IBM Hack Challenge 2022

Topic: Rush Estimator for Corporate Cafeteria

Team Name: EliteCoders

Team Members:

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1. INTRODUCTION:

1.1 Overview:

Food wastage is becoming an important issue to solve.According to the United Nations Development Programme, up to 40% of the food produced in India is wasted. About 21 million tonnes of wheat are wasted in India and 50% of all food across the world meets the same fate and never reaches the needy. In fact, according to the agriculture ministry, INR 50,000 crores worth of food produced is wasted every year in the country.

Even though the world produces enough food to feed twice the world's present population, food wastage is ironically behind the billions of people who are malnourished.

On the other hand, inability to produce sufficient food to cater the visitors by cafeteria and restaurants also hamper their sales.Food inventory management is a central job for any restaurant or kitchen manager. It's a constant balancing act of keeping enough ingredients to fill every order, but not so much that food spoils and you lose money on it.

On further analysis it can be figured out that the above dilemma can be solved by keeping a track of number of people visiting the restaurants.In other words analyzing the footfall in the restaurants and cafeteria will help us predict the accurate number of people visiting the cafeteria in the future .This number can then be predicted for weekly and daily basis.

1.2 Purpose:

The aim of this project undertaking is to provide assistance to the cafeteria owners so that they predict an accurate number of people visiting their restaurants and get insights into the data generated on a daily and weekly basis.

2 - PROCEDURE:

2.1 Existing Problem:

As discussed earlier the data shows that there has been tremendous misjudgment in the food production by the cafeteria. This is happening due to the inability to predict the right number of people visiting the cafeteria. Often it is difficult to predict the correct numbers because the footfall depends on a lot of factors, for example the presence of weekdays, weekends, holidays other than weekends, any famous public event etc. The need is to employ machine learning techniques to determine the correct numbers and present them to the restaurant owners in a presentable format (such as a dashboard) that can be easy to comprehend and gather inferences from.

2.2 Proposed Solution:

We present a desktop application and web interface to count the number of people entering and leaving the restaurants and present any data inferences via the web interface to the restaurant's owner.

Our solution can be staged as shown below:

A. Data is Paramount:

The number of parameters used and the extent of the correctness of the dataset might affect the accuracy of a machine-learning model.
To correctly extrapolate the footfall we employ machine learning algorithms. Unlike other ML models we do not incorporate a host of features, instead, we use two data points namely the date and number of

people visiting on that particular date. The data is collected over a longer duration of time to ensure that the model incorporates arbitrary holidays and other events that might result in a rush at the cafeteria.

B. Data pre-processing:

For footfall prediction, we replace the missing value with the average of the previous seven days. Even though it may not give the correct number, it is a close estimation to counter the missing data points.

C. Trained model:

We then train a time series model called FbProphet on the dataset. This model performs better than other similar models like ARIMA, AUTO-ARIMA or LSTMS, primarily because our model builds on trends, seasonalities, and regressors.It is essentially a function in the time domain that can incorporate holidays and events etc.

D. Real-Time Data Capture and Model Tuning:

A GUI is built in python which helps us capture daily counts of the people entering and leaving the cafeteria. The cafeteria inputs the IP address of the CCTV camera, using OpenCV and object detection we count the number of people visiting the restaurants this data is sent to the backend via an API post request every 24 hours and is appended in the original dataset.

This has two advantages:
1)The model is retrained with the latest dataset which helps in better prediction for the future.

2)Since each restaurant may have different footfall numbers this helps us dynamically build a dataset that will be specific to the particular cafeteria and in turn produce more accurate models which will work best for the given cafeteria.

The instruction to download the python desktop application is mentioned in the web app.

E. Web Interface to display data:

- We finally built a web application that will display these essential statistics and give useful predictions that the cafeteria owners can see. The dashboard is also responsible for displaying important statistics like expected revenue generated and the approximate amount of raw material required.

- The expected revenue is calculated by multiplying expected footfall with the price of the most sold/famous dish.

- Inventory management helps cafeteria owner stock up on the right amount of ingredients and raw materials. Ingredients and the quantity required for each food are added by the restaurant. We then help you predict the amount you may require to serve the footfall for the day.

F. Chatbot:

So much to work around, isn't it?

We understand the dilemma of our potential customers and hence we have a solution to this!

Chatbot powered by IBM Watson just makes things easier. Easy navigation will help these owners gain key insights into their cafeterias with just a few clicks. Chatbot helps you get the expected footfall, revenue, and raw materials required for the next day.

