A Major Project Final Report On

Online Auctions for Second-Hand Items with Price Prediction

[**Subject Code: CMP-490**]

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Project Work for the Degree of Bachelor in Engineering in Computer Engineering

"Online Auctions For Second-Hand Items With Price Prediction"

Supervised by Er. Mod Nath Acharya

A project work submitted in partial fulfillment of the requirements for the degree of Bachelor of Engineering in Computer Engineering

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August, 2023

Dedication

We want to dedicate this report to our lovable as well as respected parents for believing in us since the beginning and also to our late friend **Binit Ghimire,** who was always there to guide and give his ideas on project development. He was our group members to the previous and this current project. Likewise, we want to dedicate this report to our supervisor and lecturers for their continuous response towards us.

Declaration

I hereby declare that this study entitled **"Online Auctions for Second-Hand Items with Price Prediction"** is based on our original work. Related works on the topic by other researchers have been duly acknowledged. We owe all the liabilities relating to the accuracy and authenticity of the data and any other information included hereunder.

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Recommendation

This is to certify that this project work entitled **"Online Auctions for Second-Hand Items with Price Prediction",** prepared and submitted by **Amit Baral, Narayan Pokhrel, Pratima Bhandari, Sailesh Gurung** in partial fulfillment of the requirements of the degree of Bachelor of Engineering (BE) in Computer Engineering awarded by Pokhara University, has been completed under our supervision. We recommend the same for acceptance by Pokhara University.

Signature

Name of the Supervisor: Er. Mod Nath Acharya

Organization: United Technical College

Date: 2023/08/27

Certificate

This project entitled **"Online Auctions for Second-Hand Items with Price Prediction"** prepared and submitted by **Amit Baral, Narayan Pokhrel, Pratima Bhandari, Sailesh Gurung** has been examined by us and is accepted for the award of the degree of Bachelor of Engineering (BE) in Computer Engineering by Pokhara University.

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Abstract

This project focuses on the design and development of an online auction system dedicated to second-hand items. By utilizing machine learning techniques, the system predicts the present worth price of these items, serving as the starting point for bidding in the auction. Through data analysis and predictive modeling, the system aims to ensure fairness and transparency in the bidding process, providing buyers with an opportunity to bid on second-hand items while allowing sellers to receive a reasonable price.

The integration of price prediction models into the online auction system allows sellers to effortlessly upload item details and images, with the system suggesting a base price for bidding. Buyers can explore the platform, browse available items, and engage in competitive bidding. Time limits and bid notifications enhance the excitement of the auction environment. By offering a user-friendly interface and incorporating advanced machine learning techniques, this project strives to create a dynamic marketplace for second-hand items, catering to the needs of both buyers and sellers.

Key Words: *Online Auction System, Second-hand Products, Machine Learning Algorithms, Feature Extraction, Bidding, User Interface*

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Abbreviations

Abbreviation	Definition
CNG	Compressed Natural Gas
CSS	Cascading Style Sheet
DFD	Data Flow Diagram
GUI	Graphical User Interfaces
HDMA	Hybrid Auction Model
HTML	HyperText Markup Language
JS	JavaScript
MATLAB	Matrix laboratory
ML	Machine Learning
OLX	On Line eXchange.
QA	Quality Assurance
SDLC	Software Development Life Cycle
UT	Unit Testing

Chapter 1: Introduction

1.1. Background

The rapid growth of e-commerce, particularly online auctions, has transformed the way businesses and individuals engage in transactions on the Internet. The online auction market has emerged as a significant player, with projections suggesting that by 2005, online exchanges will account for 25 percent of all business transactions. Notably, global online auction giant eBay boasted 135 million registered users and hosted 1.4 billion auction items on its platform by the end of 2004. This flourishing global online auction market has also had a profound impact on China, where the online auction business has experienced rapid growth. With market size estimated to reach 21 billion Yuan and an annual average growth rate of 84 percent, the Chinese online auction market is poised for substantial expansion [1].

Online auctions are exchange mechanism for determining prices of items in the Internet. They connect buyers and sellers together in ways that were impossible previously. Recent years have witnessed the rapid development of online shopping and ecommerce websites, e.g., eBay and OLX. They are offering its users a convenient way of buying and selling goods. Online shopping markets offer millions of products for sale each day. These products are categorized into many product categories. It is crucial for sellers to correctly estimate the price of the second-hand item. State-of-the-art methods can predict the price of only one item category. In addition, none of the existing methods utilized the price range of a given second-hand item in the prediction task, as there are several advertisements for the same product at different prices [1].

The main purpose of the project is to provide a platform that connects buyers and sellers, allowing them to determine fair prices for second-hand items. The buyer and seller will be connected with a UI where they will be engaged in trading the second-hand products with including our system to predict the present worth of the product based on the features like the time period the product is used and other factors that basically impact the selling price and provide valuable information to both buyers and sellers, ultimately promoting fairness and efficiency in online auctions [1].

1.2. Problem of Statement

The problem statement for this project revolves around the limitations and challenges associated with existing online auction systems for second-hand items. Firstly, these systems often lack transparency and fairness. Buyers may struggle to determine the true value of items, as the seller can list these items on his desire with no valid pricing leading to potential issues such as overpaying or buyer dissatisfaction. Sellers, on the other hand, may find it challenging to attract buyers or negotiate fair prices for their products. The lack of transparency and accurate pricing mechanisms hinders the smooth functioning of online auctions for second-hand items [2].

Secondly, for more than two years, online auction fraud has been the number one complaint of New York state residents to government organizations that keep track. The WebWatch survey shows that 27 percent of state residents who have ever used an online auction Web site, such as eBay or Amazon, have experienced a scam or deceptive practice 32 percent of eBay users were scammed [2].

Eleven percent of online auction site users reported they never received the goods they bid on, the most common complaint. In addition, seven percent of survey respondents who received their goods said they were not in the condition they expected. Other common complaints included not being told a key detail about the item before it arrived (7 percent) and being sent an item of lesser value than the one they actually bid on and won (7 percent) [2].

To overcome these challenges, it is essential to design and develop an advanced online auction system that provides transparency, fairness, and accurate pricing for second-hand items. By incorporating machine learning algorithms and leveraging data analysis techniques, the project aims to predict item prices. This solution will empower buyers to make informed bidding decisions and enable sellers to set reasonable pricing as a result of accurate prediction of our ML algorithms [2].

1.3. Research Questions and Hypothesis

1. Can the integration of machine learning-based price prediction models into an online auction system for second-hand items enhance fairness and overall user satisfaction in the bidding process?

This hypothesis question aims to investigate the potential impact of incorporating machine

learning techniques in predicting the present worth price of second-hand items. The question implies that by utilizing these predictive models, the online auction system will provide a fair starting point for bidding, leading to increased transparency and ultimately improving user satisfaction. The hypothesis seeks to examine whether the integration of price prediction models can enhance the overall auction experience for both buyers and sellers, contributing to a dynamic marketplace for second-hand items.

1.4. Objectives

The objectives of doing this project are listed below:

1. To develop an accurate price prediction model.
2. To enhance fairness and transparency in the bidding process.
3. To create a user-friendly and dynamic auction platform.

Overall project aims to make use of different machine learning algorithms, so that the system will accurately estimate item prices, promoting fair bidding. The platform will offer a user-friendly interface for sellers to upload items and for buyers to browse and bid. With features like time limits and bid notifications, the dynamic platform will create an engaging auction experience. The project intends to revolutionize the second-hand market by providing accurate pricing, fairness and user satisfaction.

1.5. Project Scope and Applications

1. Dedicated Second-Hand Marketplaces: The system can be implemented as a standalone platform catering specifically to second-hand items, providing a focused and efficient auction experience for buyers and sellers.

2. E-commerce Giants: Integrating the online auction system into established e-commerce platforms, such as Amazon or eBay, would enhance their offerings by adding a dedicated auction section for second-hand items. This integration would attract more users and diversify their product range.

3. Niche Collectibles Platforms: Niche platforms specializing in collectibles, antiques, or vintage items can leverage the online auction system to create a vibrant marketplace. The system's accurate price predictions and transparent bidding process would be especially beneficial in these specialized markets.

4. Peer-to-Peer Marketplaces: Platforms like Craigslist or Facebook Marketplace could integrate the online auction system to enable users to sell second-hand items through auctions. This integration would facilitate fair pricing and efficient transactions for individual sellers.

1.6. Limitations and Challenges

1. Limited Availability of High-Quality Data: The availability of a diverse and high-quality dataset is crucial for training accurate machine learning models. Insufficient data can hinder the ability to build robust price prediction models and may impact the accuracy of the system.
2. Complex and Evolving Market Dynamics: The second-hand market is dynamic and influenced by various factors, including supply and demand fluctuations, economic conditions, and evolving consumer preferences. Building a system that can effectively adapt to these market dynamics and provide accurate price predictions in real-time can be a significant challenge. Ensuring the system remains up-to-date and responsive to market changes requires continuous monitoring and adjustment.
3. User Adoption and Trust: Convincing users to adopt a new online auction platform and trust the accuracy of machine learning-based price predictions can be a hurdle. Users may be accustomed to traditional bidding methods or skeptical about relying solely on algorithmic predictions.

Chapter 2: Literature Review

2.1. Introduction

The literature review section of this report primarily focuses on the observations of many research papers and systems made on similar titles. A lot of effort has been put into studying the number of research papers regarding data analysis and prediction to retrieve enough information that will help to achieve our goal.

2.2. Review of Literature

According to Hilal Hamed AL-Baddaei1 and Mohammad Saqib1n, The process of design and implementation of an online auction site for different items. First, there was discussion about study and strategies on the transition from the traditional auction to the electronic auction, and what were the strategies for the technology that had been used in the transformation. Given previous experiences and analysis of some previous literature regarding online auctions, the researcher conducted a study on how to design this system to avoid general problems and develop our system to simulate the existing auctions. This paper designed an excellent and practical system that contains what customers need in our region.

They implemented the system and made the system easier for everyone to buy and sell. The system was designed professionally and used all scientific strategies and methodologies in creating projects [3].

Similarly, Darpan Ananda focused on the concept of eAuction, an increasingly form of online procurement. There was fixed delivery policy. According to them there was a fully dynamic system which can be easily operated by the users. This research paper explored all the increasing form of online procurement where Users can freely go the website and register there and it's ready for selling or buying their product. There was trust between the users, so that they can easily register and take part in the process without having any doubt regarding security. The aim of any online system and their results were related with two points that are Customer satisfaction and Business purpose [4].

The result of this research paper was that they had a system which was much stronger and advanced than before and they also focused on the main concern of the people worldwide. Also, the main issue i.e trust and security had been taken under noticed in more effective ways [4].

In paper [5], they mentioned that auctions of any rare products were bid offline. According to them, online auctions were the most influential e-commerce business applications. Although there had been considerable efforts in setting up market places, an online auction system was the best way to bid for such products which were rare and could not be found easily anywhere. This research paper considered that the most impressive concept of the online auction system was that you didn't need to be anywhere offline. They made a system where people can bid online without investing their time and bid for particular products. Using this system buyers, sellers come online and connect on web-portal using this system. This system made conclusion that the using this web- portal registered user can propose or bid for new auctions, purchase and place bid product in order to buy that item [5].

