Safe Zone Camera

FINAL YEAR PROJECT UG 2021

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ABSTRACT

SAFE ZONE CAMERA

Human Health is turning into a major issue even in this cutting-edge period of innovation. The COVID-19 that was declared a pandemic by the World Health Organization (WHO) on March 13, 2020, after the widespread of the disease in Europe, and the drastic number of deaths in Italy is exceptionally transmissible. The current scenario has shown quite a noticeable impact on people's mental well-being besides their physical well-being. It has changed their perception about life, and their priorities regarding daily life routine have also been affected. Such a global situation can only be controlled with people's consent to behave in a particular manner instructed by health care providers such as frequent hand washing, using the facemask, avoiding gatherings, and maintaining permissible distance. But we seem to have no such mechanism to avoid such situations. So, out project reiterates on creating a device which can help in detecting the amount of people who are following SOPs regarding wearing of face mask through camera feed. This can assist in minimizing the damage caused by COVID-19. The device has two modules, one is the device itself consisting of Nvidia Jetson Nano which will be connected to Camera and a Display Screen, the second one is the training model mainly Yolo v5. The Camera live feed is sent to the Nvidia Jetson which will process the video, frames by frames and by using YoloV5 trained models will identify the person wearing masks or not. The authorities can view the detailed aspect on the Display Screen. The principle preferred standpoint of this framework is that the client does not require an expensive device to differentiate between Masked and Non-masked persons dissimilar to different devices that have been developed before. Furthermore, utilization of refined segments guarantees exactness and makes it robust.

CERTIFICATE OF CORRECTNESS AND APPROVAL

It is hereby certified that information contained in this thesis titled “Safe Zone Camera” carried out by 1) GC Hadeed Aamir 2) GC Saqib Ghaffar 3) GC Hassaan Zafar 4) GC Asad Ali 5) NC Irfan Rashid under the vigilant supervision of Maj. Ajlaan Bin Mamoon in partial fulfillment of B.E Degree in Telecom Engineering is correct and approved.

Approved By

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بسم الله الرحمن الرحيم

DECLARATION

The work, or any of its portion, written in this thesis has not been submitted for provision of any another award or qualification, either at this institute or elsewhere.

DEDICATION

In the name of ALLAH All Mighty, the Most Gracious, the Most Merciful and Benevolent. Each individual members of this Final Year Project group dedicates this work and its thesis to his parents and the project supervisor who rendered most effective and sincere guidance throughout each and every phase of this project

ACKNOWLEDGEMENTS

We would like to thank ALLAH All Mighty for bestowing upon us, His countless and incessant blessings. Whatever we have achieved , we owe it to Him, in totality. We are also highly obliged to our batchmates, acquaintences and relatives for their unflinching support which has helped us achieved all the milestones of our lives. Parents who provided support through their prayers and well wishes. We are extremely thankful to our Project Supervisor, Lecturer Danish Ilyas from Military College of Signals(MCS) who provided us moral support and encouraged us throughout the development of the project besides providing us with valuable technical help and guidance.

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CHAPTER: 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

Safe Zone Camera is a unique device to display the number of people wearing masks in a little less crowded area. In Pakistan, the COVID-19 is spreading abnormally. One of the main reasons for it is that people are not following the SOPs for their safety and no steps have been taken for their quick visualization.

This device would not only display the Scene but will also organize a report that would help agencies spying on non-preventive activities so that measures can be taken before hand. This would be a valuable contribution in recognizing the only reason for COVID-19 spreading and reducing them to a great extent.

1.1 Problem Statement

- We will be visualizing SOP's of COVID-19 through artificial intelligence provided feed of images and videos.
- Our main element is Nvidia Jetson Nano and training models.

1.2 Objectives:

- We will be detecting amount of people wearing masks or not through camera feed.
- We will get to know how many people are aware of SOPs.

1.3 Project Scope:

- Images annotating using CVAT.
- SOP's covering mask and social distance would be determined through frames and number of the faces would be the amount of people.
- Training model Yolo v5
- Individuals aligned and those not facing the camera would be a hindrance but installing cameras at different directions is a solution. Moreover if the place is over-crowded it can cause an issue detecting the SOP's.

1.4 Organization of Thesis:

The thesis consists of six chapters numbered from 1 to 6. Chapter 1 is about the Introduction of the project giving a picture to the reader of what is the purpose of the project and the scope. Chapter 2 is the Design Requirements. It gives all the information about the components used for the development, their technical specifications and features. Chapter 3 is about the Software Requirements, giving information about all the requirements and their details that are used for the development of the mobile application. Chapter 4 is the Design Methodology. This explains the working and the sequence of processes of each individual component. Chapter 5 is the Hardware Design. It explains the design of the Safe Zone Camera. Chapter 6 is the Future Work, Application and the Conclusion. This chapter explains the applications of the project and further work that can be done for the improvements.

CHAPTER: 2
DESIGN REQUIREMENTS

CHAPTER 2

DESIGN REQUIREMENTS

This chapter gives a detailed information of the components used and explains the working of each. Philips Webcam, Nvidia Jetson Nano, and SD cards are the main parts. The pin configuration, technical specifications and all the relevant information is included. It is necessary to understand what the components do and their purpose to have a clear insight of the project.

