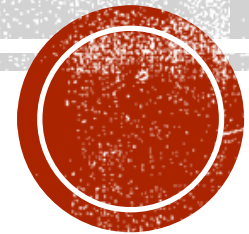


YOUTUBE TAB CLASSIFICATION AND USER PRIVACY USING FEDERATED LEARNING

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INTRODUCTION

- Monitoring student engagement and productivity on YouTube is crucial for improving learning outcomes and providing personalized support.
- A privacy-preserving architecture is proposed to detect whether students are utilizing their time on their computer or wasting it while the user's privacy is protected with federated learning.
- A dataset containing screenshots of different YouTube activities of students is used to classify them into categories using several pre-trained models.
- By distributing the learning process across YouTube and ensuring that sensitive data remains local, our approach ensures the privacy of the end user.



PROBLEM STATEMENT

- We aim to address this challenge by developing a privacy-preserving solution for YouTube activity tracking using federated learning techniques.
- This decentralized learning paradigm ensures that sensitive user data remains on the local device, thus mitigating privacy risks associated with centralized data collection.
- Ensuring student engagement and productivity in YouTube environment while preserving user privacy poses a significant challenge.
- Traditional monitoring methods often compromise privacy, raising ethical concerns and hindering widespread adoption.



OBJECTIVES

- Privacy Preservation
- Classification
- Evaluation and Validation
- Real-time Monitoring
- Model Update and Improvement



LITERATURE SURVEY

Paper	Method	Dataset	Accuracy	Limitations
Using screen capture to study user research behavior	Video screen capture technology to analyze user behavior	N/A	N/A	Resource expensive, No automatic detection
Log files for Learning Analytics from mobile screen recordings	Computer vision based machine learning to track activity of students from mobile screen recordings	118 videos	N/A	Continuous mobile screen recording not practical, Slows down performance, Raises privacy concerns
Tracking digital device utilization from screenshot analysis using deep learning	Deep learning based activity tracking from computer screenshots	4000 Screen-shots	95.4%	Do not consider user privacy



PRIVACY PRESERVATION

- In federated learning, the data remains on the individual devices or servers that generate it, and the model is trained on each of these decentralized data sources in a collaborative manner.
- The model itself is not shared with the individual devices or servers, and only the updated model weights are transmitted back and forth between the devices and the central server.
- Importantly, the entire detection process takes place solely on the user's device, with no transmission or uploading of local data to the cloud.



COMPARISON

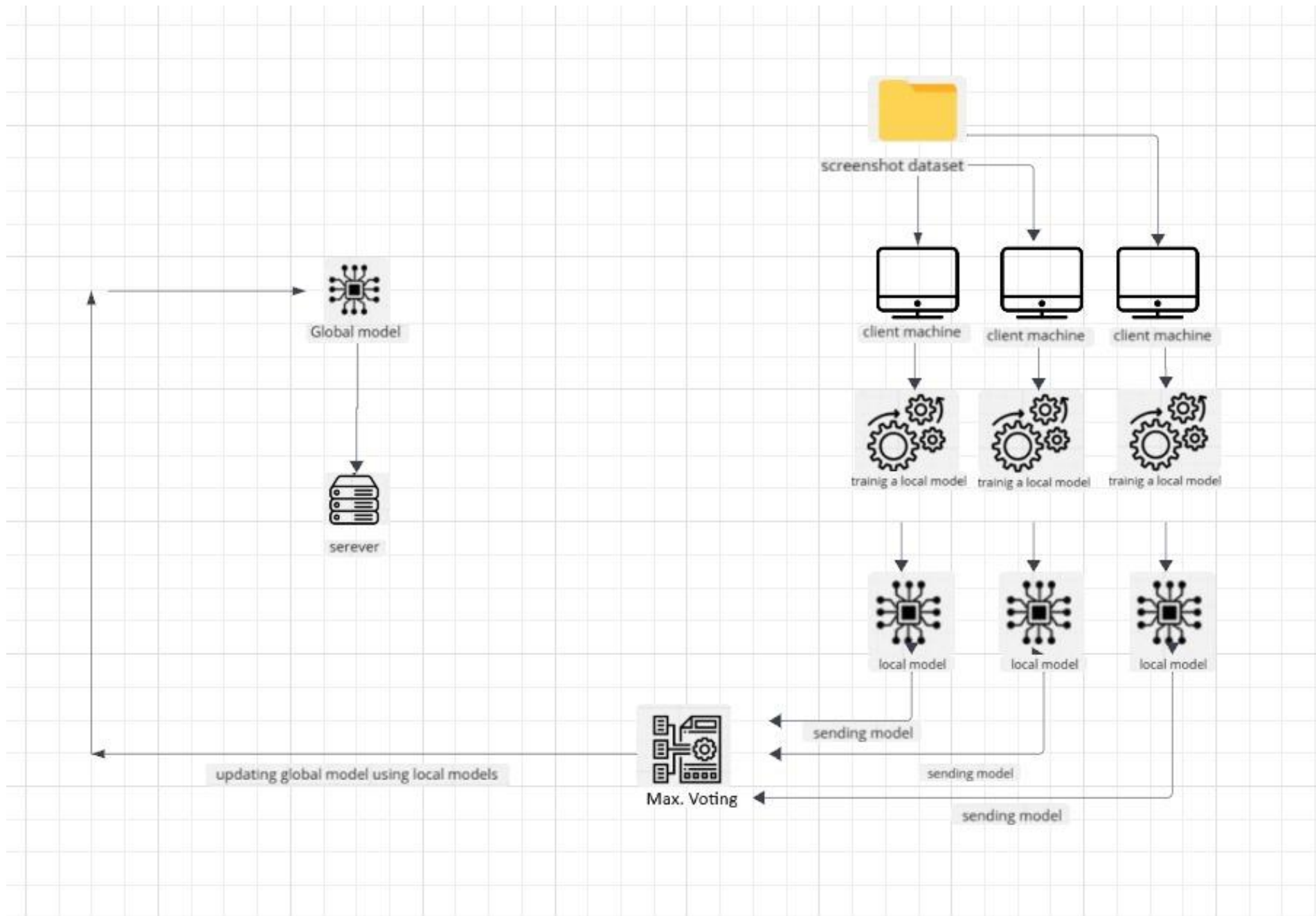
Privacy Preserving Techniques	Privacy	Utility	Accuracy	Computational Complexity
Differential privacy	High	Low	Low	Low
Homomorphic encryption	Medium	High	High	High
Secure multi-party computation	High	Medium	Medium	High
Federated learning	High	Medium	High	Low



