**Manufacture of organic compost using technology**

**A. Mariam Moustafa, B Nour hassan.**

Sharkya STEM School, Zagzig, Egypt

moustafamariam76@gmail.com

Sharkya STEM School, Zagzig, Egypt

nour09274@gmail.com

**SUMMARY**

The world faces the dual challenges of developing productive crops and managing waste, which contributes to greenhouse gas emissions and climate change. This project addresses these issues by accelerating organic waste decomposition through an in-vessel composting process, producing high-quality organic compost that enriches soil and agricultural land. The project utilizes an integrated Arduino system, comprising sensors, devices, and code, to control temperature, moisture, and ventilation. By doing so, it reduces decomposition duration by over 50% compared to traditional methods. This innovative approach offers a cheaper, healthier, and more environmentally friendly alternative to traditional fertilizers, benefiting farmers, the Egyptian economy, and the environment.

**KEYWORDS**

**Agriculture, Arduino, Climate change, Composting, Environment, Organic waste, organic fertilizers**

**INTRODUCTION** Climate change is one of the most pressing issues of our time, with far-reaching consequences for the environment, economy, and human health. The increasing levels of greenhouse gases in the atmosphere, primarily due to human activities, are leading to rising temperatures and altered weather patterns. In this context, sustainable agricultural practices are crucial for mitigating the effects of climate change.

The aim of this study is to explore the potential of composting organic waste using Arduino sensors to monitor and optimize the decomposition process. This innovative approach can help reduce waste management costs, produce nutrient-rich fertilizers, and promote productive crops.

The importance of this study lies in its potential to contribute to a more sustainable and environmentally-friendly agricultural sector. By developing a cost-effective and efficient method for composting organic waste, we can reduce the environmental impact of agriculture while improving crop yields and promoting food security.

**METHODS**

In our Methodology for creating the project, three stages were followed:

**Stage 1: Constructing of galvanized steel and blades.**

Galvanized steel is the special box through which the whole the system will be put in, so it has to be built with a special design and specifications that suit the conditions of the project. After creating its design, we deal with the Blacksmith workshop to build it, considering the Installation of the shaft and the seven blades inside it

