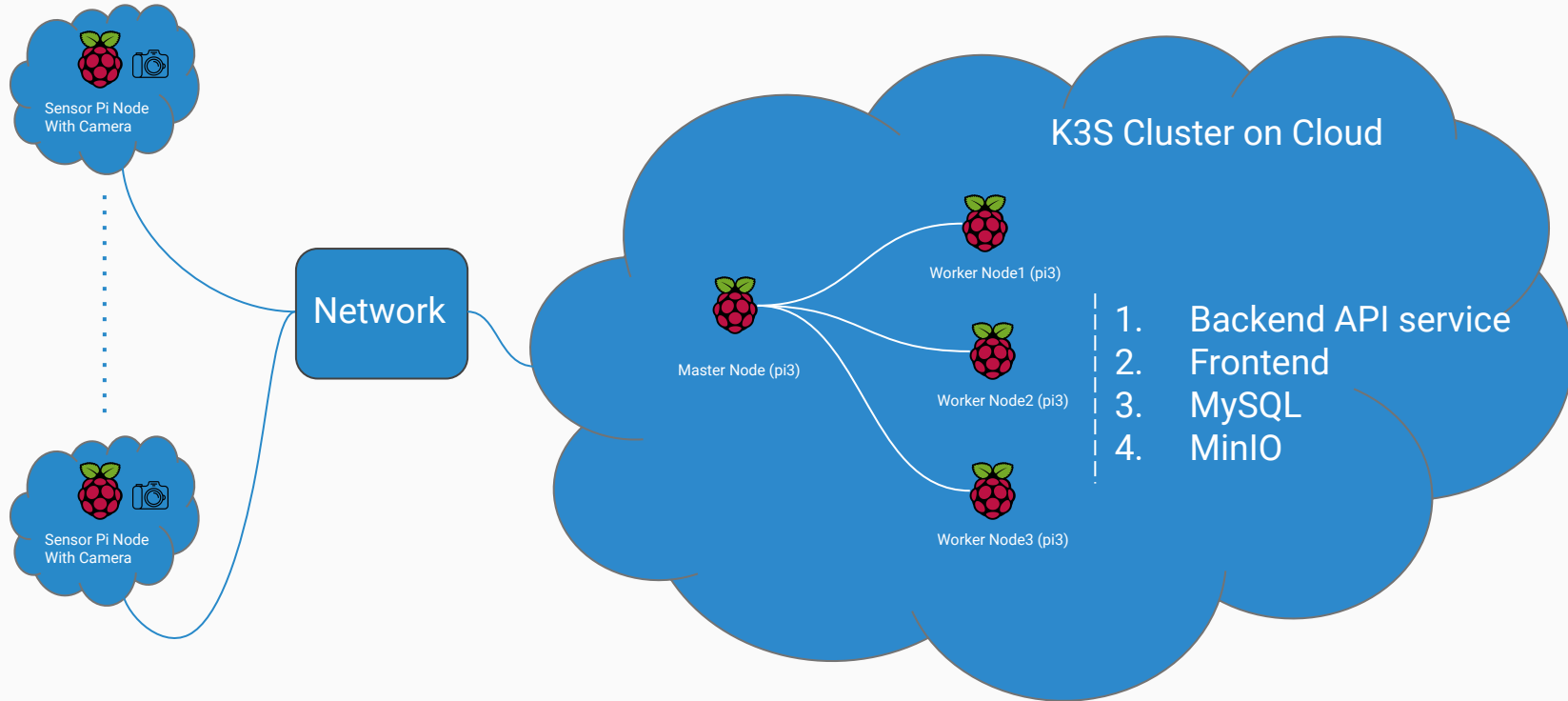
6. Sensor Node

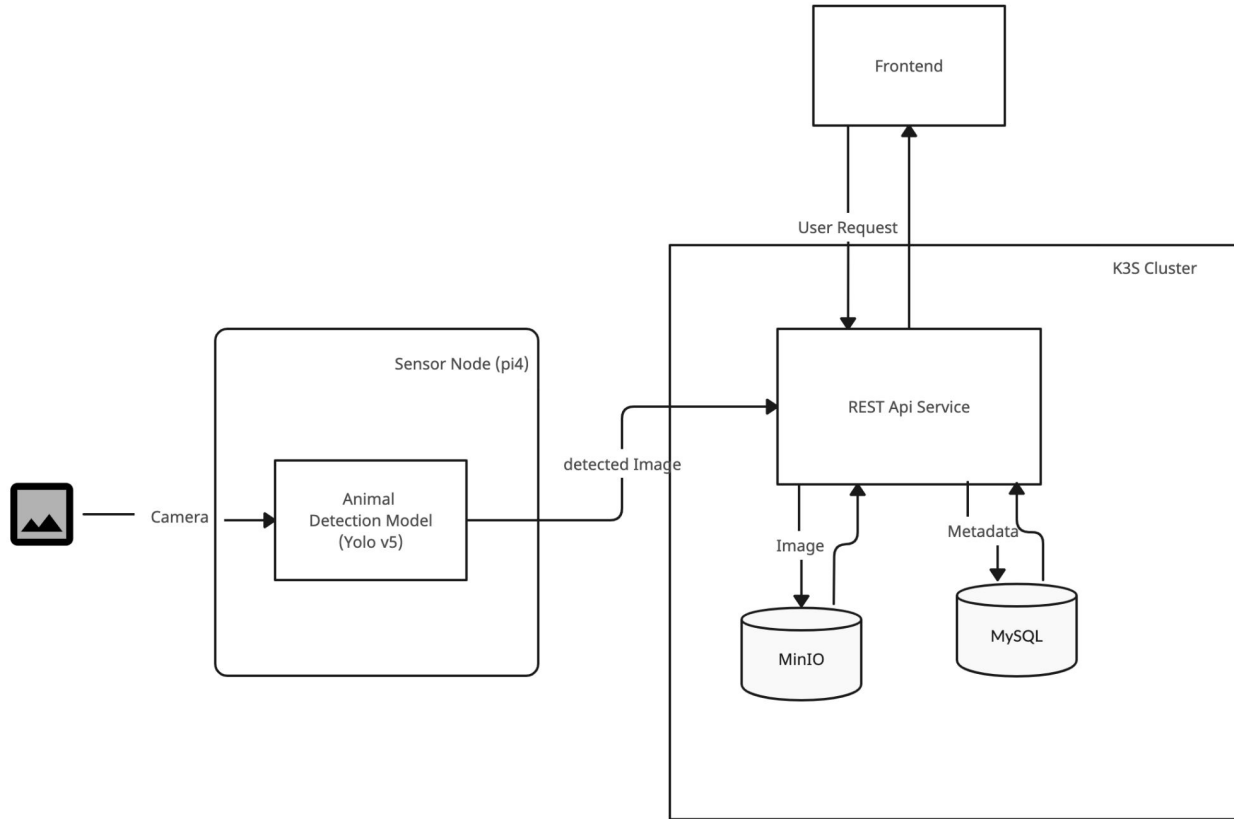
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