2.1 Philips Webcam

2.1.1 SVGA photo resolution for sharp images

The SVGA resolution of your snapshots ensures sharp images for use in documents, webpages and e-mails.

2.1.2 Smooth image with 30 frames per second video

Sit back and enjoy superior viewing with 30 frames per second video. This gives you smoother video images and a better all-round video-chatting experience.

Figure 1: Philips Webcam

2.2 NVDIA JETSON

Jetson developer kits include a non-production specification Jetson module attached to a reference carrier board. Together with JetPack SDK, it is used to develop and test software for your use case. Jetson developer kits are not intended for production use. Jetson modules are suitable for deployment in a production environment throughout their operating lifetime. Each Jetson module ships with no software pre-installed; you attach it to a carrier board designed or procured for your end product, and flash it with the software image you've developed. [1]

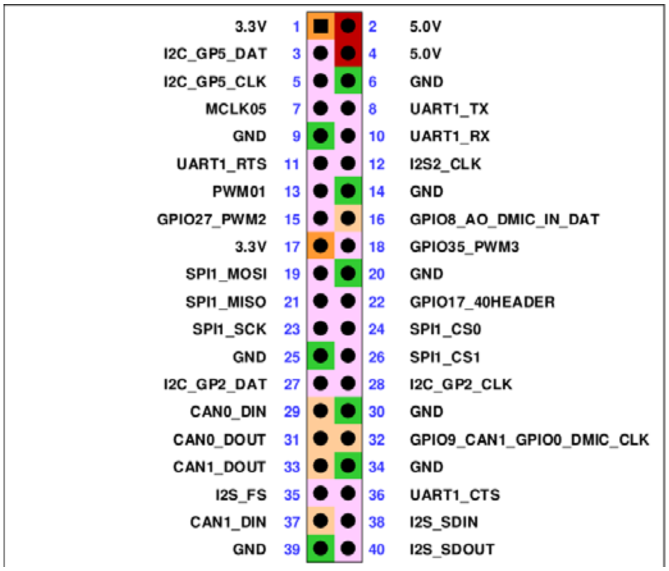
2.2.1 NVIDIA JETSON Technical Specification:

Following are the technical specifications of NVIDIA JETSON

GPU	128-core NVIDIA Maxwell™
CPU	Quad-core ARM® A57 @ 1.43 GHz
Memory	2 GB 64-bit LPDDR4 25.6 GB/s
Storage	microSD (Card not included)
Video Encoder	4Kp30 | 4x 1080p30 | 9x 720p30 (H.264/H.265)
Video Decoder	4Kp60 | 2x 4Kp30 | 8x 1080p30 | 18x 720p30 (H.264/H.265)
Connectivity	Gigabit Ethernet, 802.11ac wireless*
Camera	1x MIPI CSI-2 connector
Display	HDMI
USB	1x USB 3.0 Type A, 2x USB 2.0 Type A, 1x USB 2.0 Micro-B

Others	40-pin header (GPIO, I2C, I2S, SPI, UART) 12-pin header (Power and related signals, UART) 4-pin fan header*
Mechanical	100 mm x 80 mm x 29 mm

Tabe-1: Technical Sepecifications of Nvidia Jetson



3.3V	1	2	5.0V
I2C_GP5_DAT	3	4	5.0V
I2C_GP5_CLK	5	6	GND
MCLK05	7	8	UART1_TX
GND	9	10	UART1_RX
UART1_RTS	11	12	I2S2_CLK
PWM01	13	14	GND
GPIO27_PWM2	15	16	GPIO8_AO_DMIC_IN_DAT
3.3V	17	18	GPIO35_PWM3
SPI1_MOSI	19	20	GND
SPI1_MISO	21	22	GPIO17_40HEADER
SPI1_SCK	23	24	SPI1_CS0
GND	25	26	SPI1_CS1
I2C_GP2_DAT	27	28	I2C_GP2_CLK
CAN0_DIN	29	30	GND
CAN0_DOUT	31	32	GPIO9_CAN1_GPIO0_DMIC_CLK
CAN1_DOUT	33	34	GND
I2S_FS	35	36	UART1_CTS
CAN1_DIN	37	38	I2S_SDIN
GND	39	40	I2S_SDOUT

Figure 2: Pin Configuration of JETSON

2.3 SD Card

A Secure Digital (SD) card is amemory cardfor storing huge amounts of data andstores the data digitally. It is called secure card as the information stored in it is never lost and remains intactas long as you want.

A Secure Digital card is about the degree of a postage stamp and weighs aroundtwo grams. It is near in size to a MMC, yet tinier than increasingly prepared memory card types, for instance, a Smart Media card or CompactFlash card. A SD card incorporates a high data conversion standard and low battery usage, which are both fundamental examinations for flexible contraptions. A SD card uses streak memory to give nonvolatile limit, which suggests a power source isn't required to hold set away data.

Both MMC and SD cards give encryption abilities to tied down substance to ensure secure movement of copyrighted material, for instance, electronic music, video and computerized books .It is shown in fig 3

2.3.1 SD Card Types

Secure Digital card advancement consolidates the going with:

- SD Standard Capacity. Limits as for SDSC cards keep running from 128 megabytes to 2 GB. The default plan for these cards is FAT16 (File Allocation Table 16).

- SD High Capacity. In perspective on the SDA 2.0 detail, limits concerning SDHC cards keep running from 4 GB to 32 GB. The default position for these cards is FAT32.

