Project 2

Gold Price Prediction

A Project Submitted
in Partial Fulfilment of the Requirements
for the Degree of
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in
Computer Science and Engineering

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Abstract

The turbulence in the world markets has made gold investments more and more well-liked in recent years. But predicting gold prices for the future can be challenging. We developed the Gold Price Prediction application to address this issue, which makes predictions about future gold prices using the Flutter framework and the Random Forest Regression machine learning technique. (sci hub, 2019)

To give investors a precise and trustworthy tool for predicting gold prices, we developed this programme. Accurate predictions can help investors make well-informed decisions on the purchase and selling of gold because the gold market can be volatile. In our approach, information is gathered from a variety of sources, including historical gold prices and economic indices, and a prediction model is created using the Random Forest Regression technique. (Marcus, 2015)

By comparing anticipated gold prices with the actual values for a specific time period, we evaluated our software. With an average error rate of less than 5%, the programme produced precise estimates. Additionally, we carried out user surveys to assess the application's usability, and we discovered that users believed the interface was simple to use and the forecasts were accurate. In conclusion, our gold fee prediction software might also provide beneficial records for each person thinking about a gold funding. (Marcus, 2015)

Both new and skilled buyers can gain from it way to its accurate forecasts and consumer-pleasant format. The app uses the advantages of gadget gaining knowledge of and the adaptability of the Flutter framework to deliver unique forecasts that can assist buyers in making sensible decisions. (Developors, 2023)

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1.1 Introduction

a. Motivation-

The rising call for for gold investments and the requirement for a honest device to are expecting costs served as the primary motivations for the improvement of the Gold Price Prediction software. Due to the arena's monetary markets are so unpredictable, many buyers flip to gold as a secure haven, making it a famous investment alternative.

The Gold Price Prediction application's goal is to give traders accurate and honest facts in order to make sensible investment picks. By helping investors in minimising danger and maximising earnings, the software presents a precious service. The app can degree the gambling discipline for buyers and give them the assets they need to be triumphant in the gold market via expanding facts get right of entry to. The purpose of the software is to present traders a simple device to resource in choice-making concerning their gold funding. The Gold Price Prediction device was designed to help traders in making profitable gold investments.

b. What is the product?

The Gold Price Prediction Application is a piece of software that accurately and consistently forecasts gold prices using Flutter and the Random Forest technique. This program's objective is to give users access to the most recent gold prices so they can make wise investment choices.

The application uses statistical analysis methods and machine learning algorithms to produce extremely precise forecasts about the price of gold in the future. It makes predictions based on a range of factors that affect the gold market, such as geopolitical conditions, global economic trends, and inflation rates.

Users of the programme can access current market data, historical price trends, and expert projections thanks to the application's user-friendly layout. The straightforward design makes it simple for users to access and analyse market data.

i. Why is the product required?

The Gold Price Prediction Application is required since investing in the gold market has a high degree of volatility and unpredictability. It is challenging to make precise predictions because a variety of factors, such as global events, political instability, and economic trends, influence the

price of gold. Consequently, having a reliable forecasting tool like the Gold Price Prediction Application can help users make smart investment decisions. Because it provides real-time market data, historical price trends, and expert predictions, users can stay ahead of the competition and make wise decisions.

ii. Real world applications.

The finance and investment sectors can use the gold price prediction tool in a variety of real-world contexts. Several potential uses include:
investment management: Investment companies can utilise the Gold Price Prediction Application to learn more about their clients' investment plans, which will help those clients earn higher returns.

Individual Investors: Individual investors are able to watch the gold market using this software, assess their own assets, and spot buying and selling opportunities.
Risk management: The application is beneficial for companies who employ gold as a hedge against currency volatility. By using the app to choose the best moment to purchase or sell gold, they may always be safeguarded against changes in exchange rates.

Mining Sector: The mining sector can monitor the gold market and use the application to inform operational decisions.

1.2 Survey of already existing solutions

Indian gold prices app:

This app was about Indian gold and silver market price values mainly on gold. They designed home page interface with live price of gold in every state. They have prepared the application with features as gold price and prediction value graphs and crude oil prices with some basic UX principles. They have used the Indian based gold, silver, crude oil prices and opening and closing values of different commodities. There is methodology to build application is like historical price information, technical analysis, and machine learning algorithms. Additionally, they might consider different economic data points like interest rates, inflation rates, and geopolitical developments that could affect the price of gold.

In this application they have used regression models, decision trees, neural networks, and other statistical models among other machine learning methods. To find patterns and trends in the gold market and forecast future price movements, these algorithms examine vast amounts of past data.

User experience of the product:

After using this application as a user for some days my user experience with the product was not so good. On a scale of 10 I can give 6 for user experience. This is due to not good interface and layout has maintained. Poor chance of memorability. This issue might be occurred because they didn't take multiple user evaluation surveys to improve the product. It didn't satisfy some basic principles of UX design such as memorability, learnability, error protection and it is also taking multiple clicks to navigate from one page to another while using.

It is also lacking some efficiency due to time taking to execute a particular task and it is also not so easy to understand the graphs. Overall satisfaction with the application is below average and the good point about the application is they have given multiple choices for user to know about the trends of gold price values and we can also get some knowledge about trading commodities by using news option.

Table of comparison

ELEMENTS	**Indian gold prices app:**	**GOLDN(OUR APPLICATION)**
Princples of ui design	Some of them were missing such as the memorability, learnability, error protection and it is also taking multiple clicks to navigate from one page to another while using.	We have tried to use almost all UI design principles in our application.
Ml model	Not sure which ML model they might have used, regression models, decision trees, neural networks, and other statistical models among other machine learning methods.	We have used Random forest method to predict the Gold Prices.
Overall user experience	After using this application as a user for some days my user experience with the product was not so good. On a scale of 10 I can give 6 for user experience	We asked our fellow classmates, they really appreciated the interface and were really impressed by the usability of the application.

2. System

2.1 System Architecture

The Gold Price Prediction application will consist of two main components: the user interface and the machine learning model.

The user interface will be built using the Flutter framework, which provides a fast and customizable way to develop high-quality user interfaces for mobile applications. The user interface will include input fields for users to enter various parameters such as the date range, gold price range, and economic indicators such as interest rates, inflation rates, and GDP growth rates. The interface will also display the predicted gold prices based on the selected parameters.

The machine learning model will be built using the Random Forest Regression algorithm, a powerful machine learning algorithm that can handle non-linear relationships between input variables and the target variable. The model will be trained using historical data on gold prices and economic indicators. The model will then be used to predict future gold prices based on the selected parameters.

The system architecture for the Gold Price Prediction application will include the following components:

1. **User Interface**: The user interface will be built using the Flutter framework and will provide a user-friendly way for users to input parameters and view the predicted gold prices.
2. **Input Parameters**: The user interface will include input fields for users to enter various parameters such as the date range, gold price range, and economic indicators.
3. **Machine Learning Model**: The machine learning model will be built using the Random Forest Regression algorithm and will be trained using historical data on gold prices and economic indicators.
4. **Prediction Engine**: The prediction engine will use the trained machine learning model to predict future gold prices based on the selected parameters.
5. **Data Storage**: Historical data on gold prices and economic indicators will be stored in a database or data warehouse.
6. **APIs**: APIs will be used to retrieve data from external sources such as financial news sites, economic data providers, and social media platforms.

Overall, the system architecture for the Gold Price Prediction application will involve integrating the user interface, input parameters, machine learning model, prediction engine, data storage, and APIs to provide users with accurate and reliable predictions of future gold prices.