Similarly, a paper by Li Xuefeng, Liu Lu, Wu Lihua, Zhang Zhao illustrated that having the prevalence of the internet and e-commerce, the online exchange market, especially the online auction market developed very fast. The activities of online auction produced a large number of transaction data. According to them, if utilized properly, this data could be of great benefit to sellers, buyers and website administrators. Typically, they used the method for final price prediction so that results may help sellers optimize the selling price of their items and auction attributes. Thus, transaction time can be shortened and cost can be saved. In this paper, they collected large amounts of historical exchange data from Each net, an online auction website most famous in China and used machine learning algorithms and traditional statistical methods to forecast the final prices of auction items. They tentatively used some experiments which were performed and the prediction results were discussed to verify the proposed solution according to them [6].

According to [7], the online auction has turned into an extremely well known ebusiness exchange sort. The massive business openings pull in a great deal of employment and a large number of online stores. They outlined a hybrid auction model (HDAM) which uses a detailed technique for initial price estimation and predictive analytics. They used clustering and regression for prediction which had been implemented in view of the evaluated starting price, state of mind of the bidders to win the auction and the competitor’s appraisal for the bidder’s offers. The tests showed value estimation results utilizing the proposed approach.

They used Hybrid Price Prediction Model using regression and clustering to know about

predictability of online auction. They established the R implementations which had been used for further process. Under this different machine learning, models have been worked upon [7].

With the review of research works performed by credible researchers we see that how an online auction bidding system mechanisms and algorithm works and we develop a general concept of using this in field of Online Auction System and hence we will be developing an Intelligent Online Auction that will provides platform for buyers to bid on different items, while enabling sellers to obtain a reasonable price for their items.

Chapter 3: Methodology

3.1. Introduction

During the time of developing a project proposal for a specific project, a model has to be implemented for the analysis, design, planning, implementation and maintenance of the final output as the output of the project development phase. This model is considered as a "methodology", which is implemented by a project manager or a project lead for achieving different goals in order to fulfill the planned objectives within a pre-defined working schedule and a fixed working budget. The methodology features all of the procedures to be followed during the project development phase, along with different systematic diagrams explaining about the working principles of the project and the technologies that are to be used or implemented throughout the project development phase.

3.2 Feasibility Analysis

There are different things that need to be well taken care, from a technical standpoint, considering the availability of skilled developers, suitable technology infrastructure, and reliable internet connectivity will determine if the project can be effectively implemented. Financial feasibility requires a careful assessment of local currency considerations, development costs, operational expenses, and the potential revenue generated from the Nepalese market's appetite for online auctions.

Market feasibility entails understanding the preferences of Nepalese consumers for second-hand items, as well as the existing competition in the local e-commerce landscape. Factoring in legal and regulatory aspects specific to Nepal, such as digital transaction regulations and data privacy laws, is crucial to ensure compliance. Additionally, analyzing the project's scalability in the Nepalese context, given potential fluctuations in demand and infrastructure limitations, will be pivotal for long-term success. By meticulously evaluating these aspects, the feasibility analysis will offer insights into adapting the online auction system project to effectively cater to Nepal's unique market dynamics and requirements.

3.3 Software Development Life Cycle (SDLC)

The Waterfall model is the earliest SDLC approach that will used for software development. The waterfall Model illustrates the software development process in a

linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. The Reason behind choosing Waterfall Model over other software development life cycle (SDLC) methodologies is due to its suitability for projects with well-defined and stable requirements, clear project scope, and a linear progression of phases. Its emphasis on documentation aligns with the project's need for extensive documentation, while its structured approach is suitable for managing projects with limited resources for ongoing maintenance. The sequential phases in SDLC are:

i. Requirement analysis:

   Requirement analysis/planning is the first approach taken before any software development. All the possible requirements for the successful development of system are gathered and analyzed amongthe group members in this phase [8].

ii. System Design:

   The requirement specifications from first phase will be studied in this phase and the system design is prepared. This assist developers to analyze the hardware and software requirements also it helps indefining overall system architecture. Failure at this stage will almost certainly result in cost overruns at best and the total collapse of the project at worst [8].

iii. Implementation:

   With inputs from the system design, the system is first developed in small programs called units, which will get integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing [8].

iv. Integration and Testing**:**

   All the units developed in the implementation phase will get integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures so that user won’t face any difficulties while using the software [8].

v. Deployment:

   Once the functional and non-functional testing is done; the product will get deployed in the customer environment or released into the market [8].

vi. Maintenance:

There are some issues which could come up in the client environment or some better versions are released. Maintenance will be done to deliver the changes and also to enhance the product in the customer environment [8].

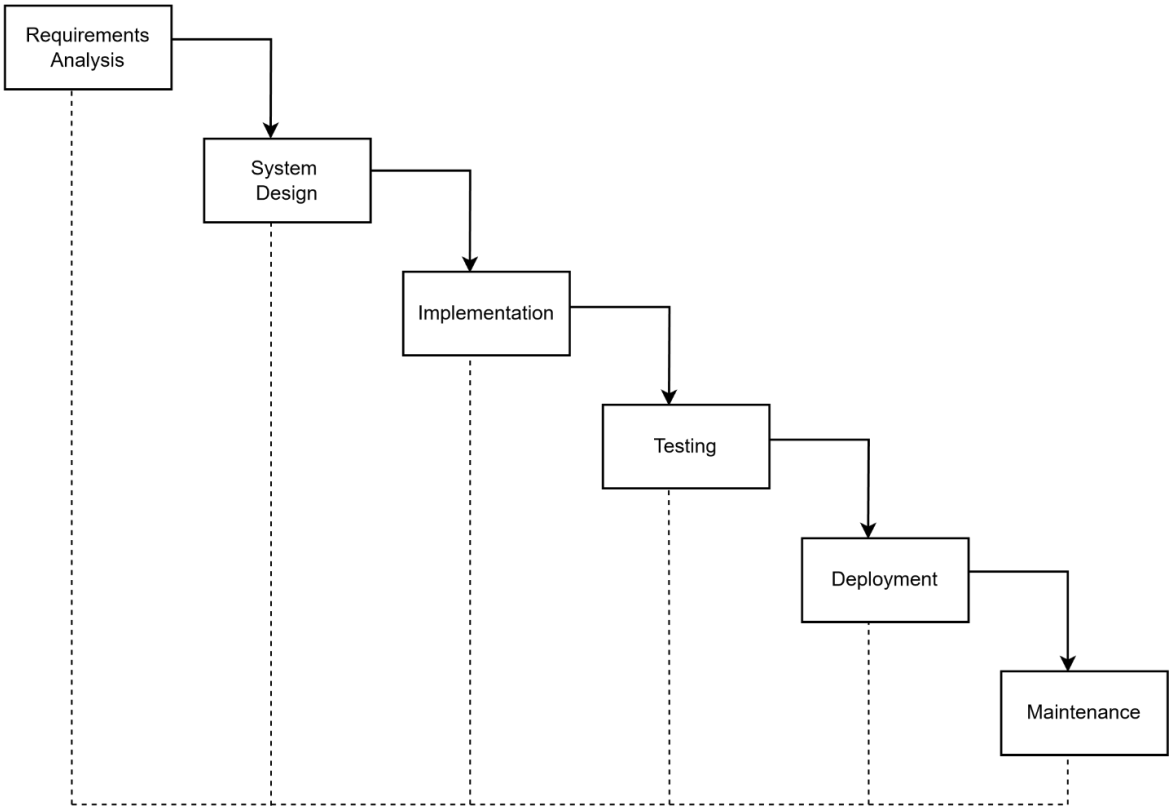

Figure 3. 1: Waterfall Model [8]

3.4 Software Analysis and Design Tools

Software analysis and design is a major procedure to go through for becoming able to transform the requirement specifications of a software project into its implementation. All of the functional and non-functional expectations of the software have to be specified during the phase of designing requirement specifications. These requirement specifications are available in the form of human-readable format or in a diagrammatic form without requiring any technical aspect of the project. Different software analysis and design tools for our project are provided below.

3.4.1 System Block Diagram

Model development for the online auction system involves collecting and preprocessing a dataset of historical sales data and item attributes. Machine learning algorithms are then employed to train predictive models that estimate the present worth price of different items. These models are integrated into the auction system, for sellers to set base prices

and for buyers to make informed bidding decisions.

Three regression algorithms linear regression, random forest regression, and gradient boosting regression were employed to predict item prices. Among them, random forest regression achieved the highest accuracy at 0.92339, followed closely by gradient boosting regression at 0.9200 and then Linear Regression which is 0.798. However, it's worth noting that gradient boosting regression proved to be Computational Complexity, Overfitting and had other associated disadvantages.

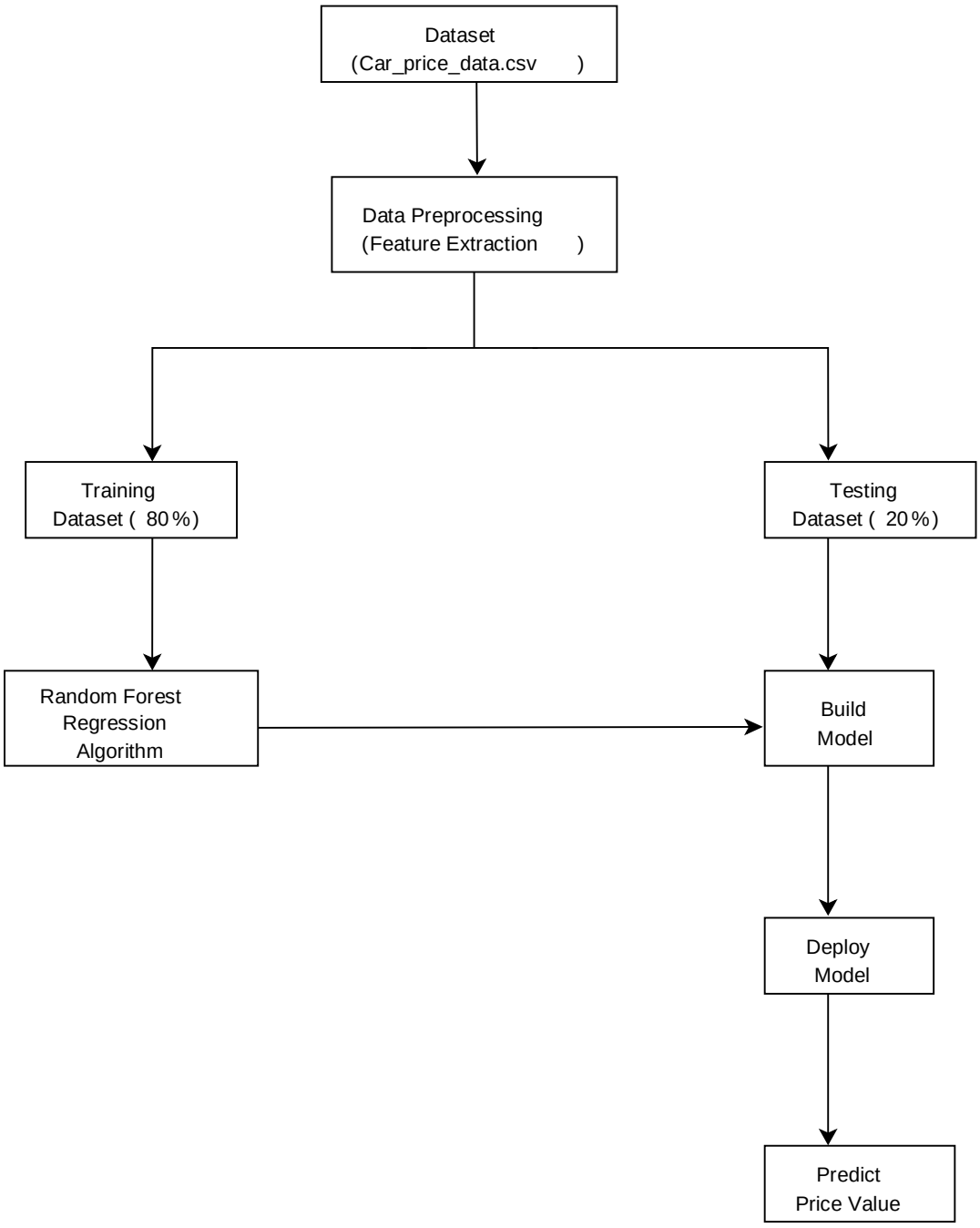

Figure 3. 2: Model Development [Group Study-2023]