**Stage 2: installation of the Arduino System.**

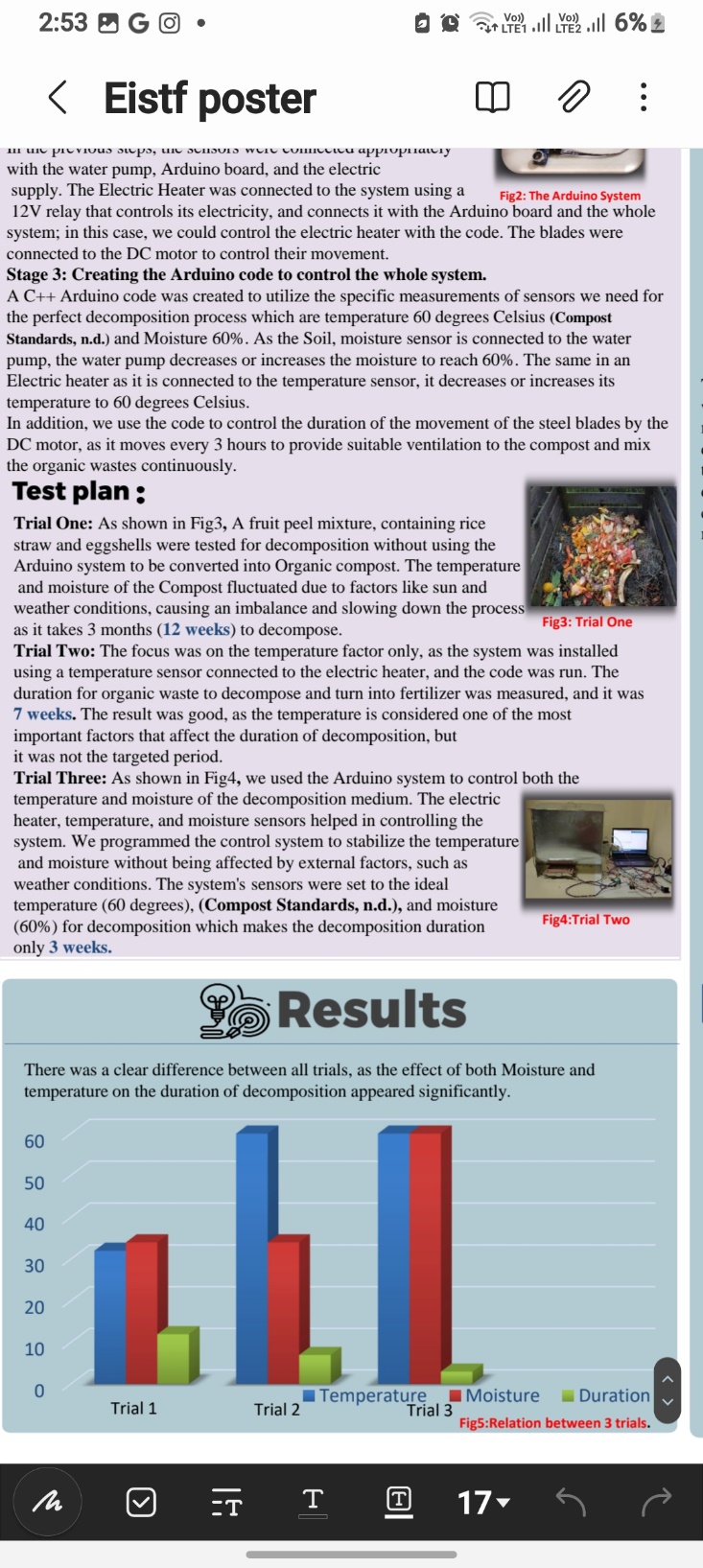
The 12V 70W Water pump was connected with the 3V/3.3V high-level relay and the electric supply then, the relay was connected also to the electric supply and the Arduino UNO R3board. The soil moisture sensor and temperature sensor were connected to the Arduino UNO R3 board. In the previous steps, the sensors were connected appropriately with the water pump, Arduino board, and the electric supply. The Electric Heater was connected to the system using a 12V relay that controls its electricity, and connects it with the Arduino board and the whole system; in this case, we could control the electric heater with the code. The blades were connected to the DC motor to control their movement.

**Stage 3: Creating the Arduino code to control the whole system.**

A C++ Arduino code was created to utilize the specific measurements of sensors we need for the perfect decomposition process which are temperature 60 degrees Celsius (Compost Standards, n.d.) and Moisture 60%. As the Soil, moisture sensor is connected to the water pump, the water pump decreases or increases the moisture to reach 60%. The same in an Electric heater as it is connected to the temperature sensor, it decreases or increases its temperature to 60 degrees Celsius. In addition, we use the code to control the duration of the movement of the steel blades by the DC motor, as it moves every 3 hours to provide suitable ventilation to the compost and mix the organic wastes continuously.