System architecture- diagram

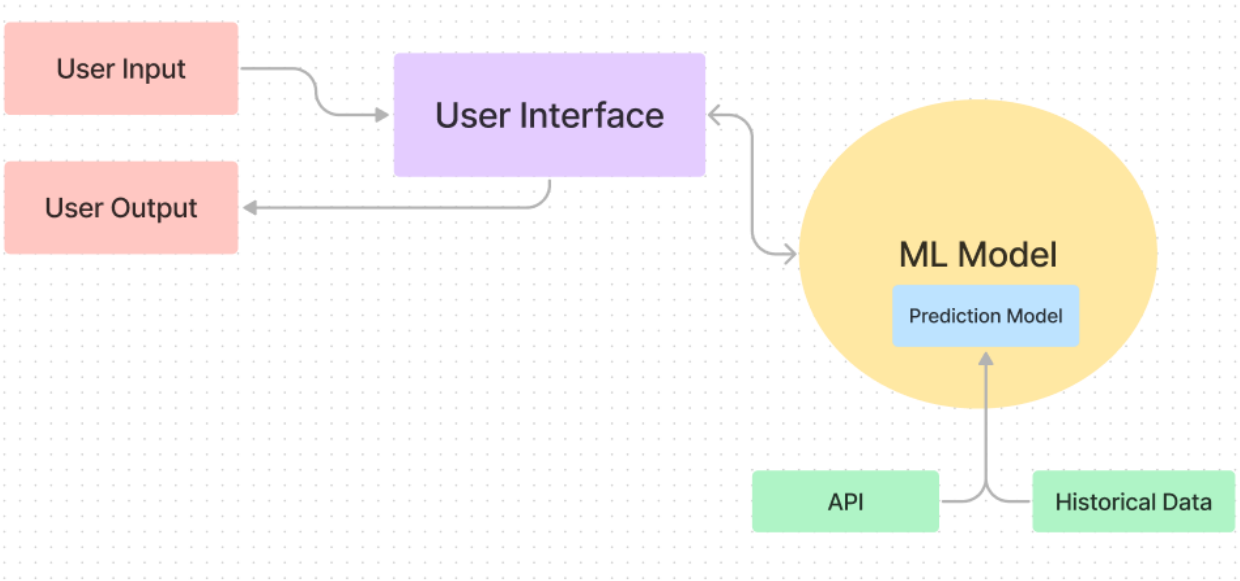

Figure.1

2.2 Features and their significance

Feature within the application	Associated design principle	Significance of the feature
Live Price	Visibility	This feature displays the current costs of gold, silver,and inflation. This helps the user study the current market and will help them decide whether they should invest or not. This also helps the users check the growth of the gold or silver price.
Prediction	Consistency	This feature will take the volume and the date in the future as user input to predict the gold price, silver price, or gold stocks. This feature is extremely helpfulfor the users to know what the future value of gold is; this will give confidence to the newcomer investors who have bare knowledge about investing.
Graphical Representation	Visibility	The time series graph of the price is displayed on the prediction page, which helps the users to understand theprice growth. The experienced investor can check the variation in the price and study the market.
Customer Support	Feedback	Sometimes, the users might have doubts regarding theapp, and they might also face some technical errors inthe application. They need to communicate with the

		technicians to solve their problem. This feature Provide the contact details to the users so they can communicatewith the service centre.
Notifications	Feedback	The application might get some urgent requirement such as updating the profile. The user must be informedabout those sudden requirements, the notifications will keep on updating the user the app.
News Feed	Feedback	The application will give updates to the users regardingthe variation in the gold price by sending notifications. This feature will help users identify a sudden rise or fall in price.

2.3 Technology stack

1. **Programming language:** Flutter for building the mobile app and Dart for designing the UI/UX.
2. **Machine learning model:** Random Forest implemented using Python and Flask
3. **Database:** MongoDB for storing the data and user information.
4. **Back-end framework:** Flask for building the API that communicates with the ML model and database.
5. **Front-end framework**: Flutter for designing the user interface of the app.
6. **Cloud platform:** AWS or Google Cloud Platform for hosting and deploying the app.

3. Methodology

3.1 ML CRISP

Business understanding

Background:

1. **Why are we choosing this subject for our project?**

• Skill development: Data accumulating, information pre-processing, characteristic engineering, model selection, and assessment are only a few of the stairs involved in predicting the rate of gold. By participating on this challenge, a student can advantage actual experience in those important talents, which can be very useful within the statistics science and machine learning industries.

• Practical application: By resolving this issue, a pupil can study greater about how system gaining knowledge of can be used to resolve troubles inside the actual international and boost the field of finance.

• Research opportunities: Predicting the fee of gold is a well-known research problem inside the machine getting to know network. This undertaking offers college students the danger to analyze contemporary field research, spot understanding gaps, and advise sparkling procedures to raise prediction accuracy. (sci hub, 2019)

2. How will this mission assist the concerned character?

Gold price prediction can also be helpful and crucial on a non-public level for the subsequent motives: (sci hub, 2019)

• Investment selections: If they're thinking about making an investment in gold, predicting the future rate of gold allow you to make knowledgeable choices about whilst to buy or sell.

• Financial planning: gold rate prediction also can be beneficial in economic making plans. If you've got gold as a part of your funding portfolio, understanding the potential destiny value of your gold holdings assist you to make higher selections about your general economic plan.

• Personal finance: Predicting the price of gold can also be vital for private finance choices. For example, if you are planning to sell some of your gold rings or coins, knowing the destiny rate of gold allow you to determine when to sell to get the first-rate price.

• Inflation hedge: Gold is regularly used as an inflation hedge, that means that its price has a tendency to upward push all through durations of inflation.Predicting the destiny rate of gold allow you to defend your purchasing strength by means of making an investment in gold throughout periods of anticipated inflation

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Business goals:

• **Improve accuracy**: Another objective might be to enhance the accuracy of gold fee predictions, as this would assist to attract extra users and retain current ones.

• **Expand purchaser base**: The utility may additionally aim to make bigger its consumer base through focused on new markets or demographics.

• **Enhance consumer engagement:** The application may also aim to beautify consumer engagement through offering additional capabilities or offerings, including indicators, notifications, or personalised pointers.

• **Improve operational performance**: Finally, the application may additionally goal to enhance its operational performance with the aid of optimizing its business methods, reducing costs, and streamlining operations, with a purpose to boom earnings.

Inventory of sources for gold fee prediction:

1. **Market records**: Market data at the present day and historical fee of gold is a key resource for gold price prediction. This consists of records on gold futures contracts, ETFs, bodily gold charges, and other gold-related economic gadgets.

2. **Economic records**: Economic information, which include GDP boom, inflation prices, hobby prices, and currency trading charges, may be used to generate insights into the overall fitness of the financial system and its capability impact on the gold market.

3**. Supply and call for facts**: Data on gold mining production, gold consumption, and gold exports and imports can be used to understand the supply and demand dynamics of the gold market.

4**. Technical analysis**: Technical analysis includes using charts and other technical indicators to perceive patterns in the gold market and make predictions approximately future rate moves (sci hub, 2019)

. Constraints of gold rate prediction:

1. **Limited information**: The gold market is rather small and risky, and there's often restricted records to be had on marketplace traits and movements. This can make it hard to perceive styles and traits in the gold marketplace and make correct predictions about future rate moves.

