Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

IETE-SF
of
Electronics & Telecommunication Engineering Department
Presents

INNOVATIVE PRODUCT DEVELOPMENT (DJ STRIKE)

Project Proposal Work

On

"Smart Mart – A Smart Shopping Experience using Computer Vision"

Academic Year: 2021-22

Group ID: 6

Group Members

Name	SAP ID	Department	Year
1.Moulik Shah	60002190065	EXTC	TE
2.Darshil Modi	60002190025	EXTC	TE
3.Parth Shah	60002190077	EXTC	TE
4. Sarthak Acharekar	60002200182	EXTC	SE
5. Deivagna Vanani	60002200101	EXTC	SE
6. Neeraj Hegde	60002200177	EXTC	SE

BE Mentor: - Aarushi Raichur

Faculty Guide: - Dr Amit Deshmukh

Smart Mart – A Smart Shopping Experience using Computer Vision

PROJECT OBJECTIVE / ABSTRACT

Recently, many attempts have been made to reduce the time required for payment in various shopping environments. In addition, as the 4th Industrial Revolution era, artificial Intelligence technology is advancing and IoT devices are becoming more compact and cheaper. So, by integrating these two technologies, access to building an unmanned environment on behalf of human beings to save users' time became easier. In this paper, we propose a smart shopping cart system based on low-cost IoT equipment and deep learning object detection technology. The proposed smart cart system consists of a camera for real-time product detection, an ultrasonic sensor that acts as a trigger, a weight sensor to determine whether a product enters or out of shopping cart, and an application of smartphone that provides a UI for a virtual shopping cart, and a deep learning server where learned product data are stored. Communication between each module is made of TCP/IP and HTTP network, and YOLO darknet library, an object detection system is used by the server to recognize the product. The user can check the list of items put in the smart cart through the app of the smartphone and automatically pay. The smart cart system proposed in this paper can be applied to implementunmanned stores with high cost-performance ratio. We have designed a cart, which uses artificial intelligenceto help the customer add his product easily. After adding his products, the customer can use the same softwareto checkout and pay the supermarket using mobile banking**.**

KEYWORDS

Electronics: Raspberry Pi 4, Rpi Camera, Jumper wires, Breadboard

Development: React, Mongo DB prime react firebase/Aws

AI/ML: Python, NumPy, OpenCV, TensorFlow, Keras, PyTorch, Media pipe, YOLO

MOTIVATION / SCOPE OF THE PROJECT

Nowadays in Supermarkets, customers have to spend a long time in the queue to get their products billed. This causes too much discomfort, and due to which the customer may not come back to the shop that often because of which the retail owners may lose their customers.

We thought how we could solve this issue and then we came up with an idea to solve these issues. We can have a self-checkout, and customized shopping experience. The customer data can be stored in a database, which would help the owner have a good customer loyalty. Retailer can serve more customers in the same amount of time.

Smart Mart – A Smart Shopping Experience using Computer Vision

***METHODOLOGY**

When the user enters our mart. He/She will get a cart. There will be a 3 camera inside the cart in length breadth and the back of the cart.

There will also be a tablet attached to the cart which will have our shopping site web app opened where the user can log in with their phone number/ email id and we will save their data in our database (mongo dB). If he/she is our existing customer, then they can log-in with their credential already saved in our db.

After the connection is established, the ultrasonic sensor in the shopping cart recognizes the product when the user puts/pulls out the product and stores the video/image entered from the r pi camera attached to the cart in the r pi for few seconds then it sends message to the central server(firebase/Aws) indicating that the streaming has started over the TCP/IP network. Then our server reads the image/video from the r pi and then uses deep learning to determine the type, the quantity, and entry/exit of the product and passes this information to the web app on user smart tablet provided in the cart using TCP/IP network. Upon receiving the message, the web app adds/delete the product data in the virtual shopping cart.

Once the shopping is completed the user will be redirected to our payment page where he/she can pay with online banking (Paytm, google pay, net banking) there will be detailed information of his/her product. Once the payment is successful the user will get a signed token number which will act as receipt which he/she should use to exit the mart.

SOCIAL IMPACT

Reduced Time: The biggest advantage of smart mart is time efficiency. It helps to reduce the queue and save time in today's fast-paced society, it goes hand in hand with busy people.

Virtual assistant: The virtual assistance inside the mart would help the customer locate his products inside the mart, thereby reducing the time for searching his products.

Paper wastage: Reduce paper wastage since the bill will be sent to the customer mail-id.

Utilization of available space: With reduced use of cashier’s, the size of the shop can be reduced.