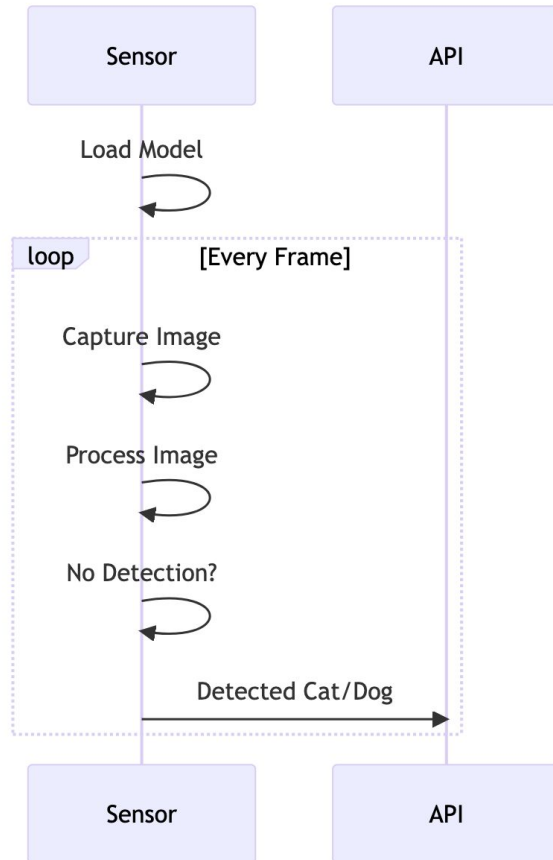
7. WebApp (REST API)

8. Data Storage

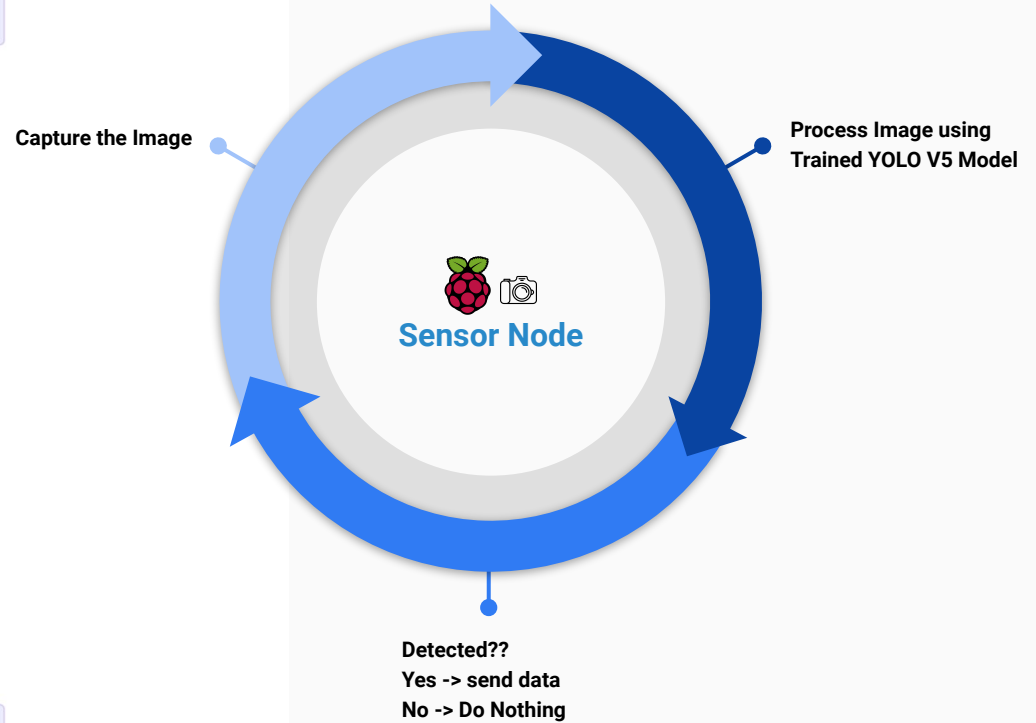
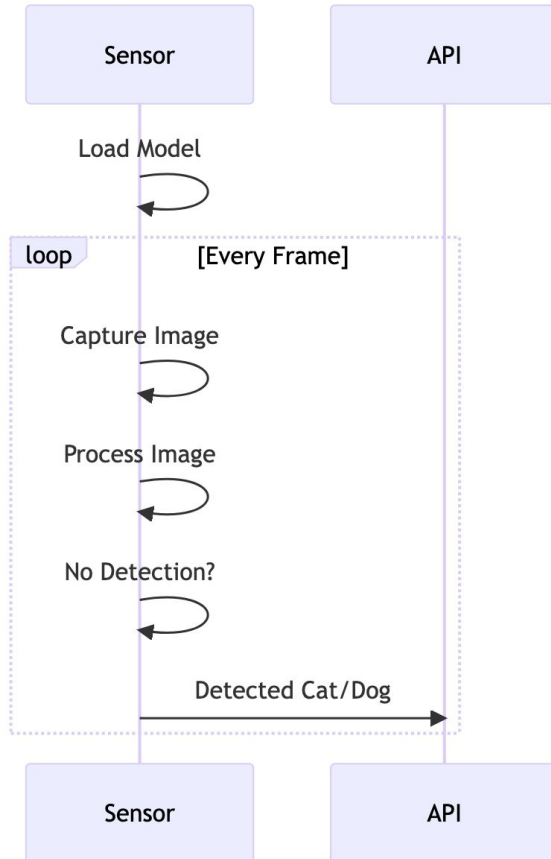
9. Frontend

