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APPLICATION FOR HIGH-QUALITY PRODUCED CROP PRICE FORECASTING THROUGH DEEP AND MACHINE LEARNING

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ABSTRACT

Agriculture is India's backbone. It is a key sector of the Indian economy, contributing roughly 17% of the country's overall GDP and employing over 60% of the population. We can use technology to improve product production in a variety of ways, but in the end, a farmer can only benefit if he makes money selling his crops. The Indian government has passed three legislations to promote agricultural produce trade throughout the country. Today, however, we can see farmers across the country battling for their rights against these rules. Farmers fear that they will be used as puppets by major retailers, and that their products would be sold at a reduced price. After analyzing the situation, we came up with the idea of developing an agricultural produce application that predicts the price of agricultural produce based on the quantity produced and previous years' sales rates, allows farmers to interact directly with retailers, and allows for product review and crop yielding rate prediction.

Keywords: KNN, GPS Navigation, Decision Tree, Regression Algorithm.

I. INTRODUCTION

A robust market is required for agriculture produced in our country. Farmers have a difficult time selling their products to clients. Farmers in India have had little choice in markets and customers for their produce for many years. Except for three states, all states require that farm produce be sold and marketed through state-owned mandis, retail markets where intermediaries pressure farmers to increase margins. Crop Cost Prediction, Language Translator, Sorting based on Geographical proximity for the farmer/customer , customizing the app for that particular farmer's crop and profit etc, using the Machine Learning, Deep Learning Algorithms - for Price Prediction and other techniques such as - GPS Navigation, KNN ,Haversine, nearest neighbour search, load balancing, Market analysis and few APIs for Geographical proximity etc would make this application an excellent crop selling tool for farmers with good profits completely eliminating the mediators and the middlemen. An E-commerce application for the farmers with all the requirements by which a farmer can sell the products, get to know about products profits and cost and can interact with the customers directly by being in the safety of home. By this application the farmers can interact with customers in their native language and also use the application without having much knowledge about technologies and mobiles etc.

II. RELATED WORK

In [1], the system is offering a platform at the government level, such as an android app and a website app, where farmers may sell their crop products at various layers of the marketing chain (market, merchant, or end user) with several alternatives. Farmers may use the platform to find out about nearby marketplaces, current stock levels, and demand for specific products in less time and with less effort. The web-based program will include information such as market details, merchant lists, farmer lists, end-user lists, and complaints lists, among other things. This will result in improved government management.

In [2], the focus of this research is on machine learning techniques for forecasting crop price using the support vector regression algorithm. Regression is a data mining methodology in which learning is used to calculate the crop price. Classification tasks and tasks with specific class labels will be considered for regression tasks. The crop price is computed by recognising our training dataset's patterns, which is provided as one of the Algorithm's inputs. The user enters the parameter input values (Yield, Rainfall, Minimum Support Price, and

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Wholesale Price Index) into the algorithm. Probability, New Record Input, and the number of Dataset Parameters are the other parameters in the Algorithm.

In [3], they propose that farmers be protected from diminishing returns by increasing rice yield and through crop rotation. In order to maximise sales profit under the assumption of irrigation, this study used predictive data analysis to anticipate the selling prices of agricultural output suited for planting in addition to rice. The pricing data for six different alternative crop types grown in settings of limited resources—turnips, muskmelons, kailan, peanuts, cantaloupes, and water mimosas—were used in this study's monthly time series analysis of Hom Pathum rice. Least Square Method, Moving Average Method (3 months, 5 months, 7 months), Single Exponential Method, Double Exponential Method, and Winters' Method were used to analyse sixty-month sale data of Hom Pathum Rice and six alternative crops. To evaluate the effectiveness of predictions, the Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD), and Mean Square Deviation were utilised (MSD). Then, for 12 case studies, the appropriate prediction approach was applied to predict the selling prices of rotation crops and rice for three different situations. They discovered Case Study 6 produced the highest level of profit (percent increase when compared with a traditional method).

In [4], Understanding the structure of both languages is required to convert an English text into Telugu using a rule based translation system. The structure and grammar of both languages influence the translation process. One of the most difficult aspects is dealing with prepositions. In Telugu, prepositions will be interpreted as postpositions. The purpose of this paper is to choose the proper postposition, create the prepositional phrase, and translate the supplied text from English to Telugu.