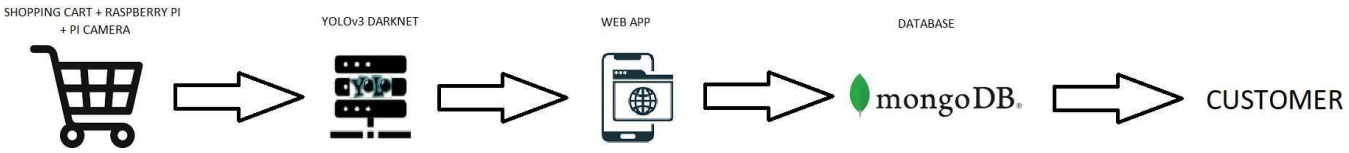
Reduced manpower: Very few employees are required to run the shop and can be utilized for other services

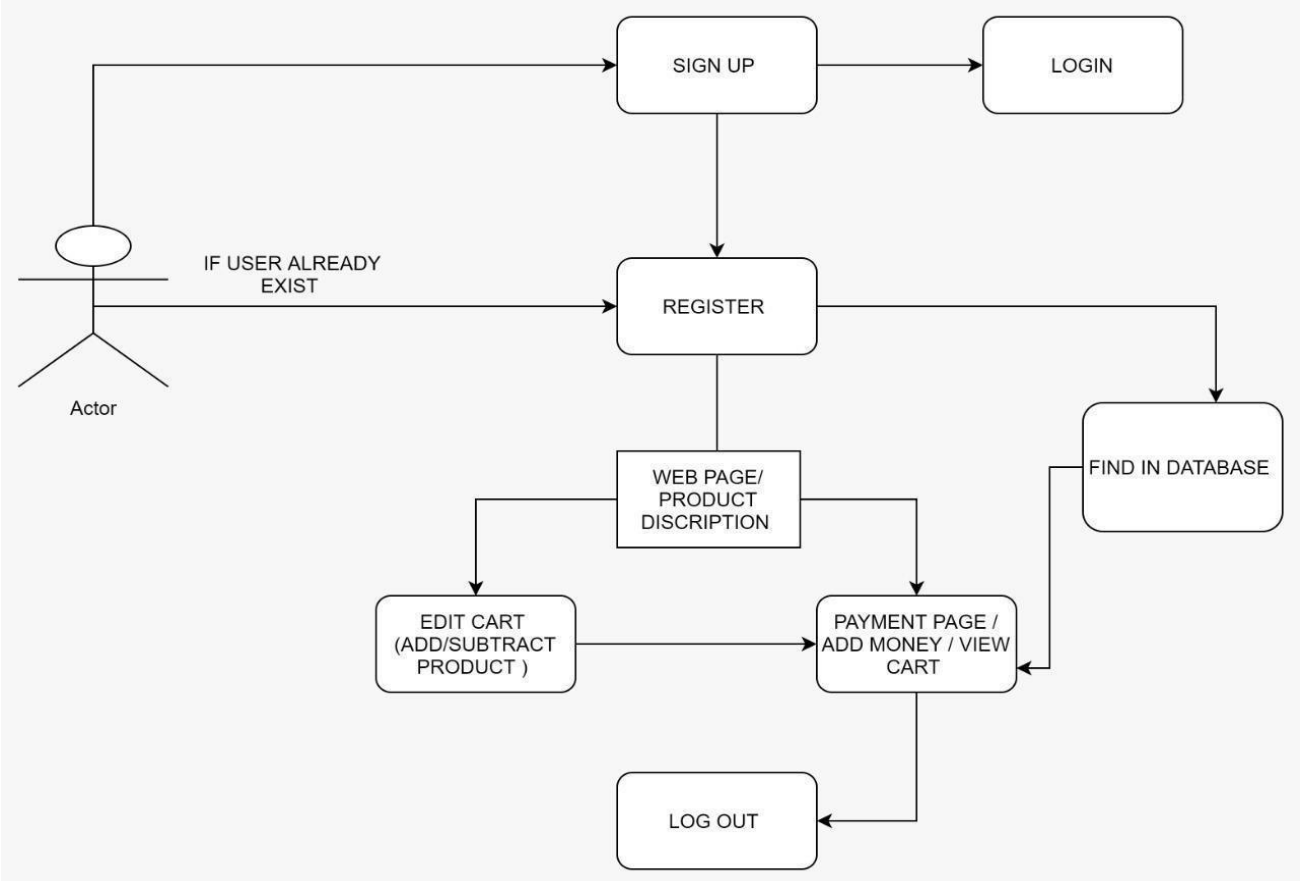
LITERATURE SURVEY

In Many Research papers, Computer Vision and Deep Learning have been used for making the shopping experience more efficient as there are many advantages of it like Reduced Time, Paper wastage, Reduced manpower etc. In [1] They used infrared sensors to determine the product movement and they have also used a charging method with the help of Raspberry PI which recognizes the product and stores it in their database and makes their cart ready for online payment without the involvement of the cashier and making their experience even better. We are creating a system with more advance features with more personalized focus toward the user’s choice and making them stay even more in the mart and converting them into a more loyal customer.

