

FRESH CONCRETE CLASS TYPE IDENTIFIER SYSTEM FOR QUALITY CONTROL UTILIZING ELECTRONIC MODULES

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ABSTRACT

Considering the increasing cases related to fraud of construction materials like cement, sand, and gravel, the fresh concrete class type identifier system would be a big help to the clients or customers. In this study, the researchers aim to develop a device that easily identifies the class types of fresh concrete using electronic modules. The temperature sensor can be embedded in concrete and used to sense the internal temperature of the curing concrete (Manuel Ramos, 2017). The Oven dry method is widely used for the determination of water content. The loss of weight that happens due to drying results in the measurement of the moisture content of the sample (Farhan Khan, 2020). The study was conducted and completed through actual testing. The result was accepted within theoretical ranges.

Based on the information above, the Fresh Concrete class type identifier system using electronic modules can function with reference to the standard temperature content of the fresh concrete as well as the workability of the moisture content through the Moisture Sensor.

Keywords: Fresh Concrete, Class A, Class B, Class C, Curing

INTRODUCTION

Concrete is a commonly used structural material in construction and is also sustainable. Construction has been halted upon the discovery of poor sea sand

concrete used in the building. The qualities of fresh concrete are very important because of their effect on the construction quality of the casting and forming process, as well as the properties of hardened concrete [1-2].

For years, the industry has had a very poor reputation for coping with the adverse effects of change, with many projects failing to meet quality targets [3].

Extreme temperatures have an impact on the qualities of fresh concrete, which can lead to cracking. Hot weather conditions can have an unfavorable effect on the characteristics of both fresh and cured concrete. Even while techniques can mitigate the negative impacts, fresh concrete quality management, from mixing to finishing, is critical in hot weather [4]. The temperature of concrete significantly affects its development [5]. Heat is produced during concrete curing by chemical reactions between cementitious ingredients and water. The accumulation of heat within the concrete mass causes a significant temperature rise. The temperature of the concrete mass is not uniform and would eventually drop to the ambient level due to heat absorption via the concrete surfaces to the surroundings, resulting in uneven thermal expansion and contraction of the concrete [6]. Concrete has a high compressive strength but a low tensile strength. As a result, cracks form anytime loads, restricted shrinkage, or temperature changes cause tensile stresses to exceed the concrete's tensile strength [7].

Testing of fresh and hardened concrete is required to monitor the construction process and ensure that acceptable concrete properties are reached. A number of tests are performed to ensure that the desired quality conforms to the requirements of the relevant national standards [8].

METHODOLOGY

Figure 1 shows the Prototyping model used by the researchers of the Fresh concrete class type identifier system. Figure 2 proclaims the block diagram of the prototype embracing the operational format of the prototype. Figure 3 reveals the Input Process Output (IPO) of the prototype which is also known as the Conceptual framework.