- SD extended Capacity. In perspective on the SDA 3.0 assurance, limits concerning SDXC stretch out from 64 GB to 2 terabytes. The default bunch for these cardsis exFAT (Extended FAT).

- SD Input Output. SDIO cards combine I/O limits with data amassing. Beginning at 2016, the basic courses of action are full or little scale gauge SDHC and SDXC cards. [8]

Figure 3: SD Card

CHAPTER: 3

SOFTWARE REQUIREMENTS

CHAPTER 3

SOFTWARE REQUIREMENTS

3.1 YOLO V5 Model Architecture: [2]

As YOLO v5 is a single-stage object detector, it has three important parts like any other single-stage object detector.

1- Model Backbone

2- Model Neck

3- Model Head

3.1.1 Model Backbone

It is mainly used to extract important features from the given input image. In YOLO v5 the CSP — Cross Stage Partial Networks are used as a backbone to extract rich in informative features from an input image. CSPNet has shown significant improvement in processing time with deeper networks. Refer to the following image:

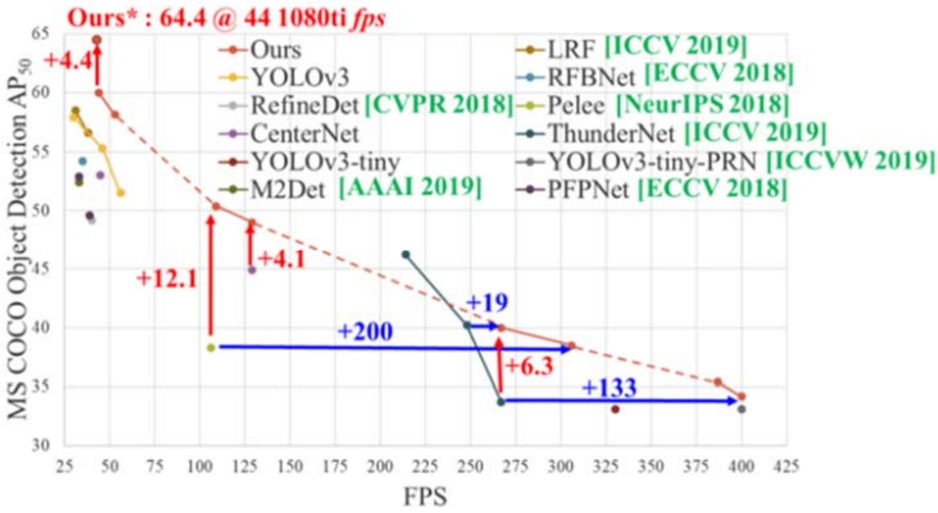


Figure 4: CSPNet [3]

3.1.2 Model Neck:

It is mainly used to generate feature pyramids. Feature pyramids help models to generalize well on object scaling. It helps to identify the same object with different sizes and scales. Feature pyramids are very useful and help models to perform well on unseen data. There are other models that use different types of feature pyramid techniques like FPN, BiFPN, PANet, etc.

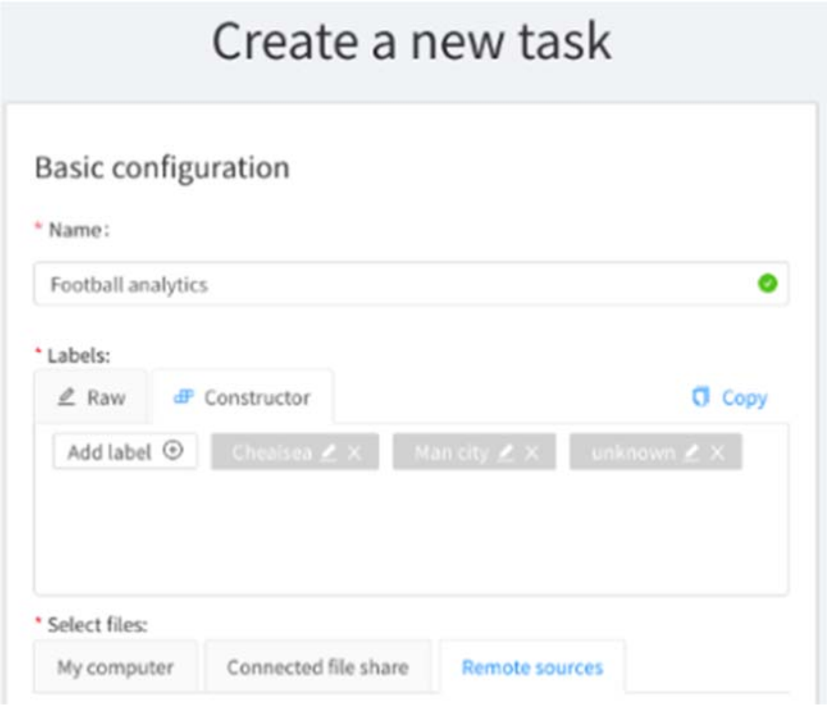
3.1.3 Model Head:

The Model Head is mainly used to perform the final detection part. It applied anchor boxes on features and generates final output vectors with class probabilities, objectness scores, and bounding boxes. In YOLO v5 model head is the same as the previous YOLO V3 and V4 versions.