METHODOLOGY OVERVIEW

- Select the best model for classification according to the dataset.
- Set up Local and Global Model.
- The YouTube Extension will silently take a screenshot of the entire screen once every minute and send it to Local Model for classification.
- The screenshot will be analyzed by the local model and classify the image.
- Another YouTube extension saves images in respective folders of class- productive or unproductive.
- Update Global Model using Local Model weights.
- Weights are used to update the server, hence privacy is maintained.
- Every client will give binary classification and on basis of result of max voting, global model is updated.





FEDERATED LEARNING IN OUR PROJECT

- We have created a Global Model and Local Model on the basis of comparison between various CNN models.
- Local model does the classification on the client's PC and saves the result in their respective files.
- Only the weights achieved after classification in local model are sent to Global model.
- Global model is updated.
- Hence, user privacy is preserved.



DATASET CREATION

- We have taken around 2700 screenshots of different YouTube channels.
- Productive images: 1512
- Unproductive images: 1181
- After pre-processing of these images, the three models – simple CNN, InceptionV3, InceptionResNetV2 are trained and validated.



MODEL EVALUATION

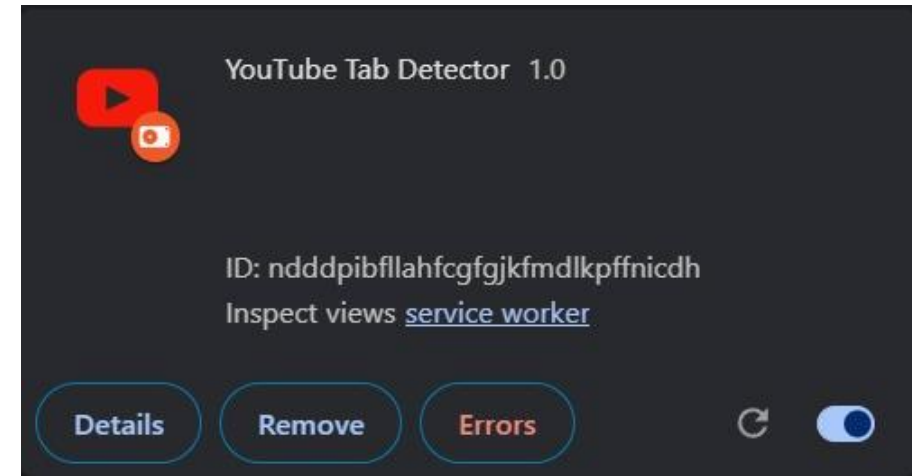
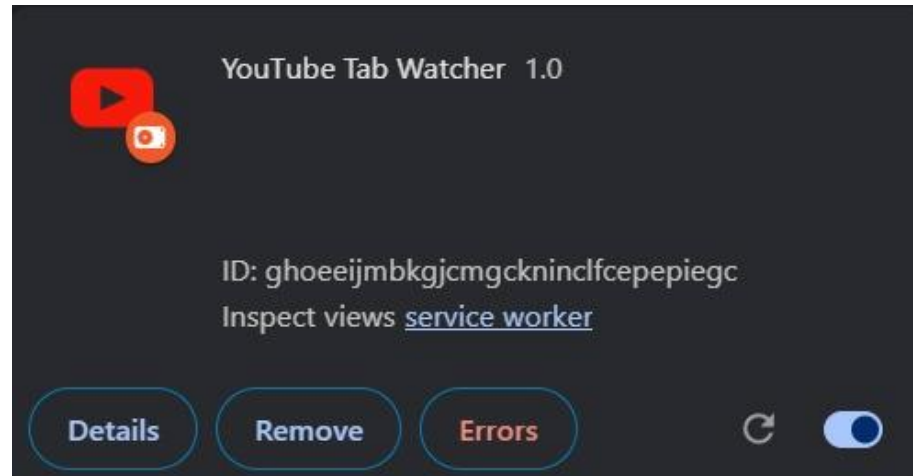
- We have taken three models- simple CNN, InceptionV3, InceptionResNetV2.
- To access the performance of our model, we have used various evaluation metrics like accuracy, precision, recall, AUC, PRC.
- Based on their performance, the best model came out to be InceptionV3.

Models	Accuracy	Precision	Recall	AUC	PRC
InceptionV3	0.987	1.0	0.9705	0.9997	0.9996