In [5], A natural foundation for modelling and analysing client interactions with E-Commerce search engines is customer interaction networks (CINs). The submission of a query based on an initial product intent kicks off customer interactions, and then progresses through a series of activities for product engagement and inquiry reformulation. The amount of time a consumer spends with a product (e.g. clicks) reflects how relevant it is to their needs. Dissatisfaction with current outcomes or a change in the customer's product purpose signal reformulation to a new inquiry. We can uncover multiple query-query and query-product correlations by analysing such interactions inside and between sessions. The features of CINs developed using Walmart.com's product search records are the focus of this work. They show in their article that the features of CINs allow them to my purpose links between inquiries only depending on the structural data they contain. The paper demonstrates how these relationships can be used to a) cluster inquiries based on purposes, b) improve the quality of searches for under performing queries, and c) Find the most influential (also known as "important") searches whose results have the biggest influence on the results of subsequent queries.

Predicting product prices is critical for selling items. The paper[6] uses two studies to forecast the product price: qualitative techniques and quantitative techniques. Qualitative cost assessment strategies are generally based on comparing a new product to prior goods in order to find similarities in the new one. The commonalities found aid in incorporating previous data into the new product, reducing the requirement to generate a cost estimate from start. Quantitative procedures, on the other hand, are based on a thorough examination of a product's design, characteristics, and production processes rather than merely relying on prior data or an estimator's knowledge. Costs are thus estimated either as the total of elementary units reflecting distinct resources utilised during a product's whole manufacturing cycle or as an analytical function of specific variables representing different product attributes. For cost prediction, the paper uses intuitive and analogical methodologies for qualitative analysis. Case-Based Methodology and Decision Support Systems (DSS) are examples of intuitive cost estimation techniques. Regression Analysis Models and Backpropagation Neural-Network (BPNN) Models are examples of analogous methodologies. Quantitative Analysis of Cost Prediction is accomplished using parametric and analytical cost estimation techniques.

The suggested paper[7] employs a Real-Time Search Engine to help users identify the best products from among India's many ecommerce websites. It will save time and money by eliminating manual filtering and providing a better shopping experience for customers. It will also assist ecommerce businesses in identifying price problems on their websites and providing better customer support. To maximise productivity, the system employs extremely efficient and targeted dynamic web crawlers that filter products at the first level using a specified set of parameters built into the system. The scraped products will go through the Product Rank

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Algorithm, which will rank each product accordingly. During these stages, the filtration process will be extremely strict, resulting in the availability of the best items for clients. The system works similarly to any other existing ecommerce system in that consumers search for products and receive them on the screen in a matter of seconds. Highly targeted web crawlers will perform web scraping and begin the filtration process as soon as a user inputs the search parameters.

[8] An application has been presented by Niket Chauhan, M. Krishnakanth, G. Praneeth Kumar, Prerna Jotwani, Utkarsh Tandon, Abhishek Gosh, Nishant Garg, and Santhi V to maximise profit for farmers. Their solution comprises a mobile application that will act as a marketplace for producers, retailers, and customers to sell and buy farm products. Their strategy strives to provide farmers with a profitable price for their farm products by eliminating intermediaries. This allows businesses or customers to purchase items from farmers at a lesser cost than usual. Crop Shop is an Android application that combines technologies and concepts to assist farmers maximise profit. It can aid farmers and buyers in such a way that neither of them has to compromise by limiting the participation of middlemen and establishing a 'trust element' in their app. In addition to these characteristics, farmers can post advertisements for their goods and use barcodes to create a systematic check-out method when delivering the commodities to the buyer. The inclusion of a trust component in their suggested system aids in the development of a consumer-vendor relationship. The farmer must simply register with the application and provide information on his or her crops. Customers can also access this information using our application. Customers can search for the crop they want and order it at the greatest price.

III. METHODOLOGY

3.1 Data Collection

The practice of acquiring and analysing data from a variety of sources is known as data collection. In order to leverage data to create workable artificial intelligence (AI) and machine learning solutions, the data must be gathered and maintained in a format that makes sense for the business challenge at hand. The real time data is collected from the Government Websites and Offices of Food and Agriculture development.

3.2 Data Augmentation

Data augmentation is a group of methods for generating extra data points from already-existing data to fictitiously increase the volume of data. Examples of this include using deep learning models to generate more data points or making little modifications to the data Data augmentation can enhance the performance and outcomes of machine learning models by adding new and diverse examples to training datasets. When the dataset is large and sufficient, a machine learning model performs better and more accurately. For machine learning models, data gathering and labelling can be time-consuming and expensive. By changing datasets using data augmentation techniques, businesses can reduce these operational costs.