3.2 Computer Vision Annotation Tool — CVAT: [4]

CVAT is termed computer vision annotation tool. It is a free tool for labeling images. It was developed and open-sourced by Intel. It is easy to use and helps to create bounding boxes and prepare your computer vision dataset for modeling. Visit CVAT website. Create an account then proceed with the following steps on how to label the data.

First and foremost, click on 'Create a New Task' then complete the pop up fields. You should have something that looks like this:



Create a new task

Basic configuration

* Name: Football analytics

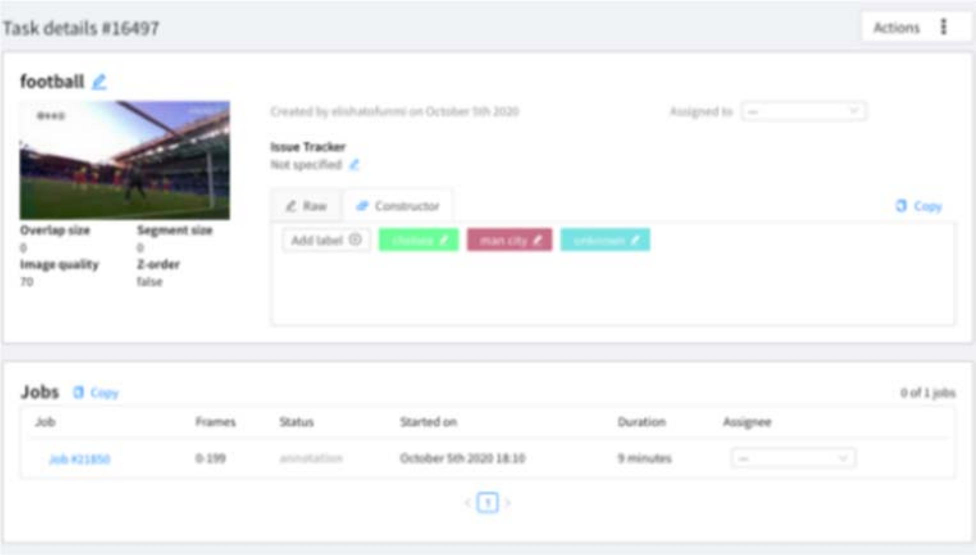
* Labels:

Cheaisea
Man city
unknown

* Select files:

Figure 5- Create task

Having created a new task, click on ‘My Tasks,’ you should have something that looks like the below.



Task details #16497

football

Created by elishatofunmi on October 5th 2020

Assigned to —

Issue Tracker
Not specified

chelsea
man city
unknown

Overlap size 0
Segment size 0
Image quality 70
Z-order false

Jobs

0 of 1 jobs

Job	Frames	Status	Started on	Duration	Assignee
Job #21850	0-199	annotation	October 5th 2020 18:10	9 minutes	—

Figure 6 - Find task

The task you recently created can be found in the ‘Job’ cell, click on the link, and you should have something that looks like the below (un-annotated). Now, go ahead to select the rectangular icon by the left pane (you could also select a polygon, depending on the project).

When you click on this, there will be a pop up, select the label of your choice. You can now go ahead and draw the bounding box across each object for the selected label. Do this for all objects in the image.

Once you are done with an image, go ahead to label the next. You can click on the left or right arrow as shown at the top of the image below (always do this after saving each image).

