High Level Design (HLD)

Concrete Compressive strength Prediction

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I. Document Version Control

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II. Abstract

Concrete is most common and oldest material for construction worldwide. Infrastructure and construction are considered as extremely sensitive domains regarding the safety issue. So, since concrete being the main component or material for the construction it would be important to measure the strength or the power of the concrete using some reliable methods. Concrete is basically a composite material composed of various base materials like cement, water, Coarse Aggregate, Fine Aggregate, and some other components. Compressive strength of concrete is measured using a conventional crushing test on a concrete cylinder. Basically, it takes 28 days of time.

1. Introduction

1.1 What is High Level Design Document (HLD)

The purpose of this High-level document (HLD) is to describe the design of the project in detail which can be used as a reference manual.

The HLD will:

- Present all the design aspects and define them in detail.
- Describe the user interface being implemented.
- Describe the software interfaces.
- Describe the performance requirements.
- Include design features and the architecture of the project.

1.2 Scope

The HLD document present the entire structure of the project in parts, such as the data ingestion, data pre-processing, solution development and the deployment part along with their respective architectures. This uses non-technical to mild technical terms which should be understandable to the administrators of the system.

1.3 Definitions

Database	Collection of all the data in tabular format at one place
Model	A Machine Learning Predictive Model
Paas	Platform as a service

2. General Description

2.1 Product Perspective

The Concrete compressive Strength Predictor is basically a Machine Learning based regression model which can predict compressive strength of concrete from all the materials used to make the concrete, some of those are: cement, water, Coarse Aggregate, Fine Aggregate, fly ash.

2.2 Problem Statement

The quality of concrete is determined by its compressive strength, which is measured using a conventional crushing test on a concrete cylinder. The strength of the concrete is also a vital aspect in achieving the requisite longevity. It will take 28 days to test strength, which is a long period. So, what will we do now? We can save a lot of time and effort by using Data Science to estimate how much quantity of which raw material we need for acceptable compressive strength.

2.3 Approach

The classical machine learning tasks like Data Exploration, Data Cleaning, Feature Engineering, Model Building and Model Testing. Try out different machine learning algorithms that's best fit for the above case.

2.4 Technical Requirements

Here "Python 3.9.12" is used, and some specific versions are used for Machine Learning process, which is deployed on the server.

All the module requirements are mentioned in the “requirements.txt”.

To get and run on your system:

➔ Open prompt on the system
➔ cd your-project-directory
➔ git clone https://github.com/Yatrik07/Concrete_Compressive_Strength_Prediction-Project.git
➔ pip install -r requirements.txt
➔ python app.py

2.5 Data Requirements

For the model training purpose, the data is taken form the Public “UCI Machine Learning Repository”

Source:

Original Owner and Donor
Prof. I-Cheng Yeh
Department of Information Management
Chung-Hua University,
Hsin Chu, Taiwan 30067, R.O.C.

Data Description:

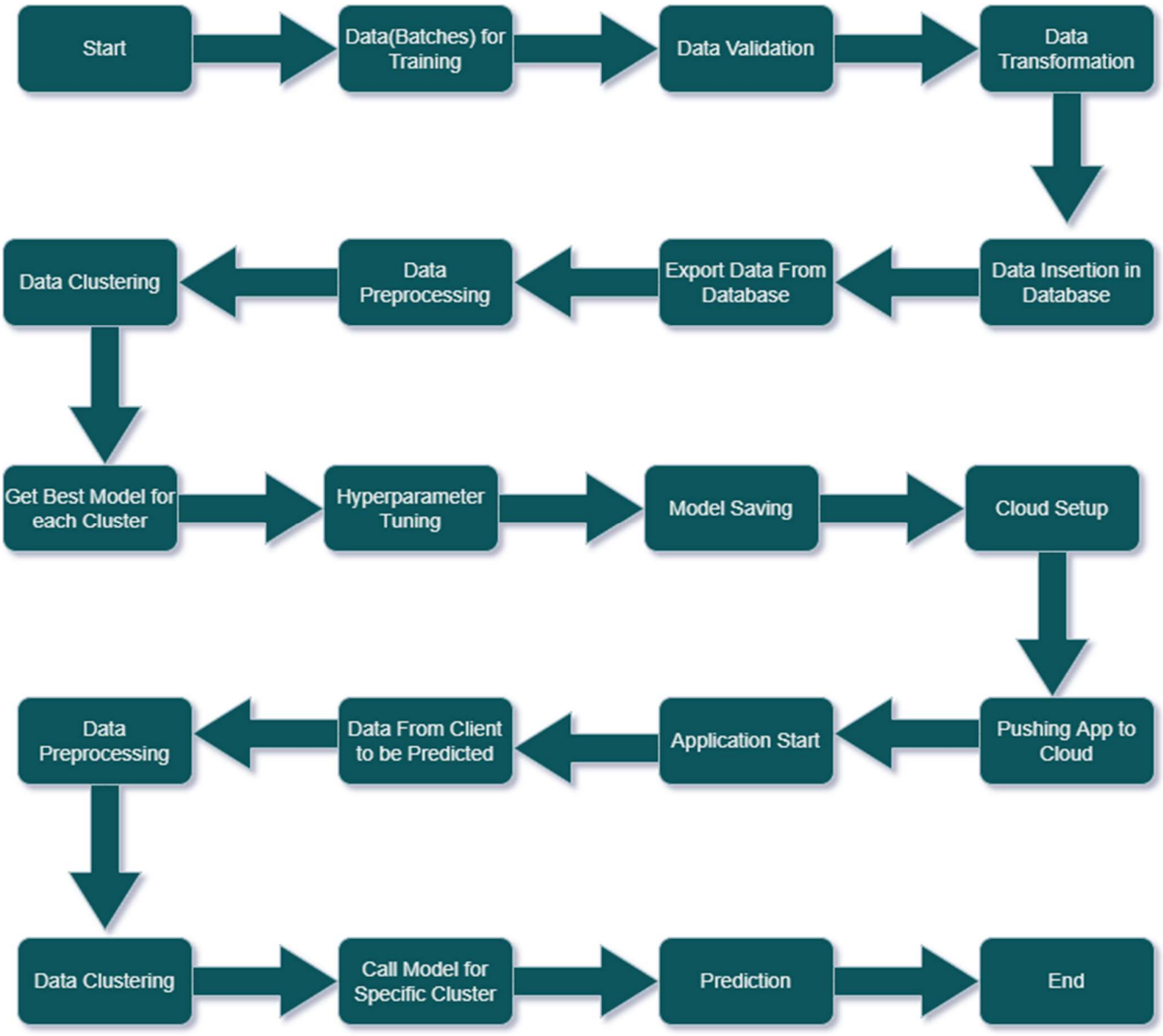
Name	Datatype	Measurement	Description
Cement	Quantitative	kg in a m3 mixture	Input Variable
Blast Furnace Slag	Quantitative	kg in a m3 mixture	Input Variable
Fly Ash	Quantitative	kg in a m3 mixture	Input Variable

Water	Quantitative	kg in a m3 mixture	Input Variable
Superplasticizer	Quantitative	kg in a m3 mixture	Input Variable
Coarse Aggregate	Quantitative	kg in a m3 mixture	Input Variable
Fine Aggregate	Quantitative	kg in a m3 mixture	Input Variable
Age	Quantitative	kg in a m3 mixture	Input Variable
Concrete compressive strength	Quantitative	Megapascal	Output Variable

2.6 Tools and Technologies used

3. Design Details

3.1 Process flow



3.2 Event Logs

Logging is the very essential part of end-to-end systems. By the logs we can make sure what is going on internally and if system crashed then why was it crashed.

Here logging used in every part of the project so the prefect scene can be imagined that what is the exact flow of the program is!

3.3 Error Handling

Here in every module the exception handling is done, so that it does not cause system failure or system error.

In case of any warnings or error occurred, it would be noted in the logs.

4. Performance

This Machine Learning based Concrete compressive strength predictor application is completely based on the data provided ti the model like other Machine Learning models.

In the model itself Cross validation and Hyperparameter tuning is done at its best. So that it should be as accurate as possible. So that it would not mislead the clients / users.

And also, as the performance is focused then, it should be noted that as the time goes, for the model to perform its best and stay updated with the data it should be retrained as well.

4.1 Reusability

The code written and the components used have an ability to be reused without any problem.

4.2 Application compatibility

The different components or modules of this project use python as their interface between them. Each component has its own task to perform, and it is the job of the python version to ensure proper transfer of the information.

4.3 Deployment

The application deployment with the Flask framework and also front-end with HTML5 and CSS is done on the Heroku Server.

4.4 User Interface

5. Conclusion

Traditionally, the strength of the concrete is also a vital aspect in achieving the requisite longevity. It will take 28 days to test strength, which is a long period.

So that using the Machine Learning based Compressive strength prediction approach is obviously a better choice.

If updated with more and good quality of data, it would be surely a better alternative so far.