High Level Design Document

Concrete Strength Prediction

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**ABSTRACT**

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 its strength, which is a long period. Hence, by the application of Data Science, one can estimate what would be the strength of a concrete block based on the material used to make the it. This will save time.

1 Introduction

1.1 Why this High-Level Design Document?

This document is prepared to predict the strength of concrete block based on the input materials Cement, Blast Furnace Slag, Fly Ash, Water, Superplasticizer, Coarse Aggregate, Fine Aggregate, Age. This will also add necessary description that will be suitable for the model preparation. This will also act as a reference manual for how different modules will interact at high level.

The HDL will:

* Present all of the design aspects and define them in detail
* Describe the user interface being implemented
* Software interfaces
* Include the architecture of the project
* List and describe the non-functional attributes like:
* Security
* Reliability
* Maintainability
* Portability
* Reusability
* Application compatibility
* Resource utilization
* Serviceability

1.2 Scope

The HLD documentation presents the structure of the system, such as the database architecture, application architecture (layers), application flow (Navigation), and technology architecture. The HLD uses non-technical to mildly-technical terms which should be understandable to the administrators of the system.

1.3 Definitions

Commonly used term with their description:

* **Database:** Collection of all the information monitored by this system
* **IDE:** Integrated Development Environment

2. General Description:

2.1 Project Perspective

The project is aimed at predicting the strength of concrete blocks based on various machine learning algorithms. This will save time as, for concrete, to determine the strength experimentally, it takes around 28 days.

2.2 Problem statement

To create an ML model that can predict the strength based on the input materials: cement, blast furnace slag, fly ash, water, superplasticizer, coarse aggregate, fine aggregate, and age.

2.3 Proposed Solution

The solution proposed here involves building a pipelined system that can automatically fetch the data from the client’s database and store it in our system. Then validate the data, preprocess the data, and then build the model to predict the strength of the concrete block. The prediction is then shared with the stakeholders.

2.4 Data Requirements

Dataset provided by the business.

2.5. Tools used

Entire programming is done on the python platform with following requirements:

* PyCharm is used as IDE
* Frameworks such as NumPy, Pandas, Scikit-learn are used to build the model
* AWS is used to deploy the model
* MongoDB is used to insert, create, update and retrieve the database
* Front end development is done using HTML/CSS

2.5.1 Hardware Requirements

* PC that can run such heavy operation
* Database storage

2.6 Constraints

The entire solution system must be user friendly, as automated as possible, and users should not be required to know any of the workings.

3. Design Details

3.1 Process Flow

To predict the concrete strength, ML model will be employed. Flow chart is mentioned below.

3.1.1 Proposed Methodology

Load the dataset from Database

Training / Validation on dataset

Model building

Prediction

Intimate to stakeholder

3.1.2 Model Training and Evaluation

Dataset in DB

Train and test split of data

Training set

Model Building /evaluation

Test Set

Predicting

3.1.3 Deployment process

Model Building

Predicting

Share results

3.2 Events Log

Every event should be logged so that user will know what actions are taken internally.

Step-By-Step logging description:

* The entire process flow should be logged.
* Developer can choose logging method. You can choose database logging/ File

logging as well.

* System should not hang even after using so many loggings.

3.3 Error Handling

If any error rises in the system, an explanation will be given to the stake holder mentioning what went wrong. An error will be defined as anything that falls outside the normal and intended usage.

4 Performance

A model that can predict the concrete strength based on the input material, will be delivered to the stakeholder. Also, model retraining is very important to improve the performance of model.

4.1 Reusability

The code written and the components used should have the ability to be reused with no problems.

4.2 Application Compatibility

The different components for this project will be using Python as an interface between them. Each component will have its own task to perform, and it is the job of the Python to ensure proper transfer of information.

4.3 Resource Utilization

When any task is performed, it will likely use all the processing power available until that function is finished.

4.4 Deployment

Model will be deployed in GCP, AWS platform

5 Dashboards

Dashboards will be implemented to display and indicate certain KPIs.

5.1 KPIs

The predicted strength of concrete block will be shared with the stakeholder

6 Conclusion

The Designed model will help stake holder to predict the strength of concrete block.