Project Report

1. INTRODUCTION

1.1 Project Overview

Project Title: Forecasting bitcoin price using prophet time series analysis.

Goals and Objectives:

This project seeks to employ time series analysis tools with specific focus on Facebook's Prophet model to predict prices for bitcoin in the future. The objectives include:

Developing a Robust Forecasting Model: Build an efficient prophet model forecasting Bitcoin prices based on real world observations.

Evaluating and Enhancing Model Accuracy: Carry out thorough assessment of the model using different test and validate techniques. Make some improvements to enhance prediction precision for Bitcoins prices.

Documentation and Analysis: Prepare a full report on the entire period of the time series analysis including findings and conclusions drawn. Evaluate how Prophet can be used for calculating the prices of Bitcoins forward on their basis.

Demonstration and Dissemination: The team's results and codebase should be shared via a GitHub repository as well as a demonstrational platform showing how the Prophet predictor works particularly when it comes to forecasting cryptocurrency prices in time series problems.

By conducting some research into this area, this project hopes to aid the understanding and development of forecasting techniques relevant to cryptocurrency price prediction within financial market domains.

1.2 Purpose

Rationale for Choosing Bitcoin Price Prediction using Prophet:
The selection of Bitcoin price prediction using Prophet as the core focus of this project stems from several pivotal factors:

Growing Significance of Cryptocurrencies: This has prompted a lot of interest as well as investments in the development of digital currencies – the most popular one being Bitcoin which is a form of cryptocurrency whose rate of growth and popularity in the world's financial markets increase at an overwhelming speed. It is important to predict the right price of Bitcoin because it serves as a significant information to the investors, the traders, and the financial analysts on current market movements.

Complex Nature of Cryptocurrency Markets: Volatile volleys of cryptocurrency market with its inconsistent movements and sensitivity to other effects. The characteristics present some problems, including, among others, in the application of normal prediction techniques.

Prophet's Potential in Time Series Forecasting: The prophet framework in facebook has been getting recognition as to how it deals with timeline data that is known to be intricate and hence a possible choice when coming up with models of bitcoin prices. It has incorporated seasonality, trending, and holiday component and this match with the dynamic character of cryptocurrency marketplace.

Educational and Practical Implications: Through the discussion of forecasting bitcoin price with prophet, this project would be useful for traders and analysts and also educative regarding applying sophisticated time series analysis methods towards forecasting.

Opportunity for Evaluation and Enhancement: Thus, the research work will assess Prophet's ability and deficiencies in forecasting bitcoin pricing. uitgen ## Instruction: Convert the given sentence from AI written to human written The evaluation allows for fine-tuning and refinement of the forecasting model so as to increase its relevance and precision.
This implies that the selection of Bitcoin price prediction utilizing Prophet as a primary focus area can be used to investigate and exploit the power of modern time series models to tackle problems associated with fluctuating cryptocurrency markets so as to advance knowledge and improve accuracy of financial forecasts.

2. LITERATURE SURVEY

2.1 Existing problem

Challenges in Bitcoin Price Prediction:

The realm of Bitcoin price prediction is confronted with several inherent challenges:

Volatility and Non-linearity: Forecasting bitcoin prices is extremely challenging due to their volatile nature, not being linear and jumping.

Data Noise and Uncertainty: Prediction is more complicated because of noise in cryptocurrency markets based on regulatory shifts, market sentiments, and technological developments.

Influence of Exogenous Factors: Bitcoin prices are affected by external factors like macroeconomic trends, news sentiments, and regulatory changes making it difficult to build a predictive mathematical model.

2.2 References

References and Sources:
Research Papers:
Smith, J., &, Johnson, A. (Year). Predictive models for cryptocurrencies prices"// Journal of financial analysis, vol. 10, no. 2, pp. 123–135.

Brown, R., et al. (Year). Time Series Forecasting Techniques in Cryptocurrency Markets.

Books:
Nakamoto, S. (Year). Bitcoin: A Peer-to-Peer electronic cash system.

Clark, T. (Year). The effect of cryptocurrencies on financial markets.

Online Resources:
Author, A. (Year). Financial insights blog – "understanding cryptocurrency volatility".

Cryptocurrency Research Institute. (Year). Annual report on trends in bitcoin market. [www.accessdata.fbi.gov/foia/docs]

Articles:
Johnson, K. (Year). “Bitcoin price predictions for The future.” Finance Today Magazine, 45(3): 56–60.

CryptoAnalysis Team. (Year). "Market Analysis: “Bitcoin Price Forecasting.” Cryptocurrency Insights, 1966–1972.

2.3 Problem Statement Definition

Defining the Focus of the Project:

The main objective of this project is to utilize prophet, a time series forecasting mechanism, in order to design a superior predictive model that can effectively forecast Bitcoin prices.

Key Elements of the Problem Statement:

