ÇANKAYA UNIVERSITY
DEPARTMENT OF
COMPUTER
ENGINEERING

Cryptocurrency Price Predictor

CENG 407

INNOVATIVE ENGINEERING ANALYSIS AND DESIGN
PROJECT REPORT

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1. Abstract

The aim of Cryptocurrency Price Predictor project is to design an application which can predict cryptocurrency prices for popular coins such as Bitcoin (BTC), Ethereum (ETH) etc. using machine learning algorithms. Different machine learning algorithms and hybrid models will be studied to develop an accurate prediction algorithm. After an evaluation of traditional methodologies used to forecast financial times series and how the cryptocurrency market reacts to the application of these methods, a mobile and/or a web application will be developed to provide prediction information by means of data visualization. Application user will be able to see the time-based price prediction graph of a selected cryptocurrency as well as the prediction's accuracy. As a result, this project aims to yield a cryptocurrency price predictor application which can help users make more informed decisions concerning the market.

Key Words: Cryptocurrency, Bitcoin, Ethereum, Machine Learning

2. Introduction

In 2021, the cryptocurrency market is worth over 3 trillion dollars with around 6000 different types of crypto coins. Ever since the first decentralized cryptocurrency, Bitcoin, emerged in 2009 the cryptocurrency market had an extremely volatile but nonetheless increasing growth. First transaction with a cryptocurrency was swapping two pizzas for 10000 Bitcoins which is now worth more than 100 million dollars. People did not really think that an invention such as this would have such magnitude in the world of economy.

Prediction of stock prices to maximize investment return holds an important place in finance. There are different discussions on the matter whether or not price prediction is possible. Behavioral Finance, which is a newly emerging Economics subfield state that it is possible to predict prices based on the study of the influence of psychology on the behavior of investors. Indeed, new research emerge everyday about price prediction and forecasting. Machine learning algorithms are able to detect patterns with generalization power thus, they can be used in cryptocurrency price prediction with varying algorithms. Some of these algorithms are Recurrent Neural Network (RNN), MultiLayer Perceptron (MLP), Bayesian Regression, Random Forest, Long Short-Term Memory (LSTM) and its extension Gated Recurrent Unit (GRU), Hidden Markov Model (HMM) each having different advantages and disadvantages when it comes to price prediction in a volatile market.

In this project, aforementioned machine learning algorithms will be tested and compared using Coinmarketcap and Kaggle Cryptocurrency datasets using libraries such as Scikit-learn, Tensorflow and Keras. Ensamble methods, which is a machine learning technique that aims to utilize numerous base models to obtain an optimal prediction model, will also be studied. After determining their advantages and disadvantages in a volatile market such as the cryptocurrency market, an application will be developed using Flutter and React.js tools which have powerful data visualization capabilities. This

mobile and/or web application will allow user to see cryptocurrency price predictions and estimated prediction accuracy. Proposed methods and system will be tested using evaluation methods such as precision parameter, confusion matrix, autocorrelation function, augmented Dickey-Fuller test for machine learning algorithms and usability testing methods for the developed application. As a result, proposed system will help users make more informed decisions concerning the volatile cryptocurrency market.

3. Related Work

3.1. Machine Learning Models Comparison for Bitcoin Price Prediction

This research paper [1] propose to discover the most efficient and highest accuracy model to predict Bitcoin prices from various machine learning algorithms. Datasets used are from 1-minute interval trading data on the Bitcoin exchange website named "Bitstamp". The results show that learning based regression models: GRU and LSTM give the better result than Theil-Sen regression and Huber regression. GRU give the best results of MSE at 0.00002 and R2 at 0.992 or 99.2%. (Where Mean Squared Error (MSE) and R-Square (R2) are two of the most common metrics used to measure accuracy for continuous variables.) Whereas the calculated time that Huber regression use is much less than LSTM and GRU.

3.2. Deep Neural Networks for Cryptocurrencies Price Prediction

This thesis [2] presents how neural networks, especially LSTM, are useful tools for trend predictions with high prediction accuracy. After explaining basics of recurrent neural networks as a nonlinear method for sequence learning, MLP, RNN, LSTM architectures and the deep learning methodology, the authors tune different hyper-parameters of the model with the trial-and-error methodology in order to obtain best prediction results. It is strongly emphasized that hyper-parameter tuning always improves the prediction accuracy of the model for all models. Overall, the topics covered in this paper guides our project greatly in the stage of literature review.

3.3. Forecasting Bitcoin Prices

This thesis [3] presents the accuracy performance comparison of two Bitcoin price prediction algorithms namely as ARIMA and LSTM forecasts for a daily time-series of bitcoin prices. The author states that LSTM predictions have better precision with respect to the ARIMA model.

4. Proposed System

The Cryptocurrency Price Predictor project will consist of two parts. The first part will be responsible predicting the cryptocurrency prices using machine learning, based on the dataset. The second part will be responsible for providing prediction information by means of data visualization on an application.

4.1. Dataset

The primary dataset consists of the price of Bitcoin sampled for the time period of Jan 2012 to December March 2021, with minute-to-minute updates of OHLC (Open, High,

Low, Close), Volume in BTC and indicated currency, and weighted bitcoin price. The dataset is provided in .csv format.