3.4.2 System Flow Diagram

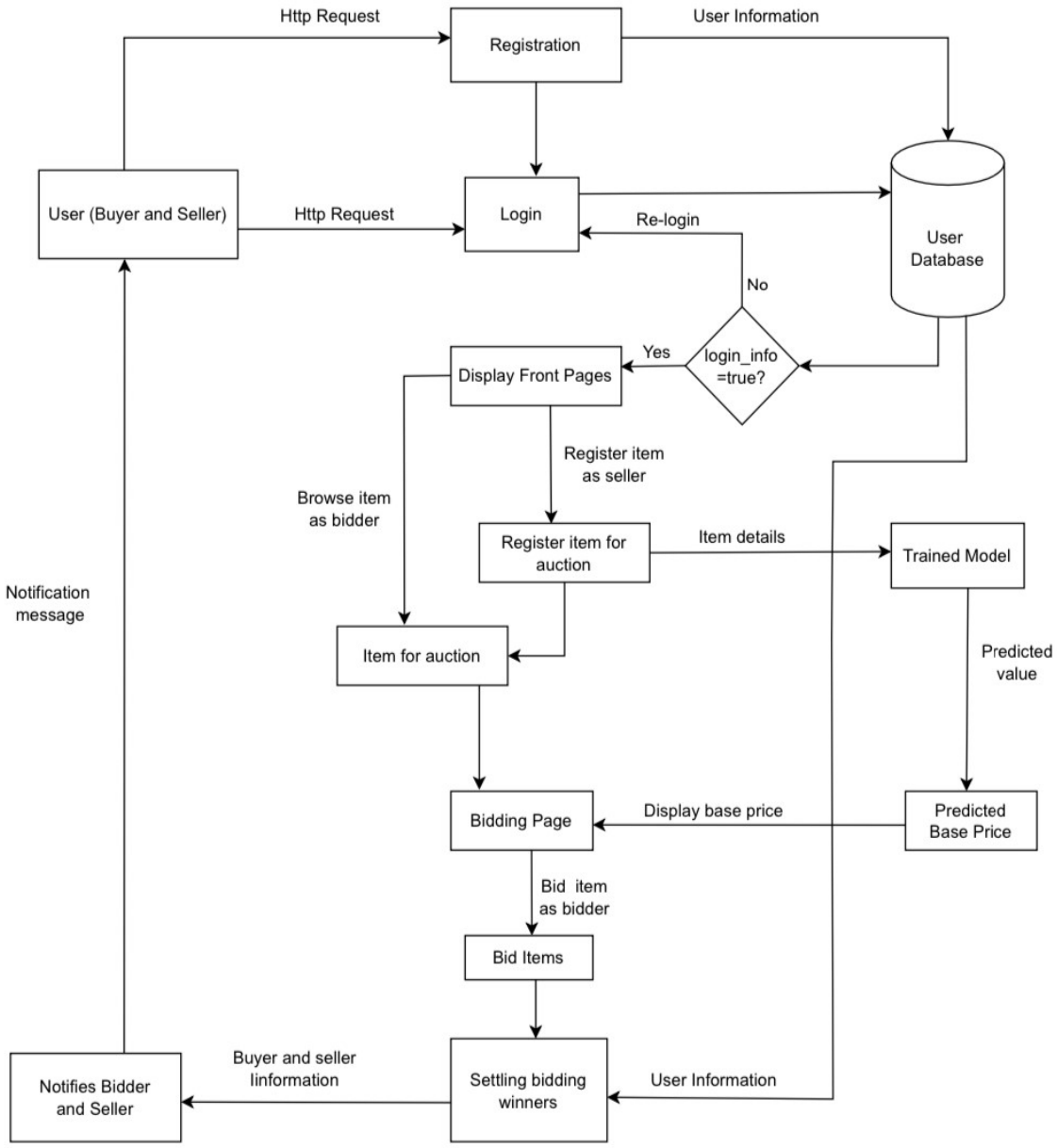

Figure 3. 3: System Flow Diagram [Group Study-2023]

The system flow diagram above illustrates the flow of information and interactions among the user interface, web server, application logic, and database components. It showcases the architectural structure and the major components involved in the online auction system for second-hand items.

3.4.3 System Flowchart

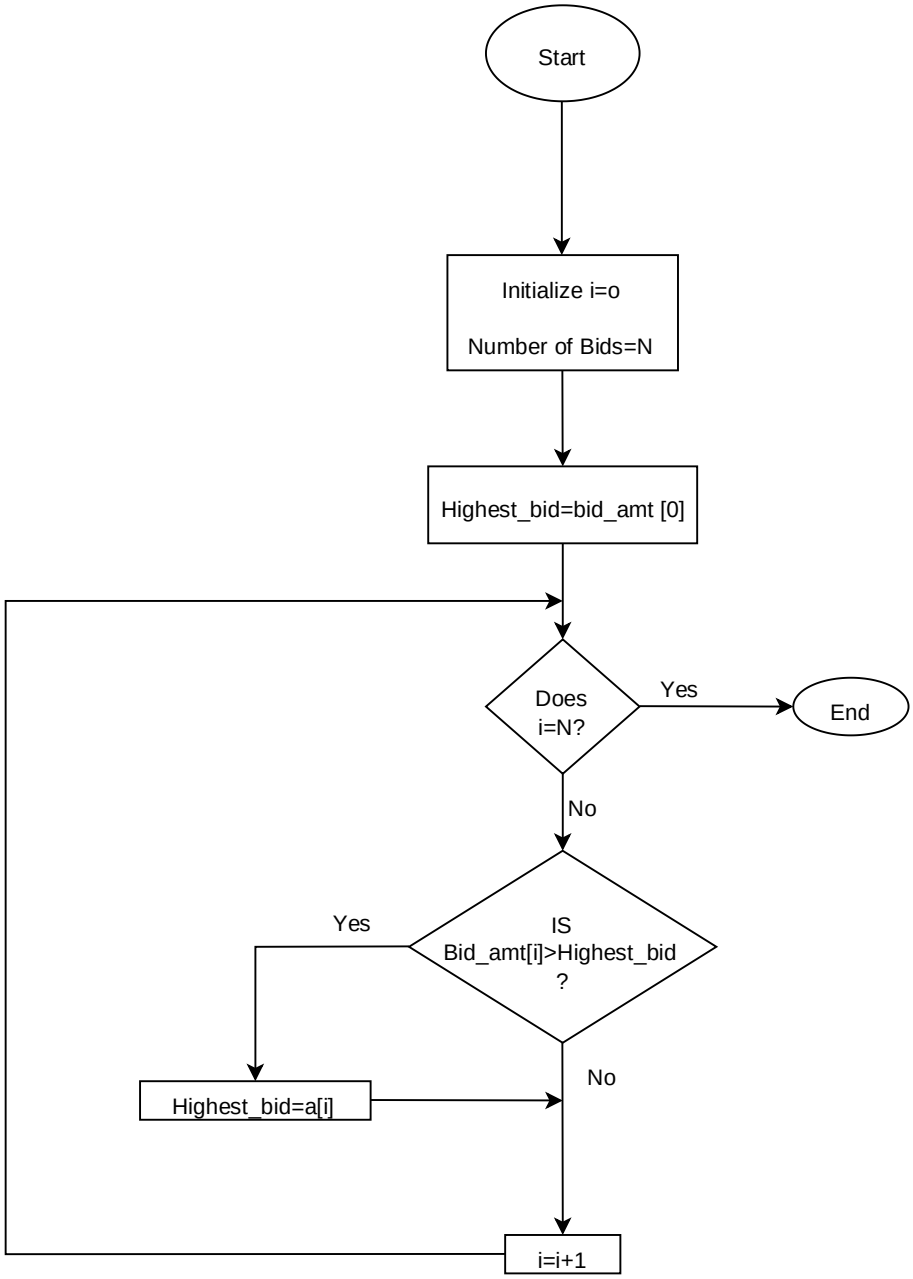

Figure 3. 4: Flowchart for determining highest bidding Winner [Group Study-2023]

The above flowchart illustrates the key steps for determining highest bidder in the online auction system where multiple bidders bid for an item above the set base price until the set time is finished. The bid amounts are kept hidden from others, and after the set time expires, the bidders with the highest bid amount win the auction.

3.4.4 Use Case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system and depicting the specification of a use case. A use case diagram can portray the different

types of users of a system and the various ways that they interact with the system.