2. **Unforeseeable activities**: Geopolitical events, such as modifications in authorities coverage or surprising natural screw ups, can have a full-size impact on the gold marketplace. These activities can be difficult to expect and may purpose unexpected and huge modifications in the rate of gold.

3**. Market manipulation:** The gold market is situation to market manipulation by means of large gamers, that may make it difficult to accurately are expecting marketplace movements.

4**. Lack of transparency:** The gold market is often characterised by using a loss of transparency, which can make it hard to appropriately assess supply and demand dynamics and make knowledgeable predictions approximately future fee actions.

5. **Limited information of market fundamentals**: Despite the significance of information marketplace fundamentals, there may be often restricted knowledge of the complicated dynamics that pressure the gold marketplace.

GOALS

1. **Increase revenue**: Increasing revenue through subscriptions, premium services, or advertising could be the main goal of a gold price prediction app.

2. **Increase accuracy:** Increasing the accuracy of gold price predictions could serve as another goal as it would help draw in new users while maintaining current ones.

3. **Increase customer base**: By focusing on new markets or demographics, the application may try to increase its user base.

4. **Increase user engagement:** By providing extra features or services like alerts, notifications, or tailored recommendations, the application may try to increase user engagement.

5. **Establish brand leadership:** Through thought leadership, content marketing, or strategic partnerships, the application may seek to become a market leader in the gold price prediction space. (sci hub, 2019)

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Data collection report:

To collect data for gold price prediction, we used a variety of sources including online databases and financial websites. Our team focused on collecting both historical and current data to ensure that our model can make accurate predictions. We also obtained the data from a website called Kaggle.

The dataset used in this project includes macroeconomic data such as inflation rates, interest rates, and which were collected from the open sources like internet and articles.

```
df1 = df[(df['Name_of_the_commodity'] == 'GOLD')]
df1
```

	Year	Month	Date	Name_of_the_commodity	Open_Price_In_Rs	High_Price_In_Rs	Low_Price_In_Rs	Close_Price_In_Rs	Notional_Turnover___Options/_Turnover_Futures_in_Rs	Trading_Volume_In_Lots	Open_Interest_\
45	2015	December	2015-12-01 00:00:00	GOLD	25183.0	25218.0	24973.0	24994.0	5.457468e+09	2171.0	
46	2015	December	2015-12-01 00:00:00	GOLD	25375.0	25442.0	25216.0	25239.0	3.789530e+10	14942.0	
47	2015	December	2015-12-01 00:00:00	GOLD	25448.0	25553.0	25331.0	25364.0	4.484650e+08	176.0	
50	2015	December	2015-12-01 00:00:00	GOLD	26143.0	26143.0	26130.0	26137.0	7.841100e+06	3.0	
150	2015	December	2015-12-02 00:00:00	GOLD	25065.0	25127.0	24814.0	24840.0	5.884058e+08	235.0	
...	...	...	...	...	...	...	...	...	...	...	
2171	2015	November	2015-11-27 00:00:00	GOLD	25401.0	25435.0	25275.0	25308.0	1.470600e+08	58.0	
2285	2015	November	2015-11-30 00:00:00	GOLD	24994.0	25115.0	24935.0	25069.0	2.295156e+10	9182.0	
2286	2015	November	2015-11-30 00:00:00	GOLD	25117.0	25298.0	25092.0	25263.0	2.102053e+10	8352.0	
2287	2015	November	2015-11-30 00:00:00	GOLD	25239.0	25354.0	25173.0	25306.0	2.423451e+08	96.0	
2288	2015	November	2015-11-30 00:00:00	GOLD	25404.0	25415.0	25404.0	25410.0	5.081900e+06	2.0	

1806 rows × 13 columns

Figure.2

The daily and weekly gold prices, gold futures prices, and exchange rates that make up the gold market statistics were gathered from financial websites including Bloomberg, Yahoo Finance. Bloomberg, and the Wall Street Journal were just a few of the news outlets from which information was gathered.

Data description:

We are using two distinct datasets for this project, one for gold price prediction and the other for gold stock price prediction. We have six aspects in the gold price data, including date, SPX, GLD (gold price), USO, SLV, Inflation rate. The gold stock price data includes maximum price and minimum price value of the stock on that day and volume of the stock.

```
[ ] print('Shape of data: ', df.shape)

    Shape of data:  (58587, 26)
```

Figure.3

The dataset consists of over 59000 records, with over features including date, gold prices, inflation rates, interest rates, gold futures and crude oil prices. There were no missing values in the dataset, and data quality checks were performed to ensure accuracy and consistency.

```
df.info()

<class 'pandas.core.frame.DataFrame'>
Int64Index: 58587 entries, 3 to 2361
Data columns (total 26 columns):
 #   Column                                                    Non-Null Count  Dtype
---  ------                                                    --------------  -----
 0   Year                                                      58561 non-null  object
 1   Month                                                     58457 non-null  object
 2   Date                                                      58457 non-null  datetime64[ns]
 3   Derivative segment                                        58457 non-null  object
 4   Instrument Type                                           58457 non-null  object
 5   Name of the commodity                                     58457 non-null  object
 6   Symbol                                                    58457 non-null  object
 7   Expiry Date                                               58457 non-null  datetime64[ns]
 8   Price unit                                                58457 non-null  object
 9   Option Type                                               58457 non-null  object
 10  Strike Price (In Rs)                                      58457 non-null  object
 11  Open Price (In Rs)                                        58457 non-null  object
 12  High Price (In Rs)                                        58457 non-null  object
 13  Low Price (In Rs)                                         58457 non-null  object
 14  Close Price (In Rs)                                       58457 non-null  float64
 15  Clearing/Daily Settlement price                           58457 non-null  float64
 16  Spot Price for basis variety (in Rs)*                     58457 non-null  object
 17  Premium Turnover (in Rs)                                  58457 non-null  object
 18  Notional Turnover   (Options)/ Turnover (Futures) (in Rs)  58457 non-null  object
 19  Trading Volume (In Lots)                                  58457 non-null  object
 20  Open Interest
(In Lots)                                          58457 non-null  object
 21  Lot size and unit                                         58457 non-null  object
 22  Open Interest (Options Notional Basis) / Open Interest (Futures) (in Rs)  58457 non-null  object
 23  No.of trades                                              58457 non-null  object
 24  Mode of Trading (% of Turnover)                           58457 non-null  object
 25  Unnamed: 25                                               58457 non-null  object
dtypes: datetime64[ns](2), float64(2), object(22)
memory usage: 12.1+ MB
```

Figure.4

The above fig describes about the different type of data structures present in the dataset. And some primary information about the dataset.

MODELING:

Random forest regression is a popular machine learning algorithm for making predictions based on multiple input variables. It is particularly useful for predicting outcomes in complex systems with many variables, where traditional statistical methods may struggle.

When it comes to gold price prediction, random forest regression can be effective for several reasons:
Non-linear relationships: The relationship between gold prices and other variables, such as economic indicators, can be complex and non-linear. Random forest regression is well-suited to identifying these non-linear relationships and making accurate predictions based on them.

Handling missing data: gold price prediction often involves dealing with missing or incomplete data. Random forest regression can handle missing data effectively, making it a useful tool for this kind of analysis.

Robustness to outliers: Random Forest regression is less sensitive to outliers than some other regression methods. This means that it can produce more accurate predictions even when the data contains extreme values.

Ability to handle large datasets: Random Forest regression can handle large datasets with many variables, making it a good choice for gold price prediction projects that involve a large amount of data.
Ensemble method: Random Forest regression is an ensemble method, which means it combines the results of multiple models to make a final prediction. This can improve the accuracy and stability of the prediction compared to a single model.