4.2. Cryptocurrency Price Prediction

This section covers the models, tools and frameworks which will be used for predicting cryptocurrency prices.

4.2.1. Recurrent Neural Network (RNN)

RNN is a neural network algorithm suitable for time series modeling. Normally it keeps details of state in a hidden state. The previously hidden state is used to calculate the current state and use the current hidden state to calculate the next state. RNN is suitable for sequence data or series time data, but it has a problem with long-term dependency data which cause vanishing gradient.

4.2.2. Long Short-Term Memory (LSTM)

LSTM is similar to RNN, with the distinction that RNN are supersets of MLP and LSTM are supersets of recurrently connected subnets also known as memory blocks. LSTM networks remember information for long periods of time to avoid the long-term dependency problem therefore they are the most used neural network model for sequence learning. The cell state and hidden state collect and send data to be processed in the next state where input-output and forget gates pass the data depending on priority.

4.2.3. Gated Recurrent Unit (GRU)

Gated Recurrent Unit (GRU) is a model which is developed from LSTM. By adjusting gates in LSTM to reset and update gates GRU achieves a less complex structure compared to LSTM. The reset gate is dictates the amount of previous state data that will be used with current input data and an the update gate dictates the amount of information which will be collected from the previous state.

4.2.4. Hidden Markov Models (HMM)

Hidden Markov Models (HMM) generate a sequence of observations using a sequence of internal hidden state. HMM are most commonly used to model time series data. This model is most commonly used in biological series but they can find applications in forecasting cryptocurrency prices as well. [3]

4.3. Tools and Frameworks

For this project, we decided to use the Python programming language for implementing machine learning algorithms. For the machine learning framework, we will use scikit-learn and/or TensorFlow.

5. Cryptocurrency Price Predictor Application

5.1. Tools and Frameworks

5.1.1. Visualization

We're working on a project called "Cryptocurrency Price Predictor" to create an app that can forecast cryptocurrency values. The user will have access to a time-based forecast of the price of a chosen cryptocurrency thanks to an accurate forecasting system. We utilize Data Visualization to help people understand the data more clearly. Complex data is made more accessible, intelligible, and usable through data visualization. Users

will be able to compare and comprehend the accuracy of the forecasts by looking at the cryptocurrency's time-based price prediction graph. With colors and lines, we want to make it easy for the user to make judgments. Our objective is to provide consumers with information that is both clear and efficient. The user will be able to simply track the graphical currency of the selected cryptocurrency in this manner. As a result, users will be able to use a bitcoin price estimator tool more effectively, allowing them to make more educated market judgments.
For data visualization, we will utilize the Recat.js package.React.js is an open-source JavaScript library that is simple to use. React and React-Native may also be used to create mobile apps.React.js is a multi-purpose library. It saves time, it's a fantasy mobile app, it's high, and it's unemployed. It is faster and has a more current user base. This is how we decided on this library for data visualization.

5.1.2. Flutter

Flutter is a cross-platform framework that aims at developing high-performance mobile applications. Flutter is publicly released at 2016 by Google. Not only can Flutter applications run on Android and iOS, but also Fuschia, Google's next generation operating system, chooses Flutter as its application-level framework.
Flutter is unique. Rather than utilizing web views or relying on the device's OEM widgets, Flutter renders every view components using its own high-performance rendering engine. This nature provides possibility to build applications that are as high-performance as native applications can be. Architecture wise, the engine's C/C++ code is compiled with Android's NDK and LLVM on iOS respectively, and any Dart code is AOT-compiled into native code during compilation [4].
Flutter supports stateful hot-reload while developing, which is considered as a major factor to boost development cycle. Stateful hot-reload is essentially implemented by injecting updated source code into the running Dart VM without changing the inner structure of the application, thus all transitions and actions of the application will be preserved after hot-reloading .

5.1.3. Dart

In Flutter, all applications are written with Dart. Dart is a programming language that is developed and maintained by Google. It is widely used inside of Google and it has been proved to have the capability to develop massive web applications, such as AdWords. Dart was originally developed as a replacement and successor of JavaScript. Thus, it implements most of the important characteristics of JavaScript's next standard (ES7), such as keywords "async" and "await". However, in order to attract developers that are not familiar with JavaScript, Dart has a Java-like syntax
Akin to other systems that utilize reactive views, Flutter application refreshes the view tree on every new frame. This behavior leads to a drawback that many objects, which may live for only one frame, will be created. Dart, as a modern programming language, is optimized to handle this scenario in memory level with the help of "Generational Garbage Collection" [5].

5.1.4. Widget

Widgets are the most important elements in a Flutter application. Widgets need to be attractive and reasonable because user see and feel them directly. Widgets do not only

control and affect how the views behave, but also handle and respond to the user's action. Thus, it is crucial that Widgets need to perform fast, including rendering and animating.
Instead of reusing the OEM widgets, just as what React Native does, Flutter team decides to provide its own widgets This means Flutter, as a platform, gets to decide when and how the widgets are rendered. In a way, Flutter moves the widgets and the renderer from system level into the application itself, which allows them to be more customizable and extensible [6]. However, having the widgets and renderer within the application makes the size of application larger.