3 - EXPERIMENTAL INVESTIGATIONS:

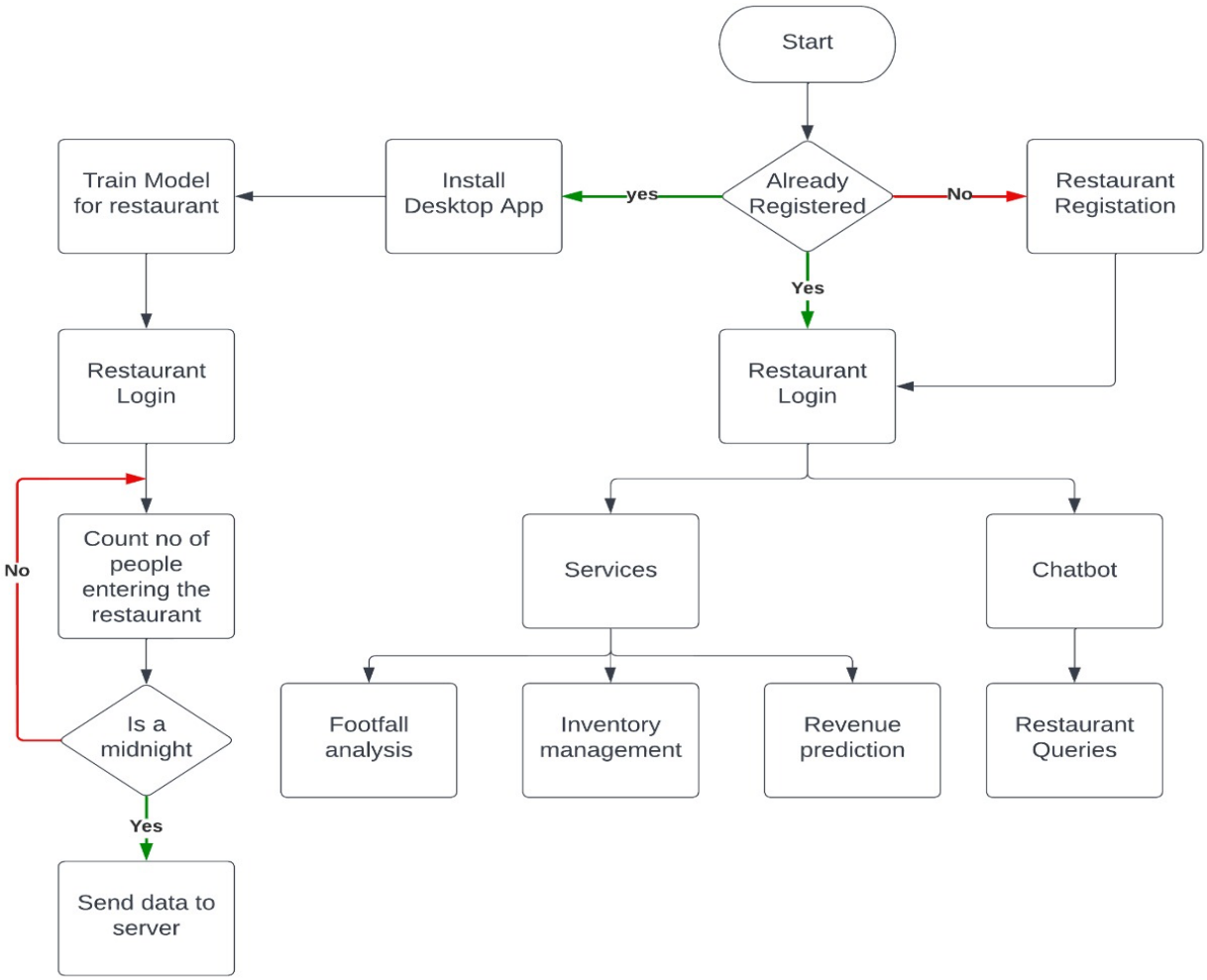
We gathered datasets from Kaggle to train the initial model.But realized that the huge dataset will not aid us in making the right predictions for restaurants of different sizes, locations and cities. So we went to various cafeterias to get an approx number of visitors for over a month. We used this data and appended it to the Kaggle dataset by removing roughly 50% of data from the original dataset. This way we increased the variety in the dataset.

The numbers sent from the GUI application are appended in an excel file which is updated daily and the model trained on this dataset will give a better result. The GUI application leverages openCV to count footfall. Hence, gradually the model so developed will give accurate predictions. This model will be different for different cafeterias owing to the variability of the dataset hence each cafeteria has its own CSV training file.