From our literature review we also acknowledged these things and found that "RANDOM REGRESSION METHOD" is best for doing this project. Overall, the combination of these factors can make random forest regression an effective tool for gold price prediction

3.2 Human Computer Interaction

Identification of usability parameters

Iteration #	Date/Month	Number of Participants	Type of Participants	Method of Feedback	Type of usability issueencountered	Improvement from previous iteration
1	**14/3/2023**	**5**	Students from BMU	Think Aloud	The user was perplexed by the search bar and the icons and settings icon on the main page. Additionally,the search was combined with an app symbol and a profile icon, whichcaused confusion for the user.	Now that thesearch bar portion is divided, the profile symbol is located in theupper-right area, with the icon separated to the left and the search bar in the middle.

2	**31/3/2023**	**7**	Team members	**Survey**	Text should be smaller, icons should all be the same size, and borders should be thinner on both sides. Both text and icon sizes should beconsistent.	We reduced the border on both sides, made all icons the same size, and uniformly sized all the text across the app as a result of the improvement of the application.

3	**12/4/2023**	**3**	University staff	**Intervie w/survey**	Users had confusion while attempting to access the predict option due to the incorrect icon used to represent the predict mode in the middle navigation bar and its failure to accurately explain the feature's purpose.	As a result, the icon was modified to a text bar, and at the bottom, bars were added with distinct columns for gold, silver, and gold stocks so that users could go to the desired selection.

4	**19/4/2023**	**6**	professors	**Expert review**	There is no provision for signing up or logging in with a Google or Facebook account.	With the usability issues faced created the option to login through google and Facebook account, colour gradings were improved.

Qualitative Parameters:

Design principles and Features used in the application

Principles of Learnability: -

Predictability: It refers to the ability of users to predict what will happen nextbased on their previous experience with the system.

As an illustration, the user may see multiple buttons on the home page when he first visits the app. These buttons are all grouped together under sections that describe how they work. What to do next is clear to the user. Three buttons maybe seen in Fig 2. under the name "predict." The user is aware that clicking on those buttons will take them to the prediction page. (nngroup.com, 2018)

Fig 5

Synthesizability & Consistency: Synthesizability refers to the ability of users to understand how different parts of the system work together. Consistency refers tothe ability of users to understand how different parts of the system work togetherin a consistent way. (nngroup.com, 2018)
It is helpful to use a feature from a gold price prediction app to explain; the user is notified whenever there is an update to the news feed area of the app. This could serve as a reminder that updating the news feed and sending out notifications are two separate system components that operate well together consistently.

Fig 6

Familiarity: It refers to the ability of user to recognize and understand elements of the system based on their previous experience with similar systems. The user should get to know what the result is once he is about to performs the action. In the application he gets to know by glancing at the profile pic that he will be directed to the profile page once he clicked on it. In the same way symbols,text, contexts will make the user let know by the previous experience. For a newuser also, he gets to know by looking at the icons/context/highlights.

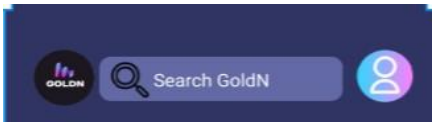


Fig 7 Fig 8

Generalizability: It refers to the ability of users to apply their knowledge of one part of the system to other parts of the system.

Numerous pages carry out identical tasks, such as the stock value, gold price, andsilver price prediction pages. They will provide predicted values after receiving user input (volume and time). The user can use the silver price and gold stocks prediction pages once they have a basic understanding of how the gold price prediction page functions.

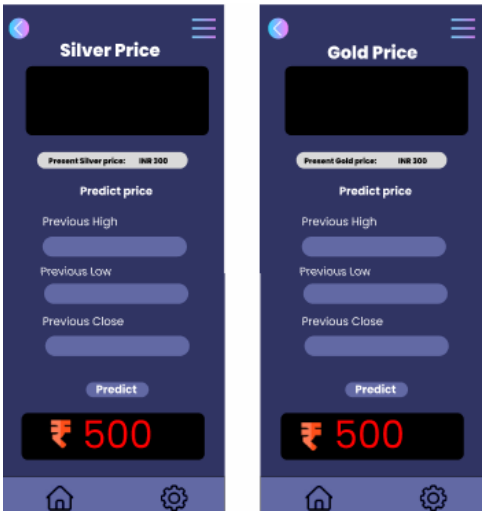


Fig 9

Types of Learnability

Cognitive Learnability: It refers to how easily user can understand the functionality of a product or system. An example of cognitive learnability is learning how to use a new software program.

Associative learnability: It refers to how easily users can associate certain actionswith certain outcomes. An example of associative learning is learning how to usea new smartphone app.

When the application was first being tested, users who observed it reported they couldn't locate the predict page since it was muddled up with other features. Thisproblem was fixed by keeping the prediction pages together and adding headings.These adjustments made it simpler for the consumers to comprehend how the application functions.

Each feature has a unique icon that explains how it works. For instance, the deleteoption on the news feed page is symbolized by a dustbin image, making it simplefor users to grasp how it works. The majority of users learned how to utilize the application in a fairly short amount of time.

Contextual Learnability: It refers to how easily users can understand the contextin which a product or system is used. An example of contextual learnability is learning how to use a new piece of machinery in a factory.

Efficiency: -

Efficiency is the ability of a system or product to enable users to complete activities swiftly and easily. It is the goal of reducing the time and effort needed to execute a task. This can be accomplished using a variety of design approaches,including cutting down on the steps needed to execute a task, offering shortcuts for frequently performed operations, and lowering the time needed to access information**.**
To access any aspect of the application, we often needed two clicks (got to knowfrom the user's survey). The ability to access all information and features directlyfrom the home page has been praised by users.

Memorability: -

The term "memorability" describes how quickly people can recall how to utilize an interface after going a long time without using it. This is crucial since consumers might not commonly use an interface and would need to learn how touse it again each time they come back. Designers can utilize logical and consistentdesign patterns, such as using standardized icons and vocabulary, to increase memorability. Designers can also offer feedback and instructions that are preciseand clear to assist users in using the interface.

In the home page of the application, the buttons are grouped together under a titleand carry out similar tasks. The addition of the icons to the options makes it possible for the user to comprehend each one's purpose just by glancing at it.

For instance, the profile button features a person's face as its icon, while the logout button is next to an exit icon. The trashcan picture used as the delete button,which can be seen in image below. All of these will aid in the user's comprehension of how the functions operate. Even if the user returns to the application after a lengthy absence, they will quickly recall how it functions.

Fig 10

Error Protection: -

Error protection describes the techniques used to stop or fix faults that could happen while a user interacts with an interface. This can be accomplished by giving users feedback, adopting consistent design principles, and offering clear and unambiguous instructions.

The ability to undo user actions, the use of uniform terminology, and clear error messages can all help achieve this.

Designing interfaces that can withstand user failures without having serious consequences is known as error tolerance. (Neil, 2012)

Fig 11

People can learn from the above image that they must enter the previous day high, low, and closing rate of the gold price, beingpermitted. so thishelps in minimizing user mistakes.