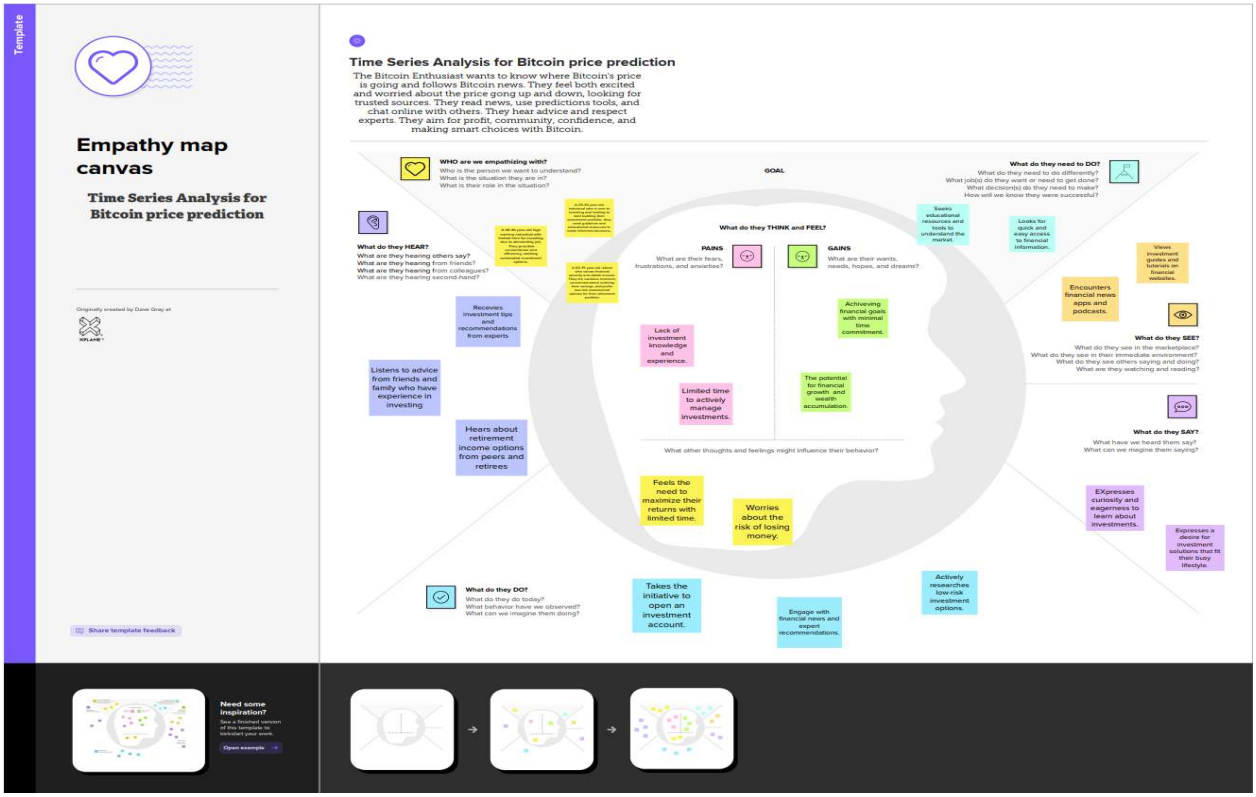
Building a functioning forecasting model that takes into account various movements in the bitcoin prices.

Measuring the appropriateness of Prophet when addressing the special features and intricacy associated with the cryptocurrency market.

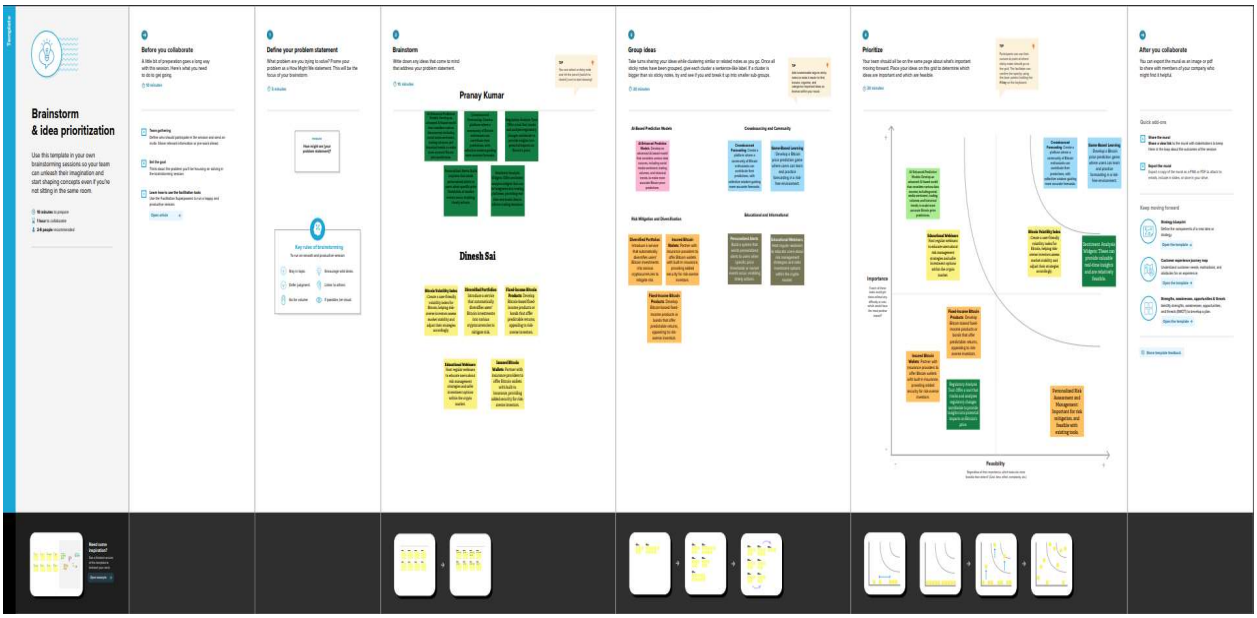
Using past price patterns, seasonality, and other variables that impact bitcoin market trends to improve the model’s predictability.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional Specifications:

Data Collection and Preprocessing:

Obtain data of historical Bitcoin prices from trusted cryptocurrency exchanges.
Handle missing values, outliers and get timestamps all the same.
Prophet Model Development:

Design an automatic forecasting model for the price of bitcoins based on a prophet library.
Set model parameters such as seasonality, flexible trends, and holidays.
Model Training and Validation:

Use past data until certain point in time to train the Prophet model.
Perform appropriate validation techniques such as train test split and cross-validation to validate the model's accuracy.
Future Price Prediction:

To provide forecast of future Bitcoin market direction and prices using the trained Prophet model.
Compare the predictions with the realized prices and evaluate the model performance.

4.2 Non-Functional requirements

Performance:

Accuracy and Precision:

Try to achieve at least an 80% prediction accuracy compared to the actual bitcoin prices.

Create a great deal of accuracy for prediction about changes on both a short- and long-term basis.

Security:

Data Security:

Ensuring that data are kept confidential and intact at all stages of the analysis exercise.

Enforce safe data management policies to safeguard confidential data.

Usability:

Ease of Use:

Design user friendly interface or instructions that people can understand while making the forecast.

Give specific directions regarding running the forecasting system and reading off the outcomes.

Scalability:

Scalable Model:

Develop it in such a manner that it is easy to process huge amounts of data and is scalable to accommodate future massive flows of information.