Smart Mart – A Smart Shopping Experience using Computer Vision

***SCHEMATIC / BLOCK DIAGRAM**





Smart Mart – A Smart Shopping Experience using Computer Vision

***DESCRIPTION OF THE PROJECT**

1. RASPBERRY PI:

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. The Raspberry Pi can interact with the outside world and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infrared cameras. The Raspberry Pi can open opportunities for you to create your own home automation projects, which is popular among people in the open-source community because it puts you in control, rather than using a proprietary closed system.

2. RASPBERRY PI CAMERA:

The Raspberry Pi Camera Module v2 is a high quality 8-megapixel Sony IMX219 image sensor custom designed add-on board for Raspberry Pi, featuring a fixed focus lens. It's capable of 3280 x 2464-pixel static images, and supports 1080p30, 720p60 and 640x480p60/90 video. It attaches to Pi by way of one of the small sockets on the board upper surface and uses the dedicated CSI interface, designed especially for interfacing to cameras.

3. OpenCV:

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high-resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people in the user community and an estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies.

4. FIREBASE:

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android, and Web apps. Firebase provides tools for tracking analytics, reporting, and fixing app crashes.

5.React:

React (also known as React.js or ReactJS) is a free and open-source front-end JavaScript library for building user interfaces or UI components. It is maintained by Facebook and a community of individual developers and companies. React can be used as a base in the development of single-page or mobile applications. However, react is only concerned with state management and rendering that state to the DOM, so creating React applications usually requires the use of additional libraries for routing, as well as certain client-side functionality.

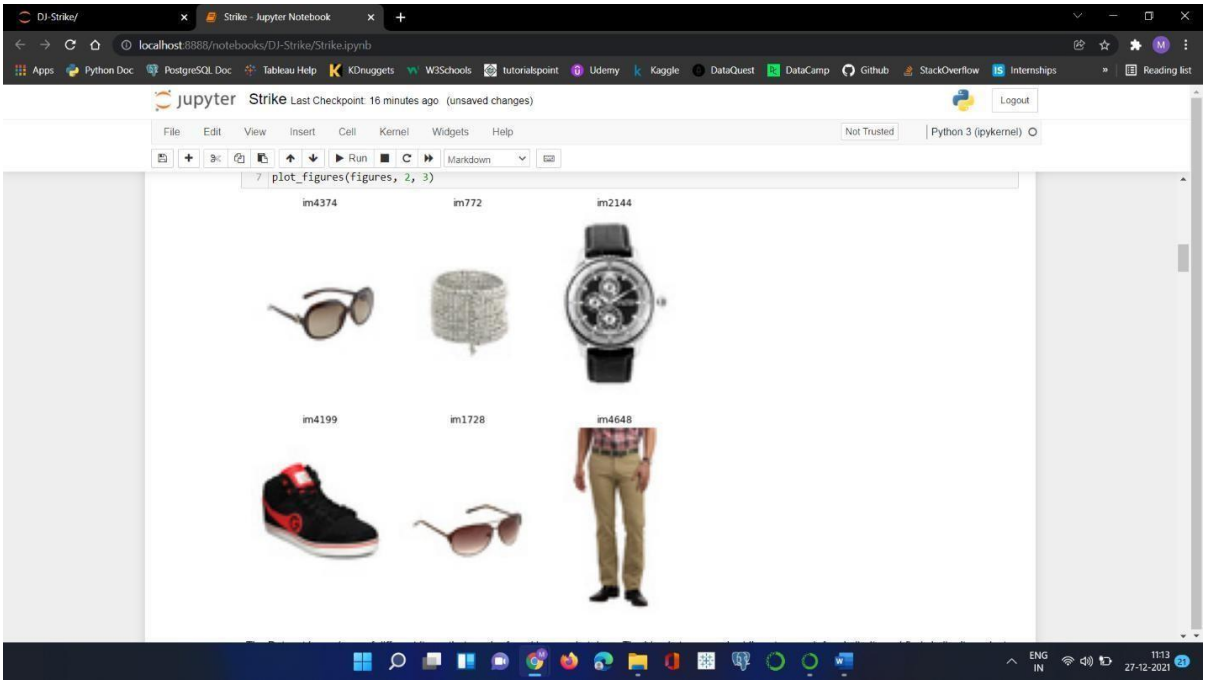
6. MongoDB:

MongoDB is a source-available cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas. MongoDB is developed by MongoDB Inc. and licensed under the Server-Side Public License (SSPL).