CNN	100	100	100	100	100
InceotionResNetV2	0.9833	0.9914	0.9705	0.9979	0.9974



EXTENSIONS

- We have created two YouTube Tab extension- YouTube Tab Watcher, YouTube Tab Detector.
- YouTube Tab Watcher classifies the screenshot as productive or unproductive.
- YouTube Tab Detector saves the classified screenshot on client's file manager.



CLASSIFICATION

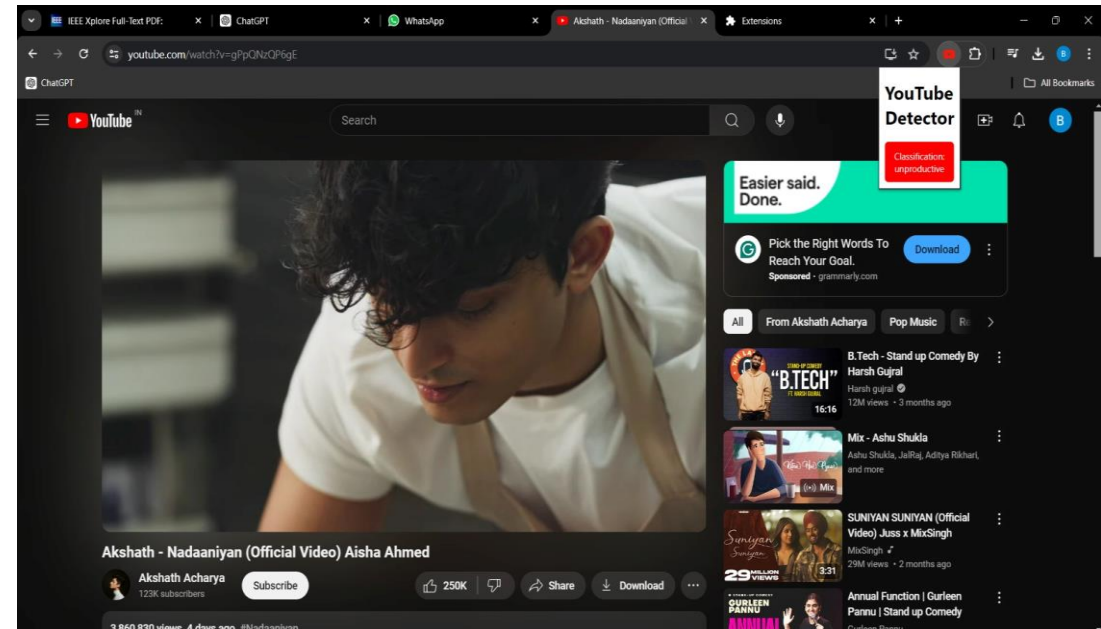
- We have created a copy of Global model on client side (local model).
- YouTube Tab Watcher detects whether the screenshot taken by Local model is productive or unproductive.

```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.22631.3810]
(c) Microsoft Corporation. All rights reserved.

E:\monitor>venv\Scripts\Activate

(venv) E:\monitor>python extension-server.py
2024-06-30 16:43:43.538339: I tensorflow/core/util/port.cc:113] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable 'TF_ENABLE_ONEDNN_OPTS=0'.
2024-06-30 16:43:44.306631: I tensorflow/core/util/port.cc:113] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable 'TF_ENABLE_ONEDNN_OPTS=0'.
WARNING:tensorflow:From E:\monitor\venv\Lib\site-packages\tf_keras\src\losses.py:2976: The name tf.losses.sparse_softmax_cross_entropy is deprecated. Please use tf.compat.v1.losses.sparse_softmax_cross_entropy instead.

* Serving Flask app 'extension-server'
* Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on all addresses (0.0.0.0)
* Running on http://127.0.0.1:5000
* Running on http://192.168.29.91:5000
Press CTRL+C to quit
127.0.0.1 -- [30/Jun/2024 16:43:50] "OPTIONS /classify HTTP/1.1" 200 -
127.0.0.1 -- [30/Jun/2024 16:44:00] "POST /classify HTTP/1.1" 200 -
127.0.0.1 -- [30/Jun/2024 16:44:00] "OPTIONS /save_screenshot/productive HTTP/1.1" 200 -
127.0.0.1 -- [30/Jun/2024 16:44:04] "POST /save_screenshot/productive HTTP/1.1" 200 -
```