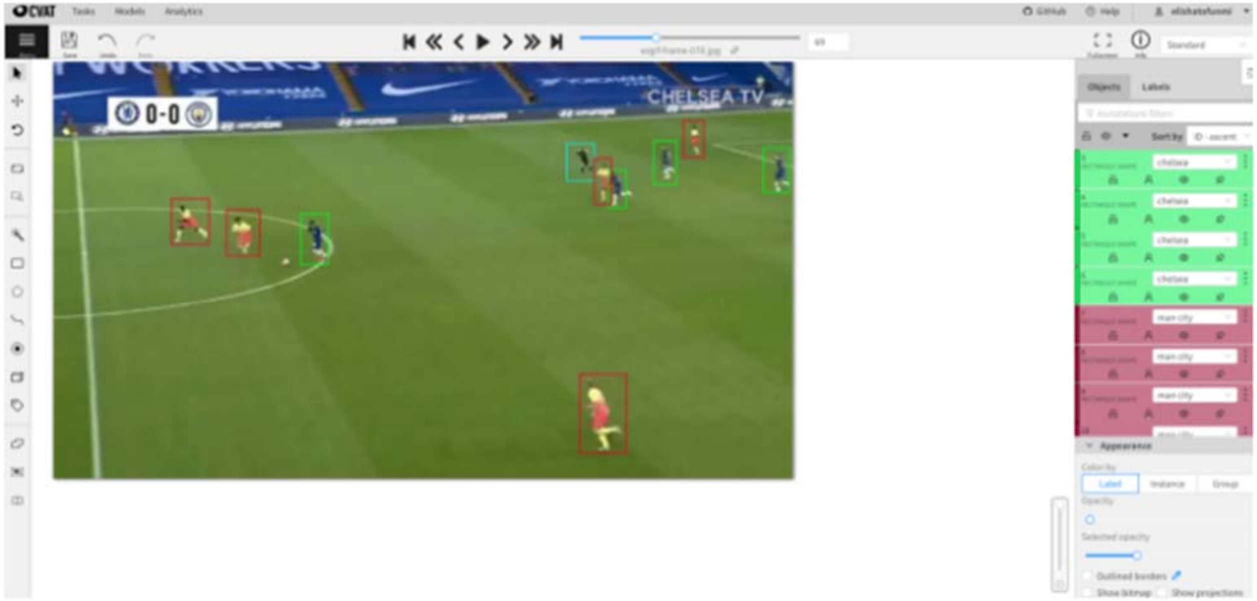
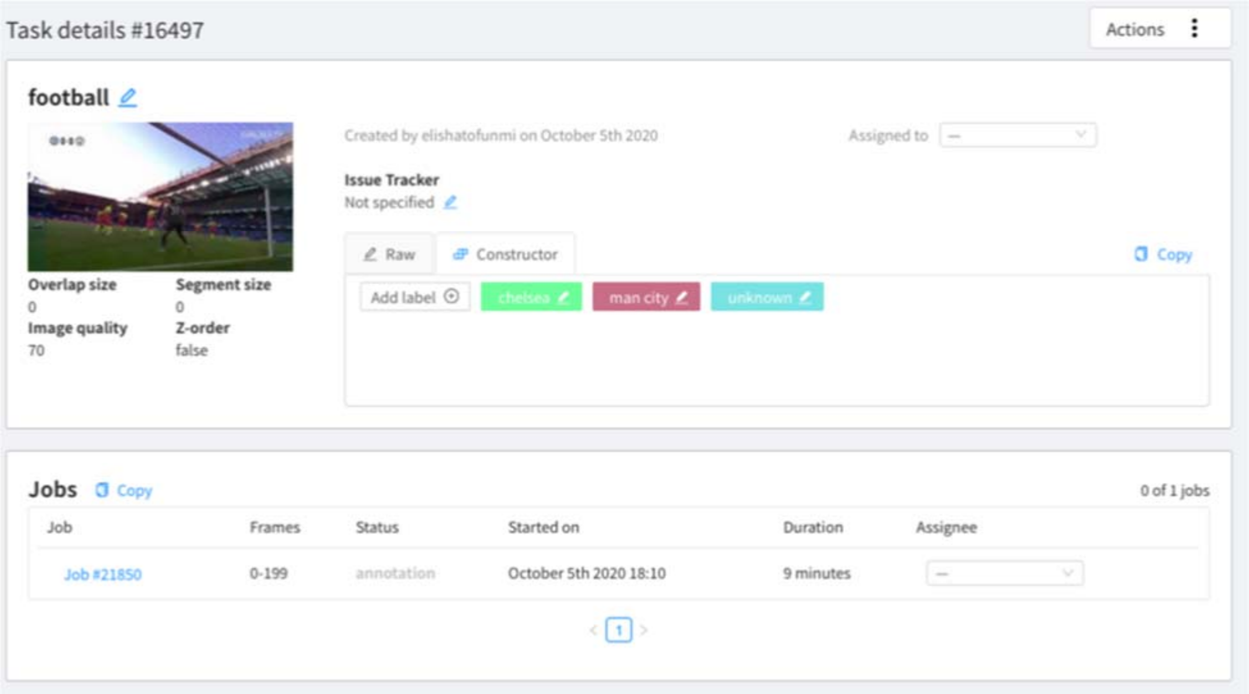


Figure 7 - Label Text

Now that you are done with all labelling, you can go ahead and export the data by returning to your tasks as shown below. Always ensure you have saved your annotations before doing this.



Task details #16497

football

Created by elishatofunmi on October 5th 2020

Assigned to —

Issue Tracker
Not specified

Overlap size: 0
Segment size: 0
Image quality: 70
Z-order: false

Jobs

0 of 1 jobs

Job	Frames	Status	Started on	Duration	Assignee
Job #21850	0-199	annotation	October 5th 2020 18:10	9 minutes	—

Figure 8 –Task Details

Go ahead to click on the three dots beside ‘Actions,’ then select dump annotations: This will export the data in your preferred choice (Tensor Flow records).

Here are the following you can do after annotating:

1. Coco 1.0
2. CVAT for images.
3. CVAT for Videos.
4. Datumaro.
5. Labelme.
6. MOT.
7. Pascal VOC.
8. Segmentation mask.
9. Tfrcords.
10. Yolo 1.1

Other things you could do from selecting action is:

1. Upload annotations.
2. Export as datasets.
3. Automatic annotations and others.

3.3 Google Colab: [5]

Google Colab is one of the most famous cloud services for seasoned data scientists, researchers, and software engineers.