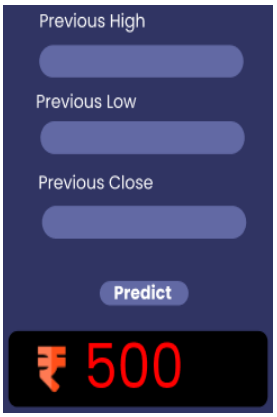


Fig 12

Satisfaction: -

Users' levels of satisfaction with an interface are measured after they use it. Thisis crucial since happy users are more likely to stick with an interface and refer others to it. Several techniques, including employing consistent design patterns, clear and succinct instructions, and asking users for input, can be used by designers to increase user happiness. Additionally, designers can employ user testing to pinpoint locations where customers could feel dissatisfied or perplexed and modify the user interface in those areas.
Additionally, a considerable number of improvements have been made to the application after multiple iterations in which several user recommendations were considered, and a revised/updated application prototype has emerged. Users werepleased with the programme as a result of this procedure. (Neil, 2012)

Utility: -

Utility describes how well a user interface satisfies their needs. Users are more likely to use an interface that fits their demands and offers them value; therefore,this is crucial. The use of consistent design patterns, clear and straightforward instructions, and user research to determine user needs and preferences are just afew techniques designers can employ to increase utility. Additionally, designers can use user testing to pinpoint any areas of the interface where users could struggle with it and adjust it accordingly.

We identified the issues that users believe need more change from the usability table above. The usability flaws have been addressed and resolved in subsequentupdates/iterations.

3.3 Mobile Application Development

Our app is designed to provide users with accurate predictions on the future prices of gold and silver. By utilizing cutting-edge technologies such as artificial intelligence and machine learning, our app analyses a wide range of data sources such as market trends, historical prices, economic indicators, and more to generate reliable predictions.

The app is person-pleasant and intuitive, allowing customers to without difficulty get entry to actual-time updates at the costs of gold and silver. Users can customize their settings to receive signals when the fees of those precious metals attain sure levels or when there are big changes in the marketplace. Important widgets used inside the application:

1. **Container**: To make a square container, use this widget. The Live Gold Price field and the app's historical past are both created using this code. (Panigraphy, 2015)
2. **Scaffold:** Using this widget, a body, a backside navigation bar, and a top app bar are created as a fundamental material design scaffold. In a fabric app, it is normally the primary widget to appear
. 3. **AppBar:** Using this widget, a top app bar may be created with a identify, actions, and navigation icon that are all predetermined. It can be used as a scaffold's child widget. (Panigraphy, 2015)
4. **Stack:** Used to set up widgets in a vertical stack. The diverse widgets are placed at the display the use of this code.
5. **Positioned**: We used this widget to place a widget relative to the Stack it is in. In this code, it is used to put the unique icons and textual content fields on the display screen. (Panigraphy, 2015)
6. **Text:** This widget is used to display textual content with a specific fashion. It requires you to specify the textual content string, the font family, font size, and colour of the textual content.
7. **Navigator:** A widget that allows you to navigate between one-of-a-kind monitors or routes on your app. It takes a context and a MaterialPageRoute as arguments. (Panigraphy, 2015)
8. **MaterialPageRoute**: A magnificence that defines a path that indicates a Material-style conversation field or Fullscreen modal. It takes a builder feature as argument that returns the widget that ought to be displayed while the direction is pushed. (Panigraphy, 2015)
9. **TextField**: used to display a string of textual content and has numerous homes that may be customized, which includes fashion to set the font, length, coloration, and different text properties. In this code, it's far used to create the hunt bar. (Panigraphy, 2015)

10. **Icon** : This widget is used to show icons from numerous icon sets inclusive of Material Icons and FontAwesome. It requires you to specify the icon records and the dimensions of the icon (Panigraphy, 2015)

11. **GestureDetector:** used to hit upon gestures like taps, drags, and long presses. In this code, it's miles used to hit upon faucets on the User icon. (Panigraphy, 2015)

12. **FutureBuilder**: used to construct a widget tree based totally at the brand new snapshot of a Future. In this code, it is used to show the modern gold fee fetched from the GoldPriceService.

13. **Switch**: A fabric design widget that permits the consumer to toggle among states - on and stale. It takes price, onChanged and activeColor as arguments. (Panigraphy, 2015)

14. **SizedBox**: A widget that forces its child to have a selected width and/or top. It takes width and peak as arguments. (Panigraphy, 2015)

15. **BorderRadius**: This widget is used to create a rounded border for a square widget. It calls for you to specify the horizontal and vertical radii of the border. (Panigraphy, 2015)

16. **IconButton**: This widget is used to create an icon button with a precise icon records and a callback characteristic that is precipitated whilst the button is pressed. (Panigraphy, 2015)

17. **CircleAvatar**: This widget is used to create a circular avatar photograph with a specified radius and photograph supply. It may be used as a child widget of a GestureDetector. (Panigraphy, 2015)

18. **CircularProgressIndicato**r: This is a widget in Flutter that suggests a spinning wheel to indicate that the app is busy or loading. It is regularly used to expose development whilst the app is awaiting statistics to be fetched or for a mission to be finished. (Panigraphy, 2015)

.**Dependencies used in the application** (Tjondronegoro, 2013)

Flutter: SDK for building native mobile applications using Dart programming language.

cupertino_icons: A package that provides the icons that are designed for the iOS platform in Flutter.

http: A package that provides a way to make HTTP network requests in Flutter.

flutter_launcher_icons: A package that provides an easy way to generate launcher icons for both Android and iOS apps.

flutter_icons: A package that provides a way to generate Android and iOS app icons with just one command.

flutter_test: A package that provides a way to write unit and widget tests in Flutter.

Backend functionalities in the application

- **Live Gold and Silver Prices:**

  The present values of gold and silver are displayed on the first page of the application, which will help the user know the status of gold and silver in the market. The data is fetched to the screen using the metal price API from the goldapi.io website.

- **Prediction Page:**

  The application consists of a machine learning model that predicts the future price of gold. The application takes the previous high, low and closing values of gold and silver as user input and displays the predicted gold price and silver price.

- **The Gold and Silver price predictions:**

  The gold and silver prices are displayed on the gold and silver prediction pages, respectively.

- **Notification:**

The application will keep users informed by delivering notifications when the price of gold changes. The application promptly notifies the user of any price changes by letting them know how much the value of gold has changed