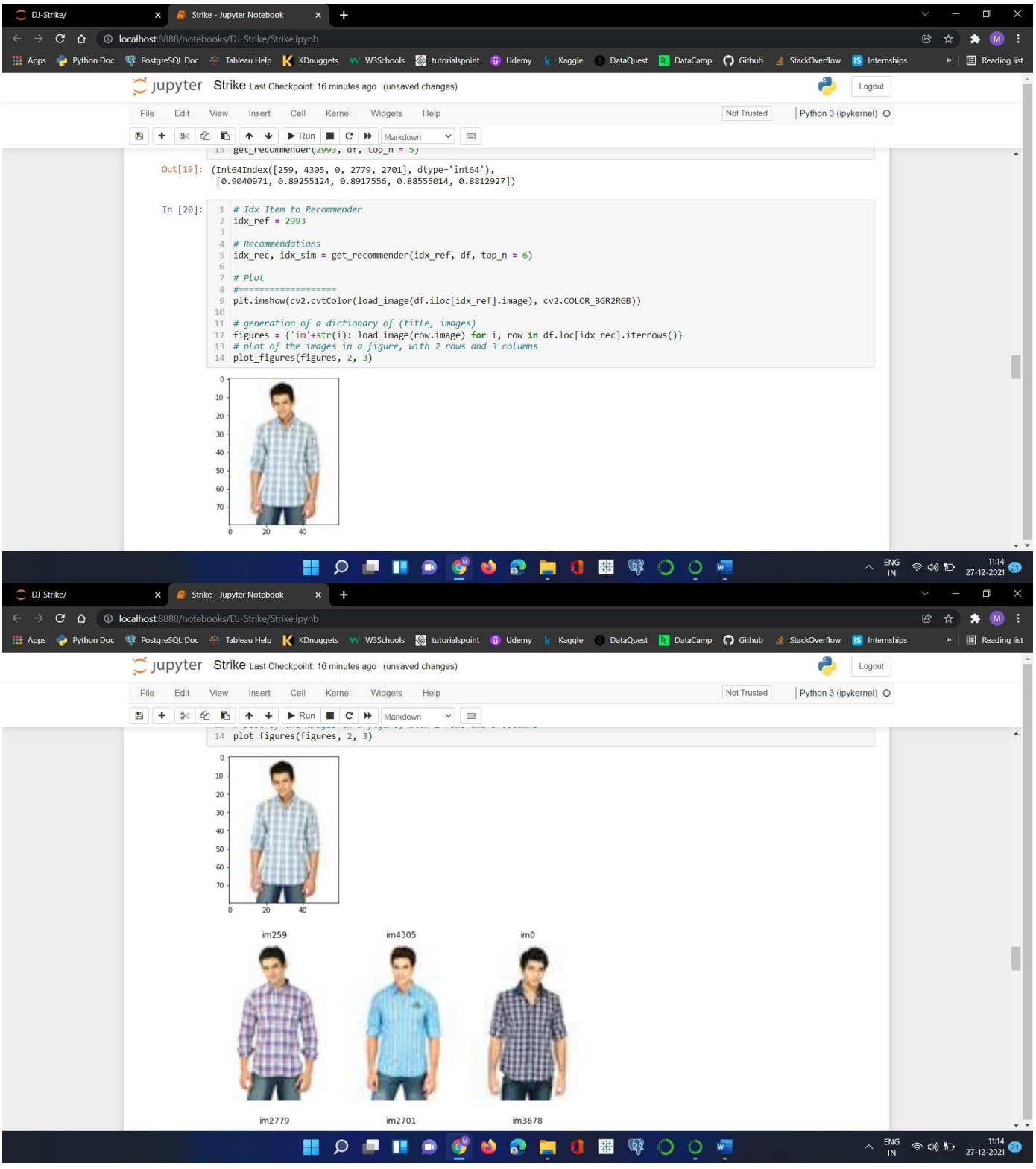
Project Simulation and Progress

(1) Machine Learning

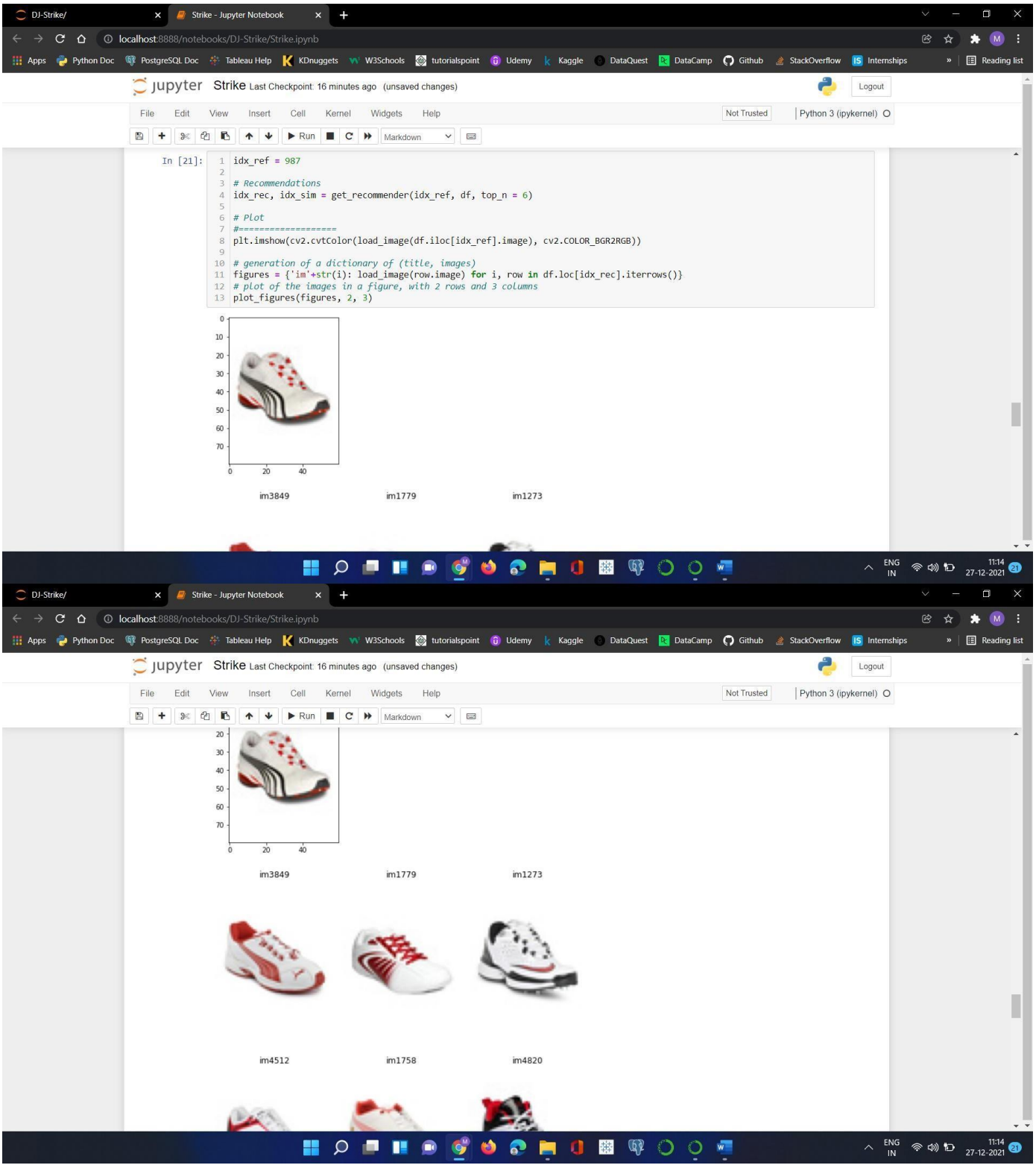
In Machine Learning we have created a Recommendation Model using CNN Of Myntra Fashion Dataset where basically with the help of Image Data, we recommended similar items a user would buy**.**