**RESULTS AND DISCUSSION**

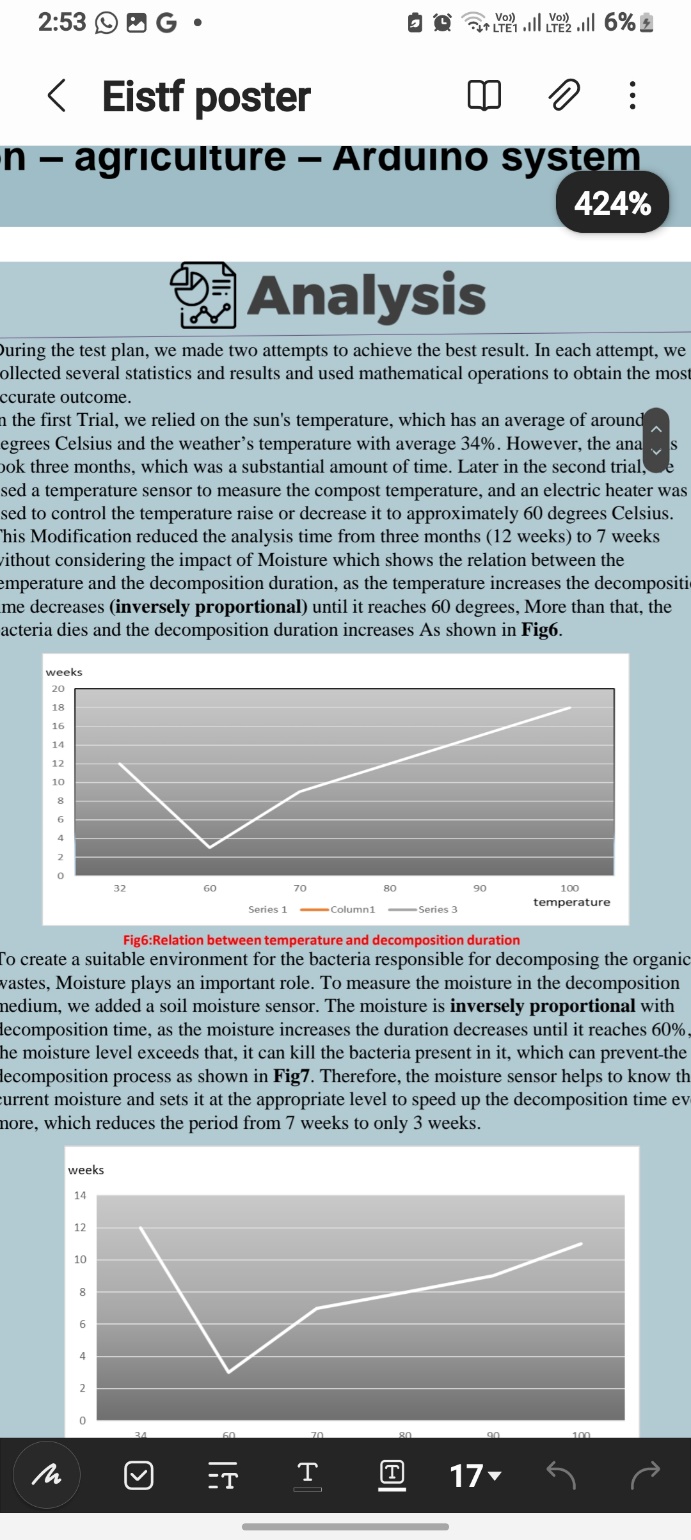
There was a clear difference between all trials, as the effect of both Moisture and temperature on the duration of decomposition appeared significantly.

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**Figure1 (relation between three trails)**

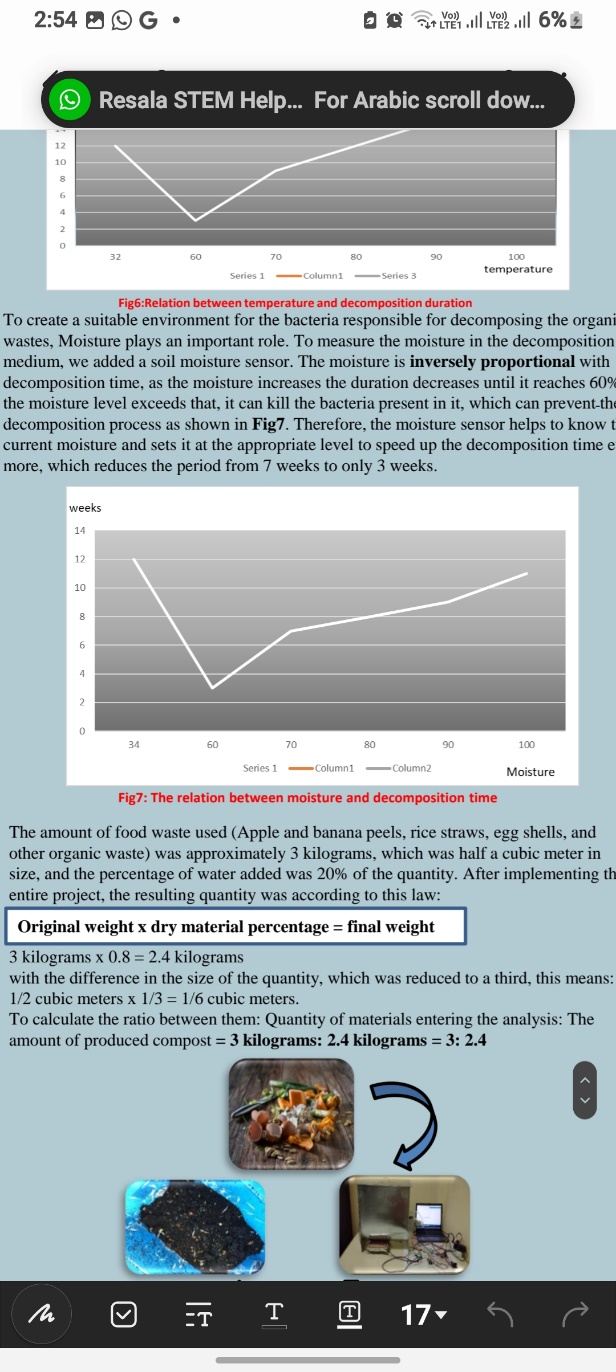
During the test plan, we made two attempts to achieve the best result. In each attempt, we collected several statistics and results and used mathematical operations to obtain the most accurate outcome.