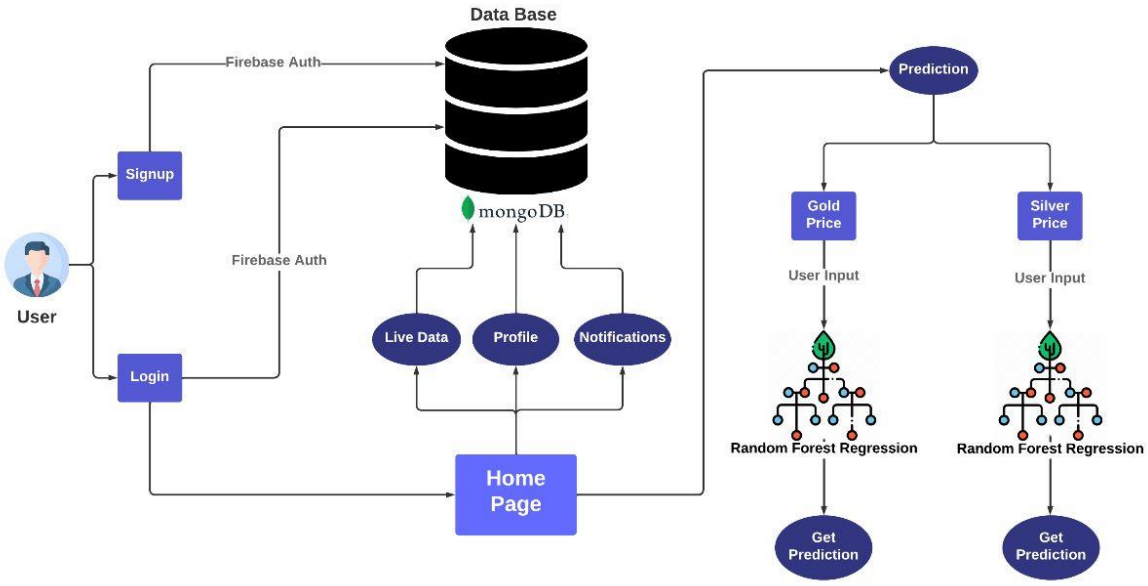


Figure.13

4.Result

4.1 UI results

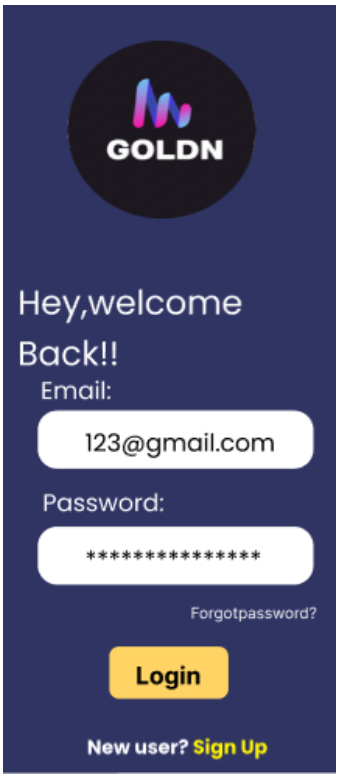


Figure 14

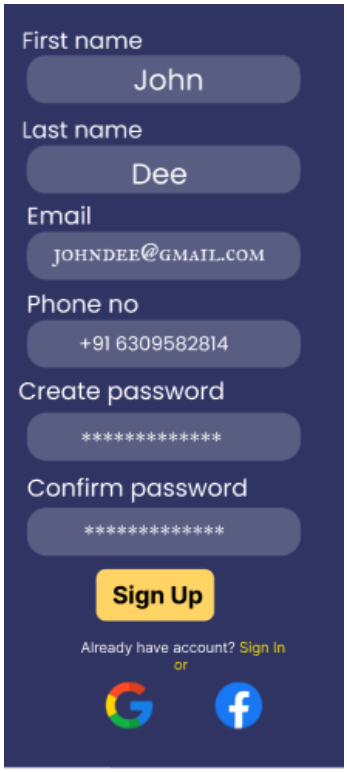


figure 15

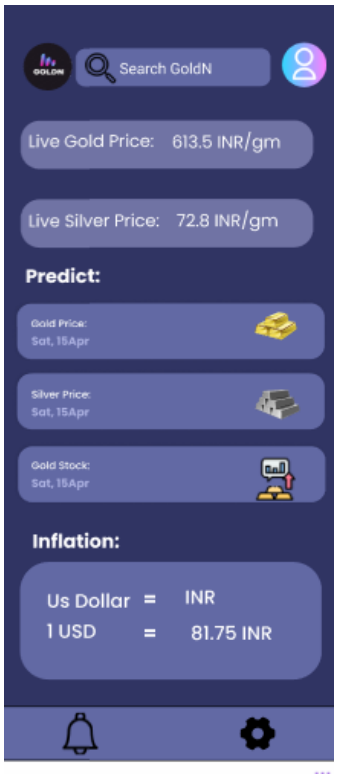


figure 16

The first figure is the welcome page of our Gold Price prediction application, it includes the user to enter the email and password to login or sign up to the application.

The second figure here shows the sign up page, for the user when they visit the application for the first time they can enter all their details and create an account using the UI of this application.

The third figure here shows the homepage that appears to the user when the user has logged into his account. It has option to predict silver gold and gold stock, also shows the inflation rates and the live prices of both silver and gold.

Figure 17

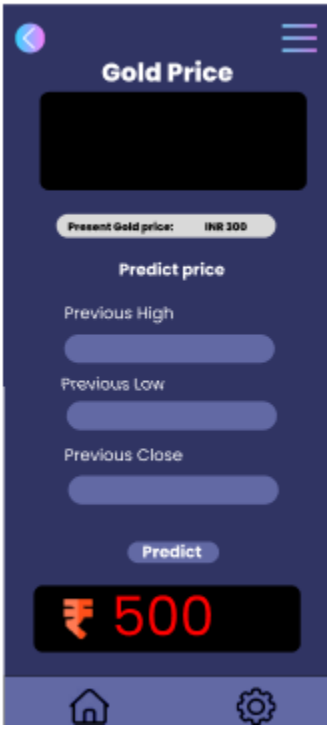
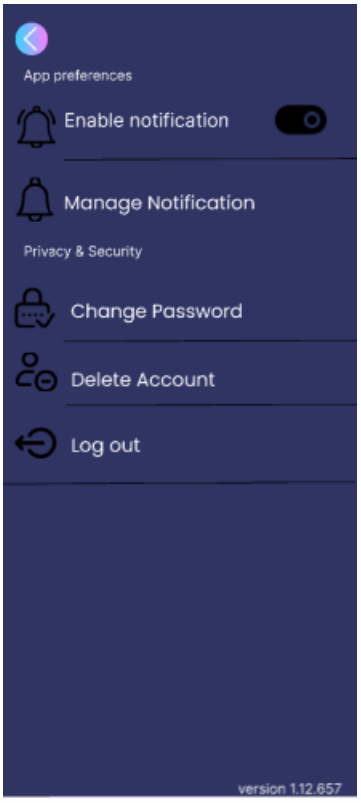
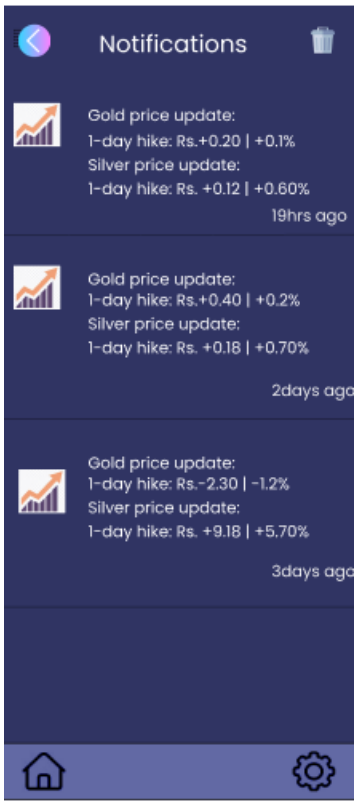


figure 18

- The first figure here is the prediction screen for the values of the silver price.
- The second figure here is the prediction screen for the values of the gold price.





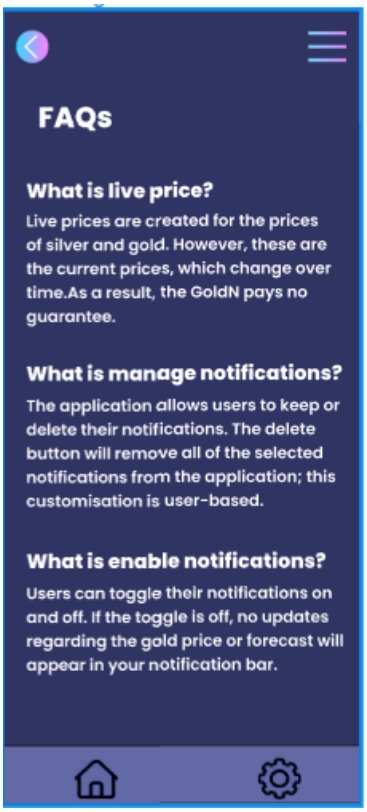


Figure 19 figure 20 figure 21

- The first figure here is the screen that appears when we click the settings button.
- The second figure here is the screen that appears when we click settings notification.
- The third figure here is the screen that appears when we click FAQs in settings page.