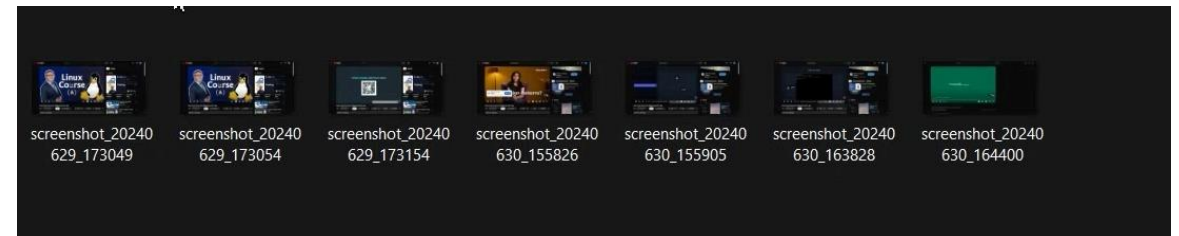
FOLDER CREATION

- After taking the screenshot every minute, a folder named 'screenshot' is created in file manager by the extension YouTube tab detector.

project_youtube_complete	29-06-2024 23:30	File folder
screenshots	29-06-2024 17:30	File folder
unproductive	29-06-2024 22:31	File folder

- YouTube extension classifies the screenshot as productive or unproductive and save it in their respective folders.

Name	Date modified	Type	Size
productive	30-06-2024 16:38	File folder	
unproductive	29-06-2024 17:30	File folder	



UPDATE GLOBAL MODEL

- In the background, the Client model and Global model run simultaneously at one-minute intervals. After the screenshot is taken, the Client model updates its weight to Global model. Update Global model by using simple voting from the weights achieved from various local models.

```
C:\Windows\System32\cmd.e  X  +  v

(venv) E:\monitor>python background.py
Running client-side.py
C:\Users\lalit\AppData\Local\Programs\Python\Python311\Lib\site-packages\torchvision\models\_utils.py:208: UserWarning:
The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' instead.
  warnings.warn(
C:\Users\lalit\AppData\Local\Programs\Python\Python311\Lib\site-packages\torchvision\models\_utils.py:223: UserWarning:
Arguments other than a weight enum or 'None' for 'weights' are deprecated since 0.13 and may be removed in the future. T
he current behavior is equivalent to passing 'weights=Inception_V3_Weights.IMAGENET1K_V1'. You can also use 'weights=Inc
eption_V3_Weights.DEFAULT' to get the most up-to-date weights.
  warnings.warn(msg)
Local model trained and saved as 'local_model.pth'
Running aggregation.py
C:\Users\lalit\AppData\Local\Programs\Python\Python311\Lib\site-packages\torchvision\models\_utils.py:208: UserWarning:
The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' instead.
  warnings.warn(
C:\Users\lalit\AppData\Local\Programs\Python\Python311\Lib\site-packages\torchvision\models\_utils.py:223: UserWarning:
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he current behavior is equivalent to passing 'weights=Inception_V3_Weights.IMAGENET1K_V1'. You can also use 'weights=Inc
eption_V3_Weights.DEFAULT' to get the most up-to-date weights.
  warnings.warn(msg)
Global model updated and saved as 'global_model.pth'
|
```



CONCLUSION

- Our project achieved classification using InceptionV3.
- Utilized Federated Learning to ensure user data remains private and secure by enabling decentralized model training on local devices, mitigating privacy risks associated with centralized data storage.
- Overall, our project exemplifies the synergy between advanced machine learning methodologies and privacy-preserving technologies, offering a compelling framework for enhancing user interaction and security in digital environment.