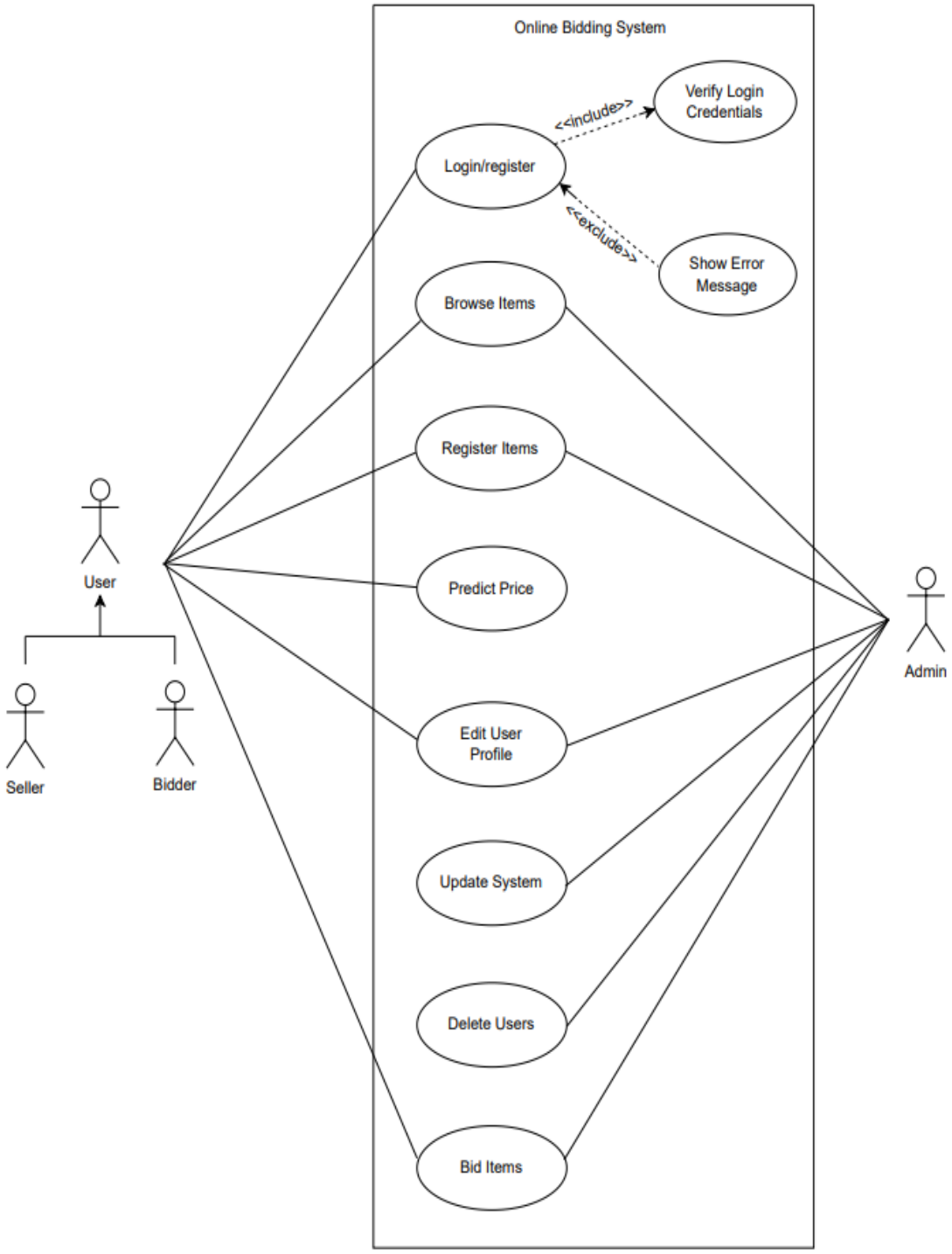

Figure 3. 5: Use Case Diagram [Group Study-2023]

The diagram above depicts the use case diagram of the system that shows the actors and the system. It explains the service provided to the actors by the system. Basically, two kinds of actors are explained in the system viz. registered user (seller and bidder) and

system admin. A registered user is allowed to browse items, register items for auction, predict the price of items and make bids in auction for items. The user can also edit their profile while admin is responsible for system update and basically controlling and monitoring different users.

3.4.5 Design of Database

The database of the system uses the SQLite database.

BidApp	
Field	Type
id	BigAutoField
participant	ForeignKey(id)
post	ForeignKey(id)
amount	IntegerField

UserApp	
Field	Type
Id	BigAutoField
User	ForeignKey(id)
date_of_birth	DateField
full_name	CharField
phone_number	CharField
primary_location	CharField

PostApp	
Field	Type
id	BigAutoField
user	ForeignKey(id)
winner	ForeignKey(id)
bidstart	IntegerField
buynow	IntegerField
category	CharField
comp_image	ImageField
date_end	DateTimeField
date_posted	DateTimeField
description	TextField
sell_location	CharField
sold	BooleanField
title	CharField

3.4.6 Data flow Diagram (DFD)

A data flow diagram (DFD) illustrates how data is processed by a system in terms of inputs and outputs. As its name indicates its focus is on the flow of information, where data comes from, where it goes and how it gets stored. The below two diagram depicts the level 0 and level 1 data flow diagram of our system respectively. It shows how external entities, user and admin, flows the data to different processes.

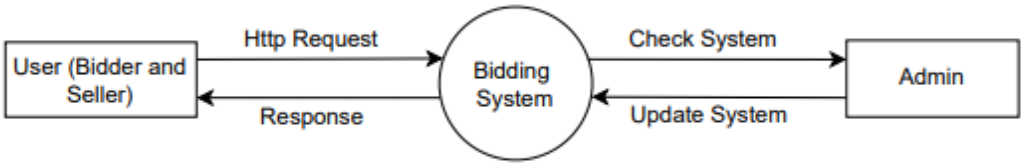

Figure 3. 6 : level 0 DFD [Group Study-2023]

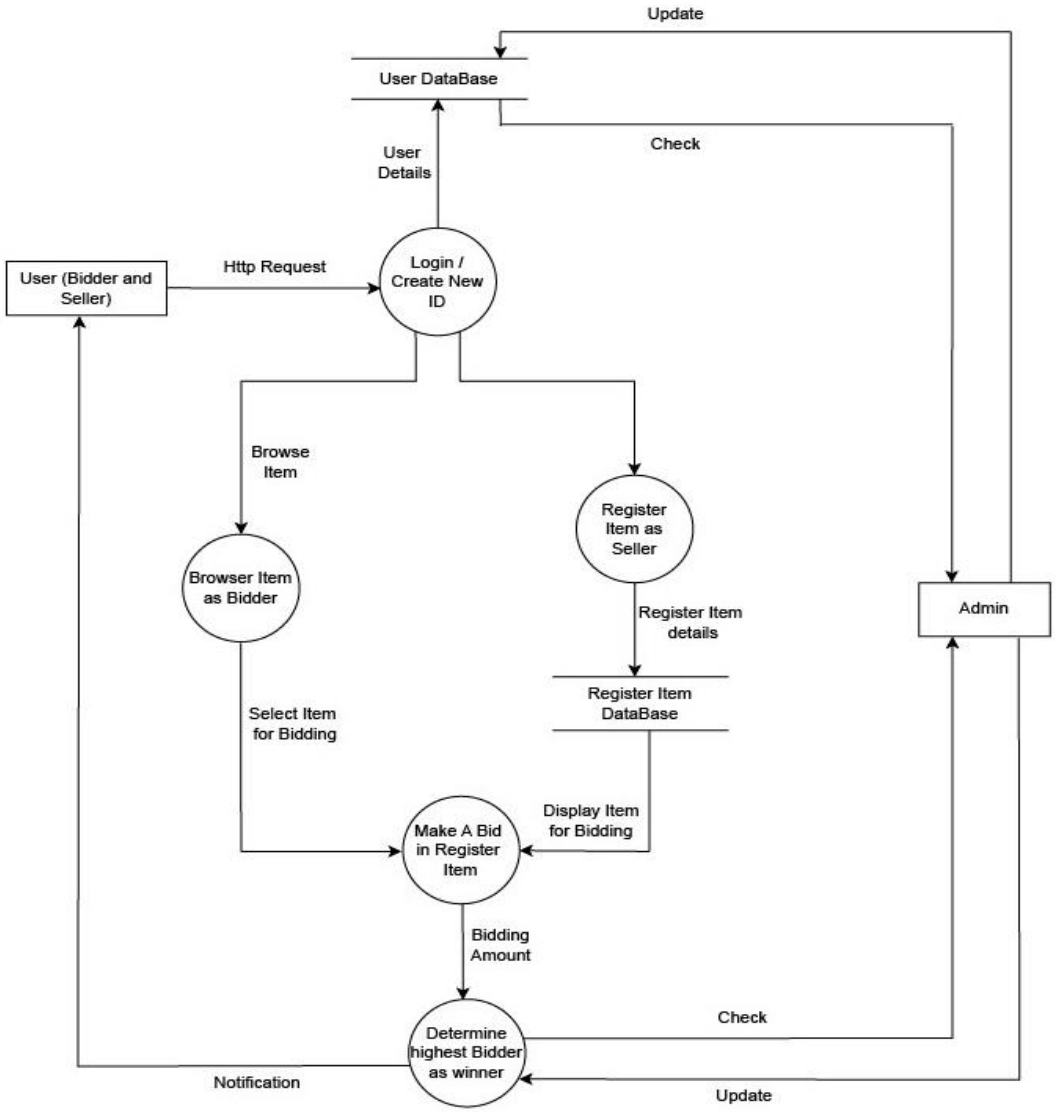

Figure 3. 7: level 1 DFD [Group Study-2023]

3.5 Implementations of Algorithms

Certainly, algorithm plays a crucial role in running and managing projects. They are step by step procedures or sets of rules designed to solve specific problems or performs specific task. In the context of a project, algorithms are often used to streamline processes, optimize resource allocation, make decisions, or analyze data. Throughout the project, we performed detailed analysis on several algorithms, specifically focusing on their functionality, performance, and suitability for our specific project requirements and they are:

3.5.1 Linear Regression

Linear regression is used to predict the relationship between two variables by applying a linear equation to observed data. There are two types of variables, one variable is called an independent variable, and the other is a dependent variable. Linear regression is commonly used for predictive analysis. The main idea of regression is to examine two things. First, does a set of predictor variables do a good job in predicting an outcome (dependent) variable? The second thing is which variables are significant predictors of the outcome variable? For predicting the outcome, we observed data between two variables through the following equation [9].

Linear Regression Equation:

$$Y=a + bX$$

Where, X is the independent variable and it is plotted along the x-axis

Y is the dependent variable and it is plotted along the y-axis

Here, the slope of the line is b, and a is the intercept (the value of y when x = 0).

We found the value of a and b by using the below formula:

$$a=\frac{(\sum y)\ (\sum x^2)-(\sum x)\ (\sum xy)}{n(\sum x^2)-(\sum x)^2} \quad \text{.....1}$$

$$b=\frac{n(\sum xy)-(\sum x)\ (\sum y)}{n(\sum x^2)-(\sum x)^2} \quad \text{.....2}$$

Equation 1: Linear Regression Equation

3.5.2 Random Forest Regression

Here, the terms Regression is a machine learning technique that is used to predict values across a certain range. Similarly, Random Forest regression is an ensemble learning technique. It means you can take multiple algorithms or same algorithm multiple times and put together a model that's more powerful than the original. Prediction based on the trees is more accurate because it considers many predictions. This is because of the average value used. These algorithms are more stable because any changes in dataset can impact one tree but not the forest of trees.so Here we used equations for predicting the value for random forest regression which is given below [10]:

$$\hat{y} = \frac{1}{N}\sum_{i=1}^{N} f_i\ (x) \quad \text{.....3}$$

Equation 2: Prediction of output through Random Forest Regression

where:

$\hat{y}$ represents the predicted value or output.

N is the total number of decision trees in the Random Forest.

$f_i(x)$ represents the prediction of the ith decision for a given input x.

3.5.3 Gradient Boosting Regression

Gradient boost is a machine learning algorithm which works on the ensemble technique called 'Boosting'. Like other boosting models. So that Boosting idea is to train weak learners sequentially, each trying to correct its predecessor. This means, the algorithm is always going to learn something which is not completely accurate but a small step in the right direction but a small step in the right direction. As the algorithm moves forward by sequentially correcting the previous errors, it improves the prediction power. Gradient boost is one of the most powerful techniques for building predictive models for both classification and Regression problems. It improves the accuracy of the model by sequentially combining weak trees to form a strong tree. In this way it achieves low bias and low variance [11].

3.6 Tools and Technologies

3.6.1 Python

Python is a popular general-purpose programming language that can be used for a wide variety of applications. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together It is highly interactive and known for its high level of abstraction, syntax, modules &frameworks. Python is incredibly easy to learn and use for beginners and newcomers in the industry. The language is the most accessible among all the programming languages available and gives more emphasis on natural language. Modules & Frameworks of Python are explained below [12]:

1. Pandas: - Pandas is a Python library used for working with data sets. Pandas allows us to analyze big data and make conclusions based on statistical theories. Pandas is a Python package that provides fast, flexible, and expressive data structures designed to make working with structured (tabular, multidimensional, potentially heterogeneous) data easily. It aims to be the fundamental high-level building block for doing real world data analysis [13].
2. NumPy: - NumPy is a Python library used for working with arrays. NumPy is a Python

library used for working with arrays. NumPy, which stands for Numerical Python, is a library consisting of multidimensional array objects and a collection of routines for processing those arrays. Using NumPy, mathematical and logical operations on arrays can be performed [14].