4.2 ML Results google colab notebook

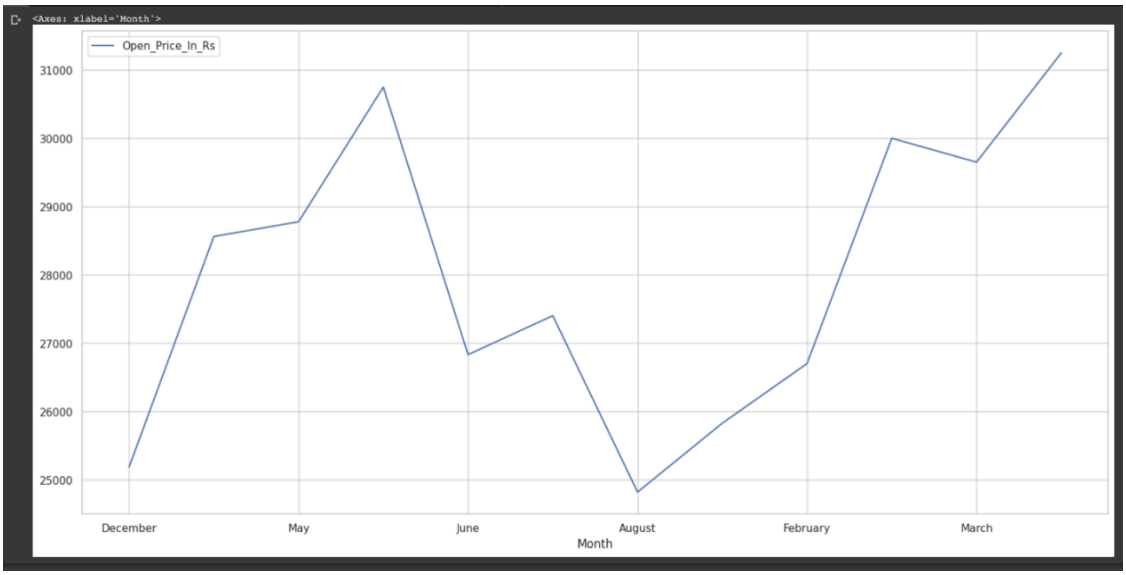


Fig 22

This figure represents the time line graph of month vs open price value of gold prices. from this figure we can see that the price of gold is gradually increasing but at some point it decreased suddenly it may be because of real world volatility that because of some other commodity prices and market values.

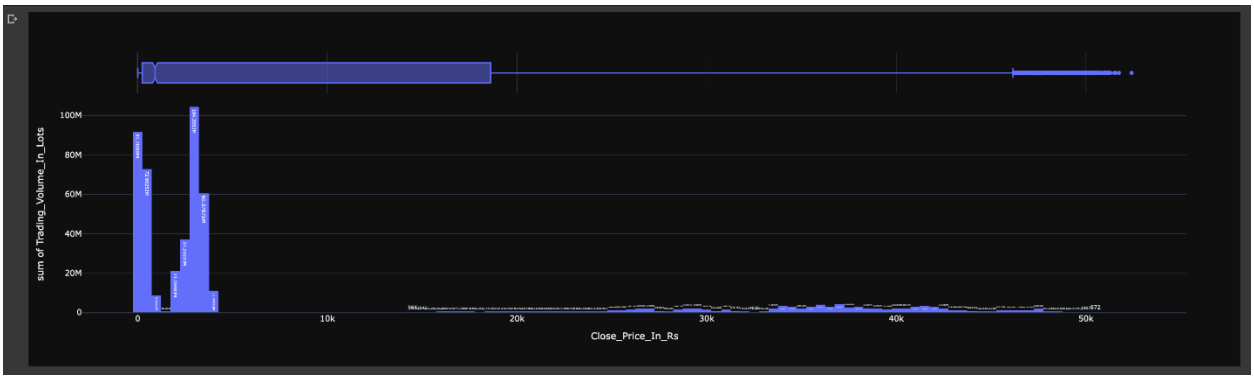


Fig 23

The histogram is a popular graphing tool. It is used to summarize discrete or continuous data that are measured on an interval scale. It is often used to illustrate the major features of the distribution of the data in a convenient form. it is used to know the insights of a variable in a timeline

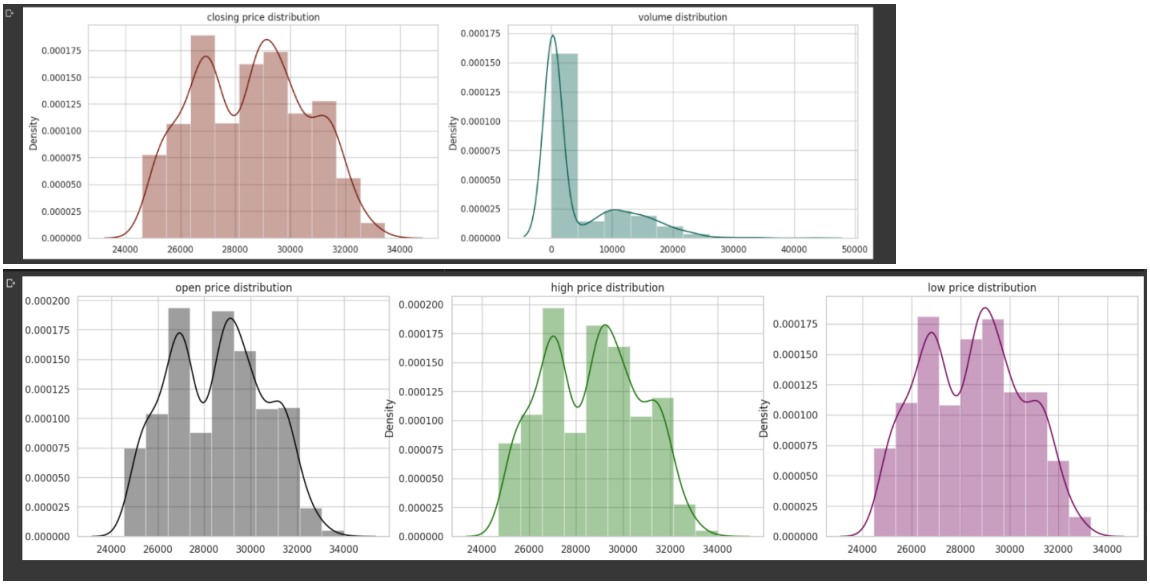


Fig 24

This figure represents the distribution plot or histogram which is a univariate data analysis which means which means the data distribution of one variable will be shown against other variable to summarize discrete or continuous data that are measured on an interval values and we can also analyse the relation between the two variables and also time vs one variable value