6. Software Requirements Specification

6.1. Introduction

6.1.1. Purpose

The purpose of this document is to describe the application which is called CryptoCast. This application aims to provide time series forecasting for a selected cryptocurrency. This application has been prepared for users who want to get information about predicted future prices of cryptocoins. The user will be able to register and build profile in which they can track multiple types of cryptocoins.

6.1.2. Scope

This software system will be a Cryptocurrency Price Predictor System for potential investors who may gain insight on a future price of a selected cryptocurrency generated using machine learning algorithms. This system will be designed to try and maximize the return on investment (ROI) by providing a platform which has enhanced visualization services. The platform will be implemented on a web application and a native android application to predict cryptocoin prices using time series forecasting algorithms namely as Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), and Hidden Markov Models (HMM).

6.2. General Description

6.2.1. Glossary

Term	**Definition**
API	Application Programming Interface
CUDA	Compute Unified Device Architecture
GPU	Graphics Processing Unit
HTML	Hypertext Markup Language

IEEE	Institute of Electrical and Electronics Engineers
ML	Machine Learning
OS	Operating System
REST	Representational State Transfer
SQL	Structured Query Language

6.2.2. User Characteristic

6.2.2.1. User

Users must have a browser installed on their personal computer (PC) or another smart device with a browser in order to utilize the Cryptocurrency Price Predictor platform as a web application. The application must be mobile-friendly. It must be able to connect to devices running the Android or iOS operating systems in order to do so. In order to utilize the applications, users must have internet connectivity and other essential gadgets. The ability to use a web browser is required of all users.

6.2.2.2. Administrator

The administrator must have a browser on a personal computer (PC) or another smart device with a browser to use the Cryptocurrency Price Predictor platform as a web application. The program should be accessible via a mobile device for administrators. It must be able to connect to devices running on the Android or iOS operating systems in order to accomplish this. The administrator must have internet connectivity as well as the other devices needed to run the applications. A web browser is required of the administrator.

6.2.3. Product Perspective

The app will use a web-based app or/and an iOS mobile app, and an Android mobile app. The application runs in the latest version of Chrome or Firefox browser on Windows, Linux, and Mac. In addition, access will be provided from mobile devices. So, it will be compatible with iOS and Androids. These applications will connect to a REST API built with .NET Core to store and retrieve data from a Microsoft SQL database.

6.3. Overview

This document obeys the requirements stated in IEEE Std 1016-2009, IEEE Recommended Practice for Software Requirements Specifications.

6.4. Interface Requirements

6.4.1. User Interface

There will be two different user interfaces for different types of users. The types are the administrator and standard user.

In standard user interface type, the user will be able to see the value movements of the cryptocurrency they want. Users can manage their subscriptions and create new subscriptions. He/She will be able to determine the time range of crypto currency movements. Users will be able to compare cryptocurrency charts and add various metrics. Also users will be able to set alarms and reminders for the values of the cryptocurrencies it subscribes to.

Users with admin authority can only see the membership information of standard users in the interface that is specific to admin authority. Admins can also update the subscription fees for cryptocurrencies. Admins can stop predictions and subscriptions of any cryptocurrency when there is a problem. Admins can also prepare and publish announcements.

6.4.2. Hardware Interfaces

Users do not need high hardware to run this program, because all predict operations will be done by the server and the application. Users only need a hardware that can connect to the internet.

For the server and application, a CUDA capable GPU is needed to make predictions as quickly as possible.

6.4.3. Software Interfaces

6.4.3.1. Server Side

The background data must be updated and quickly obtained from a provider and given to the model. The results of the model should be graphed together with the visualization tool and reflected in the application.

6.4.3.2. Client Side

The web and mobile application developed will be accessible over any browsers that run on any OS, supporting at least HTML version 5 and having Java enabled.

6.4.4. Communication Interfaces

The default communication protocol for data transmission between server and the client is Transmission Control Protocol/ Internet Protocol (TCP/IP). At the upper-level HyperText Transfer Protocol (HTTP, default port=80) will be used for communication between the web server and client.

6.5. Functional Requirements

6.5.1. Main Page

The first page will welcome the user to the application and display widgets for the most popular cryptocoin price values and predicted price values within an hour, day and week.

6.5.2. Login Page

The login page should provide two text fields, one for username and one for password. In the case of mismatch between username and password system should notify the user. Users that have not yet registered cannot log in. They must use register page to

create an account for the application. If the user forgot their password, they should use forgot password button which redirects to password reset page.

6.5.3. Register Page

In this page, the user can register by filling the required information which are email address, username, and password. After filling in the required information, the user can continue and register to the application. Password Reset Page In this page the user will enter their registered email. Then they the system will send a password reset email link which will direct to this change password page.

6.5.4. Change Password Page

This page can be accessed from password reset email link. The page provides two text fields, one for new password and one for verifying the new password. After changing the password, the user can activate their account with the new password.

6.5.5. Coin Summary Page

This page uses visualization tools to provide time versus predicted price graph of selected cryptocoin. The time axis of the graph can be selected to display prediction values ranging between 1 hour and 1 month. Actual price and previously predicted price may be displayed as an overlay graph to inform the user about the prediction accuracy.