3. Scikit-learn: - Scikit-learn is a free machine learning library for Python. It features various algorithms like support vector machine, random forests, and k-neighbors, and it also supports Python numerical and scientific libraries like NumPy and scipy. Scikit-learn is the most useful and robust library for machine learning in Python. It provides a selection of efficient tools for machine learning and statistical modeling including classification, regression, and clustering and dimensionality reduction via a consistence interface in Python [15].
4. Matplotlib: - Matplotlib is a low-level graph plotting library in python that serves as a visualization utility. It is one of the most popular Python packages used for data visualization. It is a cross platform library for making 2D plots from data in arrays. As such, it offers a viable open-source alternative to MATLAB. Developers can also use Matplotlib's APIs (Application Programming Interfaces) to embed plots in GUI applications [16].
5. Seaborn: - Seaborn is a library for making statistical graphics in Python. It builds on top of matplotlib and integrates closely with pandas' data structures. Seaborn helps you explore and understand your data. Its plotting functions operate on data frames and arrays containing whole datasets and internally perform the necessary semantic mapping and statistical aggregation to produce informative plots. Matplotlib makes the hard things possible while Seaborn 12 makes complicated things uncomplicated. However, Seaborn is not an alternative to Matplotlib but a complement of it [17].

3.6.2 HTML/CSS

HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets) are two of the core frontend technologies for designing web pages and web applications. HTML defines the structure of a page, while CSS defines its style. CSS is used to format the layout of a webpage.

3.6.3 JavaScript

JavaScript (JS) is lightweight interpreted or just in time compiled programming language with first class functions. While it is most web-based scripting language that has been widely used in web application development. In particular, it is often used to add a variety

of dynamic functions to web pages, providing users with a smoother and more pleasing browsing experience [18].

3.5.4 Bootstrap

Bootstrap is the most popular CSS Framework for developing responsive and mobile-first websites. Bootstrap 5 is the newest version of Bootstrap [19].

3.6.5 Django

Django is a high-level Python web framework that enables rapid development of secure and maintainable websites. Built by experienced developers, Django takes care of much of the hassle of web development. It is free and open source, has a thriving and active community, great documentation, and many options for free and paid-for support. Django is well-supported by many web hosting providers, who often provide specific infrastructure and documentation for hosting Django sites [20].

3.6.6 Visual Studio Code

Visual Studio Code is a streamlined code editor, with the tools needed for a quick code-build debug cycle. It comes with built-in support for JavaScript, Typescript and Node.js and has a rich ecosystem of extensions for other languages.

3.6.7 SQ-Lite

SQLite is a self-contained, serverless, zero-configuration, transactional database engine. The code for SQLite is in the public domain and is free for use for any purpose, commercial or private. With all features enabled, the library size can be less than 750KiB, depending on the target platform and optimization settings. There is a tradeoff between memory usage and speed.

Chapter 4: Implementation Details and Results

4.1 Data Collection and Data Analysis

Data Collection was the main challenging part of this project. Data collection plays a crucial role in developing a successful online auction system for second-hand rare items. It involves gathering comprehensive and relevant information to train the predictive models and facilitate the auction process. The data collected typically includes historical sales data and item attributes. Initially, we started by searching datasets on different secondary sources and finally chose a dataset from 'Kaggle Datasets'. We selected a real-world car_price_predict.csv dataset, which contains 278 data and 9 features in total. The key attributes feature of our collected dataset are Car_Name, Year, selling_Price, Present_Price, Kms_Driven, Fuel_Type, Seller_Type, Transmission and Owner.

After the selection of dataset, we move towards its preprocessing. The machine learning models use mathematical equations. So categorical data is not accepted, so we converted it into numerical form. Later, we went for data analysis and visualization. To acquire proper knowledge on the dataset, we applied several statistical analyses on the attributes of the dataset. We tried to map several attributes of the dataset and tried to establish a relationship between them to extract some essential trends and patterns of this data. We produced several different graphs to visualize and understand the data. Some of them are given below:

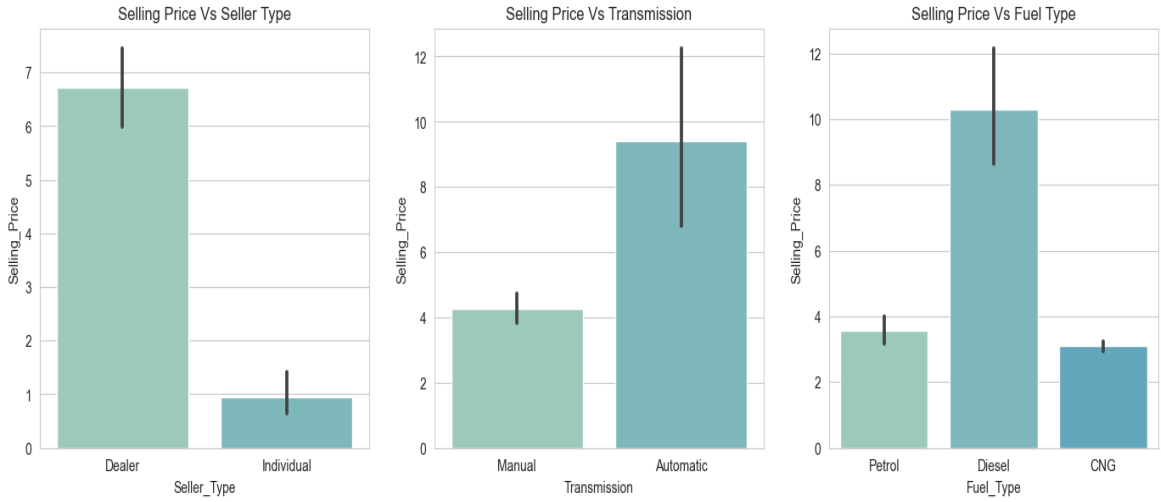

Figure 4. 1: Selling_Price Attribute Vs Seller_Type, Transmission and Fuel_Type

From the Fig above, following points which are mentioned below: -

- Selling Price of cars seems to have higher prices when sold by Dealers when

compared to Individuals.

- It can be observed that selling price would be higher for cars that are automatic.
- Selling price of cars with fuel type of diesel is higher than petrol and CNG.

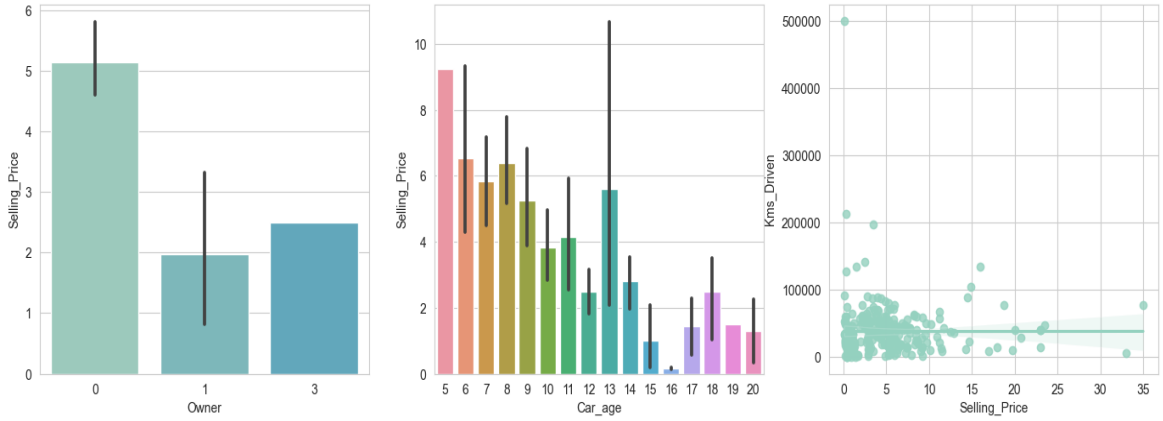

Figure 4. 2: Selling_Price Vs Owner, Car_age and Selling_Price

Similarly, from fig ii following conclusion was drawn: -

- Selling Price is high with less owners used Cars.
- Selling Price of cars 2 years would be high and gradually decreases with car of 17 years old.
- Lesser the Kms driven higher the selling price.

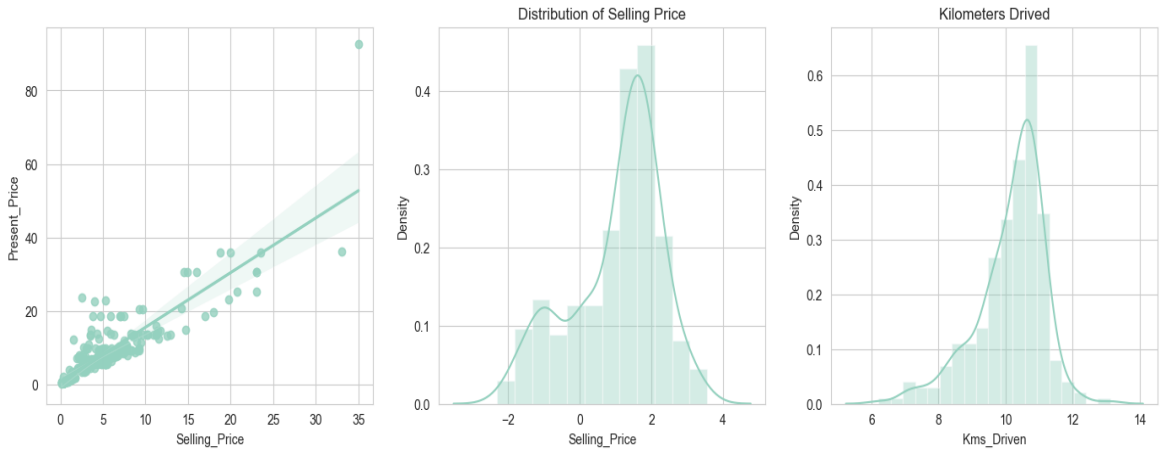

Figure 4. 3: Regression and Distance plot

From the fig above, we found out that selling price tends to increase with increase in present price of the car.