10. Kubernetes and Apps Deployment

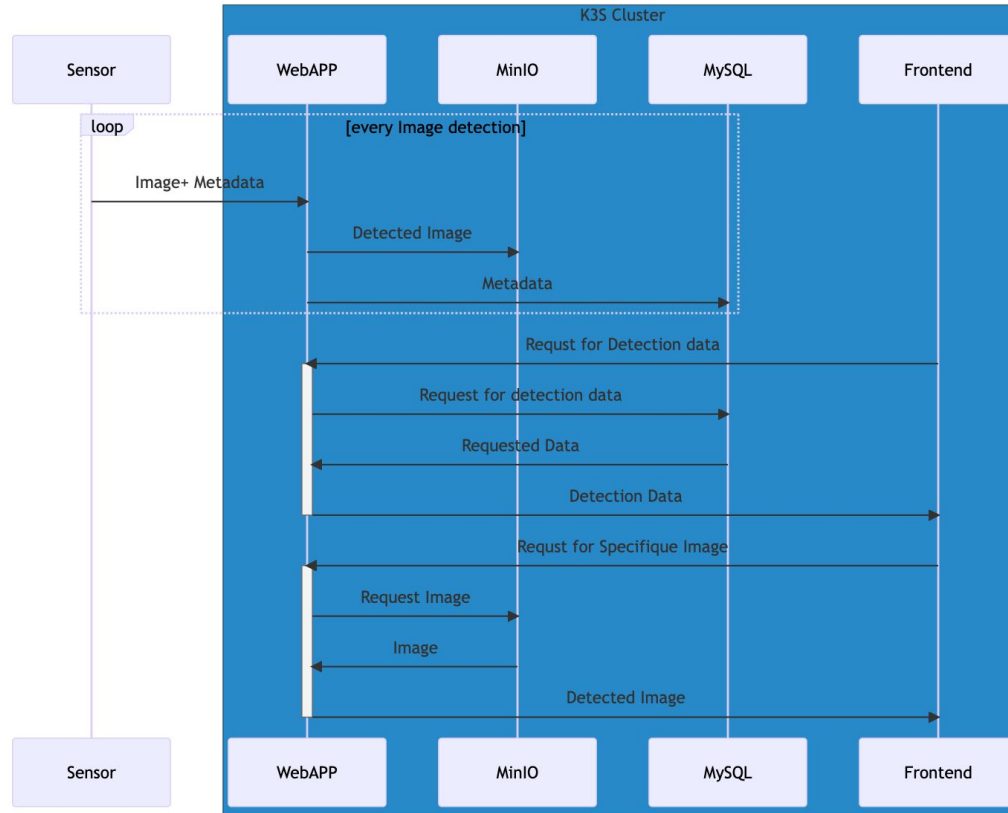
Sequence Diagram (Sensor Node)



Sequence Diagram (Sensor Node)



Sequence Diagram (K3S)



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

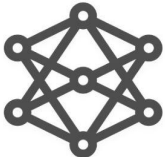
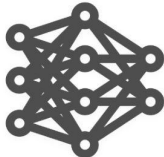
10. Kubernetes and Apps Deployment