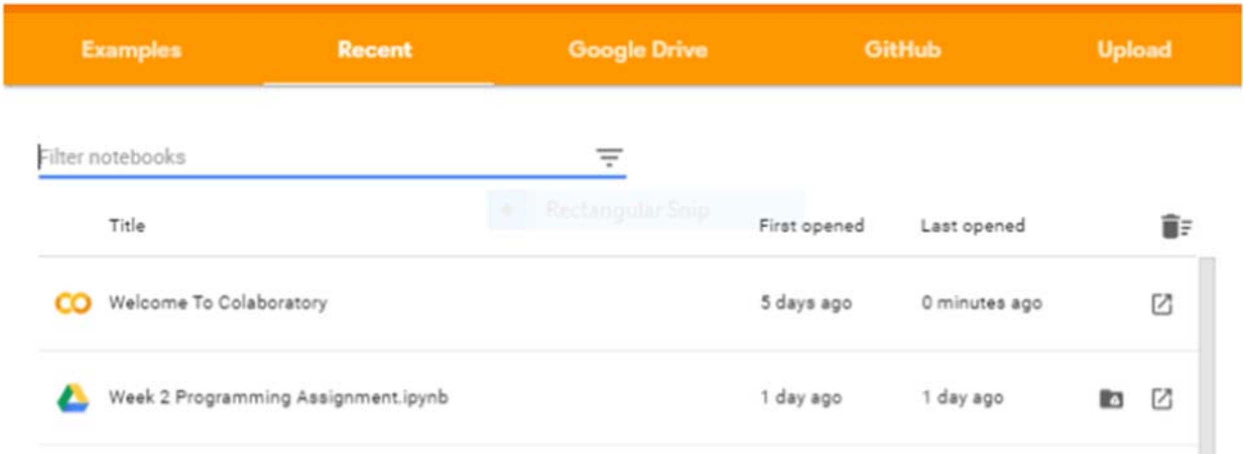
3.3.1 Why Colab:

There are several benefits of using Colab over using your own local machines. Some of the benefits of Colab are

1. You do not require to do an environment setup. It comes with important packages pre-installed and ready to use.
2. Provides browser-based Jupyter Notebooks.
3. Free GPU
4. Store Notebooks on Google Drive
5. Importing Notebooks from Github
6. Document code with Markdown
7. Load Data from Drive
8. and much more

3.3.2 Creating a new notebook

To create a new Notebook on Colab, open https://colab.research.google.com/, and it will automatically show your previous notebooks and give an option to create a new notebook.



Title	First opened	Last opened
Welcome To Colaboratory	5 days ago	0 minutes ago
Week 2 Programming Assignment.ipynb	1 day ago	1 day ago

Figure 9 – Previous Notebooks

Here you can click on NEW NOTEBOOK to start a new notebook and start running your code in it. By default, it is a Python 3 notebook. I will show you later how to make a new Python 2 notebook.

Alternatively, if for some reason you do not see this prompt, or you canceled it, You can make a new notebook from “**File > New Notebook”**.

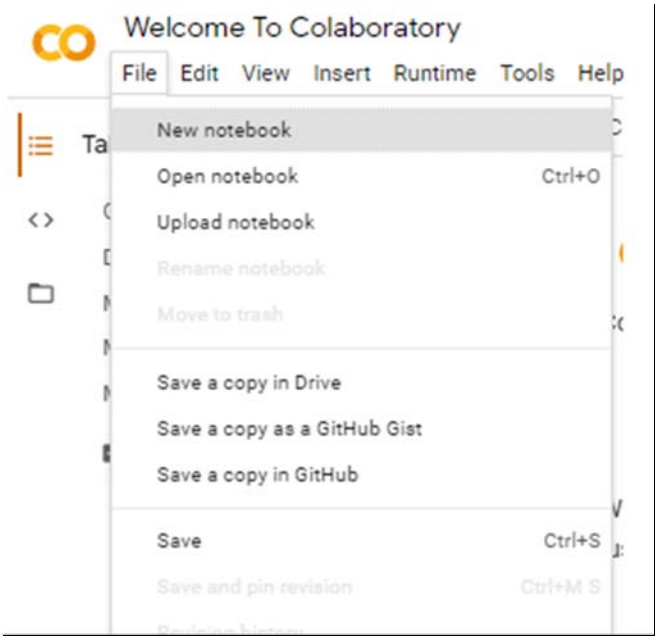


Figure 10 – Creating a New Notebook

3.3.3 Import Notebooks from GitHub/local machine:

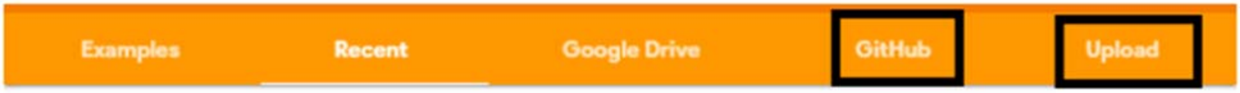
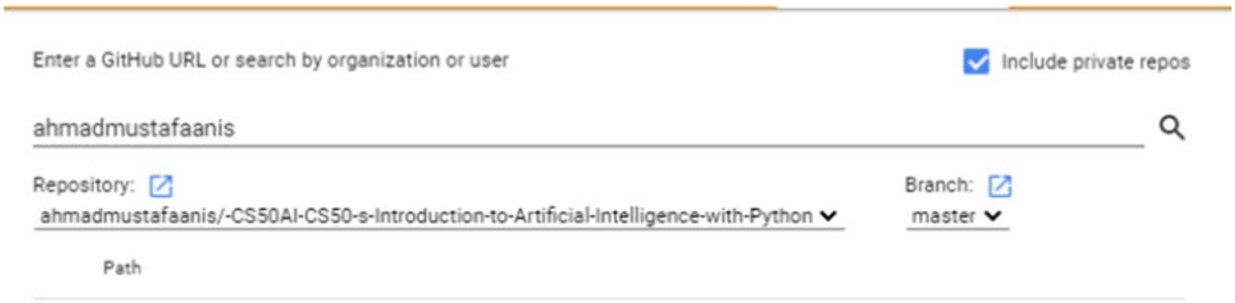


Figure 11 – Importing Notebook

Here you can see these 2 boxes which show GitHub and Upload option.