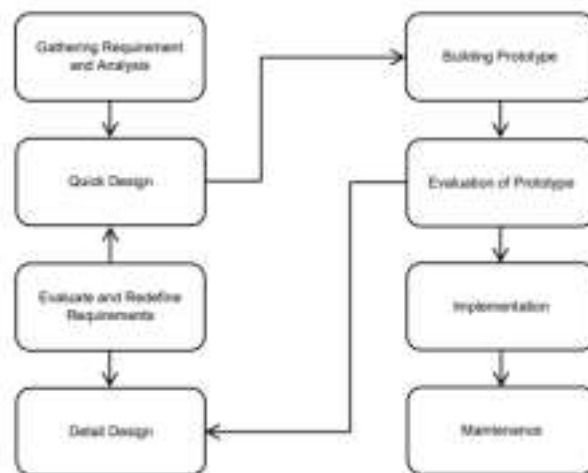


Figure 1. Prototyping model

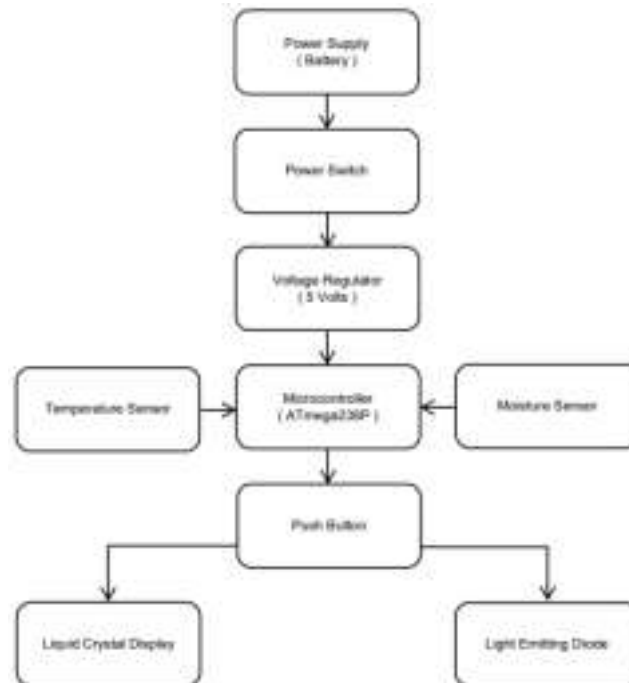


Figure 2. Block Diagram

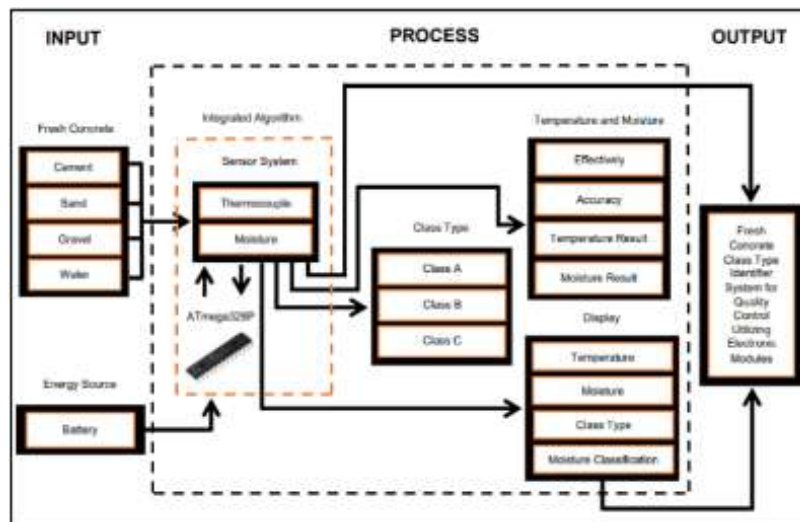


Figure 3. Conceptual Framework

RESULTS AND DISCUSSIONS

Figure 4 manifests the Actual image of the Prototype which is a compact type of device that can be preferred anywhere by end users. This prototype has a built-in Atmega328P Microcontroller which acts as the brain of the system where the manipulation and calculation of Temperature, and water/moisture content of the fresh concrete occurs. Especially, the real-time result of categorization of the concrete mixture class of a specific fresh concrete specimen. Figure 5 expresses the researchers gathering the data of temperature and moisture content of the fresh concrete inside the concrete cylinder mold. Figure 6 shows the actual testing of the prototype with fresh concrete specimens.



Figure 4. Actual Prototype of Fresh Concrete Class type identifier system



Figure 5. Recording the data



Figure 6. Actual Testing

A. Functionality Testing

The researchers determined the functionality of the device, which required a set of tests. from the Atmega328P microcontroller, temperature content monitoring, moisture content monitoring, displaying the data on the LCD, and the LED indicator. Upon testing these functions, the researcher can say that the device is functioning well.