Dataset

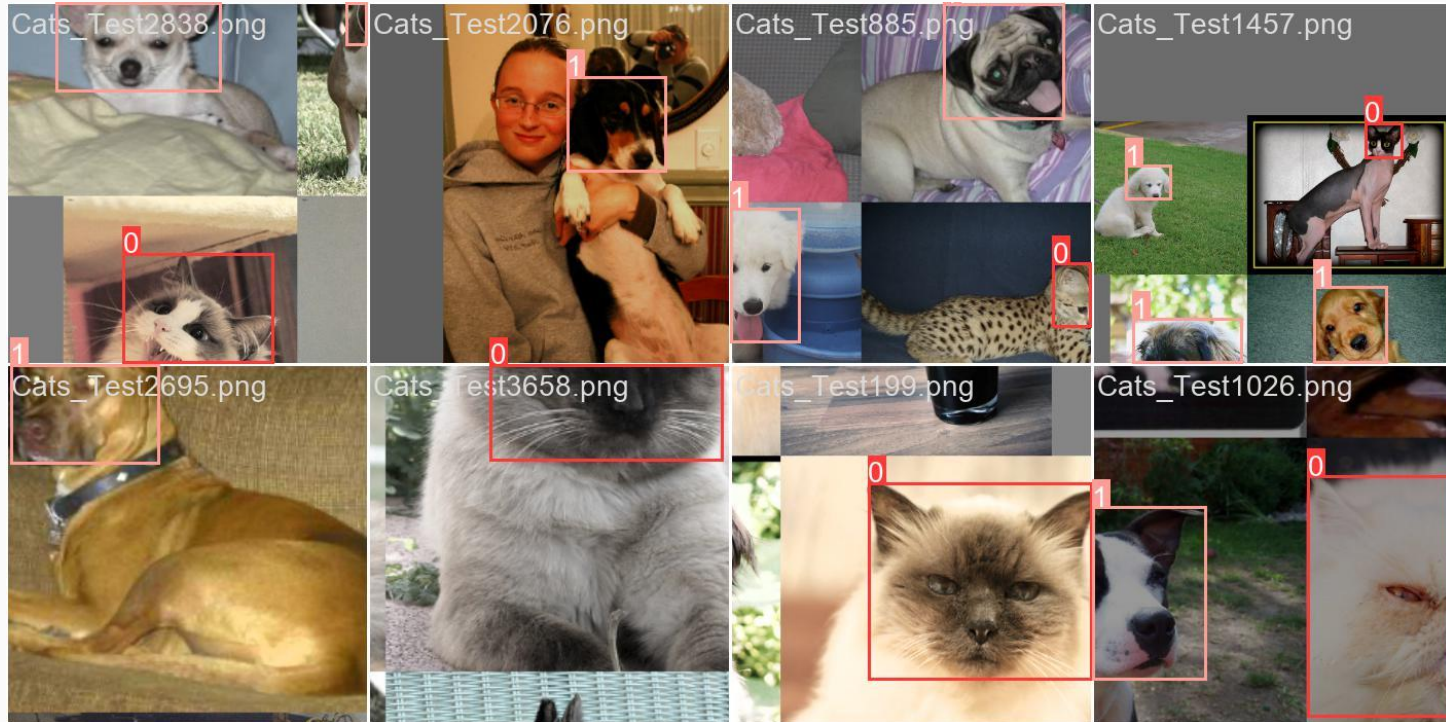
<https://www.kaggle.com/datasets/andrewmvd/dog-and-cat-detection/code>

Dataset contains 3686 images of cat and dogs with bounding box.

