Chapter 9
Enhancing Concrete Strength Prognostication Through Machine Learning and Robotics

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ABSTRACT

Concrete is a widely used construction material globally due to its exceptional properties. The strength of concrete varies based on the composition of cement, blast furnace slag, fly ash, water, superplasticizer, coarse aggregate, and fine aggregate. By altering the ingredients in different proportions, the process can anticipate the concrete strength through the various machine learning techniques. The study in this chapter involves the utilization and comparison of three algorithms, viz. Random Forest, Gradient Boosting, and Linear Regression models to analyse the concrete strength. Among these models, gradient boosting yielded superior results. In order to predict concrete strength from these models, three sensors in the field paves the way for better analysis, such as, an acoustic emission sensor, a strain gauge sensor, and a wireless concrete maturity sensor. This approach proves to be highly effective in achieving optimal concrete strength using machine learning techniques.

DOI: 10.4018/979-8-3693-6150-4.ch009

INTRODUCTION

In a world where every major construction is built by concrete, safety in these buildings during dangerous events. Depending on the proportion of each ingredient in concrete, its properties can change drastically, making it useful for multiple purposes. This research paper focuses on enhancing its strength. Stronger concrete is required to be strong enough to face any danger while also being sustainable for the foreseeable future. Using durable concrete can enhance the longevity of structures, reducing the need for maintenance, improve its resistance to weathering and can lead to increased structural capacity due to more slender and efficient structures. To determine the correct proportion of ingredients to manufacture the strongest concrete, three sensors: an acoustic emission sensor, a strain gauge and a wireless concrete maturity sensor are used. The data from these sensors are passed through three different regression models: Random Forest, Gradient Boosting and Linear Regression. The aim of this paper is to compare the actual results, produced by graphs, with the predicted data, produced by the regression models, to accurately ascertain the perfect mixture of concrete.

Concrete is really important in building because it's strong and lasts a long time. Making strong concrete depends on getting the mix of ingredients just right. Strong concrete keeps buildings safe in emergencies, lasts longer, needs less fixing up, and can hold heavier stuff. In this study, we're using special sensors sound, strain, and wireless ones to watch how concrete sets and handles weight as it dries. These sensors give us data to figure out how different ingredient amounts affect how strong the concrete gets. Then, we use fancy computer models to analyze this data. These models help us predict how strong the concrete will be and check if our predictions are right by testing the concrete.

Our study, called “Improving Concrete Strength Prediction with Sensors, Computers, and Robots,” is all about using these sensors, computers, and robots to make concrete stronger. We want to predict and make the best concrete mixes to build safer, longer-lasting, and more eco-friendly buildings. Being eco-friendly is really important to us. Making concrete usually makes a lot of pollution, but by figuring out the best mix of ingredients and using smart technology, we can make concrete in a way that's less harmful to the environment. Plus, if buildings last longer and need fewer repairs, we're helping the planet too. Concrete has been around for ages, but now with cool technology, we can make it even better. By adding sensors into the mix, we can watch how it's doing in real-time and make it stronger and last longer. This not only keeps us safe but also makes building things cheaper and better for the environment. The sensors in concrete aren't just for predicting strength; they also help us keep an eye on how the building is doing over time. By watching for any damage or wear and tear early on, we can fix things up before they become big