Smart Mart – A Smart Shopping Experience using Computer Vision

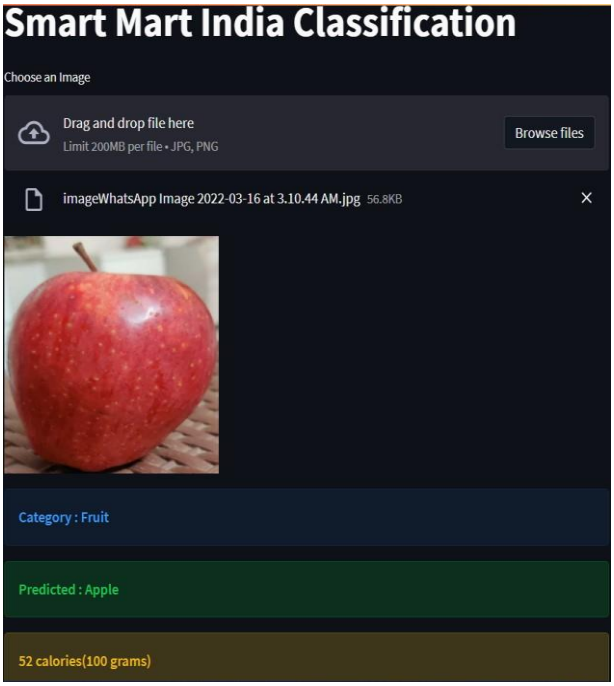


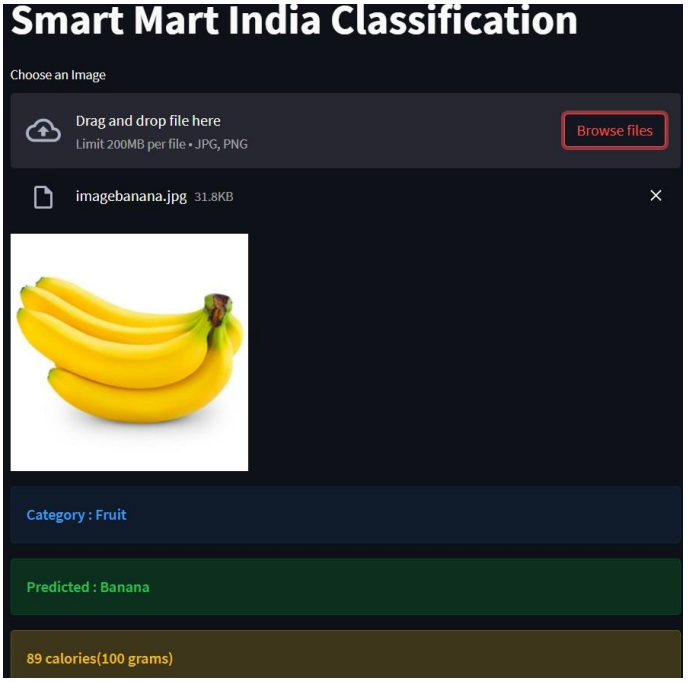
Smart Mart – A Smart Shopping Experience using Computer Vision



Smart Mart – A Smart Shopping Experience using Computer Vision

We have also created our object detection model with MobileNet Framework for this Model as it had the highest precision accuracy, and we used the Fruits and vegetable dataset from Kaggle to train our dataset. We trained our models for 50 epochs and used Early Stopping for this case and implemented our model on Streamlit through which we created an Interactive dashboard for our testing purposes.