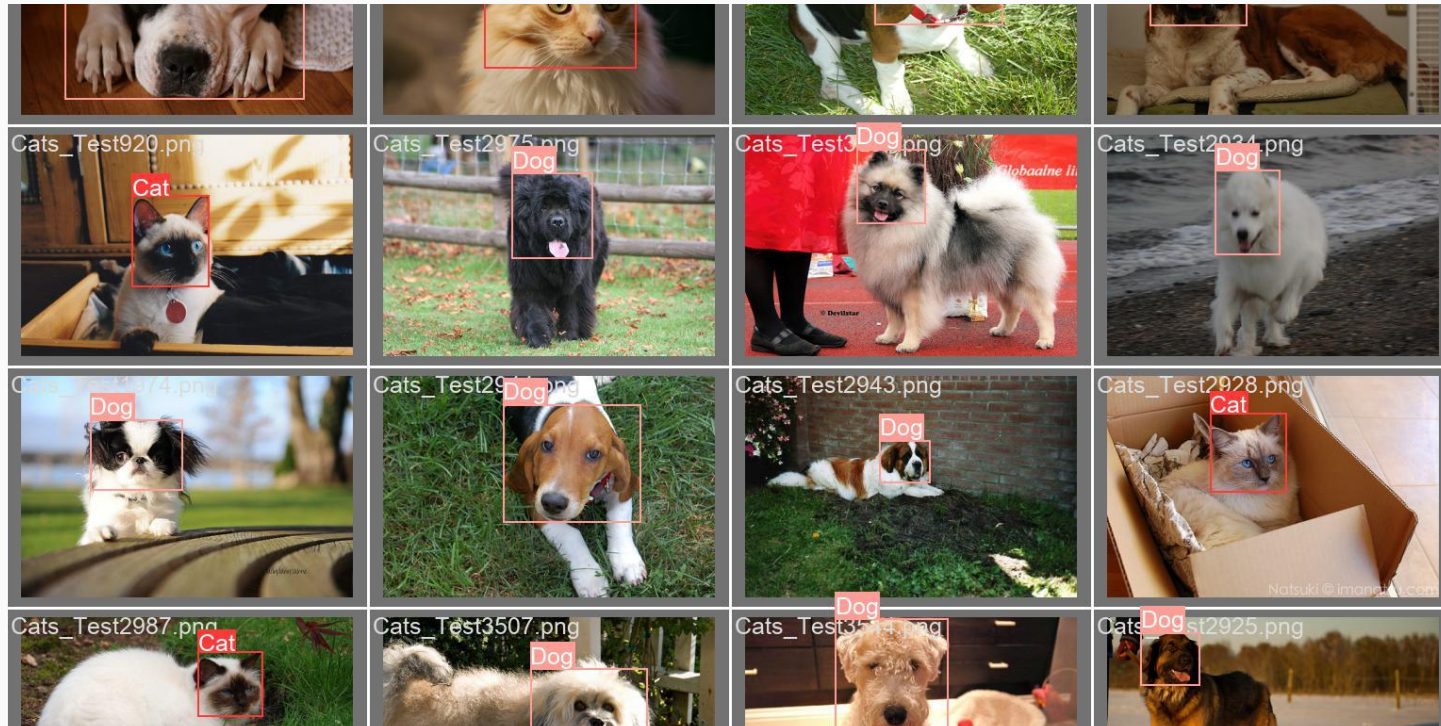


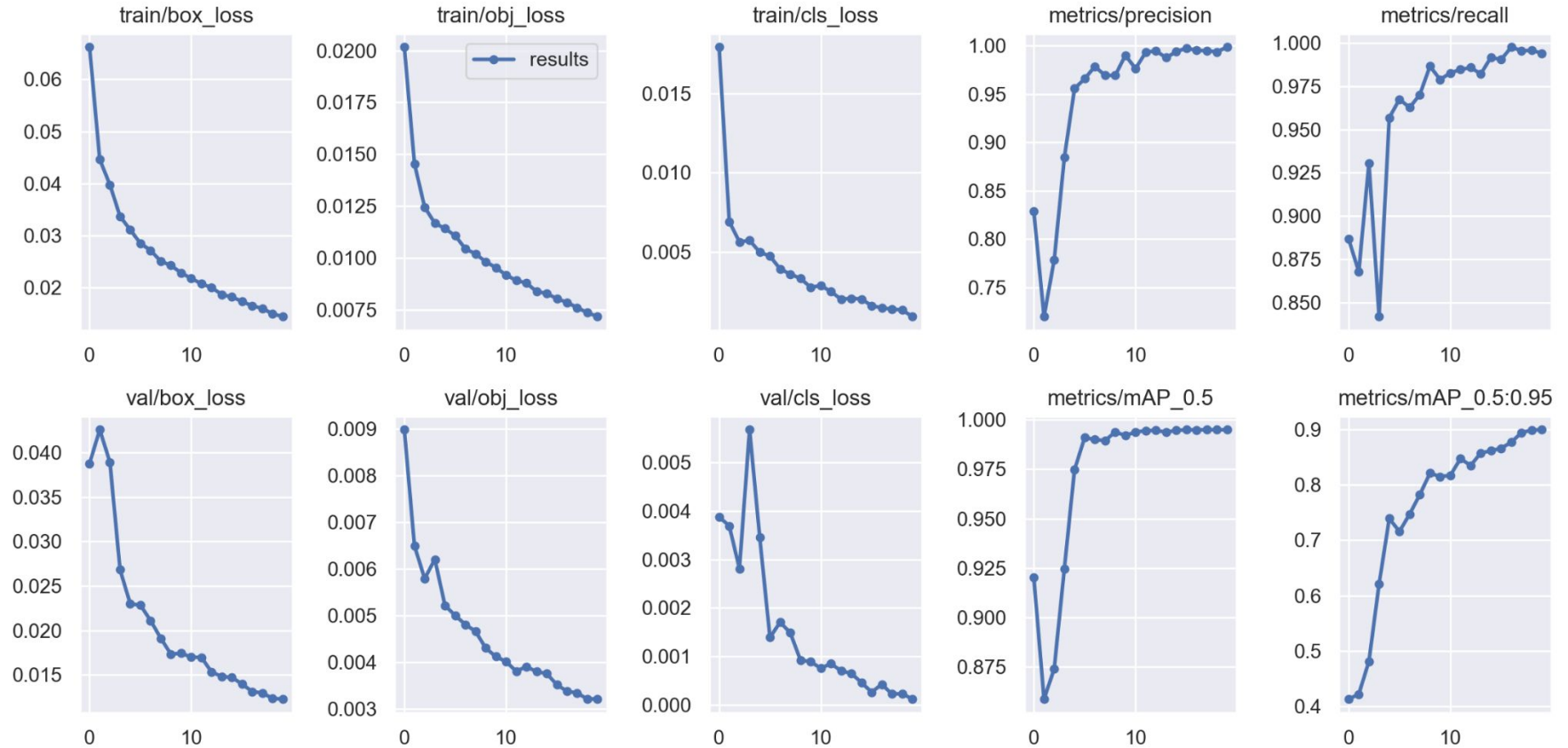
			
Small YOLOv5s	Medium YOLOv5m	Large YOLOv5l	XLarge YOLOv5x
15 MB _{FP16} 2.4 ms _{V100} 37.0 mAP _{COCO}	42 MB _{FP16} 3.4 ms _{V100} 44.3 mAP _{COCO}	92 MB _{FP16} 4.4 ms _{V100} 47.7 mAP _{COCO}	170 MB _{FP16} 6.9 ms _{V100} 50.8 mAP _{COCO}