FUTURE WORK

- Increase the size of dataset to make the model work more accurately.
- Make use of the achieved classification to make conclusions about the user.
- Accomodate screens of various devices to enhance its applicability in the real-world.

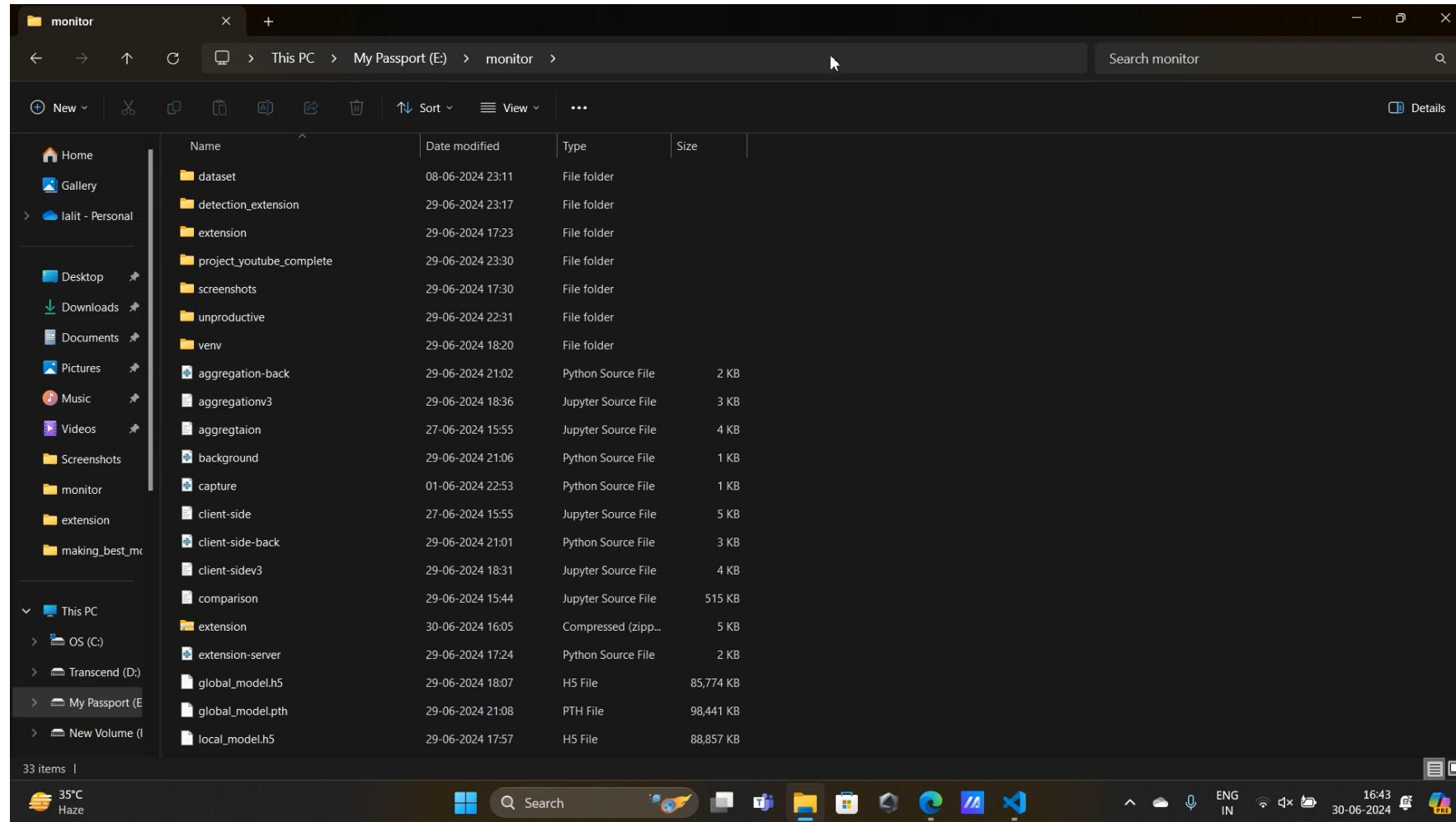


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PRACTICAL IMPLEMENTATION



THANK YOU