3.3 Training

The proposed work has the data of different features. The data is trained using different algorithms to understand the working of these algorithms. To train a model is to simply take labelled samples and learn (determine) good values for all the weights and the bias.

3.4 Visualization

We can observe how the data appears and what sort of correlation the properties of data hold with the help of data visualisation. It's the quickest approach to check if the features match the output. Confusion Matrix is used to visualize the accuracy. This work interprets the model by generating a heat map to visualize the data.

3.5 Testing and Accuracy

The models are tested and their respective accuracies are calculated. The models are also tested with the real-time data collected and thus validated the performance of the models

Fig. 3.1 Block diagram of proposed system

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Crop Price Prediction

Crop Price Prediction is useful to get the prices of the Products in the application dynamically. It can be done by training a model to get the accurate price for the crop according to the market prices.

Prices can be calculated using Min – Max Models (provided in the dataset of the government website). Here three algorithms are considered and compared. The best suitable algorithm for the price prediction will be used for the application.

Linear Regression

A supervised learning machine learning algorithm is linear regression. It performs a regression operation. Regression creates a value for the goal prediction based on independent factors. It is generally used for forecasting and figuring out how variables are related to one another. The kind of relationship that is assessed between the dependent and independent variables, as well as the number of independent variables used, vary between different regression models.

Decision Tree

The decision tree is the most effective and popular categorization and prediction tool. Each leaf node (terminal node) carries a class label, whereas each internal node symbolises a test on an attribute, each branch a test result.

Random Forest Classifier

A well-known machine learning algorithm called Random Forest makes use of supervised learning strategies. It can be used in machine learning for both classification and regression problems. It is based on ensemble learning, a technique for combining several classifiers to tackle a challenging problem and improve the performance of the model. "Random Forest is a classifier that contains a number of decision trees on various subsets of a given dataset and takes the average to enhance the predicted accuracy of that dataset," according to the name. The random forest gathers the predictions from each decision tree and predicts the ultimate result based on the majority votes of predictions, as opposed to depending just on one decision tree.

Neural Networks

An artificial intelligence technique called a neural network trains computers to process information in a manner similar to that of the human brain. Deep learning is a kind of machine learning process that uses networked nodes or neurons arranged in a layered structure to mimic the structure of the human brain. Computers can use this adaptive system to learn from their errors and keep getting better. Artificial neural networks thus aim to provide more accurate solutions to complex problems. In this scenario, I have used the Sequential model from the keras library to train the pre-processed data.

IV. DATASET DESCRIPTION

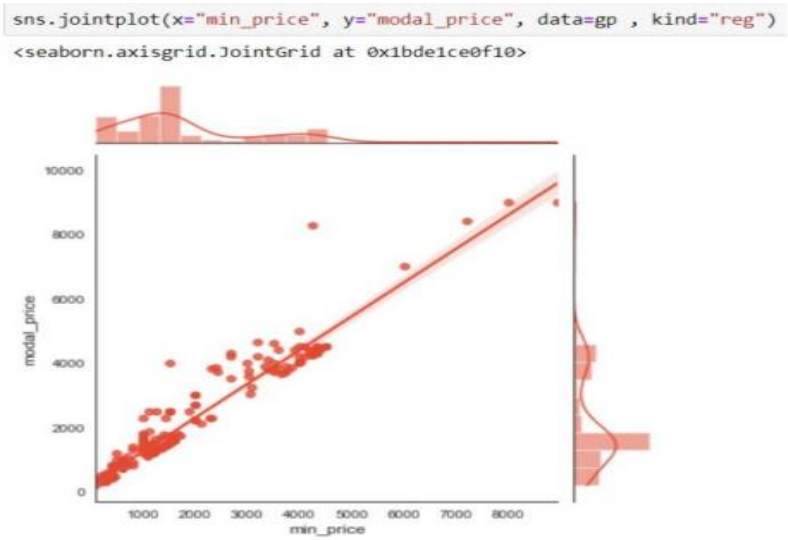

Fig. 4.1. Min Price vs Modal Price Comparison

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The Dataset is collected from the Government Website of Telangana with valid fields and it is trained well also using data obtained from online. The dataset gives the information about various crops produced in the districts of the Telangana state with the Minimum, Maximum and Modal prices of the crops that were sold per quintal.