B. Accuracy Testing

Figures 7, 8, and 9 show testing results of the temperature content of the fresh concrete inside the concrete mold cylinder. Theoretically, each category of a concrete mixture (Class A, B, and C) must not be less than 28 degrees Celsius nor greater than 35 degrees Celsius. From the data results the prototype meets the theoretical requirements. Figure 10, 11, and 12 shows the testing results for the Moisture content of the fresh concrete with soil moisture sensor-based value where the voltage gathered from the moisture probes are converted to a unitless value which shows from different class types of a concrete mixture

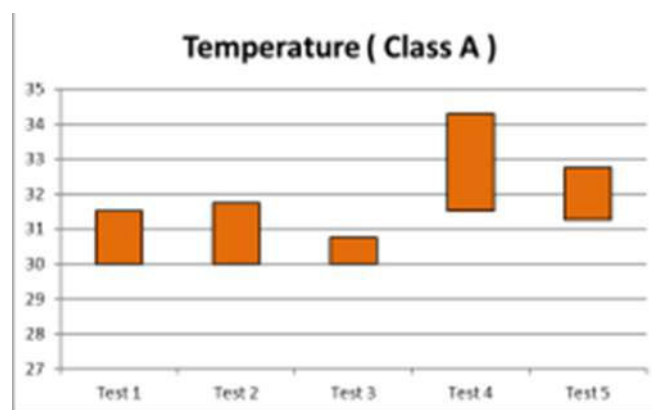


Figure 7. Graph for Temperature content of Class A

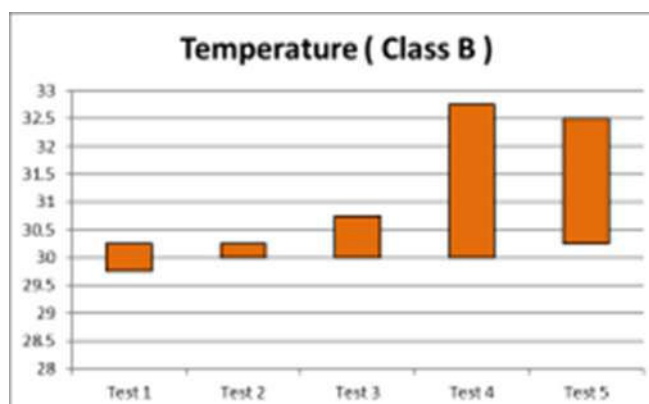


Figure 8. Graph for Temperature content of Class B

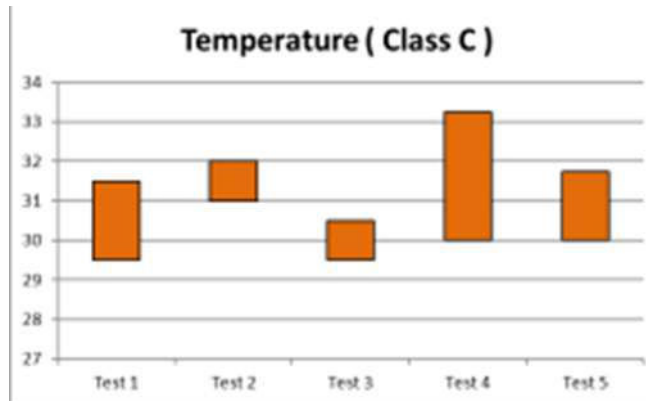


Figure 9. Graph for Temperature content of Class C

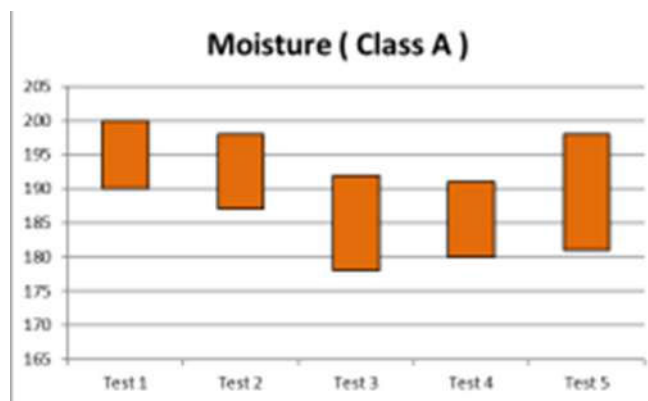


Figure 10. Graph for Moisture content of Class A

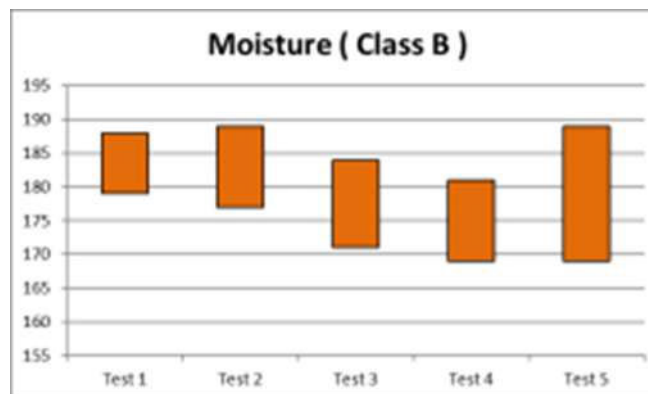


Figure 11. Graph for Moisture content of Class B

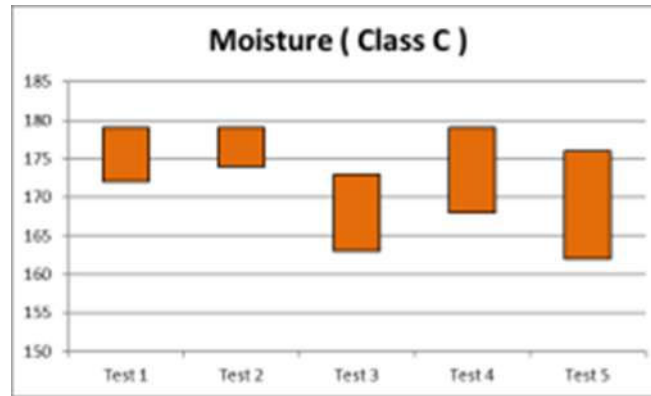


Figure 12. Graph for Moisture content of Class C

C. Performance Efficiency

The researchers compared the concrete specimen results from the fresh concrete class type identifier system testing contrasts with the manual system in terms of Pascal per inch (PSI) per concrete class type and temperature and moisture content result to determine the advantages of the prototype compared to the traditional system.

CONCLUSION AND FUTURE WORKS