Finally, the react frontend of the web app along with the MongoDB+ backend work coherently to update and display important statistics to the restaurant owners.

4- FLOWCHART

Comprehensive working of the whole system.



5 - Technology Stack:

Frontend: ReactJs, NextJS
Backend: Flask, MongoDB

Desktop App: Python

Machine Learning: Python, SciKitLearn, Tensorflow,OpenCV

Key IBM Services:

- IBM Cloud Functions
- IBM Web Hooks
- IBM Watson Assistant
- IBM Watson Studio

6 - References:

1) Bharatpur, Abhilash Singh. (2022). A LITERATURE REVIEW ON TIME SERIES FORECASTING METHODS.

2) A. Sharma, J. Pathak, M. Prakash and J. N. Singh, "Object Detection using OpenCV and Python," 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), 2021, pp. 501-505, doi: 10.1109/ICAC3N53548.2021.9725638.

3) Zunic, Emir & Korjenić, Kemal & Hodžić, Kerim & Donko, Dzenana. (2020). Application of Facebook's Prophet Algorithm for Successful Sales Forecasting Based on Real-world Data. International Journal of Computer Science and Information Technology. 12. 10.5121/ijcsit.2020.12203.

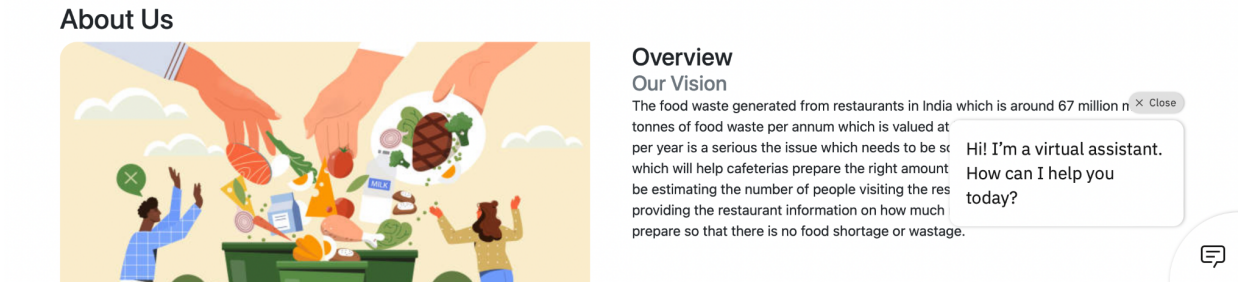
4) Qiao, Siyuan & Chen, Liang-Chieh & Yuille, Alan. (2020). DetectoRS: Detecting Objects with Recursive Feature Pyramid and Switchable Atrous Convolution.

5) Abdualgalil, Bilal & Abraham, Sajimon. (2020). Tourist Prediction Using Machine Learning Algorithms.

6) Ben Baccar, Yacine. (2019). Comparative Study on Time Series Forecasting Models. 10.13140/RG.2.2.32241.02408.

7 - RESULT

Landing Page:



Statistics for Footfall, Revenue and ingredients:

To produce good revenues and provide clients with ample food, estimations must be accurate. What if the estimate is incorrect? In which case the estimation is useless. If it is higher, whatever food is left will be ruined, resulting in money being squandered and having a negative social impact. Our proposed solution will tackle this issue by making accurate predictions and offering services to the restaurant which will curb food wastage .

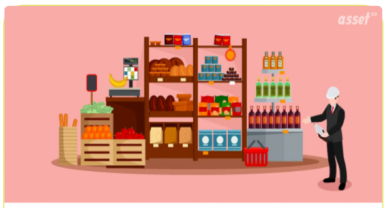
Services We Provide

Footfall Analysis

Analyzing your cafeteria footfall has never been so easy. Thanks to our powerful Machine Learning Model and analytical tools, we bring it to your fingertips.

Revenue Prediction

This tool can estimate the revenue of your cafeteria. It will help you to analyze your cafeteria's performance and to determine the feasibility of opening a new outlet.



Inventory Management

Our very special feature is the inventory management system. Update your menu online for the coming week and predict how much raw materials need to be purchased to meet the demand.