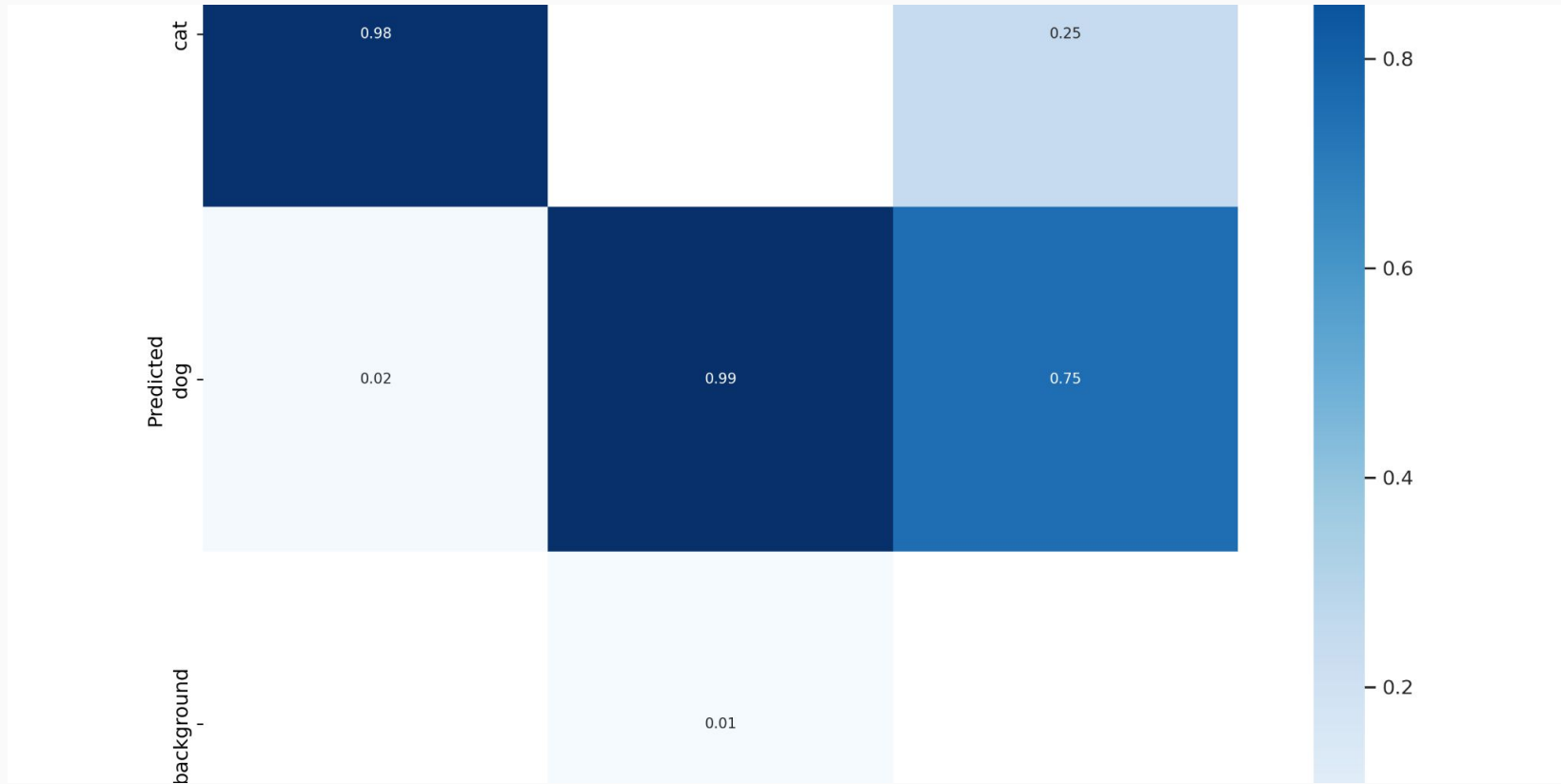
Train Batch image in Model Training



Validation Batch image in Model Training







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Load the trained model

Sensor Node Workflow:

- At first it loads the model we trained to detect cat and dog
- Then its keep capturing images (1)
- Send the image to Image processor (2)
- If any cat or dog is detected, it sends the data to the Backend server through REST api

Image Detection and sending the data

1. Capture the Image

2. Image Processor

3. Send The Data To API

Filter
Detected
Data

Plot /
Draw on
Image

Detected?