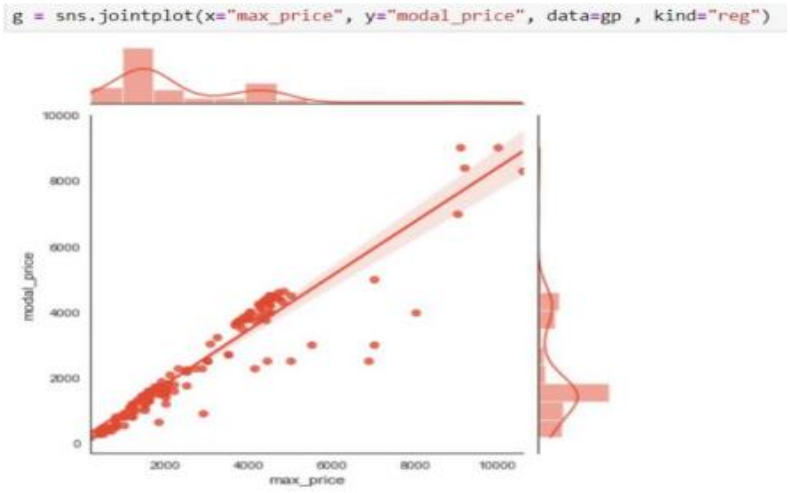

Fig. 4.2. Max Price vs Modal Price Comparison

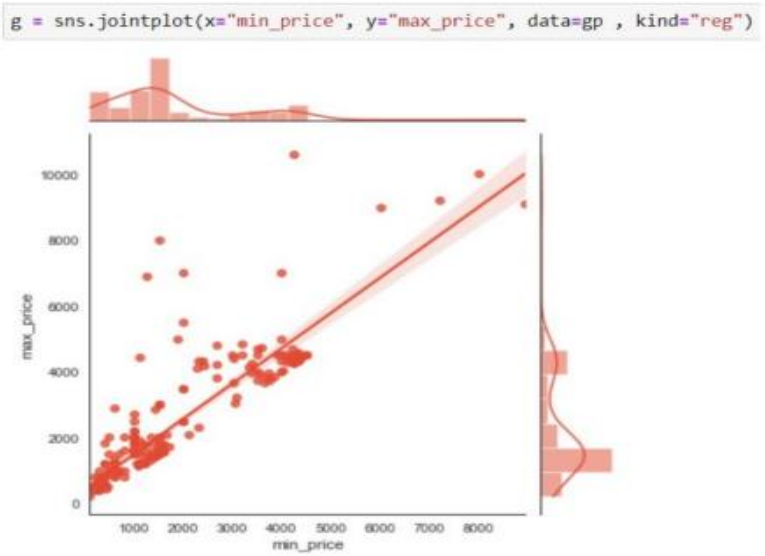

Fig. 4.3. Min Price vs Max Price Comparison

V. RESULTS AND COMPARISON OF ALGORITHMS FOR CROP PRICE PREDICTION

5.1 Minimum Price Comparison of Algorithms for Crop Price Prediction

Model	Accuracy
Linear Regression	0.65022
Decision Tree Classifier	0.77214
Random Forest Classifier	0.95112
Neural Network	0.98573

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5.2 Maximum Price Comparison of Algorithms for Crop Price Prediction

Model	Accuracy
Linear Regression	0.66875
Decision Tree Classifier	0.78149
Random Forest Classifier	0.96973
Neural Network	0.98624

VI. PROPOSED APPLICATION AND ITS FUNCTIONALITY

The proposed process flow architecture will be used to address the issue. The application which will be named "Agrotrades" either connects the farmers directly to the customers or it buys the produce from the farmers and puts them in the godowns as per the orders and requests sent by the customers. Agrotrades also keeps a security check for the kind and quality of the item considering its type and the date from which the crop had been harvested and assigns the price; where the base considerations are the MIN, MAX and MODAL price set by the government. For evaluating the crop quality from the date of harvesting, different regression algorithms specific to different crop produce will be used. The different parts of the system architecture are:

(i) Farmer (seller) side Functionality: Once a user starts their registration process, details of whether the user is a purchaser or seller are collected and if the user is a seller (farmer), once they login they can select the category of the product(fruits, commercial, grains, dairy etc); upload and edit the details of the crop they are going to sell such as crop name, type, quantity, quality and few pictures and videos of the same. The farmer can also view the details of the crops which are on demand to plan his next crop accordingly. He will also be able to view the detailed analysis of profits he had procured and which crop gave him the most profit. When a customer places an order for a particular item, Quality check is done by Agrotrades considering the type of produce and also the date of harvesting. Once the price is assigned, the farmer can sell it if he/she is satisfied. The farmer can either directly connect to the customer or can sell via AgroTrades. Figure 6.1 demonstrates the procedure for Farmer side Functionality.