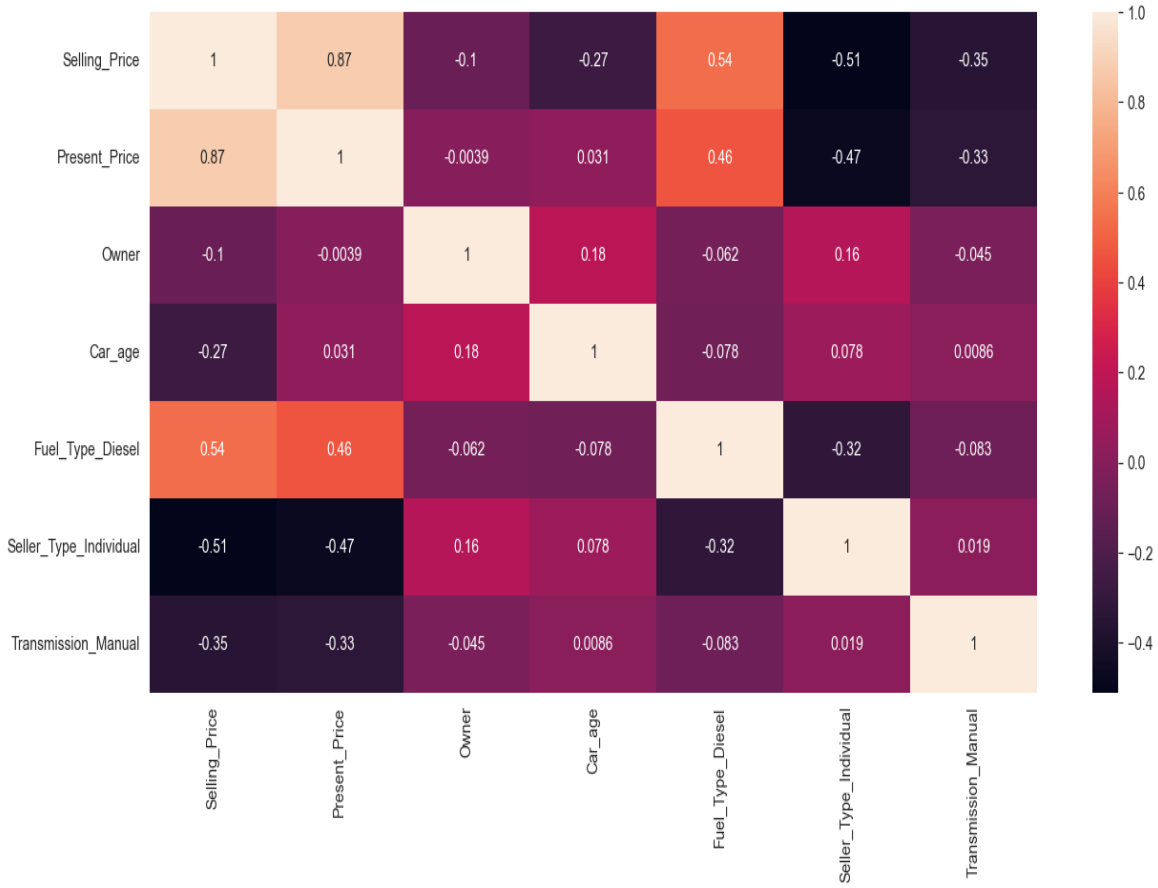

Figure 4. 4: Correlation Heat Map

This correlation heat map helps us to analyze the correlations between various item attributes and the final sale prices.

4.2 User Interface

When we approach the mid-term defense of our project, we have completed about 70 percent of the proposed work. Along with model development and data analysis portion, we also took tasks of front-end development portion simultaneously. We have almost completed our frontend portion using HTML and CSS.

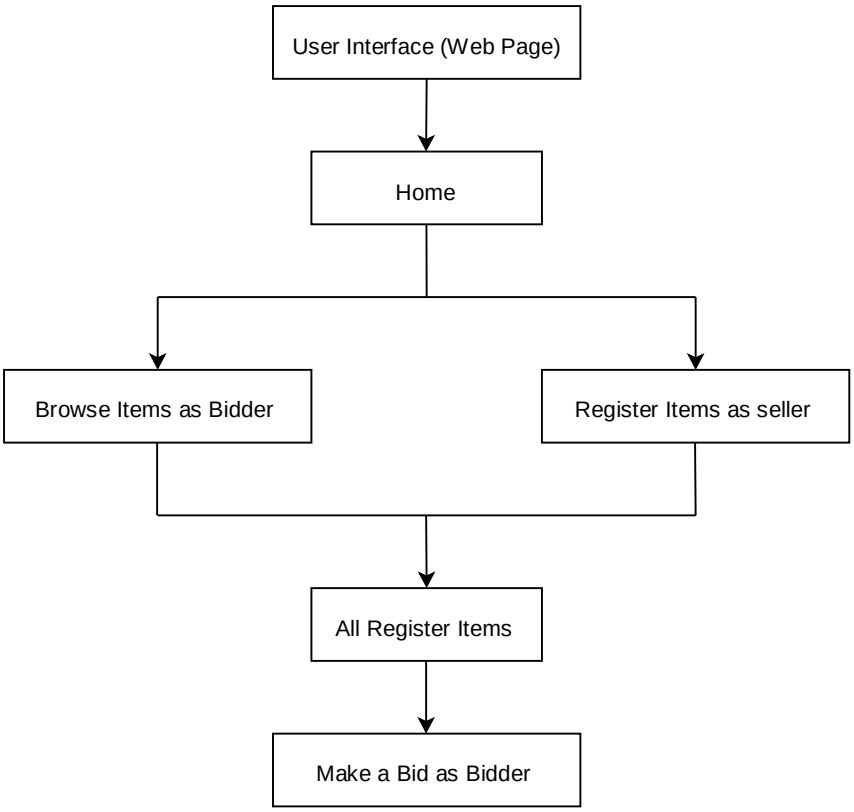

Figure 4. 5: Frontend Contents [Group Study-2023]

Some of the screenshots of our frontend part are as follows:

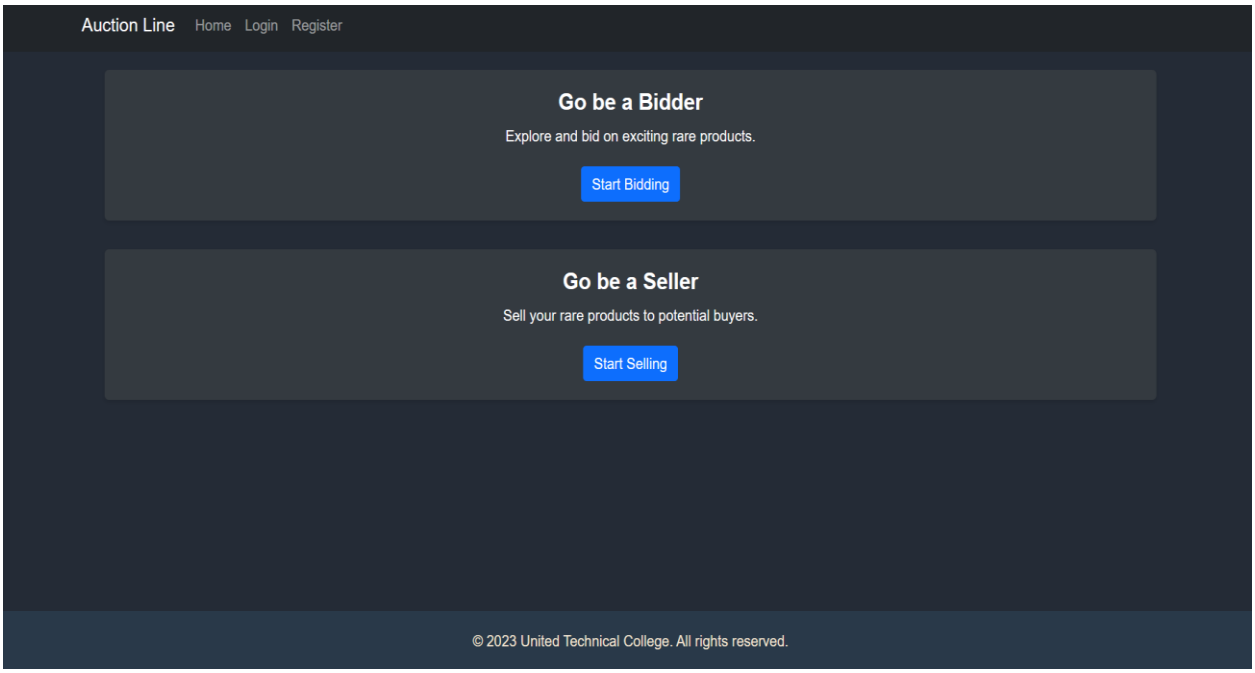

Figure 4. 6: Home Page of our Frontend [Group Project-2023]

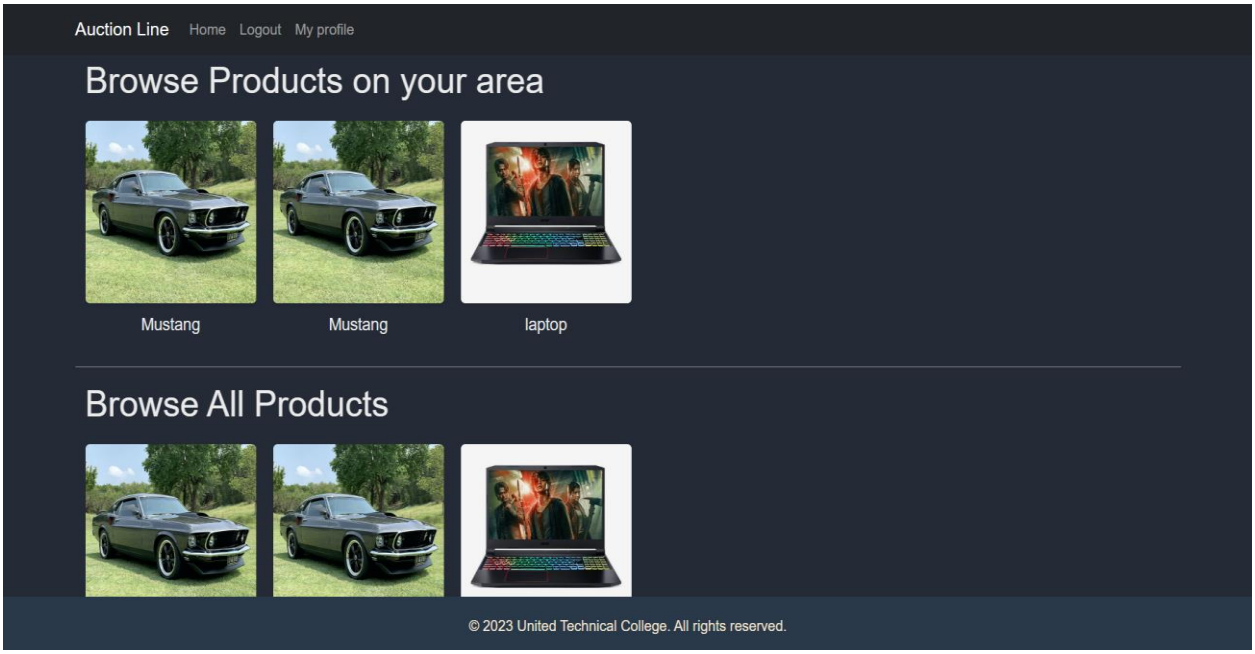

Figure 4. 7: Products Browsing Page [Group Project-2023]