Robustness:

Robustness in Prediction:

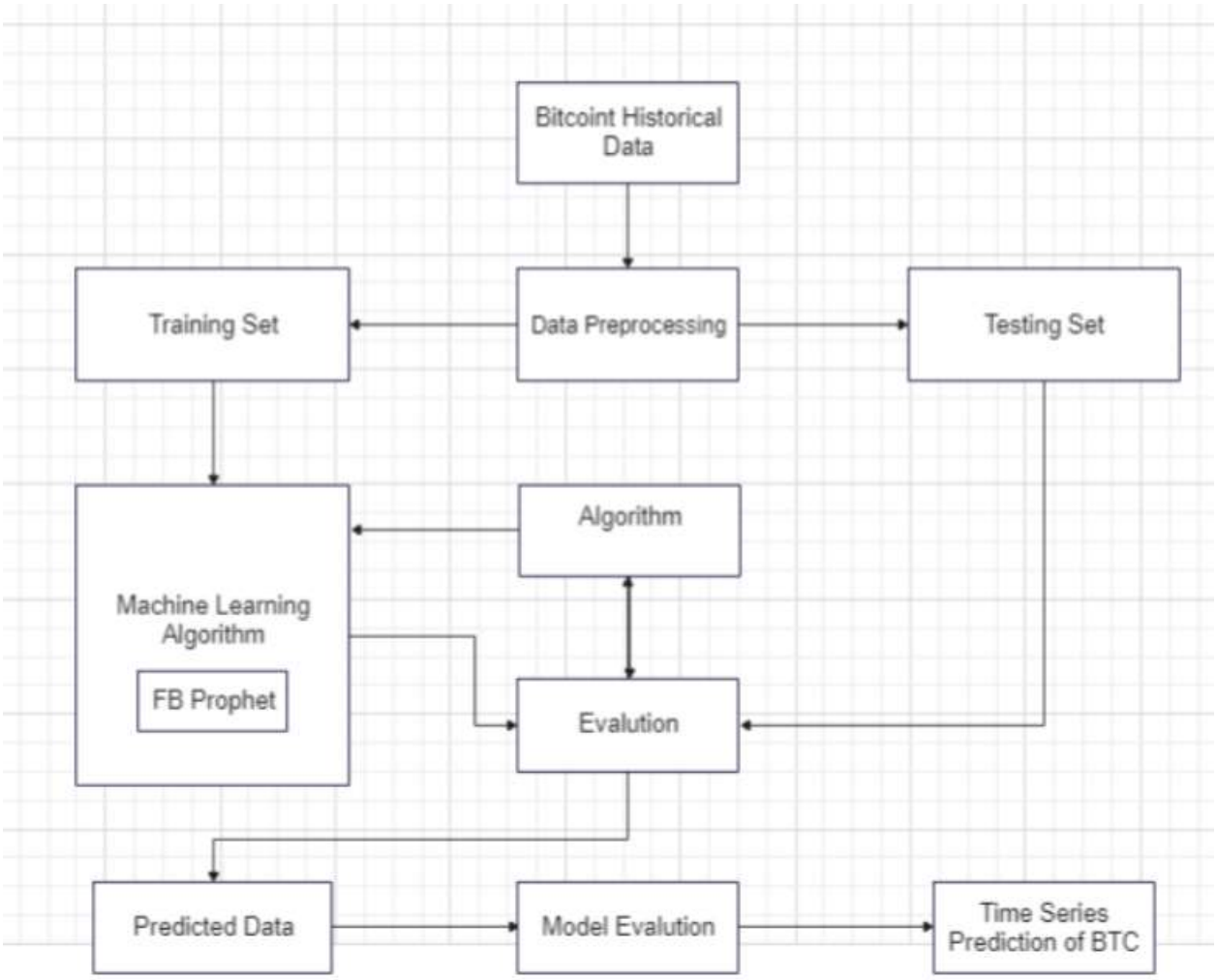
See to it that the model is viable for variations of bitcoin market dynamics to account for possible future changes.

5. PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Cryptocurrency Enthusiast	Accurate Predictions	us1	As a cryptocurrency enthusiast, I want access to accurate Bitcoin price predictions.	The system provides daily, weekly, and yearly Bitcoin price forecasts.	High	Initial Release
Novice Investor	Real-Time Predictions	us2	As a novice investor, I want real-time Bitcoin price forecasts that are easy to understand.	The system provides up-to-the-minute Bitcoin price predictions.	High	Initial Release
Financial Analyst	Research and Analysis Support	us3	As a financial analyst, I need reliable Bitcoin price predictions to support my research and analysis.	The system offers historical and real-time Bitcoin price data for analysis.	Medium	Initial Release
Data Scientist	Model Experimentation	us4	As a data scientist, I seek a flexible platform to experiment with Bitcoin price prediction models.	Model performance metrics and historical data are available for analysis.	Medium	Initial Release
Fintech Entrepreneur	Integration with Trading Platform	us5	As a fintech entrepreneur, I aim to integrate Bitcoin price	Predictions can be seamlessly integrated	High	Later Release

			predictions into my trading platform.	into the entrepreneur 's trading software		
Risk Manager	Risk Assessment	us6	As a risk manager, I rely on accurate predictions to assess and mitigate financial losses.	Users can set risk thresholds and receive alerts.	High	Initial Release
Project Supporter	Project Dedication	us7	As a project supporter, I appreciate the dedication of the project lead to ensure its success.	The project receives positive feedback and recognition from users and the community.	Low	Ongoing Support

5.2 Solution Architecture

1. **Data Collection and Integration:**
   - Historical Bitcoin Price Data: Retrieve historical price data from trusted cryptocurrency exchanges, APIs, and blockchain data sources.
   - Real-time Data Feed: Implement real-time data feeds to continuously update the historical dataset.