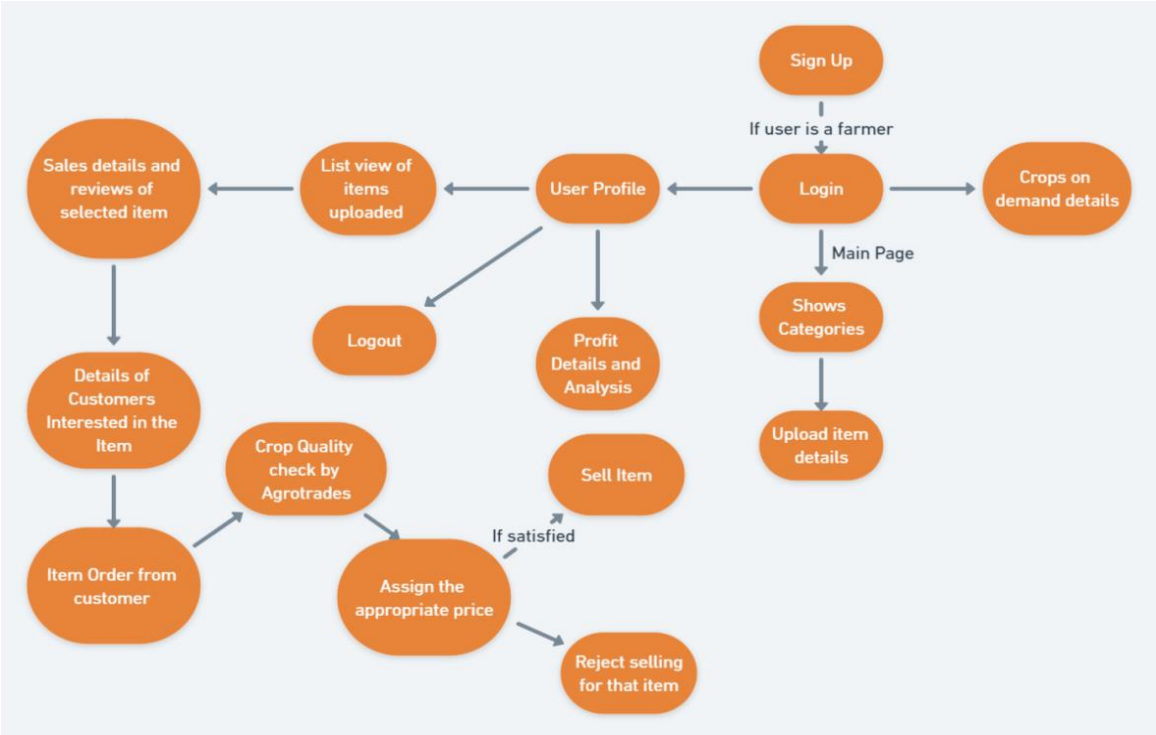

Fig 6.1

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(ii) Purchaser side Functionality : If the user is a purchaser, as he signs up and logs in, he will be asked to select the category(fruits, commercial, grains, dairy etc) and then he will be asked to choose how much quantity is required for him :

- Huge (In 100s or 1000s of quintals)
- Huge to Medium (1 to 100 quintals)
- Medium (50kg to 100kg)
- Small (Less than 50kg)

If the customer is not very clear about the product he wants he can also search and select the product using the search bar. He can view the complete details of the crop along with the farmer. If the quantity requested is available from one farmer and also if they can arrange for the transport, customers can connect with the farmers directly. If the requested quantity by the customer is too huge and not available just at one farmer or if the transportation is not available; they can order via Agrotrades and get the delivery of the produce. If the customer cancels the order of any item he/she requested; cancellation fee will be applicable. The customers can rate the produce, farmer; and can also write the reviews of the product they received which would intern be helpful for the farmer to review about his product. Figure 6.2 demonstrates the functionality of the purchaser side.