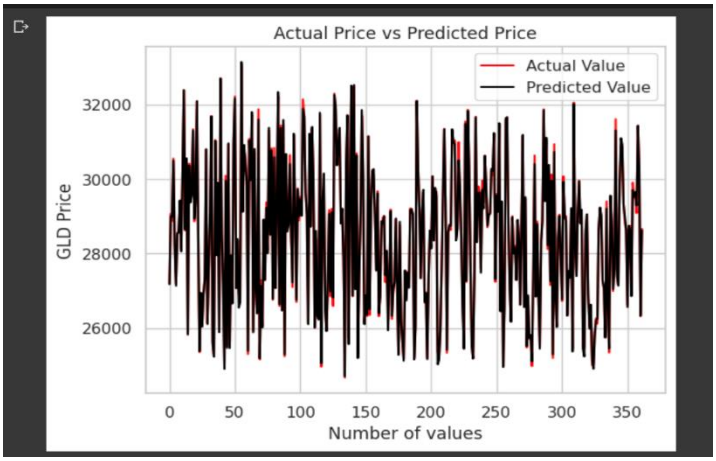


Fig 25

This figure represents about difference between predicted value and actual price value of gold. this is done using the random regression tree algorithm with 150 estimators(tree) where first we will split the data into train and test sets and we will apply regression analysis algorithm on it and we will use test data to know the accuracy of prediction value and we can check the accuracy based on some parameters like RMSE,MSE.

5.Project management

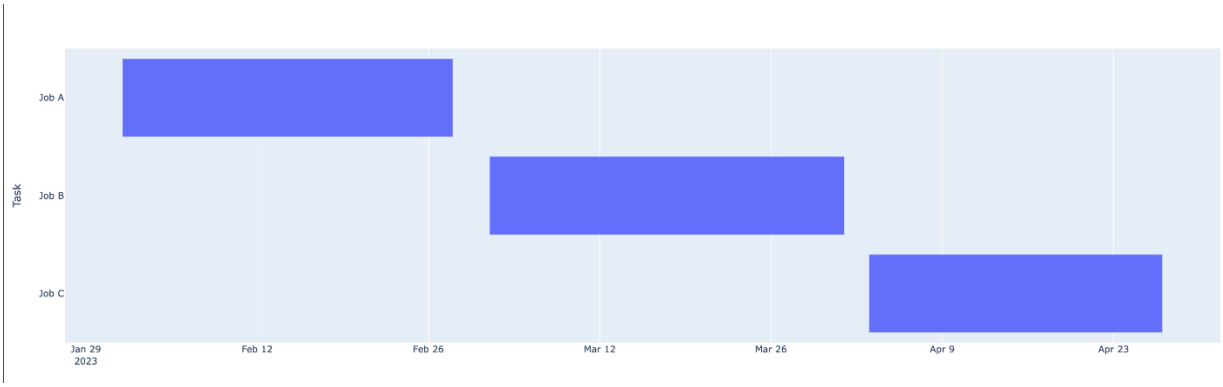


Fig 26

5.2- TASK A:

We have started collecting data from various resources such as online websites, MCX, etc. And we have started creating a prototype for our mobile application by using software called figma in which we can create a basic user interface design with some HCI principles like usability, memorability, and error protection.

TASK B:

After creating the prototype in figma we have figured out the algorithm that which needs to be used and fit for the data set has been used based on quality and quantity of our dataset. And then we have started the ML-CRISP which is the quality methodology serves to mitigate risks that affect the success and efficiency of the machine learning application. So, then we did univariate and bi-variate analysis, before this we have cleaned our data and pre-processed for better understanding and results. And for Mobile application we used flutter software using dart programming language. And also, we have took some surveys from some targeted users and students to identify the usability issues in our mobile application design to update them based on the user feedback to make it more efficient.

TASK C:

We have completed our flutter application design and created a database to store the data. And using the ML algorithm we have tested and trained the dataset and using two to three algorithms to check the accuracy between predicted and actual value. We took usability evaluations and connected the live price using APX to mobile application and have finally been able to make a detailed report of the project

5.3 How did you split up project amongst yourself? How were the tasks distributed amongst yourself?

We are 6 members in the group so we assigned the work in 2's, 2 of us were doing the UI designing part, the other 2 were working on the Flutter app development and the remaining 2 worked on the ML model and data collection. All of us collectively worked for the reports and all presentations.

6.Discussions

6.1 Key Learnings

The ability to expand the application's scope in several ways is one of the key lessons learned from this project.

Data pre-processing: because gold price data often contains noise and outliers, which can affect the accuracy of prediction. To mitigate this, we need to pre-process the data by applying various statistical techniques such as data cleaning etc.

Model selection: there are several machine learning models which are used for time series prediction project. such as ARIMA, LSTM, Random regression tree method and we need to find the best fit one for our project based on our quality and quantity of our dataset to get best results with good accuracy.

We also have learned the principles of design that need to be maintained while doing any mobile application and the user experience principles. These are some major key learnings from this project.

a. Limitations

1) As there were not many existing applications based on gold price prediction it has limited us to know more about the existing features and it was difficult to understand the need of the investors because no such application had received any feedback before this.

2) The data availability has been a big limitation while doing this product because the availability of quality data is essential for accurate prediction. And gold price data was not readily available in internet or in any other resources and the data which we got might be unreliable or incomplete.

3) The market volatility was also a limitation due to gold market can be highly volatile and prices can fluctuate rapidly in response or change in investor sentiment, and it will become challenging to us to predict the price values accurately.

4) And the biggest limitation for this project is assumptions and limitation of models, various models used for gold price prediction are based on certain limitations and assumptions. These assumptions may not always hold true in real world and these limitations of model may affect the accuracy of the price value.

6.2 Challenges

- **User Interface Design:** The user interface of the application needs to be intuitive and user-friendly, providing users with easy access to relevant information and features. This will be challenging because this mobile application targeted users can also be uneducated but might be interested in investing, so to make sure them to navigate easily in the application it will be challenging to create an interface.

- **Scalability:** Algorithms can become computationally expensive as the size of the user and item databases grows. This can make it difficult to provide real-time prediction to users.

- **Real-time Data Updates**: The gold price is highly volatile, and prices can fluctuate rapidly in response to news events or changes in investor sentiment. Therefore, the application needs to be updated with real-time data to provide accurate predictions to users.

- **Security and Privacy**: The application may require access to personal and financial data, such as credit card information. Therefore, ensuring the security and privacy of user data is crucial.

- **Monetization Strategy**: Developing and maintaining a mobile application can be expensive. Therefore, having a monetization strategy that balances the needs of the user with the financial sustainability of the application is crucial.

- **Real-time Data Updates**: The gold price is highly volatile, and prices can fluctuate rapidly in response to news events or changes in investor sentiment. Therefore, the application needs to be updated with real-time data to provide accurate predictions to users.

- **Model Complexity**: Developing an accurate prediction model can be challenging, and more complex models can be resource-intensive and may not be suitable for mobile devices with limited processing power.

6.3 Future scope

1. Including new data sources: We are including more data sources in our study, such as market mood, political happenings, and economic indicators. This can help us improve your model and produce more precise forecasts.

2. Extending to additional metals: Once we have a reliable model for forecasting gold prices, we may think about extending your research to other precious metals like silver, platinum, and palladium.

3. Creating a trading plan: With precise price forecasts, you may create a trading plan to take advantage of market patterns. This can entail applying our approach to find chances for purchasing and selling, or to guide long-term investment choices.

4. Building a platform for gold investors: With accurate price predictions, you can consider building a platform for gold investors to access your insights and make informed decisions. This could involve creating a subscription-based service or partnering with existing investment platforms.

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8. Plagiarism Report

GoldN_group17_report2023.pdf

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