6.5.6. Coin Discussion Page

This page allows registered users create threads about specified cryptocoin and which the users can share their comments and insights. The comments may be upvoted/downvoted or replied. Highest upvoted comments will be displayed at the top of the thread.

6.5.7. Profile Page

The profile page will display account information such as name and e-mail. In addition to this user can create and manage collections which contains their favorite/selected cryptocoins.

7. Software Design Description

7.1. Introduction

7.1.1. Purpose

The purpose of this document is to describe the Cryptocurrency Price Predictor System application which is named “CryptoCast”. Main purpose of this application is to provide time series forecasting for a selected cryptocurrency. Therefore, “CryptoCast” application is developed for users who want to get predicted price information about of cryptocoins. The user will also be able to register and build profile in which they can track multiple types of cryptocoins and discuss topics based on the current cryptocoin market.

7.1.2. Scope

The scope of this document is to provide in-depth details about the essential components of the Cryptocurrency Price Predictor System. This documents consists of Cryptocurrency Price Predictor System design principles and its specifications, application functionalities and meanings. This document will adhere to definitions declared in SRS document.

7.1.3. Glossary

Term	Definition
ROI	Return On Investment
RNN	Recurrent Neural Network
LSTM	Long Short-Term Memory
GRU	Gated Recurrent Unit
HMM	Hidden Markov Models
GUI	Graphical User Interface
API	Application Programming Interface
CUDA	Compute Unified Device Architecture
GPU	Graphics Processing Unit
HTML	Hypertext Markup Language
IEEE	Institute of Electrical and Electronics Engineers
ML	Machine Learning
OS	Operating System
REST	Representational State Transfer
SQL	Structured Query Language

7.1.4. Overview

- “Design Considerations” section covers the tools used for this project and explains the motive behind their selection.

- “Architecture” section presents software and hardware architecture diagrams which describes the project.
- “System Interfaces” section gives information about the database and application framework.
- “User Interface Design” section presents figures and comments about GUI design used in the project.
- “Process Design” section explains use cases and sequence diagrams for each type of user.
- “Database Design” section presents an ER diagram of the database and table of field explanations which gives a more detailed information about the database relations used in this project.

7.2. Design Considerations

7.2.1. Approach

• The data is separated into time intervals ranging from one hour to one month.

• Each sample of data will be saved in the database.

• The data is available in.csv format.

• Using libraries such as Scikit-learn, Tensorflow, and Keras, machine learning methods will be evaluated and compared using Coinmarketcap and Kaggle Cryptocurrency datasets.

• Ensemble techniques will be investigated, which is a machine learning methodology that seeks to use many base models to build an ideal prediction model.

• If there is an issue, administrators can halt any cryptocurrency projections.

• After studying comparable projects and research publications, the precise ML method to be utilized will be determined.

• For estimate, the ML with the best training and accuracy will be utilized.

• An anticipated price chart of the selected currency vs time is generated using visualization tools. The user may see the actual price and the previously anticipated price as an overlay graph to see how accurate the forecast was.

• For the created application, evaluation methods such as accuracy parameter, confusion matrix, autocorrelation function, enhanced Dickey-Fuller test for machine learning algorithms, and usability testing methods will be used to test the proposed methods and systems.

7.2.2. Tools Used

• The system will use time series forecasting methods such as Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), and Hidden Markov Models to anticipate utilizing a web application and a native Android application (HMM).

• A CUDA competent GPU is required for the server and application to produce predictions as rapidly as feasible.

• Any browser that supports HTML 5 and is Java-enabled will be able to use the program.

• TCP/IP stands for Transmission Control Protocol/Internet Protocol. HyperText Transfer Protocol (HTTP, default port=80) will be used for communication between the web server and the client at the highest level.

• We'll use the Recat.js library for data visualization.

7.2.3. Constraints

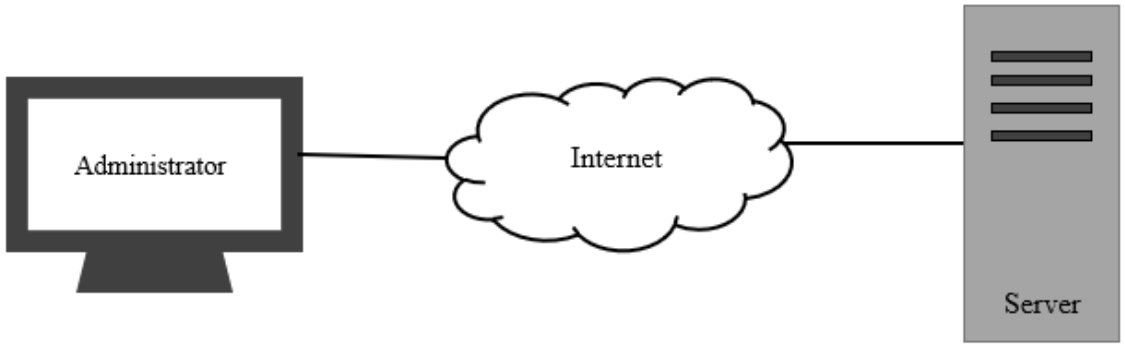
There is no constriction.