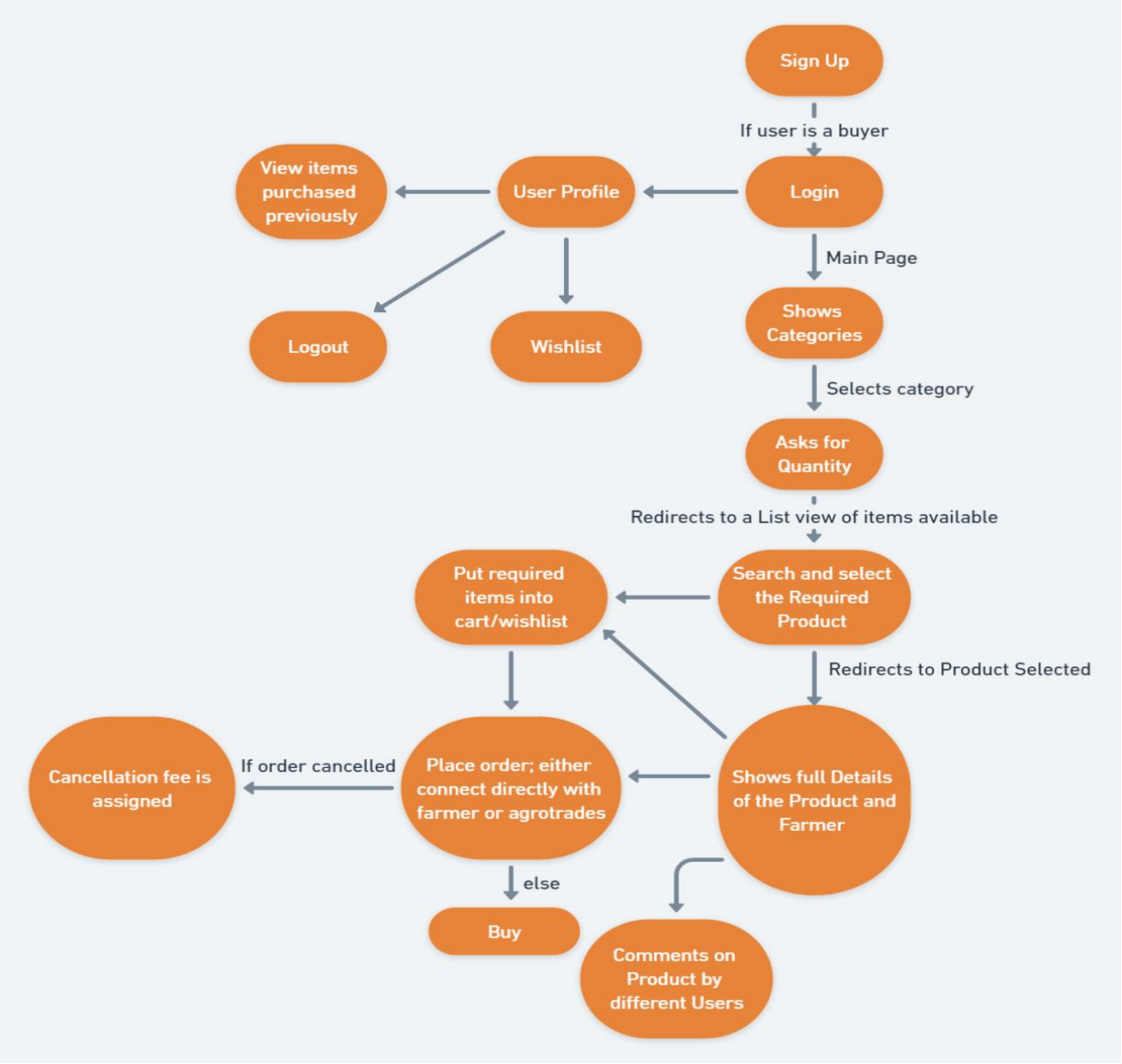

Fig 6.2

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(iii) Agro Trades Functionality: This functionality is only applicable for the staff of Agrotrades. They can view all the Customer Order Requests for respective products and check for the Quality. If the crop is freshly harvested and the quality is upto the mark; the MIN, MAX and MODAL price assigned by the government is taken into consideration and based on the demand for the crop, the respective price for the crop is assigned. If the crop is not freshly harvested, and it's quality isn't as expected, then using different regression algorithms for that particular crop, agrotrades assigns a generous price to the farmer. If the farmer agrees to sell for that assigned price, agrotrades connects him to the customer either directly or through agrotrades. If both the customer and farmer opt for connecting directly their details are shared to each other. If not, agrotrades buys the produce from farmers and sends them to the respective Godown and from there, the item is distributed to the customers. No staples