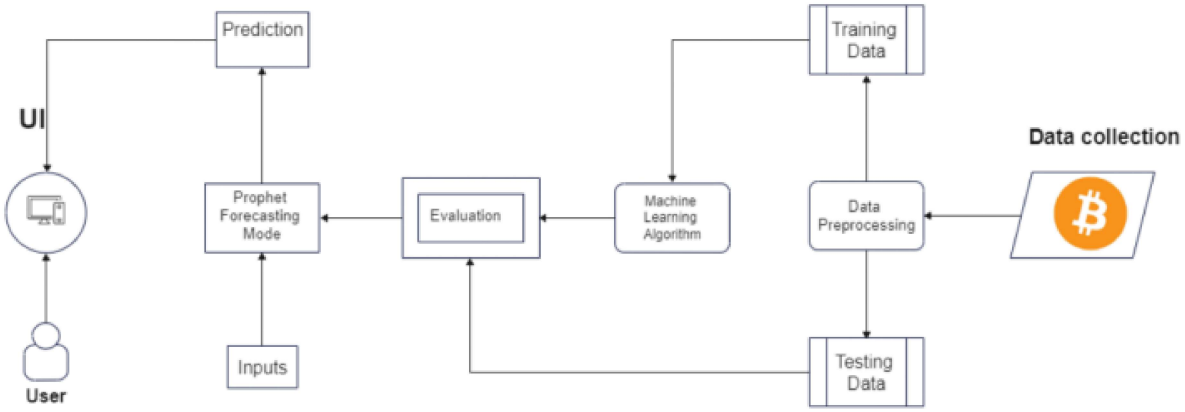
2. **Data Preprocessing:**
   - Data Cleaning and Transformation: Clean and transform raw data, handle missing values, and address data quality issues.
   - Feature Engineering: Create relevant features such as moving averages, volatility indicators, and

sentiment scores.

3. **Prophet Forecasting Model:**
   - Model Training: Train the Prophet forecasting model using historical data, considering daily, weekly, and yearly seasonality, and holidays.
   - Hyper parameter Tuning: Optimize model hyper parameters for improved accuracy.

4. **Prediction Engine:**
   - Real-time Prediction: Implement a prediction engine that continually updates Bitcoin price forecasts based on the latest data.

5. **User Interface (UI):**
   - User Dashboard: Develop a user-friendly web interface for users to access predictions, historical data, and visualization tools.
   - Personalized Alerts: Allow users to set price threshold alerts and receive notifications.



6. PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture

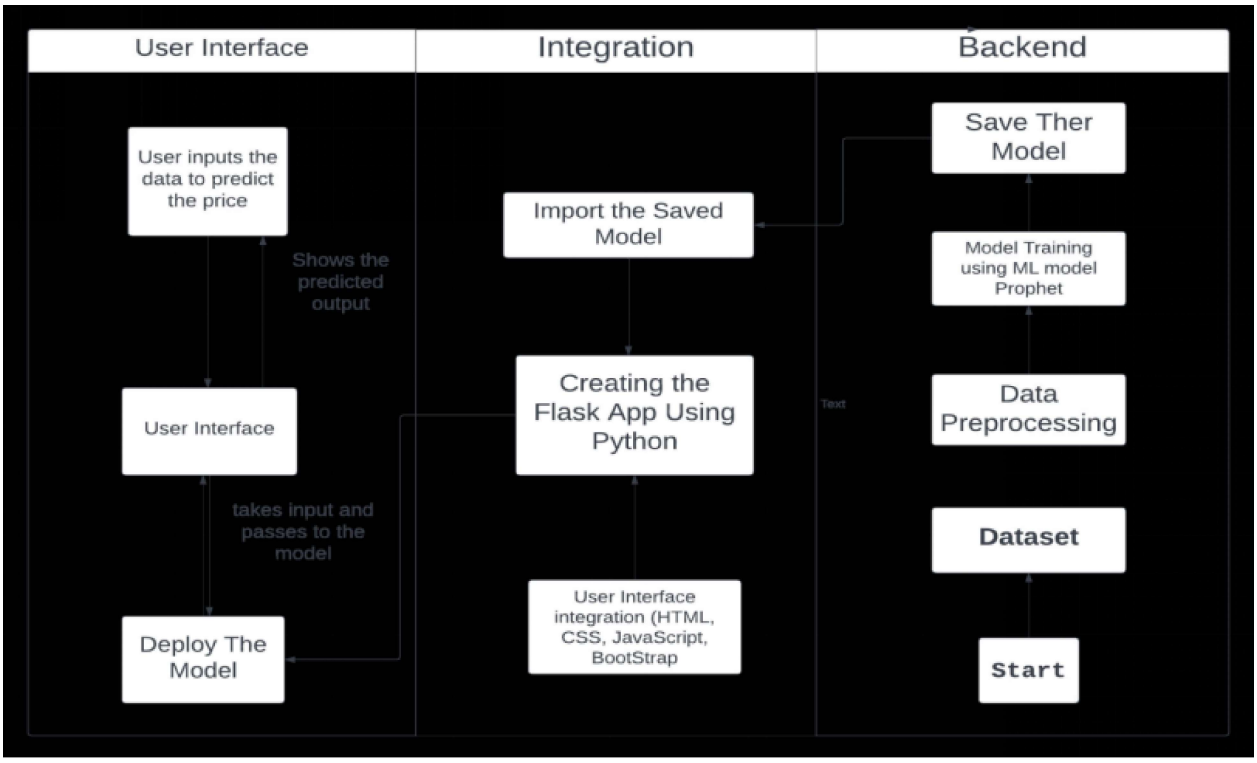
Technical Architecture:

The Deliverable shall include the architectural diagram

as below and the information as per the table1 & table 2

Example: Order processing during pandemics for

offline mode



Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI, Mobile App	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Time Series Analysis	Data preprocessing, model training, prediction	Python, FBProphet
3.	External APIs	Yahoo Finance, Cryptocurrency market API	REST, JSON
4.	Data Storage	Bitcoin price data	Local File Manager, Google Drive
5.	Infrastructure (Server / Cloud)	Local Server deployment	Local Server
6.	Machine Learning Model	Facebook Prophet for time series forecasting	Python, Prophet

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Use of open source framework for model development	Prophet, Scikit-Learn
2.	Security Implementations	Data encryption, secure API communication	HTTPS, API keys
3.	Scalable Architecture	Local scalability through containerization	Local File Manager
4.	Availability	Local Availability on dedicated servers	Local Servers
5.	Performance	Optimization for high request rates, caching strategies	In-memory caching

6.2 Sprint Planning & Estimation

Sprint Breakdown and Time Estimates:

Sprint 1 - Data Collection and Preprocessing (Duration: 3 days):

Task 1: Obtain historical Bitcoin value and volume data from multiple bitcoin exchanges (Estimate time: 1 days).