Expected Customers today

27

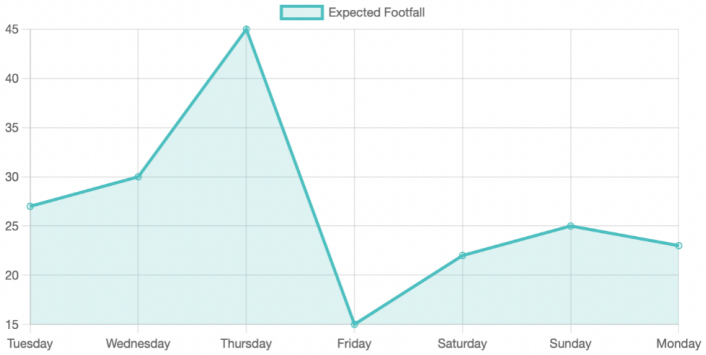
+12.5 % more than yesterday

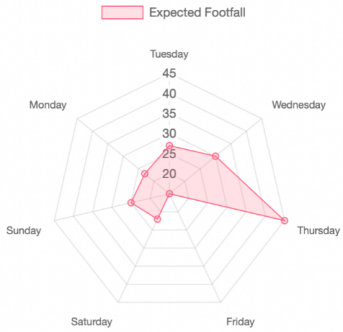
Expected Revenue today(₹)

1890

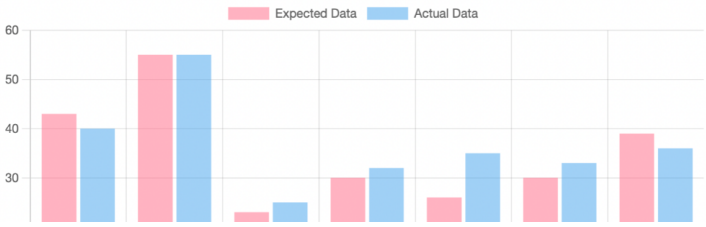
+96.88 % more than yesterday

Predicting Current Weeks Footfall





Past Week Predicted and Actual Footfall

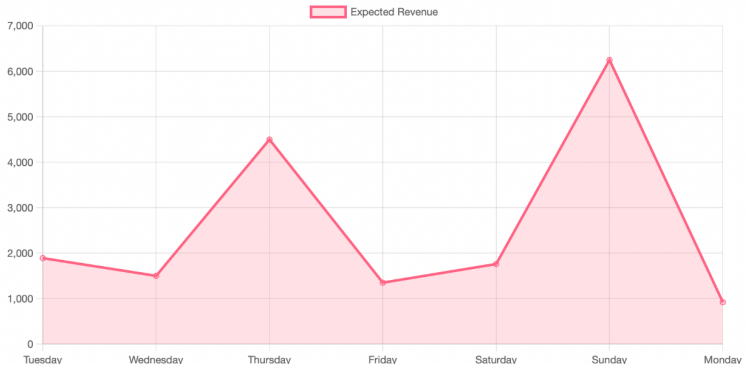


#	Day	Footfall Expected	Actual Footall
1	Tuesday	40	43
2	Wednesday	55	55
3	Thursday	25	23
4	Friday	32	30

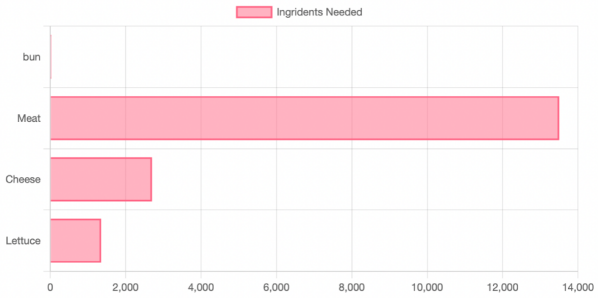
Expected Customers today
27
+12.5 % more than yesterday

Expected Revenue today(₹)
1890
+96.88 % more than yesterday

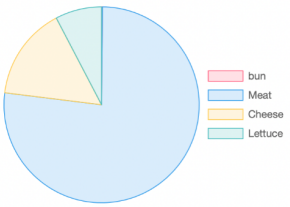
Predicting Current Weeks Revenue



Ingredients Required Today



Ingredients Quantity Comparision



Note: All Ingredients mentioned here are measured in ml/gm.