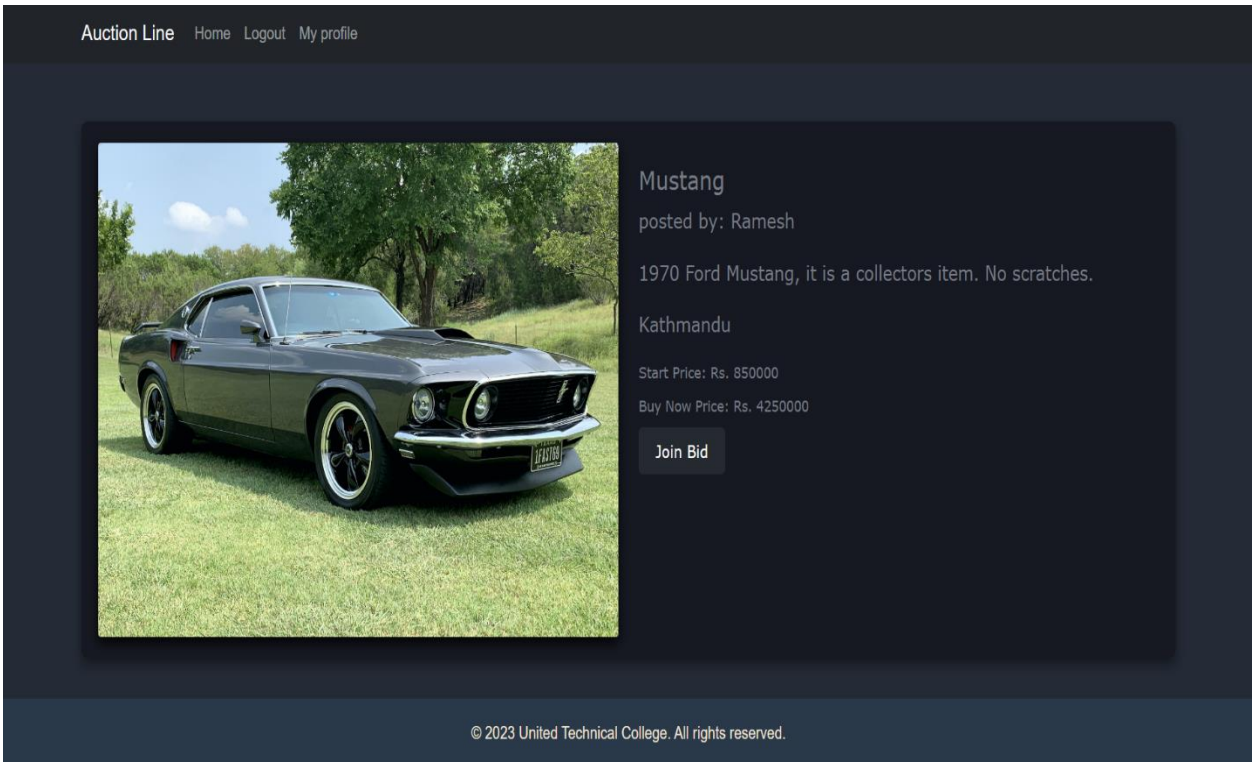

Figure 4. 8: Detail Description of the Product [Group Project-2023]

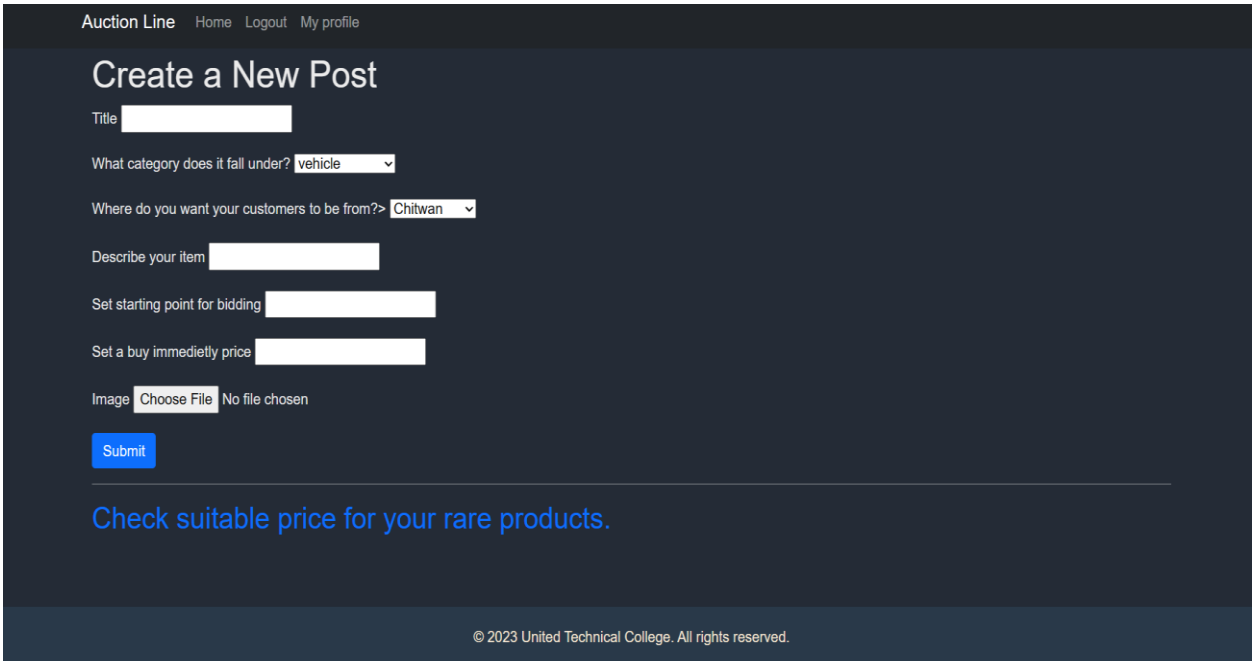

Figure 4. 9: New products Addition by a Seller [Group Project-2023]

Figure 4. 10: Present Price Prediction of Products [Group Project-2023]

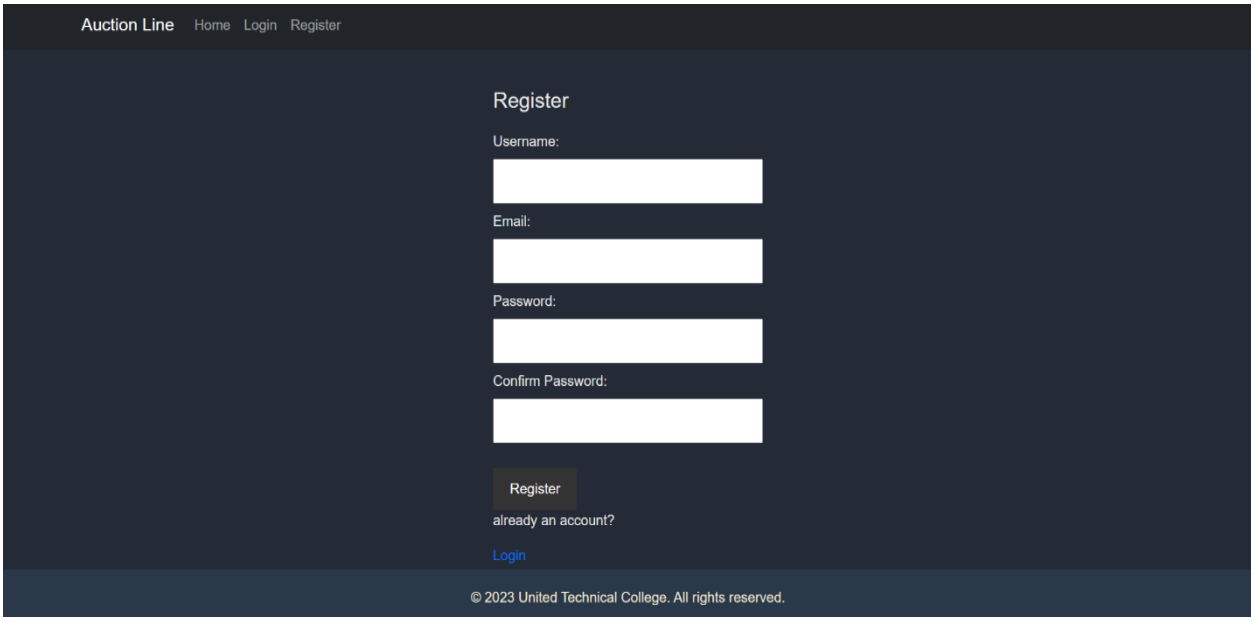

Figure 4. 11: Registration Page for New Users [Group Project-2023]

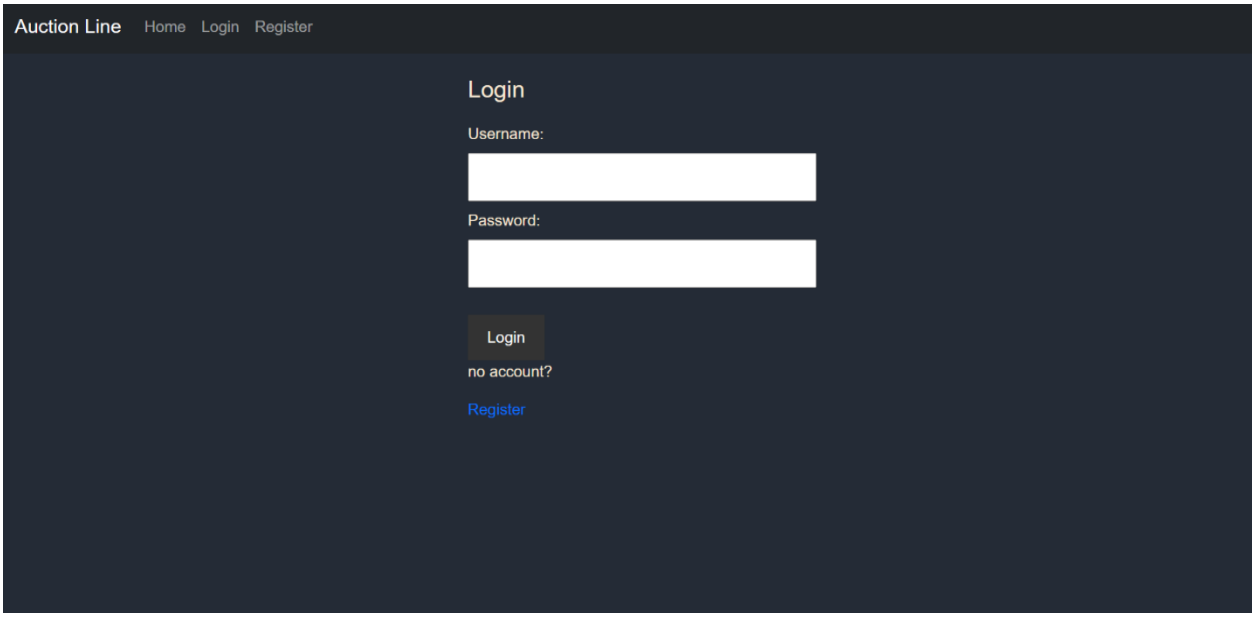

Figure 4. 12: Login Page [Group Project-2023]