7.2.4. Assumptions and Dependencies

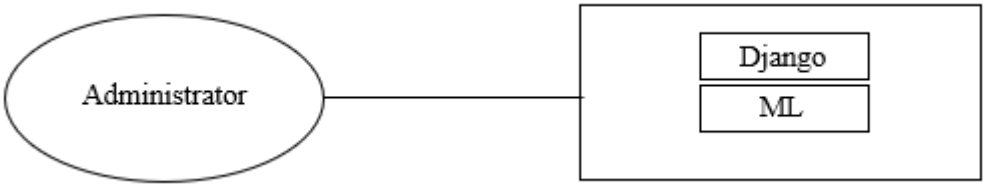
There is no system for CryptoCast design.

7.3. Architecture

7.3.1. Hardware Architecture



7.3.2. Software Architecture



7.4. System Interfaces

To store and retrieve data from a Microsoft SQL database, the system will connect to a REST API created with.NET Core. Transmission Control Protocol/Internet Protocol (TCP/IP) is the default communication protocol for data transmission between the server and the client. HyperText Transfer Protocol (HTTP, default port=80) will be used for communication between the web server and the client at the highest level. At least HTML version 5 is required, as well as Java.

7.4.1. External System Interfaces

There are no external system interfaces needed.

7.5. User Interface Design

Cryptocurrency Price Predictor System is a mobile-based cryptocurrency price prediction system which serves three different types of user. These users are Guest, Registered User and Admin. Based on these user types, system will include seven different interfaces:

- “Main Page” interface consisting of price prediction data display for Guest and Registered Users to see.
- “Login Page” interface consisting of username and password fields which Registered Users use to access their personalized profiles.
- “Register Page” interface consisting of email address, username, and password fields which allow Guest users to become Registered Users.
- “Change Password Page” interface consisting of verification code and new password fields which allow Registered Users to change their existing password.
- “Coin Summary Page” interface consisting of visualization tools to display personalized time versus predicted price graph of selected cryptocurrencies for only Registered Users to see.
- “Coin Discussion Page” interface consisting of create threads and view threads sections which allow only Registered Users to share their comments and insights about a specific cryptocurrency.
- “Profile Page” interface consisting of name, email and collections sections for only Registered Users to see.

7.5.1. Screen Definitions

7.5.1.1. Main Page

Figure 7.5.1.1: Main Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Guest and Registered users see this page first. There are three box designs which contain Current Value, Predicted Value and Combined Current/Predicted Value Graph for three of the most popular cryptocoins such as Bitcoin, Etherium and XRP. Each value display and graph show dates which are clickable buttons that can be set to hours, days and weeks if desired. Lastly, there is a "≡" button which the users can click to be redirected to Login, Register, Coin Summary, and Profile pages.

7.5.1.2. Login Page

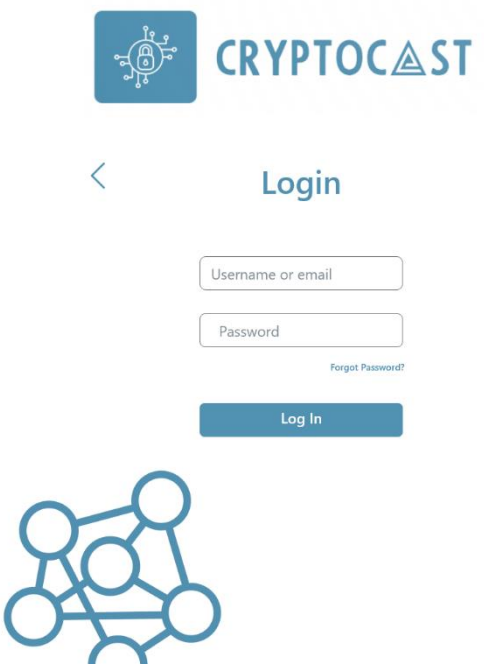


Figure 7.5.1.2: LoginPage

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Registered users can log in to Cryptocurrency Price Predictor System using a username and password. There are two text input areas for username and password and a button to log in. There are also two other buttons which the Registered user can click to be directed to Password Reset page if they forgot their password and Guest user can click to be directed to Register Page if they want to create an account. Lastly, there is a "<" button which the users can click to be directed to the Main page.

7.5.1.3. Password Reset Page

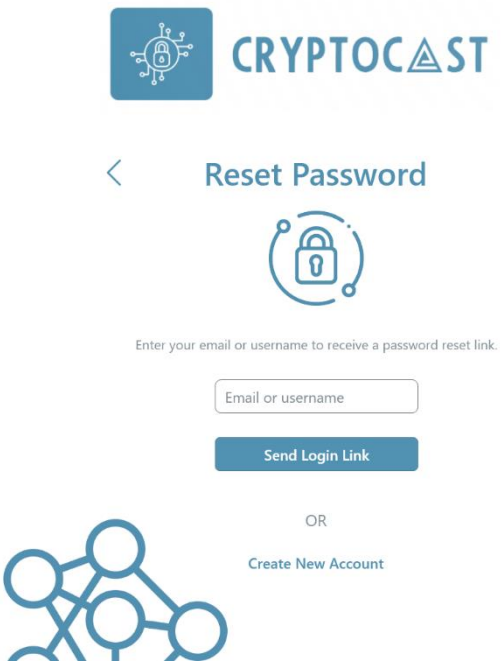


Figure 7.5.3.1: Password Reset Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Password Reset page is designed for Registered users who do not have access to their Profile page. There is one text input area for username or email and a button to submit input which sends a password reset link to registered email. There is also one other button which the Guest user can click to be directed to Register Page if they want to create an account. Lastly, there is a "<" button which the users can click to be directed to the Main page.