This study proposed a system that can help to assist the end users to identify electronically the property of the particular fresh concrete and it will help the construction workers if the mixture is precise. This prototype is a compact device and Atmega328P Microcontroller based. The main input for the data is Temperature and moisture sensors which have better sensitivity than other commercial electronic sensors. The Atmega328P Microcontroller manipulates the data to get real-time results where the data are displayed on an LCD screen. Since this prototype is new and supporting theories are limited the researchers performed experimental testing claiming to set the parameters assuming the properties of the fresh concrete specimens are acceptable in practical manners. Theoretically, the acceptable temperature range for a particular concrete mixture is 28 to 35 degree Celsius to consider as good concrete mixture. Especially, for the water content of the fresh concrete ideally the concrete mixture has a specific range of water volume per particular area, for example, the concrete mold cylinder. Throughout testing the researchers noticed that each class type has a specific range of moisture sensor values for Class A concrete mixture the moisture sensor values range from 200 to 188, for Class B it is 187 to 175 and for Class C it is 175 to 160. The data are visible from graphs 10 to 12 from this the researchers claim that categorizing the concrete mixture is achievable. The researchers conducted final testing and still the results show the accuracy of the prototype. The prototype converges the required performance for monitoring the temperature and water content of fresh concrete. And especially for categorizing the concrete mixture classes is achieved in real-time results for the fresh concrete testing.

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