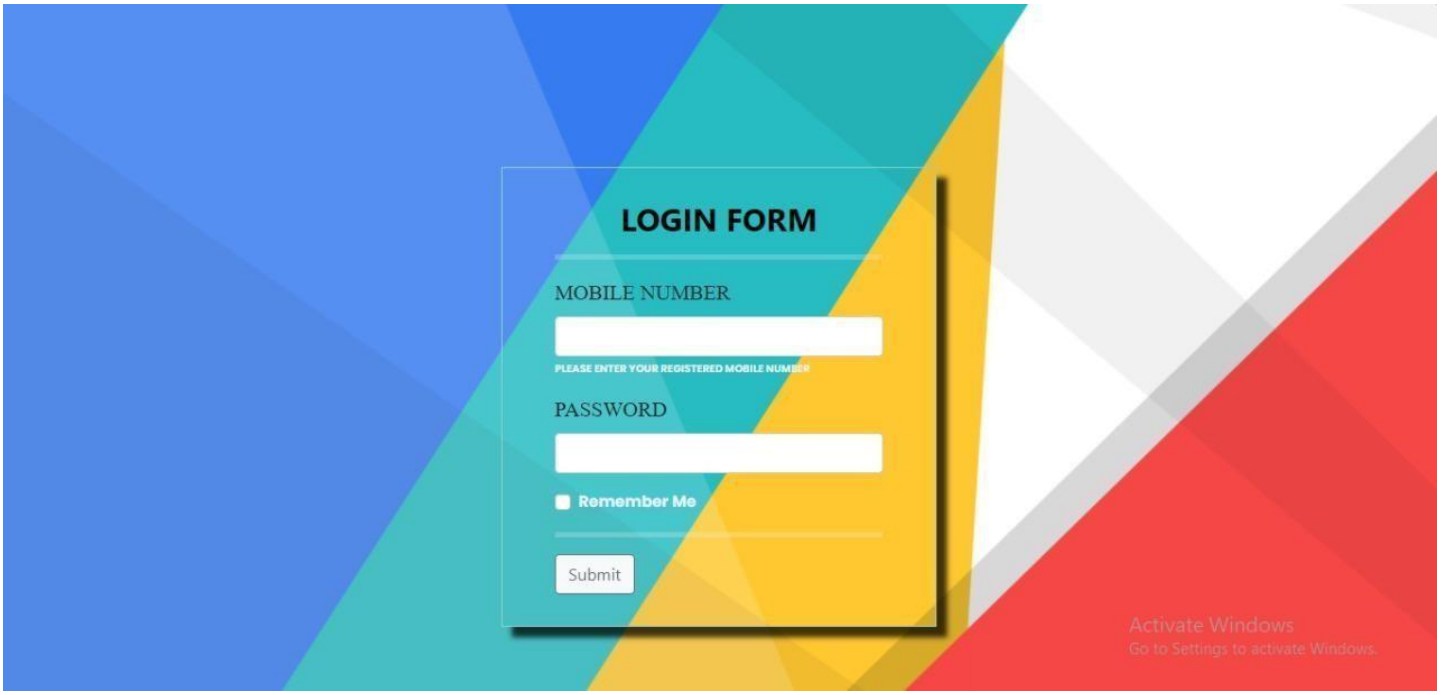


Now in the remaining part we will improve our model performance by creating a ROI and making inference time better by reducing the weights of our model and testing with the model in Real-Time.

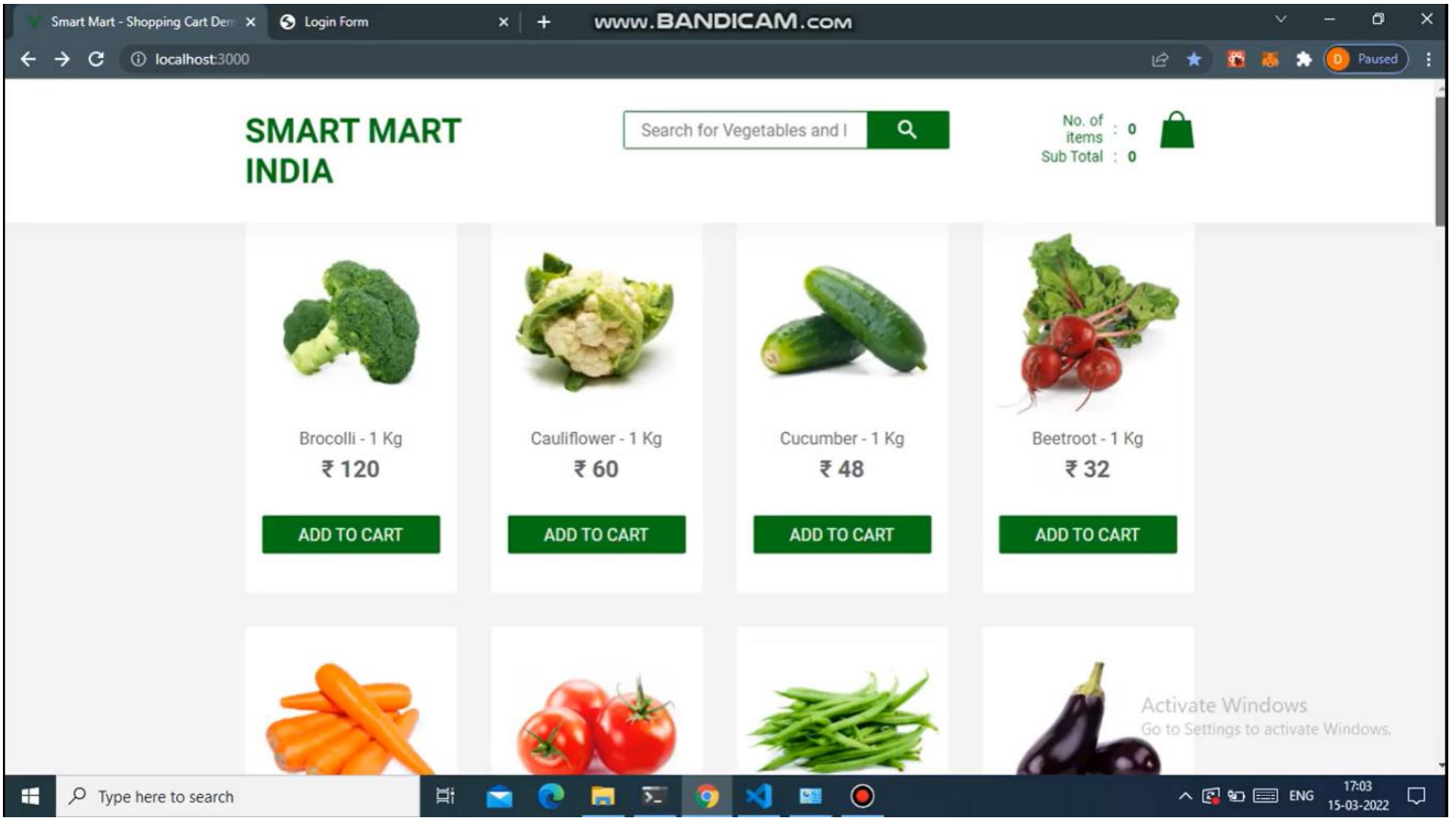
Smart Mart – A Smart Shopping Experience using Computer Vision