7.5.1.4. Change Password Page

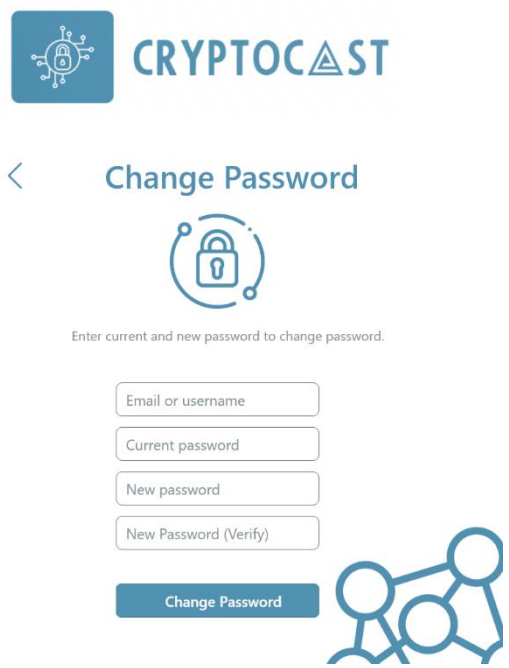


Figure 7.5.1.4:Change Password Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Change Password Reset page is designed for Registered users who have access to their Profile Page. There are four text input areas for email or username, current password and two new password areas which are used for verification purposes. There is button to submit password change and a "<" button which the users can click to be directed to the Main page.

7.5.1.5. Register Page

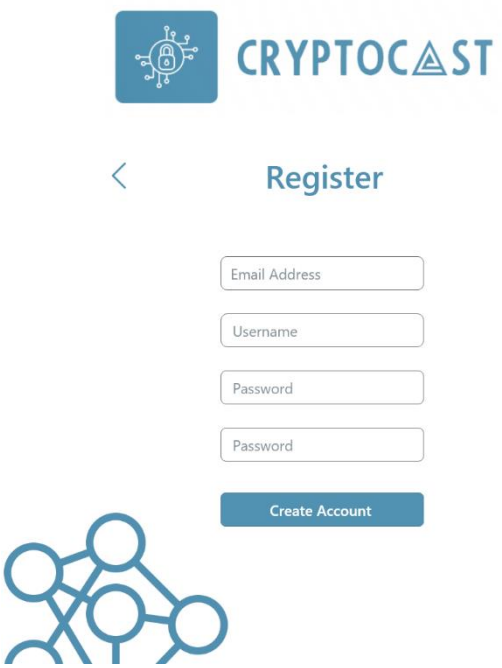


Figure 7.5.1.5: Register Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Guest users can create a new account to log in to Cryptocurrency Price Predictor System using an email address, username and password. There are four text input areas for email, username, and two password areas which are used for verification purposes. There is a button to create account and a "<" button which the users can click to be directed to the Main page.

7.5.1.6. Profile Page

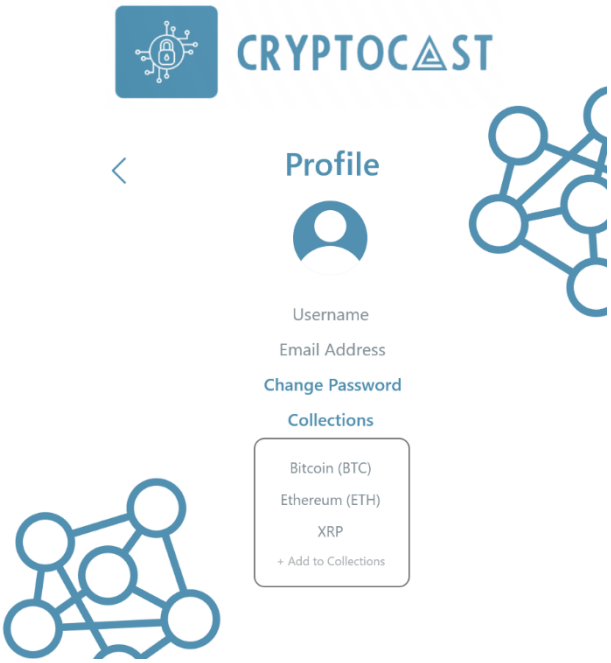


Figure 7.5.1.6: Profile Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Registered users can see their account details such as username and email information. There is a button to change password which the users can click to be directed to the Change Password page, a collections button which the users can click to be directed to the Collections page and a Prefferred Currency dropdown menu which the users can click to select desired currency type displayed in the application. Lastly there is a "<" button which the users can click to be directed to the Main page.