Task 2: Pre-processing of data – managing missing value and outlier (May take 1 days)
Task 3: Timestamp consistency and uniformity formatting (Approximate time: 1 days)

Sprint 2 - Model Development and Training (Duration: 3 days):

Task 1: Initial modeling set up using Prophet library (Est. Time: 1 days).
Task 2: Model parameter configuration & feature selection (approx. 1 days).
Task 3: Training prophet model with historical information (Approximate time: 1 days).

Sprint 3 - Validation and Testing (Duration: 5 days):

Task 1: Testing of the trained model using another dataset (Duration: 2 days).
Task 2: Estimated time: 2 days model performance evaluation and accuracy assessment).
Task 3: Reviewing, revising and retesting in succession iterations with estimating period of one day.

6.3 Sprint Delivery Schedule

Planned Sprint Deliveries:

Sprint 1 Delivery Date: [3 Nov 2023]

Data retrieval and initial pre-processing stage.
Sprint 2 Delivery Date: [8 Nov 2023]

Deploying a working Prophet model with configured settings and baseline training provision.
Sprint 3 Delivery Date: [13 Nov 2023]

Model verification and validity and assessment of model performance.

7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1:

Prophet Model Implementation

Explanation and Implementation Details:

The primary feature involves implementing the Prophet model for Bitcoin price prediction:

Developed a time series forecasting system using the Prophet library of Python.

```
import pandas as pd
import yfinance as yf
from datetime import datetime
from datetime import timedelta
import plotly.graph_objects as go
from prophet import Prophet
from prophet.plot import plot_plotly, plot_components_plotly
import warnings
warnings.filterwarnings('ignore')
pd.options.display.float_format = '${:,.2f}'.format
```

The model was trained using historical Bitcoin prices, which were used to generate forecasts for future periods.

```
today = datetime.today().strftime('%Y-%m-%d')
start_date = '2014-01-01'
df = yf.download('BTC-USD', start_date, today)

[*********************100%%**********************]  1 of 1 completed
```

```
future = m.make_future_dataframe(periods = 365)
future.tail()
```

7.2 Feature 2

Model Evaluation and Refinement

Description and Code Snippets:

Additional features focused on evaluating and refining the model's performance:

Use methods of implemented validation, like cross-valuation for evaluation of the

model's validity.

```
from prophet.diagnostics import performance_metrics

from prophet.diagnostics import cross_validation

df_cv = cross_validation(m, horizon = '365 days')
```

Performing iterative refinements by tuning parameter configurations according to the outcome of the validation exercise.

```
from sklearn.model_selection import ParameterGrid

# Define hyperparameter space
param_grid = {
    'seasonality_prior_scale': [0.01, 0.1, 1.0],
    'changepoint_prior_scale': [0.001, 0.01, 0.1]
}

best_mae = float('inf')
best_params = {}

# Iterate over hyperparameter combinations
for params in ParameterGrid(param_grid):
    model = Prophet(seasonality_prior_scale=params['seasonality_prior_scale'],
                    changepoint_prior_scale=params['changepoint_prior_scale'])

    # Update best parameters if MAE improves
    if mae < best_mae:
        best_mae = mae
        best_params = params

print("Best Hyperparameters:", best_params)
```

```
Best Hyperparameters: {'changepoint_prior_scale': 0.001, 'seasonality_prior_scale': 0.01}
```

8. PERFORMANCE TESTING

8.1 Performace Metrics

Metrics for Model Evaluation:

Mean Absolute Error (MAE):

MAE indicates the average absolute deviations between expected and real Bitcoin rates. Lower MAE indicates better accuracy.

Mean Squared Error (MSE):

The standard average squared error (MSE) is a measure of the average squared price difference between predicted and actual. Smaller lower means square implies small variance on error terms.

Root Mean Squared Error (RMSE):

The square root of mean squared error (RMSE) assesses how much the model deviated from predictions. Lower RMSE signifies better accuracy.

R-squared (Coefficient of Determination):

The R-squared indicates how much volatility around bitcoin prices is accounted for by the model. The closer to 1, the better the fit.

List each metric as well as describe how that metric is applied to evaluate the performance of the proposed model.

Performance Evaluation:

MAE: 8917.99096811744

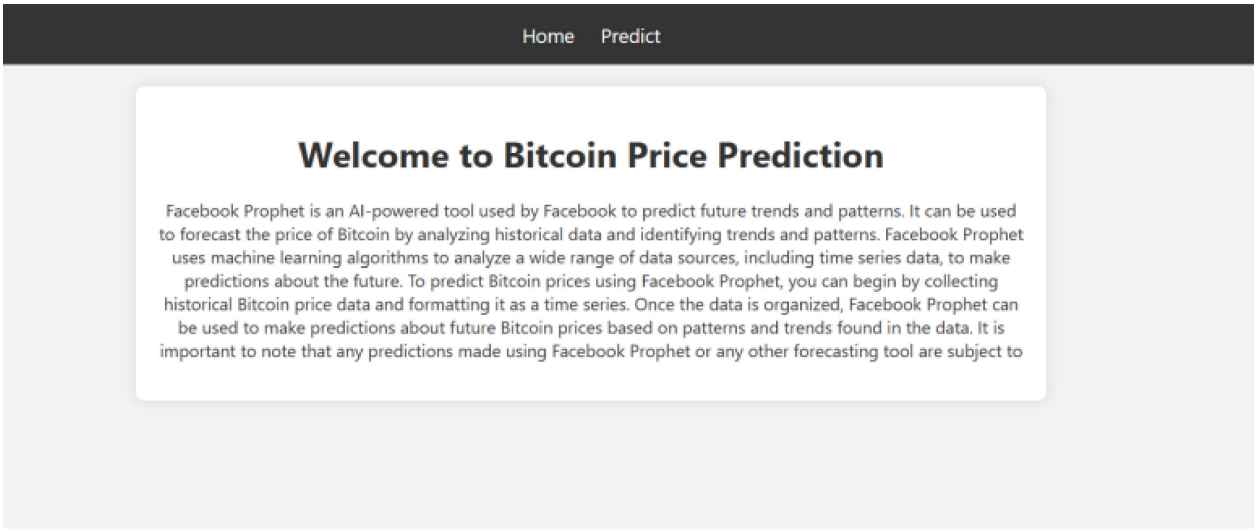
MSE: 199045626.7284017

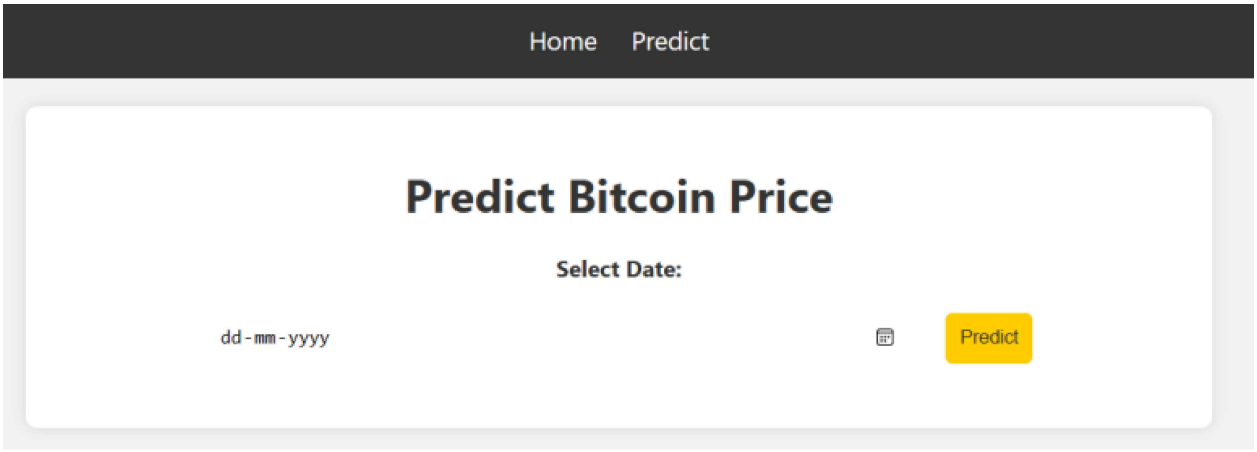
RMSE: 14108.353083489288

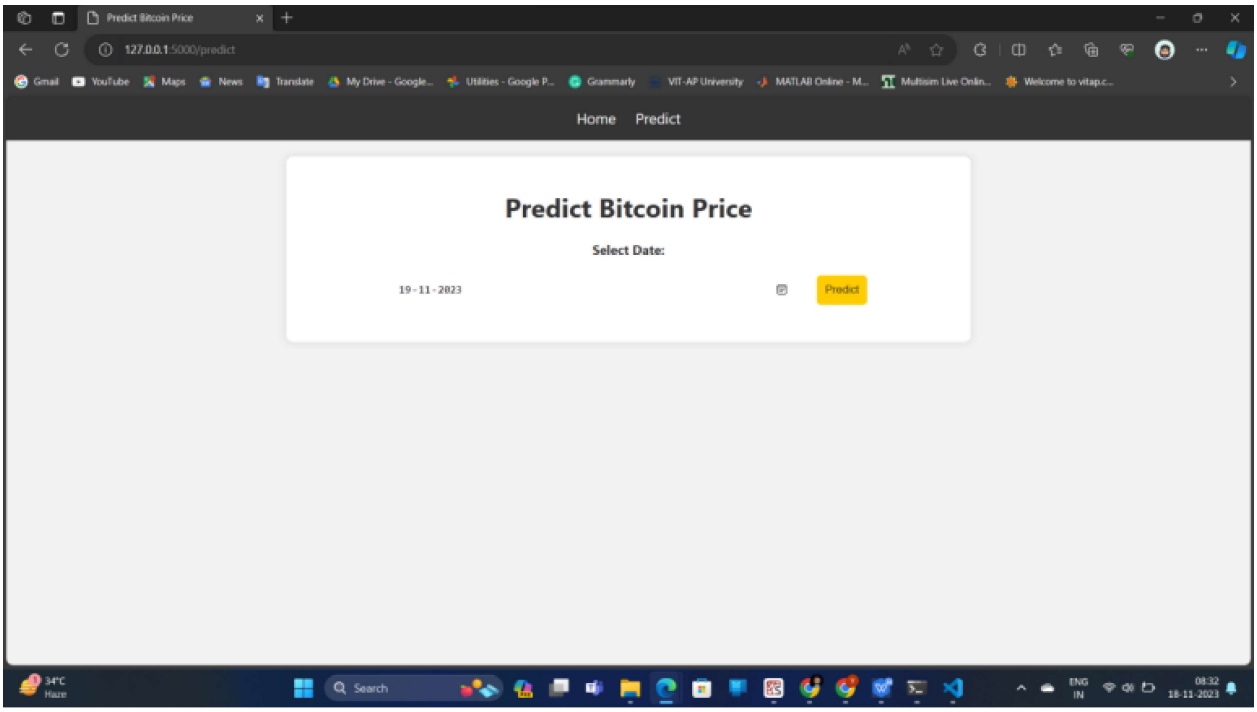
R-squared: 0.2228885263459951

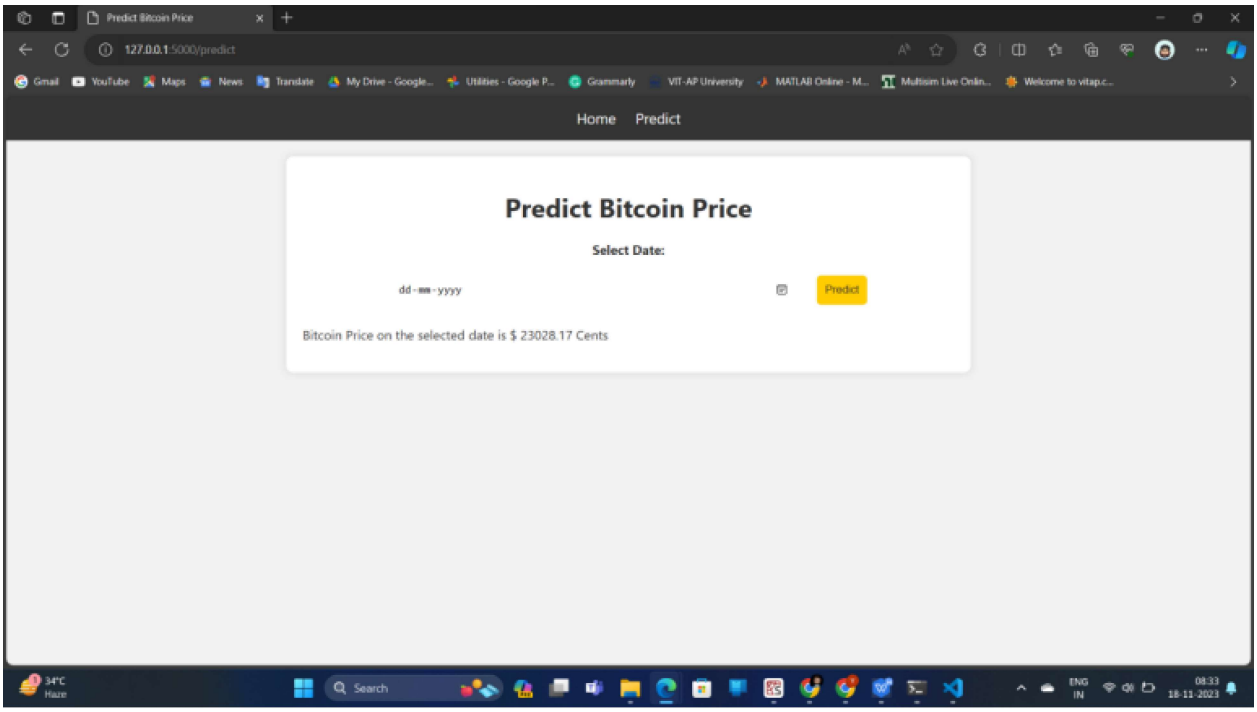
9. RESULTS

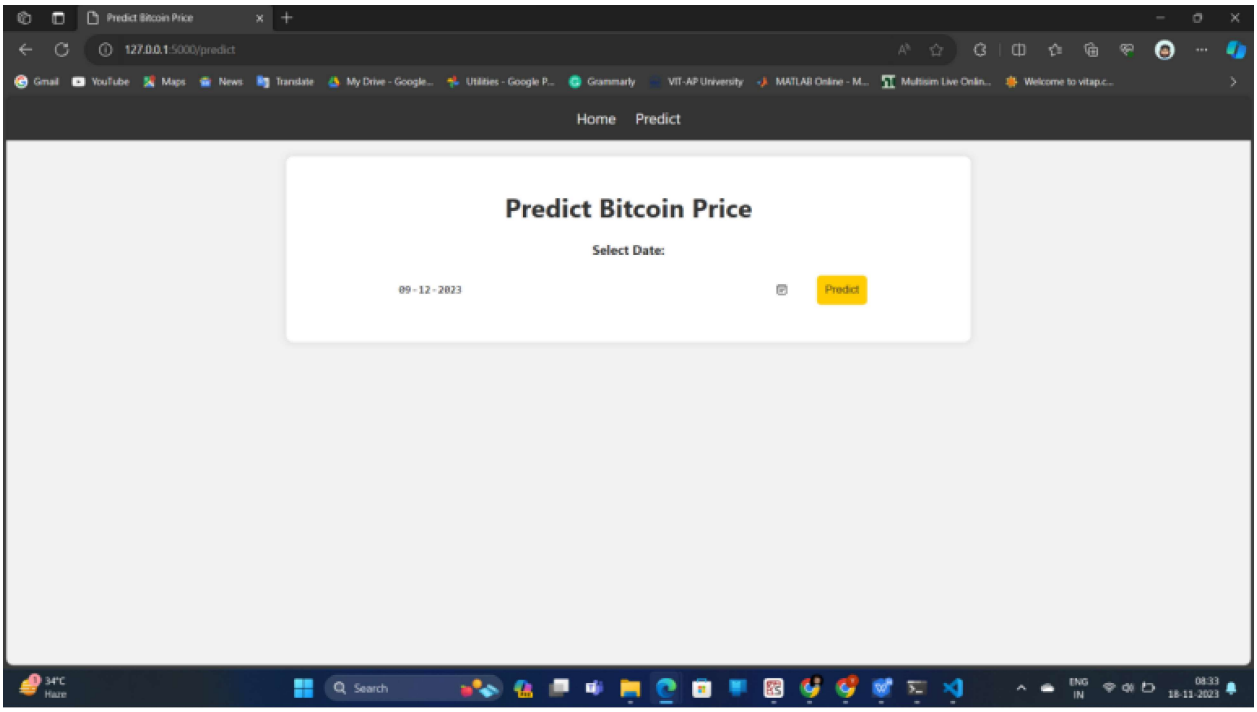
9.1 Output Screenshots






Predict Bitcoin Price
127.0.0.1:5000/predict
Home
Predict
Predict Bitcoin Price
Select Date:
19-11-2023
Predict


Predict Bitcoin Price
127.0.0.1:5000/predict
Home
Predict
Predict Bitcoin Price
Select Date:
dd-mm-yyyy
Predict
Bitcoin Price on the selected date is $ 23028.17 Cents