Ingredients

#	Ingredient Name	Quantity Expected (ml/gm)
1	Bun	27
2	Meat	13500
3	Cheese	2700

Steps to download Desktop Application:

Steps to Follow

Link Account

Create an account and copy your restaurant id

Copy Id

Download

Download the software and run the .exe file

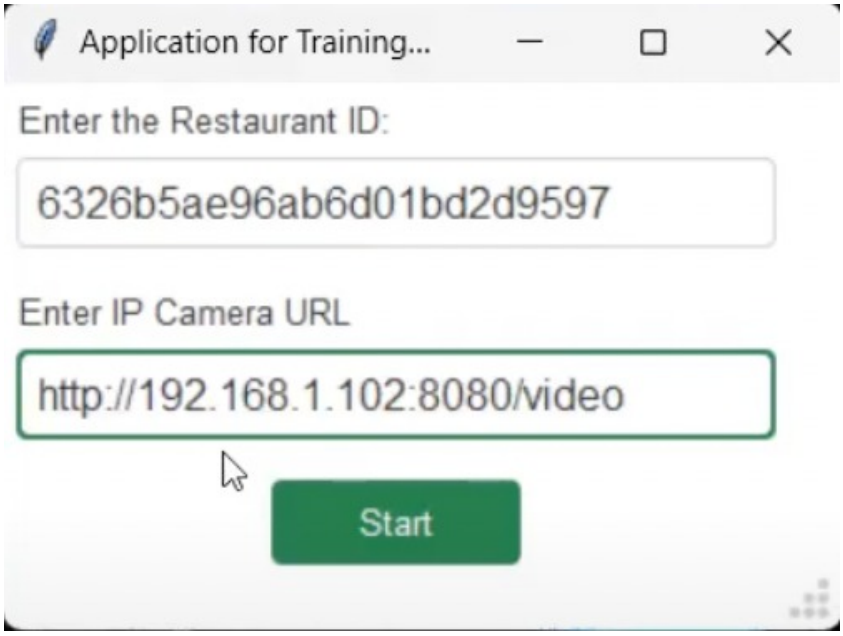
Download

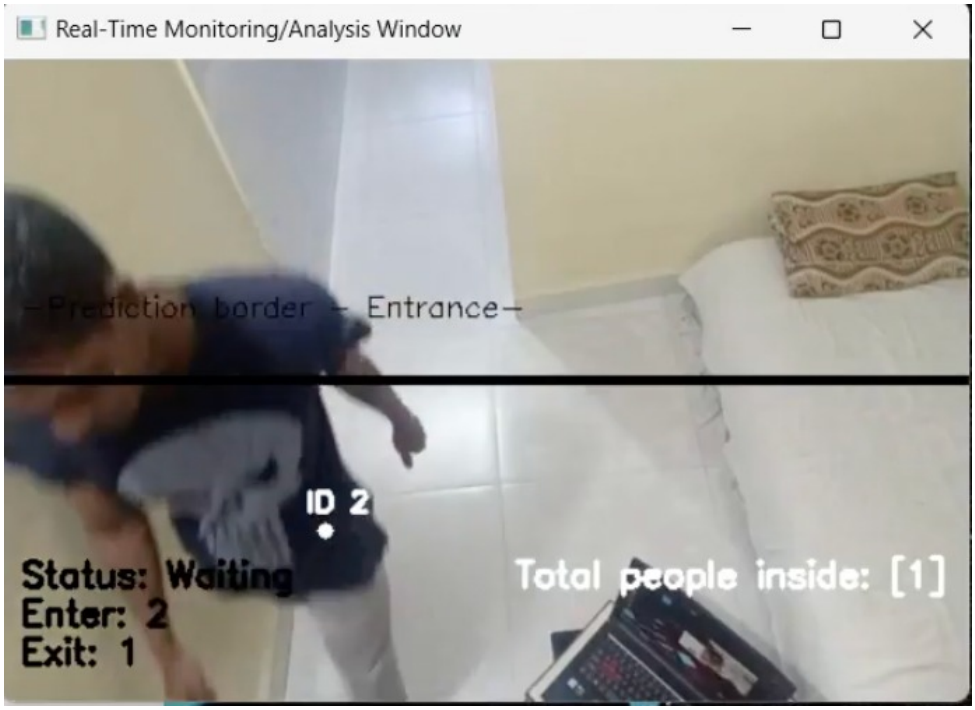
Connect to your IP camera

Enter your IP camera's details and restaurant ID

Note: Recommended to run for at least 3 months to get accurate predictions. If any interruptions in software runtime it can be resumed from that checkpoint.

GUI of the desktop application to count visitors




Real-Time Monitoring/Analysis Window
Prediction border
Entrance
ID 2
Status: Waiting
Enter: 2
Exit: 1
Total people inside: [1]