7.5.1.7. Coin Summary Page

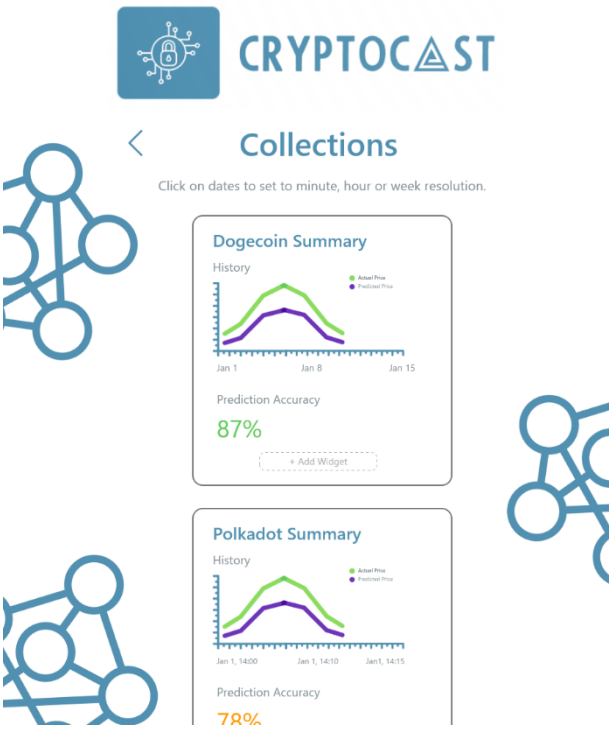


Figure 7.5.1.7: Coin Summary Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Coin Summary Page is only accessible to Registered users and it is very similar to Main page design in the sense that there can be a number of box designs which contain Current Value, Predicted Value and Combined Current/Predicted Value Graph for any selected cryptocurrency. Each value display and graph show dates which are clickable buttons that can be set to hours, days and weeks if desired. These box designs are also expandable, by clicking “+Add Widget” button, the user can choose to personalize their selected cryptocurrency box by adding features such as prediction accuracy or Actual vs. Predicted Price Overlay Graph. Lastly there is a "<" button which the users can click to be directed to the Main page.

7.5.1.8. Coin Discussion Page

Figure 7.5.1.8: Coin Discussion Page

The Cryptocurrency Price Predictor System logo "CryptoCast" is displayed at the top of the page. Total number of members and online members are displayed under Coin Discussion Page header. Username and Post title is shown below Posts header for each post in a preview form. Each preview has a upvote and downvote counter which other users can vote on and a tag that categorizes each post such as “News” or “Discussion”. Lastly there is a "<" button which the users can click to be directed to the Main page.

7.6. Process Design

7.6.1. Use Cases

7.6.1.1. Administrator Use Cases

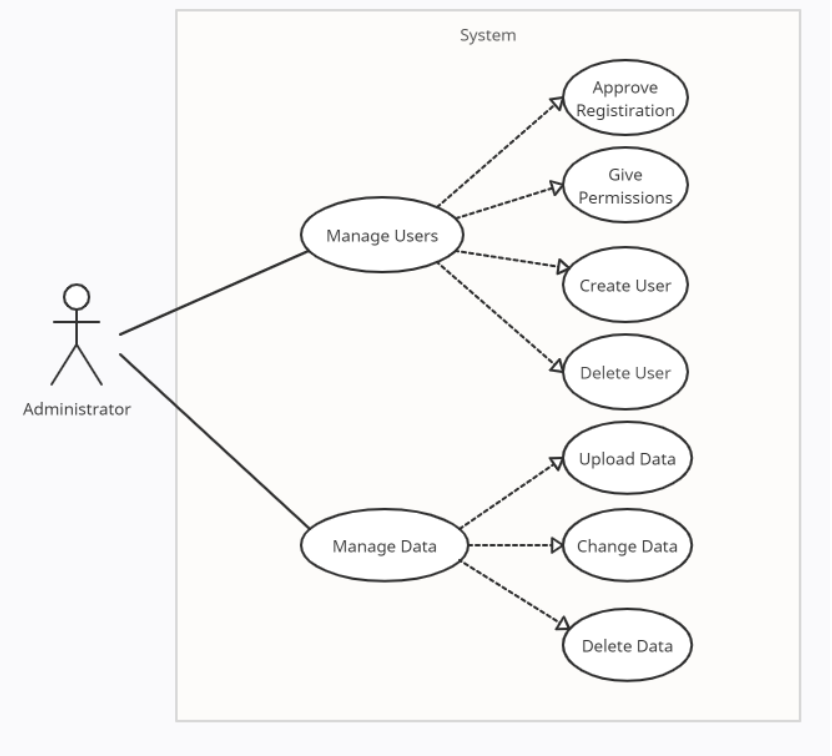


Figure 7.6.1.1: Administrator Use Case Diagram

Use Case Name: Manage Users
Use Case Number: 1
Actors: Administrator
Overview: This use case captures the process of creating, deleting, and managing users within the system.
Typical Flow Description: 1. After the registration is completed, the Administrator approves the registrations through the system. 2. The Administrator can give users specific permissions and prohibitions. 3. The Administrator can delete user. 4. A confirmation e-mail is sent to user by the system.
Precondition: 1. The User must not use an existing account email.
Postcondition: 1. A confirmation e-mail is sent to user by the system.
Alternative Flow Description: 1. The user can not register the system. 2. The administrator can create user

Use Case Name: Manage Data
Use Case Number: 2
Actors: Administrator
Overview: This use case captures the process of creating, updating and deleting data within the system in order to make predictions.
Typical Flow Description: 1. The Administrator can upload new coin data to system. 2. The Administrator can change the existing coin data. 3. The Administrator can delete coin data. 4. The Administrator saves the changes in database
Precondition: 1. The data must not duplicate.
Postcondition: 1. The result of the data entry must affect the system behavior positively.
Alternative Flow Description: 1. The data is duplicated. 2. The Administrator finds and deletes the duplicate data. 3. The Administrator saves the changes in database.