Pet (Cat / Dog) detector

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```
//Image  
{  
  "image": "base64....."  
}
```

← Detected Image as Base64 encoded

```
// Data  
{  
  "detected_at": "detection time",  
  "confidences": [  
    "('Animal1', 99)",  
    "('Animal 2', 90)",  
    ...  
    "('Animal N', 89)",  
  ]  
}
```

← Detection Time

← List of detection data

api

GET /api/ Api Home

POST /api/ Sensor Data

GET /api/sensor-data Api Home

views

GET / Home

GET /get-image/{img} Get Image

Schemas

```
Body_sensor_data_api_post {
  detected_at* string($date-time)
  title: Detected At
  confidances* Confidances {
    title: Confidances
    {
      }
  }
  image* string($binary)
  title: Image
}
```

HTTPValidationError >

ValidationError >

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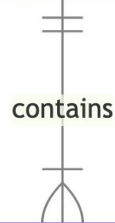
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DETECTION		
int	id	PK
string	image_name	
timestamp	detected_at	
timestamp	created_at	
timestamp	updated_at	




CONFIDANCE		
int	id	PK
string	animal_name	
int	confidence_ratio	
int	sensor_data_id	FK

```
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| id | int | NO | PRI | NULL | auto_increment |
| image_name | varchar(255) | NO | | NULL | |
| detected_at | timestamp | NO | | NULL | |
| created_at | timestamp | YES | | CURRENT_TIMESTAMP | DEFAULT_GENERATED |
| updated_at | timestamp | YES | | CURRENT_TIMESTAMP | DEFAULT_GENERATED on update CURRENT_TIMESTAMP |
+-----+-----+-----+-----+-----+-----+
5 rows in set (0.01 sec)
```

```
mysql> describe confidence;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| id | int | NO | PRI | NULL | auto_increment |
| animal_name | varchar(255) | NO | | NULL | |
| confidence_ratio | int | NO | | NULL | |
| sensor_data_id | int | NO | MUL | NULL | |
+-----+-----+-----+-----+-----+-----+
4 rows in set (0.17 sec)
```

User

 Object Browser


 Access Keys

 Documentation

Administrator

 Buckets

 Policies

 Identity ▾

 Monitoring ▾

 Events

 Tiering

 Site Replication

← Object Browser

Start typing to filter objects in the bucket



detectedanimals

Created on: **Tue, May 23 2023 01:33:58 (GMT+2)** Access: **PRIVATE** 6.1 MiB - 20 Objects

Rewind ↶












Refresh ↻

Upload ↗

< detectedanimals / db5af87d7de34a9da5a9420f344f84b6.jpg



Create new path 📁

<input type="checkbox"/>	Name	Last Modified	Size
<input type="checkbox"/>	 d82560829a5f4865a15387bc38f85ef2.jpg	Wed, Jun 07 2023 12:02 (GMT+2)	251.5 KiB
<input type="checkbox"/>	 1a7b1560e3cd4b4383254a0711100f3d.j...	Wed, Jun 07 2023 12:02 (GMT+2)	280.8 KiB
<input type="checkbox"/>	 db5af87d7de34a9da5a9420f344f84b6.j...	Wed, Jun 07 2023 12:02 (GMT+2)	311.1 KiB
<input type="checkbox"/>	 092a936de7f941859811955f6b4927f6.jpg	Wed, Jun 07 2023 12:02 (GMT+2)	283.7 KiB
<input type="checkbox"/>	 e03cfd0d3b574ef0aba746b14e4d191a.jpg	Wed, Jun 07 2023 12:02 (GMT+2)	343.3 KiB
<input type="checkbox"/>	 c79b7df533d64a69854cc4bf9c441c67.j...	Wed, Jun 07 2023 12:02 (GMT+2)	333.9 KiB
<input type="checkbox"/>	 d96f721796f64f818a37677f28f36a0b.jpg	Wed, Jun 07 2023 12:02 (GMT+2)	375.3 KiB
<input type="checkbox"/>	 da19304e70294575b74c7219527365a0....	Mon, May 29 2023 19:24 (GMT+2)	372.9 KiB
<input type="checkbox"/>	 b23e55dc18064bf79721a409227d2219.j...	Mon, May 29 2023 19:24 (GMT+2)	384.1 KiB
<input type="checkbox"/>	 b8563e022fde4e9d9410480586f01961.j...	Mon, May 29 2023 16:15 (GMT+2)	308.9 KiB
<input type="checkbox"/>	 56af35e52c47415db1d1d2b22c6abcd.j...	Mon, May 29 2023 16:04 (GMT+2)	295.7 KiB



db5af87d7de34a9da5a9420... |→

Actions:

 Download

 Share

 Preview

 Legal Hold

 Retention

 Tags

 Inspect

 Display Object Versions

 Delete

Object Info



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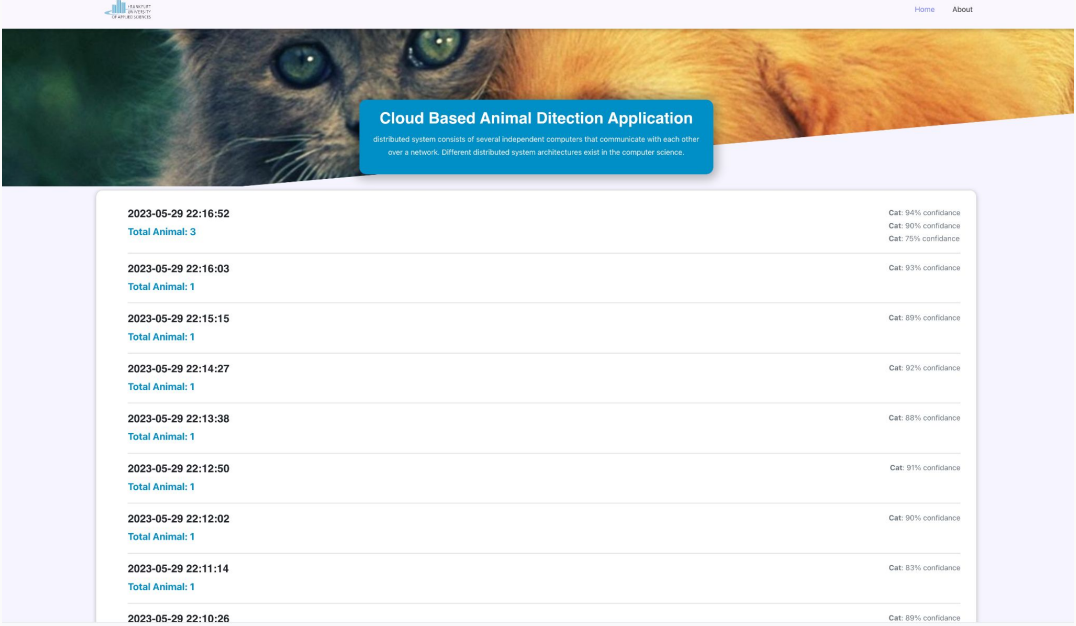
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- Latest Detection data can be viewed
- Detected image can be observed in the detection detail page



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Home About

Cloud Based Animal Ditection Application

distributed system consists of several independent computers that communicate with each other over a network. Different distributed system architectures exist in the computer science.

2023-05-29 22:16:52	Cat: 94% confidence
Total Animal: 3	Cat: 90% confidence
	Cat: 75% confidence
2023-05-29 22:16:03	Cat: 93% confidence
Total Animal: 1	
2023-05-29 22:15:15	Cat: 89% confidence
Total Animal: 1	
2023-05-29 22:14:27	Cat: 92% confidence
Total Animal: 1	
2023-05-29 22:13:38	Cat: 88% confidence
Total Animal: 1	
2023-05-29 22:12:50	Cat: 91% confidence
Total Animal: 1	
2023-05-29 22:12:02	Cat: 90% confidence
Total Animal: 1	
2023-05-29 22:11:14	Cat: 83% confidence
Total Animal: 1	
2023-05-29 22:10:26	Cat: 89% confidence

© Cloud Based animal detection project

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10. Kubernetes and Apps Deployment

- This project is a combination of several micro services.
- It can be very easily deployed on Kubernetes cluster

This is how we did this:

1. Installed Kubernetes on 4 pi, keeping 1 master and 3 worker node
2. Dockerized WebApp and uploaded the docker image Docker hub.
3. Configured Kubernetes files for MySQL, MinIO, and WebAPP and deployed their docker image to the Kubernetes.