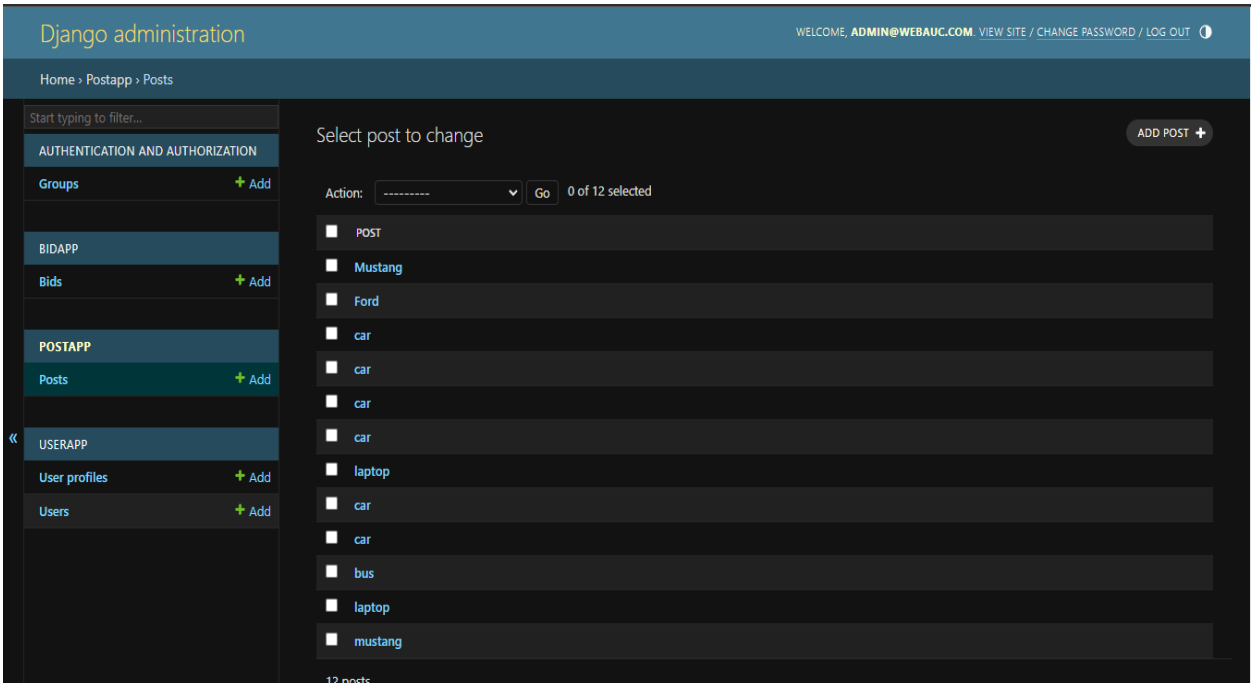

Figure 4. 13: Admin Panel [Group Project-2023]

Chapter 5: Conclusion and Recommendation

5.2 Conclusion

In conclusion, the successful implementation of this online auction system marks a significant step towards revolutionizing the market for second-hand items. Through the integration of cutting-edge machine learning techniques, the project has achieved a crucial dual objective: enhancing user experience and ensuring fair pricing. The frontend development has paved the way for a user-friendly platform where buyers and sellers can seamlessly interact. The incorporation of price prediction models empowers sellers with an effortless means of setting starting prices, while also granting buyers an informed starting point for their bids. As the system's data analysis and predictive modeling work in harmony, it fosters transparency and equity throughout the bidding process. The blend of technological innovation and user-centric design positions this platform as a dynamic marketplace, catering to the diverse needs of both buyers and sellers of second-hand products.

5.3 Future Enhancement

There can be a plenty of work that can be done in future, expanding the range of products offered on the platform is a strategic move. By diversifying the product categories beyond second-hand items, the platform can tap into a wider market and attract a broader audience. This expansion could encompass electronics, fashion, collectibles, and more, creating a comprehensive marketplace that caters to diverse consumer interests. The development of a dedicated mobile app would provide convenient access via smartphones, bolstering user engagement. To enhance the user experience, an advanced recommendation system could suggest items based on browsing history and bidding patterns. Real-time updates for ongoing auctions would heighten the excitement of bidding. The integration of secure payment gateways would ensure seamless transactions, while seller verification and ratings would enhance the platform's credibility. Creating virtual auction rooms for live bidding events would foster a sense of community, and localized versions in various languages and currencies would cater to global audiences.

Exploring blockchain integration could introduce transparency and security to transactions. Features like social sharing, seller analytics, and collaborations with brands would augment user engagement and expand the platform's reach. The introduction of

charitable auctions could infuse a philanthropic dimension, and gamification elements like badges and rewards would incentivize active participation. These envisioned enhancements collectively paint a picture of an evolving platform poised to revolutionize the landscape of second-hand item transactions.

References

[1] L. Xuefeng, L. Lu, W. Lihua, and Z. Zhao, "Predicting the final prices of online auction items," *Expert Systems with Applications*, vol. 31, no. 3, pp. 542–550, 2006. doi:10.1016/j.eswa.2005.09.077

[2] Help Net Security, "Problems with online auctions, badware, protecting personal data," Help Net Security, https://www.helpnetsecurity.com/2008/12/18/problems-with-online-auctions- badware-protecting-personal-data/ (accessed Jul. 16, 2023).

[3] H. Baddaei and M. Saqib, "Design and implementation of an online auction in al-somhan showroom with Information Technology and Information," *Journal ofStudent Research*, 2021. doi:10.47611/jsr.v10i3.1297

[4] D.Anand, "Implementation of online E –auction to overcome the problem of corruption with effective and efficient procurement with transparency," *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, vol. 12, no. 2, pp. 517–520, 2021. doi:10.1ss7762/turcomat.v12i2.866

[5] N. Rathi *et al.*, "Online auction system," *International Journal of Computer Science and Mobile Computing*, vol. 11, no. 3, pp. 17–22,2022.doi:10.47760/ijcsmc.2022.v11i03.002

[6] L. Xuefeng, L. Lu, W. Lihua, and Z. Zhao, "Predicting the final prices of online auction items," *Expert Systems with Applications*, vol. 31, no. 3, pp. 542–550, 2006. doi:10.1016/j.eswa.2005.09.077

[7] S. Kumar and R. Rishi, "Hybrid Dynamic Price Prediction Model In online Auctions," *International Journal of Applied Engineering Research*, vol. 12, no. 0973–4562, pp. 598–604, 2017.

[8] B. Lutkevich and S. Lewis, "What is the waterfall model? - Definition and guide, "Software Quality, https://www.techtarget.com/searchsoftwarequality/definition/waterfallmodel fbclid=IwAR2kxFhH5_JRpnEgBTUmC0Q2tVA6y35zYWj9THWLuPu13vYy1slk YbFbM2Y (accessed Jul. 16, 2023).

[9] VEDANTU, "Linear regression," VEDANTU, https://www.vedantu.com/maths/linear-regression (accessed Jul. 15, 2023).

[10] Anu, "Random Forest regression: A complete reference," AskPython, https://www.askpython.com/python/examples/random-forest-regression (accessed Jul. 15, 2023).

[11] R. Munagala, “Gradient boost for regression explained,” Numpy Ninja, https://www.numpyninja.com/post/gradient-boost-for-regression-explained (accessed Jul. 15, 2023).

[12] “Python,” Python.org, https://www.python.org/doc/essays/blurb/ (accessed Jul. 15, 2023).

[13] Pandas introduction, https://www.w3schools.com/python/pandas/pandas_intro.asp (accessed Jul.15, 2023).

[14] “Numpy,” Introduction to Numpy, https://www.w3schools.com/python/numpy/numpy_intro.asp (accessed Jul. 15, 2023).

[15] S. Pal, “Scikit-Learn Tutorial: Machine Learning in python,” Dataquest, https://www.dataquest.io/blog/sci-kit-learn-tutorial/ (accessed Jul. 15, 2023).

[16] “Matplotlib,” Matplotlib getting started, https://www.w3schools.com/python/matplotlib_getting_started.asp (accessed Jul. 15, 2023).

[17] “Seaborn,” An introduction to seaborn-seaborn 0.12.2 documentation, https://seaborn.pydata.org/tutorial/introduction (accessed Jul. 15, 2023).

[18] MozDevNet, “JavaScript,” MDN, https://developer.mozilla.org/enUS/docs/Web/javascript (Accessed Jul. 15,2023).

[19] Bootstrap 5 tutorial, https://www.w3schools.com/bootstrap5/ (accessed Jul.16,2023).

[20] MozDevNet, “Django Learn Web Development: MDN,” Learn web developmentMDN,https://developer.mozilla.org/enUS/docs/Learn/Serverside/Django/Introduction (accessed Jul. 16, 2023)

Appendix

Front-End Code:

For Bid:

```
{% extends 'base.html' %}
{% block styles %}
<style>
  .c2ontainer {
    padding: 20px;
  }
  .bid-info {
    background-color: #f2f2f2;
    padding: 20px;
    border-radius: 5px;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.1);
  }
  .bid-info h2 {
    color: #333;
    font-size: 24px;
    margin-bottom: 10px;
  }
  .bid-info p {
    color: #666;
    font-size: 16px;
    margin-bottom: 5px;
  }
</style>
{% endblock %}
{% block content %}
<div class="c2ontainer">
  <h1>Bid Details</h1>
  <div class="bid-info" id="'bid-info">
    <h2>{{ item.title }}</h2>
    <p>{{ item.description }}</p>
    <p>Minimum Bid amount: <span id="high-bid">{{ item.bidstart }}</span></p>
   {% if item.sold %}
     <h2> Sold to {{ item.winner.full_name }} </h2>
   {% else %}
    <p>Buy Now Cap: {{ item.buynow }}</p>
    {% if selfbid %}
    <a href="/sell/{{ item.slug }}"><button type="submit" class="btn btn-primary"
id="stop-btn">stop Bid</button></a>
    {% endif %}
    {% if bid %}
    <p>My current Bid: {{ bid.amount }}</p>
    {% endif %}
    {% if not selfbid %}
    <form method="post">
      {% csrf_token %}
```

```
    <input type="number" name="amount" id="bid-amount">
    <button type="submit" class="btn btn-primary" id="bid-btn">Place Bid</button>
   </form>
   {% if msg %}
    <p>{{msg}}</p>
   {% endif %}
   {% endif %}
   {% endif %}
  </div>
</div>
{% endblock %}
```

Back-End Code:

In Django, data is created in objects, called Models, and is actually tables in a database. When we created the Django Project, we got an empty SQLite database.

```
class Bid(models.Model):
    post = models.ForeignKey(Post, on_delete=models.CASCADE)
    participant = models.ForeignKey(UserProfile, on_delete=models.CASCADE)
    amount = models.IntegerField()
    datetime = models.DateTimeField(default=datetime.now())
    def save(self):
        if int(self.amount) < int(self.post.bidstart):
            raise ValueError('Bid cannot be less than minimum amount.')
        super().save()
```

Fig: Model for Bid App

```
class Post(models.Model):
    def namecomFile1(self, filename):
        return '/'.join([f"{self.category}_pics", str(self.slug),
'comp_pic.jpg'])
    def nameFile1(self, filename):
        return '/'.join([f"{self.category}_pics", str(self.slug),
f'optional_pic{1}.jpg'])
    def location(self):
        usrp = UserProfile.objects.filter(user=self.user).first()
        location = usrp.primary_location
        return location
    user = models.ForeignKey(get_user_model(), on_delete=models.CASCADE)
    title = models.CharField(max_length=255)
    category = models.CharField(max_length=255, default='Any')
    description = models.TextField(null=True)
    comp_image = models.ImageField(upload_to=namecomFile1,null=True)
    sell_location = models.CharField(default='any', max_length=128)
    sold = models.BooleanField(default=False)
    winner = models.ForeignKey(UserProfile, on_delete=models.CASCADE,
null=True, default=None)
    bidstart = models.IntegerField(default=0)
    buynow = models.IntegerField(default=0)
    date_posted = models.DateTimeField(default=datetime.now())
    date_end = models.DateTimeField(default=None)
```

Fig: Model for Post App

```
class UserProfile(models.Model):
    user = models.ForeignKey(CustomUser, on_delete=models.CASCADE)
    full_name =models.CharField(max_length=255)
    primary_location = models.CharField(max_length=128)
    date_of_birth = models.DateField()
    phone_number = models.CharField(max_length=12)
```

Fig: Model for User Profile