7.6.1.2. User Use Cases

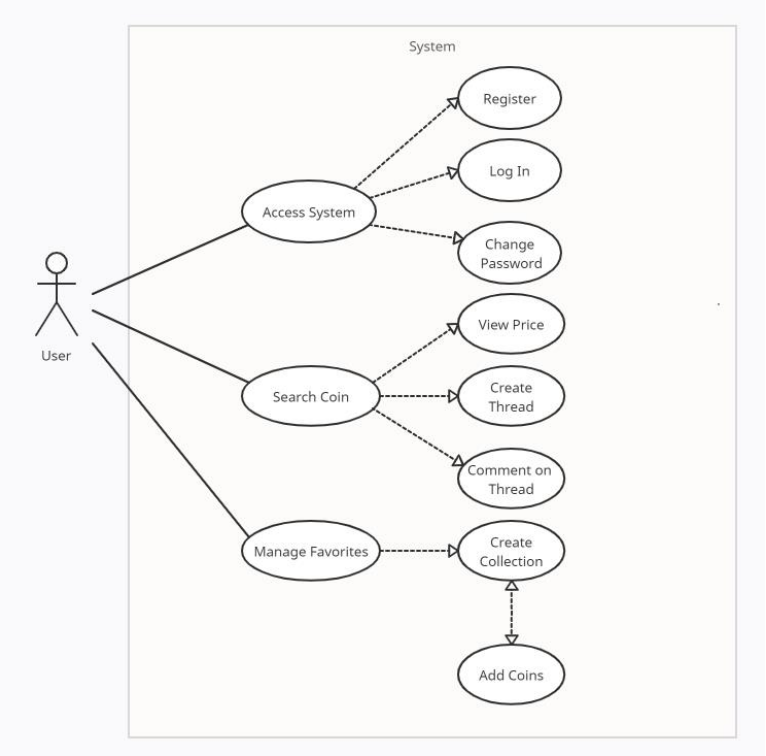


Figure 7.6.1.2: User Use Case Diagram

Use Case Name: Access System
Use Case Number: 3
Actors: User
Overview: This use case captures the process of registering, logging in, changing password and other base actions the User can take within the system.
Typical Flow Description: 1. The User registers to system. 2. A confirmation email is sent to User. 3. The User can log in the system after confirming the email. 4. The User can change password.
Precondition: 1. The User must not use an existing account email.
Postcondition: 1. The User should access all pages within his/her permissions and navigate in system without any problem.
Alternative Flow Description: 1. The user has already had an account. 2. The can directly log in to system.

Use Case Name: Search Coin
Use Case Number: 4
Actors: User
Overview: This use case captures the process of searching and navigating through coin information within the system.
Typical Flow Description: 1.The User is in Coin Summary Page. 2. The User can see the details about the searched coin. 3. The User can view predicted price graphs about the searched coin 3. The User can jump to Coin Discussion page. 4. The User can create thread about the coin. 5. The user can comment on an existing thread.
Precondition: 1. The User must be registered.
Postcondition: 1. The User can display the information.
Alternative Flow Description: 1. The User searches a coin. 2. The coin information does not exist within the system. 3. The User can make a request about a new coin.

Use Case Name: Manage Favorites
Use Case Number: 5
Actors: User
Overview: This use case captures the process of managing the system profile according to preferences.
Typical Flow Description: 1. The User is in Profile page. 2. The User can create a collection. 3. The User can add coins to the created collection. 4. The System considers the coins within the collection as favorized. 5. The System makes suggestions according to coins in the collection.
Precondition: 1. The User must be registered.
Postcondition: 1. The User should be notified about the coins in the collection.

7.7. Database Design

There are 3 tables in the planned database of the system. The tables are User, Reading, Location and Reading Type. Their content is explained in their respective table definition sections.

7.7.1. Table Definitions

7.7.1.1. User

Field	Type	Decription
ID	Integer	Auto generated positive integer id for table entry
UserName	CharField	Username of the user
Password	CharField	Password of the user
Email	EmailField	Email of the user
Name	CharField	First name of the user
Surname	CharField	Last name of the user
AuthorityLevel	Integer	Level of moderation authortiy of user (0 for regular user)

7.7.1.2. Message

Field	Type	Decription
ID	Integer	Auto generated positive integer id for messages
SenderId	Integer	Message's sender id number
Date	DateTimeField	Messages's send date
Topic	CharField	Message's topic
Body	CharField	Body of message

7.7.1.3. Coin

Field	Type	Decription
ID	Integer	Auto generated positive integer id for coins
Name	CharField	Coin name
Price	Float	Price of the coin on the specified date
Volume	Float	Volume of the coin on the specified date
Change	Float	Change of the coin on the last 24 hours (with %)
Date	DateTimeField	Messages's send date

8. References

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