```
pi@rspmaster:~ $ kubectl get nodes
NAME          STATUS    ROLES          AGE   VERSION
worker3      Ready    <none>         66d   v1.26.4+k3s1
worker2      Ready    <none>         66d   v1.26.4+k3s1
worker1      Ready    <none>         66d   v1.26.4+k3s1
rspmaster    Ready    control-plane,master 66d   v1.26.4+k3s1
pi@rspmaster:~ $
```

```
pi@rspmaster: ~  
→ ~ ssh pi@192.168.0.59  
pi@192.168.0.59's password:  
Linux rspmaster 6.1.21-v8+ #1642 SMP PREEMPT Mon Apr 3 17:24:16 BST 2023 aarch64  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Wed Jul 5 12:20:08 2023 from 192.168.0.25  
  
Wi-Fi is currently blocked by rfkill.  
Use raspi-config to set the country before use.  
  
pi@rspmaster:~ $ kubectl get all  
NAME                                READY   STATUS    RESTARTS   AGE  
pod/mysql-67cdc9b99-hmdnk           1/1     Running   14 (68m ago)  42d  
pod/minio-deployment-5956f84945-dhqfc 1/1     Running   12 (28d ago)  42d  
pod/webapp-deployment-6996cf9d6-h494t 1/1     Running   20 (65m ago)  36d  
  
NAME                                TYPE          CLUSTER-IP      EXTERNAL-IP      PORT(S)          AGE  
service/kubernetes                  ClusterIP      10.43.0.1        <none>            443/TCP          66d  
service/mysql-service                ClusterIP      10.43.55.15     <none>            3306/TCP         42d  
service/minio-service                ClusterIP      10.43.195.15    <none>            9000/TCP         42d  
service/webapp-service               LoadBalancer  10.43.136.103   192.168.0.59,192.168.0.60,192.168.0.61,192.168.0.62 8080:30080/TCP  36d  
  
NAME                                READY   UP-TO-DATE   AVAILABLE   AGE  
deployment.apps/mysql                1/1     1             1           42d  
deployment.apps/minio-deployment     1/1     1             1           42d  
deployment.apps/webapp-deployment    1/1     1             1           36d  
  
NAME                                DESIRED   CURRENT   READY   AGE  
replicaset.apps/mysql-7bf4dbd57d     0         0         0       42d  
replicaset.apps/mysql-67cdc9b99      1         1         1       42d  
replicaset.apps/minio-deployment-5956f84945 1         1         1       42d  
replicaset.apps/webapp-deployment-6996cf9d6 1         1         1       36d  
pi@rspmaster:~ $
```


DEMO TIME

Question??



- Project GitHub Link: <https://github.com/nuruddinsayed/CloudApp101>
- Docker Image of WebApp: https://hub.docker.com/r/nuruddinsayed/webapp-animal_detector