For Github, at first, you need to authorize with Colab with your GitHub, and then it will show you all available repositories from which you can create a new notebook.



Enter a GitHub URL or search by organization or user

☑ Include private repos

ahmadmustafaanis

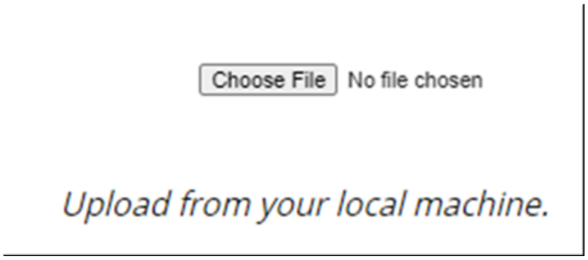
Repository: ahmadmustafaanis/-CS50AI-CS50-s-Introduction-to-Artificial-Intelligence-with-Python

Branch: master

Path

Figure 12 - Select Github Notebook

For uploading from your local machine, you will be prompted to upload a file from your local machine to run it in Colab.



Choose File No file chosen

Upload from your local machine.

Figure 13- Select Local Notebook

CHAPTER: 4

DESIGN METHODOLOGY

CHAPTER 4

DESIGN METHODOLOGY

In this chapter, application and hardware approach is discussed used for the development of the project. A block diagram is shown below in fig 14 to demonstrate the methodology.

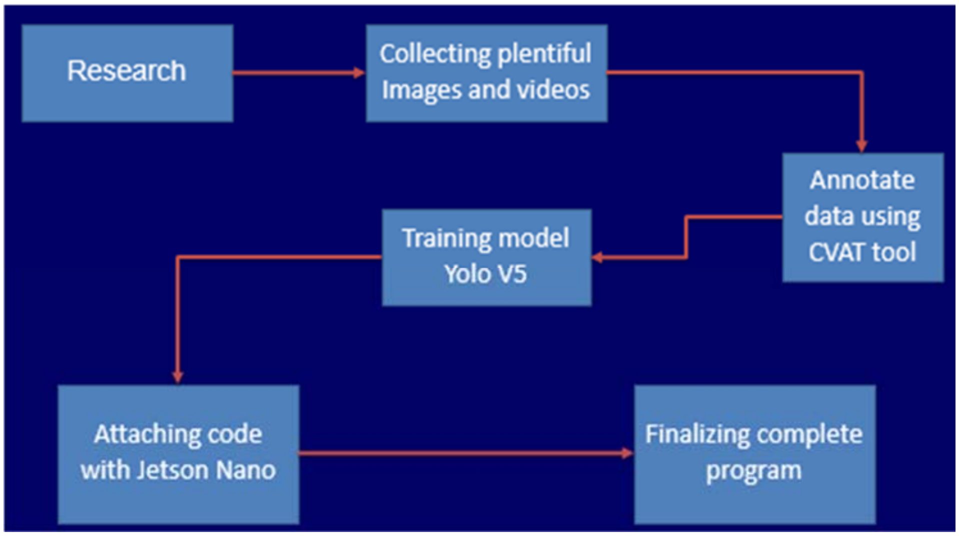

Research
Collecting plentiful Images and videos
Annotate data using CVAT tool
Training model Yolo V5
Attaching code with Jetson Nano
Finalizing complete program

Figure 14: Block Diagram of Safe Zone Camera

Safe Zone Camera is a device which helps the Safety Monitoring personnel to maintain check and balance among people by looking into a screen which displays how many people have wore Mask and how many have not wore Masks. It also helps to analyze that are people following the SOPs for prevention from COVID-19 or not !

4.1 Explanation

The working of each component is explained step by step below:

4.1.1 Working of Philips Webcam:

Webcam is used to capture the live feed from the group of people under observation. It records the live footage sends it to the Nvidia Jetson Nano via USB cable which is attached to the USB port. It can also help to capture pictures of people under observation.

4.1.2 Working of CVAT:

CVAT as explained earlier is computer vision annotation tool. It helps to annotate images by labeling them according to the requirement. In our case, we had 10k images containing people wearing masks and 5k images of people not wearing masks. We segregated images and annotated them via CVAT in their respective manner.

4.1.3 Working of YOLO.v5:

An object detector is designed to create features from input images and then to feed these features through a prediction system to draw boxes around objects and predict their classes. The YOLO model was the first object detector to connect the procedure of predicting bounding boxes with class labels in an end to end differentiable network. Training procedures are equally important to the end performance of an object detection system, though they are often less discussed. Here Images annotated with CVAT are input into YOLO.v5 which then saves the images into its model. This model will then be used to predict the people wearing Masks or not.

4.1.4 Working of Google Colab

Google Colab allows to combine executable code and rich text in a single document, along with images, HTML, LaTeX and more. They are stored in Google Drive account.
This is a free source which provides a fast GPU for training models Python (tensor flow lib.) would be used as programming language

4.1.5 Working of Nvidia Jetson Nano

Nvidia Jetson Serves as the Brain of the Project. It gets the video/Picture from the Webcam via USB Port and it saves it in its database. It processes already saved picture annotated via CVAT and training models of YOLO.v5. The predictions from YOLO.v5 help the Nvidia to separate the Masked and non-masked people. NVIDIA then displays the Count of Masked and non-masked people on the Screen.