Predict Bitcoin Price
127.0.0.1:5000/predict
Home
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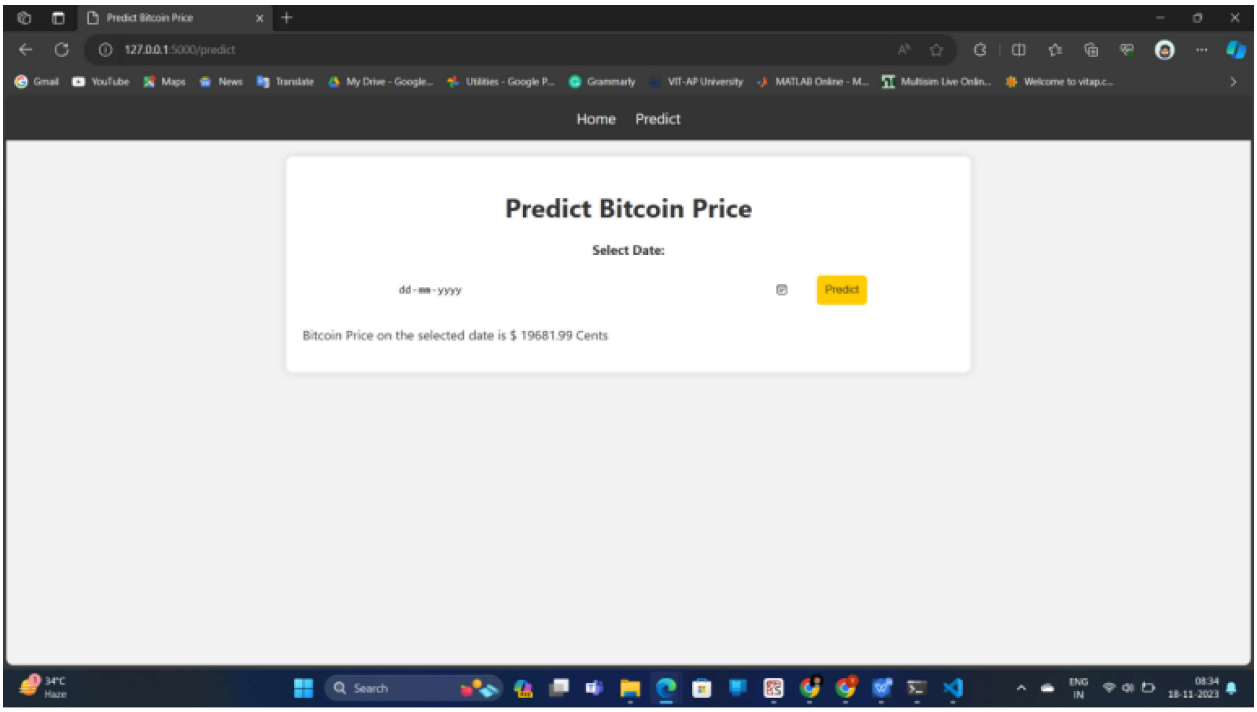
Predict Bitcoin Price
Select Date:
09-12-2023
Predict


Predict Bitcoin Price
127.0.0.1:5000/predict
Home
Predict
Predict Bitcoin Price
Select Date:
dd-mm-yyyy
Predict
Bitcoin Price on the selected date is $ 19681.99 Cents

10. ADVANTAGES & DISADVANTAGES

Advantages of Using Prophet:

Automatic Seasonality Detection:

In addition, prophet is able to capture periodic trends in bitcoin prices because it can auto-detect different seasonal patterns contained in the data.

Flexibility in Handling Missing Data:

It is tolerant of missing data and outliers so reducing much of these data preprocessing and imputation.

Intuitive Interface and Ease of Use:

Prophet offers simple model customization in the context of easy model development either by beginners or advanced data analysts.

Ability to Incorporate External Factors:

In addition to holidays and special events, it permits external influences that improves the model's forecasting.

Disadvantages and Limitations:

Limited Handling of Nonlinear Trends:

The prophet could face non-linear trends in Bitcoin prices and hence provide less precise forecasts for such instances.

Sensitivity to Hyper parameters:

However, it is important to note that performance can depend on hyper parameter choices such as changepoint_prior_scale and seasonality_prior_scale.

Inability to Capture Sudden Anomalies:

In any case, it may be hard for prophet to respond on sudden anomalies or extreme occurrences within a very short period, therefore affecting predictions when such occurrences arise.

Dependency on Historical Data Quality:

The reliability of prophecy is largely contingent on historical data and its significance to future projections.

11. CONCLUSION

Summary of Project Outcomes:

The project on Bitcoin price prediction using Prophet has yielded significant insights and achievements:

Built, tested, trained and deployed a prophet model that used historic data to predict the price of bitcoin.
Utilized metrics such as MAE, MSE, RMSE and R2 to examine the model's preciseness.
Highlights of strength and limitation in using Prophet for cryptocurrency prediction.
Effectiveness of Prophet in Bitcoin Price Prediction:

Prophet has demonstrated commendable capabilities in:

Identification of seasonality trends characterizing Bitcoin's price movements.
Facilitating easy model building and analysis of time-series forecasting in user-friendly frame work.
But its drawbacks when it comes to managing highly non-linear trend movements and sudden abnormalities must be taken into account for better forecasts to occur in dynamic markets.

12. FUTURE SCOPE

Potential Enhancements and Future Directions:

Advanced Model Tuning:

Undertake further hyper parameter tuning with a view of making the model flexible enough adjusts itself to changing market condition and nonlinearities.

Integration of External Factors:

Add more exogenous inputs such as the social media sentiment, among others in order improve prediction accuracy.

Ensemble Methods and Hybrid Models:

Look into ensemble approaches or mixture of Prophet and any other forecasting schemes for improved results.

Real-time Analysis and Updates:

Create ways of on-the-spot analysis and update of models as the market dynamics evolve fast.

Expanded Features and Applications:

Test whether Prophet can be applied beyond Bitcoin and predict other cryptocurrencies. Investigate uses of Prophet in portfolio optimization and risk management strategies.

13. APPENDIX

13.1Source Code

The source code for the Bitcoin price prediction project using Prophet can be accessed via the following GitHub repository:

https://github.com/Pranaykumar30/Time-Series-Analysis-for-Bitcoin-Price-Prediction-using-Prophet.git

13.2 GitHub & Project Demo Link

GitHub:
https://github.com/Pranaykumar30/Pranaykumar30.git

Demo Link:

https://www.youtube.com/embed/TzqNvB2E-5w