(2) Development

In development, we have created a working log-in page for our website and once we get the dataset, we will start working on Backend using Mongo DB. For Front -end we will start making required web pages using the dataset we will fetch from Mongo DB.



In the Web Development side, we created our E-commerce Website, with interactive features where the customer could login to the website and add a product to the cart and then make a payment. Now before the final review we will integrate our website with the model and also make a connection to the Raspberry Pi through which we will make our feed input Real-time.



(3) HARDWARE IMPLEMENTATION

In Hardware part we have used Raspberry-pi and Rpi Cam for creating our sample smart basket. In this basket the customer/user will put the product inside the cart and the code running live on rpi would detect the specified product and through which we can update their shopping cart on website accordingly.

BUDGET

SR. NO.	COMPONENTS	QUANTITY (in units)	AMOUNT (in Rs)
1.	Raspberry Pi 4(2gb)	1	3200.00
2.	Raspberry Pi camera module v2	3	4950.00
3.	Breadboard	1	105.00
4.	Jumper wire	1	89.00
5.	Miscellaneous expenses		656.00
	TOTAL		9000.00

Conclusion

With the increasing demand for facial recognition in daily use, this is the right time to build the system. In this project, we have discussed two different algorithms which are image detection and face recognition and how they can be used together to create a new mode of payment and a system which can be used to turn the shopping marts into smart mart. There can be many more measures such as iOS suitable app, in-app chatbot, admin side interface, etc. which can be done to improve the quality and security of the system and make help more businesses.
Our goal for the next phase of this project is to create a fully end to end working model of our project where we will be working more on development of our site and creating a user-friendly interface and also improving our computer vision model to improve the accuracy in extracting visual features (produce & barcode items) for instant recognition. We are also planning to work more on recommendation so customers can search, locate and compare products while they shop, and we can offer real-time recommendations based on cart content or location to increase basket size. Customers can also request assistance with a single tap.

REFERENCES

[1] Tereza Soukupova and Jen Cesh, “Real Time Eye Blink Detection and Facial Landmarks” in proceeding of Center of Machine Perception, Department of Cybernetics, Prague, 2016

[2] R. Padilla, C. F. F. Costa Filho and M. G. F. Costa, Evaluation of Haar Cascade Classifiers Designed for Face Detection, Venice, Italy, 2016

[3] A. Asthana, S. Zafeoriou, S. Cheng, and M. Pantic. Incremental face alignment in the wild. In Conference on Computer Vision and Pattern Recognition, 2014. 1, 2, 3, 4, 5, 7

[4] J. Cech, V. Franc, and J. Matas. A 3D approach to facial landmarks: Detection, refinement, and tracking. In Proc. International Conference on Pattern Recognition, 2014. 7

[5] M. Chau and M. Betke. Real time eye tracking and blink detection with USB cameras. Technical Report 2005-12, Boston University Computer Science, May 2005.

[6] Yuchen Wei, Son Tran, Shuxiang Xu, Byeong Kang and Matthew Springer “Deep Learning for Retail Product Recognition: Challenges and Techniques” 12 Nov 2020.