will be put in godowns, as the crop may get deteriorated. Therefore, the produce would be taken to the godowns only upon the order request of the customer. Each district of Telangana would be having one main godown and every mandal of that district would be having its separate godown. This way the delivery process would be less tedious and would not require extra manual effort. Also, farmers will have a rating based on cooperativeness with the agent of AgroTrades, and high rating means reliable farmer; low rating can put them in suspicious and fraudulent requests. Figure 6.3 demonstrates the functionality of staff view.

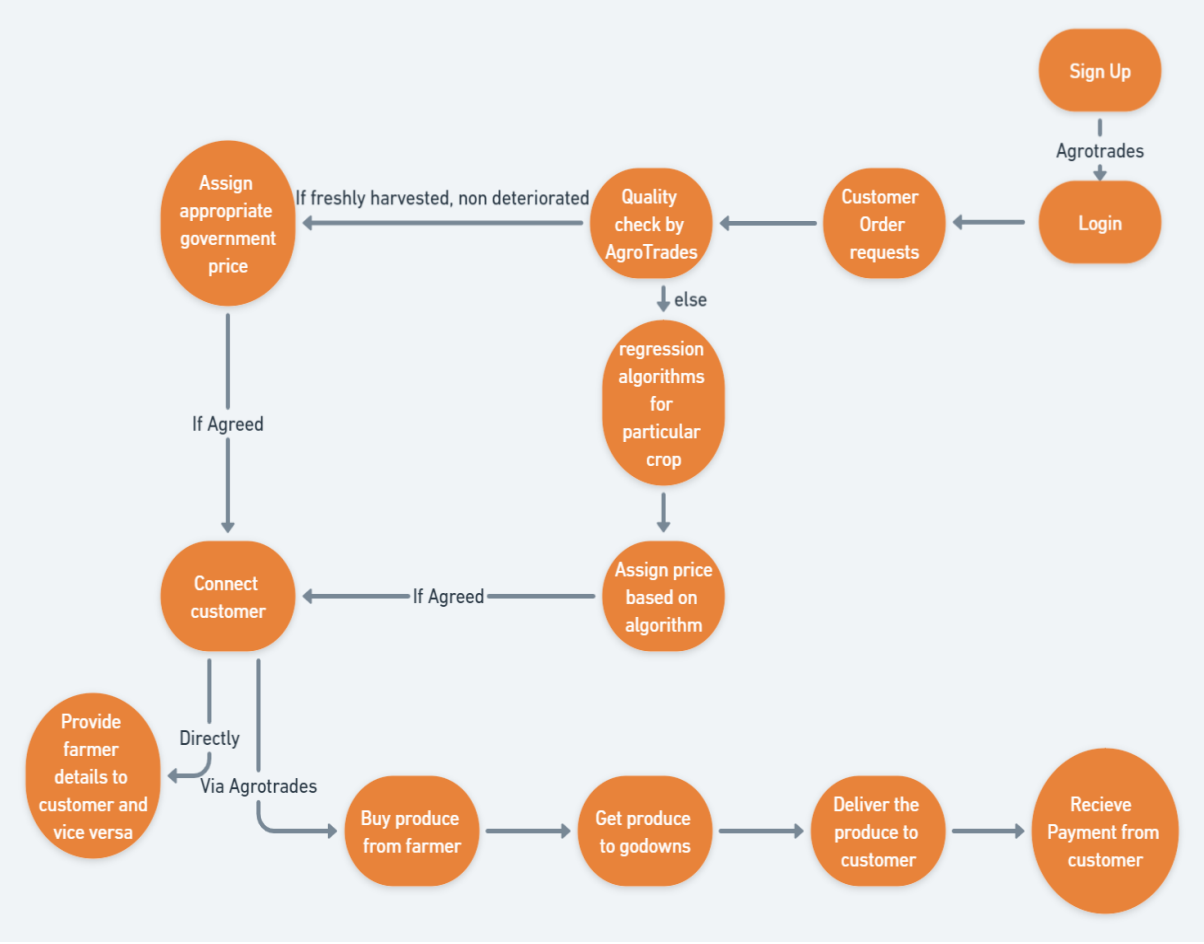

Fig 6.3

(iv) Admin Functionality: This functionality is only applicable for the admin of Agro Trades. Once the admin signs up and logins, he/she can edit and delete posts, pages or comments. The admin can create new users and sites; block the user and delete or update the uploaded data. Basically, the admin functionality consists of all the typical jobs that an admin needs to do. Figure 4 demonstrates the functionality of the admin side.