CHAPTER: 5

HARDWARE DESIGN

CHAPTER 5

HARDWARE DESIGN

In hardware design, how the components are integrated to each other and what is the final product of hardware is discussed. The integration of following components with Raspberry Pi (which is the central part of device) is given below:

5.1 Integration of Philips Webcam with NVIDIA Jetson:

Integration of Philips Webcam with Nvidia Jetson Nano is simple. They are connected with each other via USB port, NVIDIA jetson has 4 USB Ports. It is better to use the V3 port for Philips Webcam as V3 USB port enables fast data transferring capability between devices.

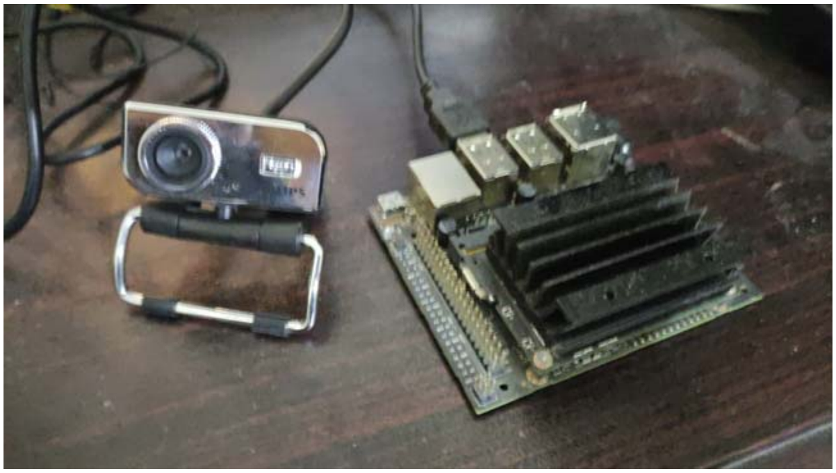


Figure 15 - Integration

Precautions:

1. Jetson Nano should not be given more than 5V/3A, it may damage the Jetson,
2. Heat sinks should be used for the proper functioning of Nvidia Jetson.
3. YOLO.v5 must be given a very large amount of data set to better predict the situation.
4. Philips Webcam should operate on 5V/0.5A.
5. This Product should not be used under water, it will damage the whole circuitry.

CHAPTER: 6

Results

CHAPTER 6

RESULTS

6.1 After compiling the processed code, we get the following results:

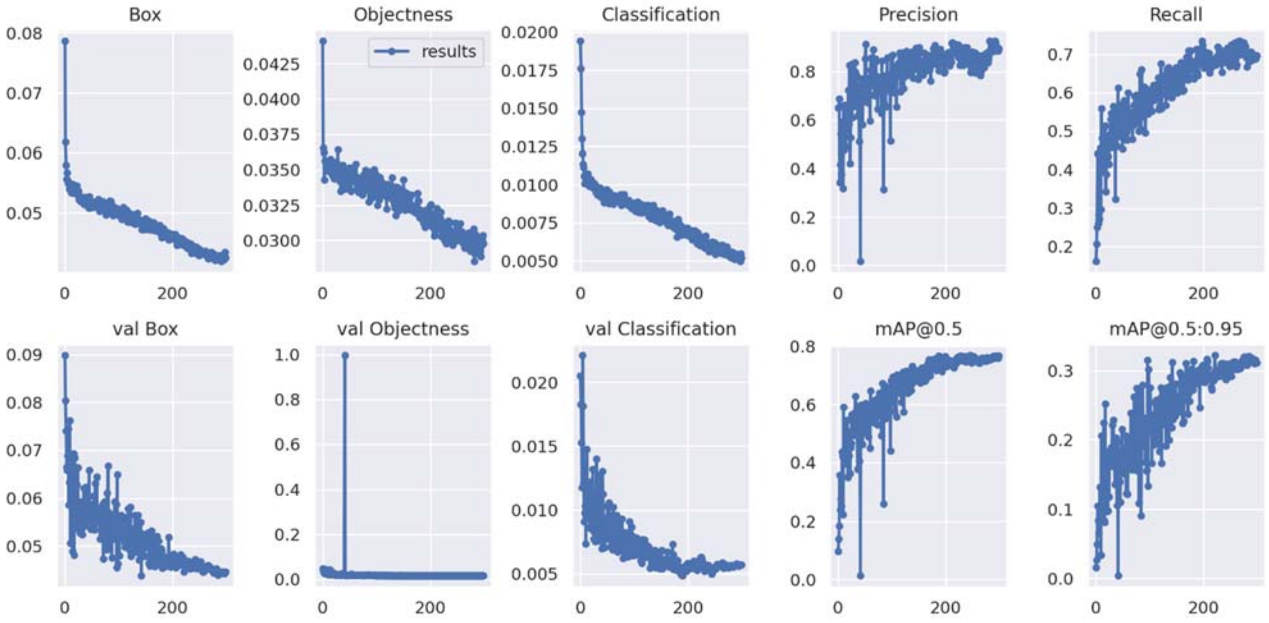


Figure 16 – Results