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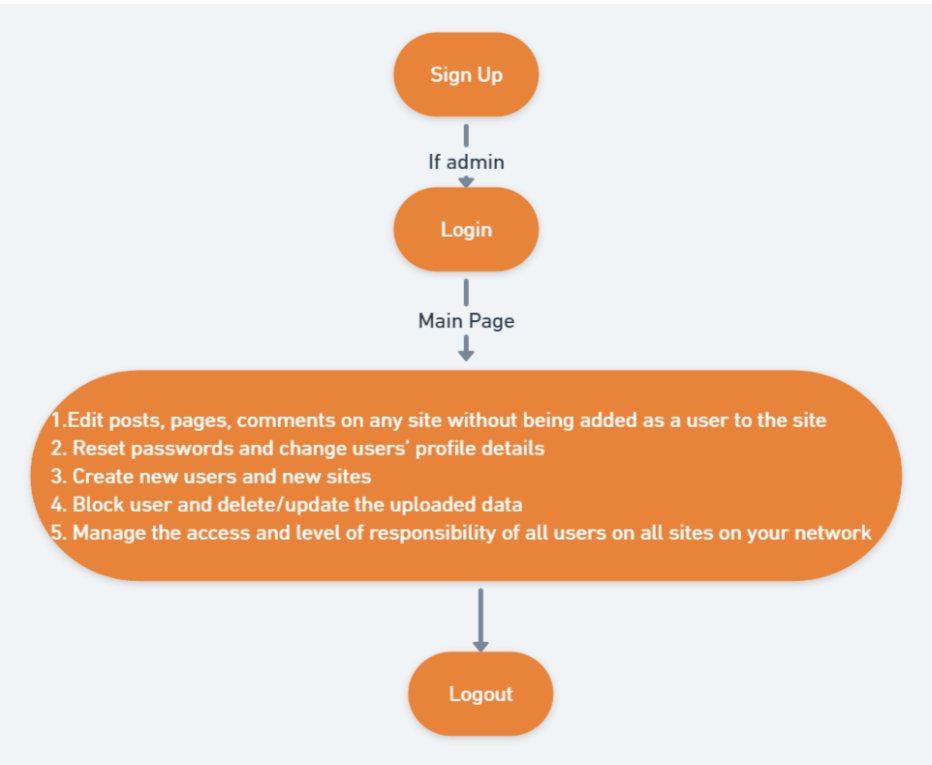

Fig 6.4

VII. CONCLUSION

Hereby we conclude that the application helps farmers to grow economically and provides them with personalised data with statistics of their products. The application reduces manual work, makes it easy for the farmer to sell his products and gives him the insights of the market trends and his profits. The Application uses the deep learning algorithm to predict crop-price which helps farmers in many ways.

Appendix

Group Contribution Statement

A. Tejaswini Jakka

- Project Proposal
- Designed the AgroTrades Application
- Dataset procurement
- Literature Survey of existing methods
- Implemented the Machine Learning and Deep Learning Algorithms for Crop Price Prediction
- Developed the AgroTrades application using Django
- Performed Price Trend Analysis for a variety of commodities for different districts of Telangana
- Analysed Max vs Modal vs Min crop price comparison
- Final project writeup

B. Prajwal Ganugula

- Designed the AgroTrades Application
- Literature Survey of existing methods
- Dataset procurement
- Data cleaning, organizing and pre processing
- Analysis of crop prediction outcomes

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VIII. FUTURE WORK

1. The Proposed system and application runs only in the web which can be developed using mobile
2. As of now, this application is only limited to the Indian state of Telangana. Therefore, in the future I hope to expand it to all the users of India and eventually to global users.
3. Banking and payment transactions to be done within the application
4. Transportation facility for the product from "AgroTrades".

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