In the first Trial, we relied on the sun's temperature, which has an average of around 32 degrees Celsius and the weather’s temperature with average 34%. However, the analysis took three months, which was a substantial amount of time. Later in the second trial, we used a temperature sensor to measure the compost temperature, and an electric heater was used to control the temperature raise or decrease it to approximately 60 degrees Celsius. This Modification reduced the analysis time from three months (12 weeks) to 7 weeks without considering the impact of Moisture which shows the relation between the temperature and the decomposition duration, as the temperature increases the decomposition time decreases (inversely proportional) until it reaches 60 degrees, More than that, the bacteria dies and the decomposition duration increases As shown in Fig2.



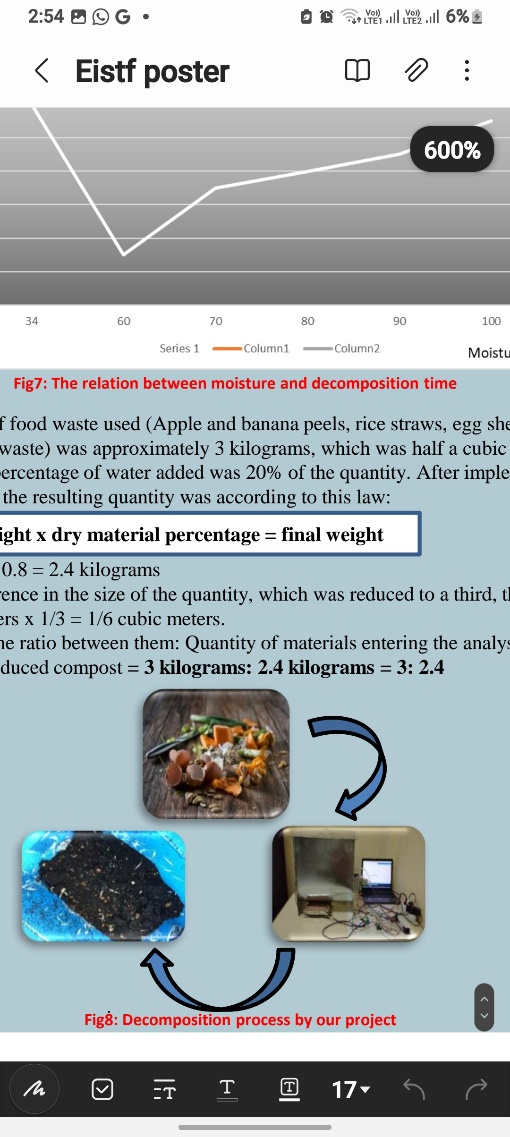
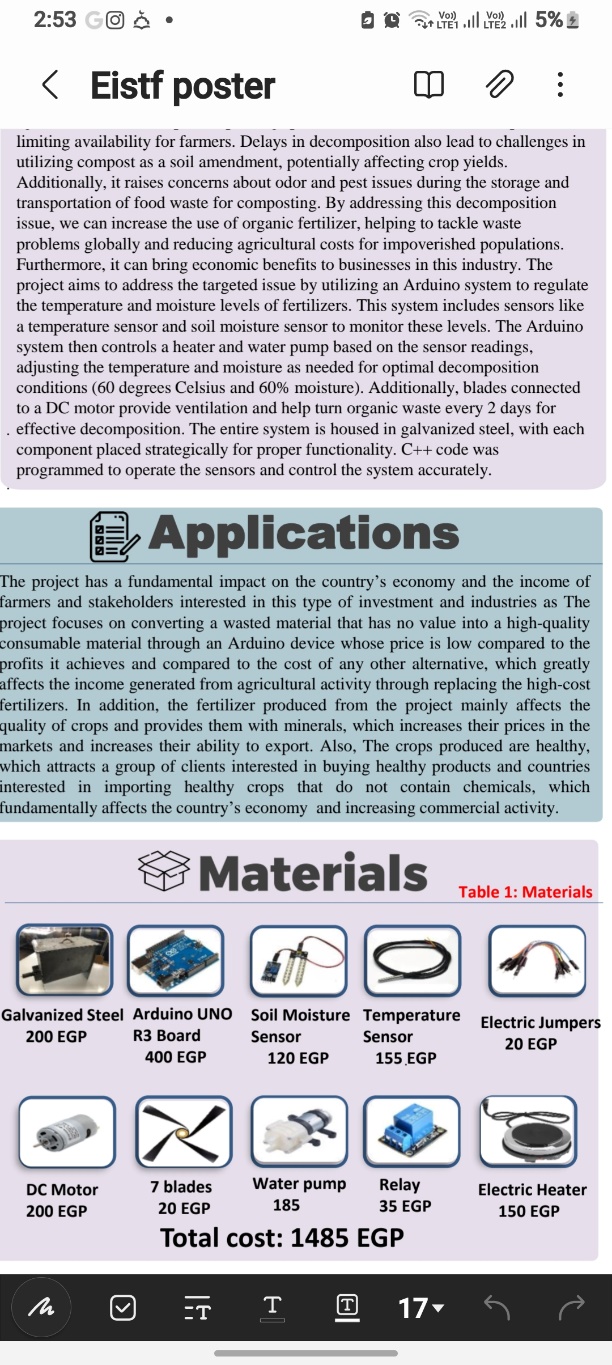
**Figure2 (Relation between temperature and decomposition duration)**

To create a suitable environment for the bacteria responsible for decomposing the organic wastes, Moisture plays an important role. To measure the moisture in the decomposition medium, we added a soil moisture sensor. The moisture is inversely proportional with decomposition time, as the moisture increases the duration decreases until it reaches 60%, If the moisture level exceeds that, it can kill the bacteria present in it, which can prevent the decomposition process as shown in Fig3. Therefore, the moisture sensor helps to know the current moisture and sets it at the appropriate level to speed up the decomposition time even more, which reduces the period from 7 weeks to only 3 weeks.



**Figure3 (The relation between moisture and decomposition time)**

The amount of food waste used (Apple and banana peels, rice straws, egg shells, and other organic waste) was approximately 3 kilograms, which was half a cubic meter in size, and the percentage of water added was 20% of the quantity. After implementing the entire project, the resulting quantity was according to this law: **3 kilograms x 0.8 = 2.4 kilograms**  with the difference in the size of the quantity, which was reduced to a third, this means:1/2 cubic meters x 1/3 = 1/6 cubic meters. To calculate the ratio between them: Quantity of materials entering the analysis: The amount of produced compost = 3 kilograms: 2.4 kilograms = 3: 2.4

**Figure2 (Decomposition process by our project) Table1 (the material and cost)**

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# CONCLUSIONS

Organic Compost is one of the most useful types of fertilizer that benefits the soil and crops and saturates them with minerals. In addition, it is the best for the Egyptian economy, as it is lower in cost than any other compost due to its reliance on organic waste as a raw material. However, some challenges hinder its manufacture, the most important of which is the duration of decomposition of organic compost. Therefore, the project solves this problem and aims to significantly accelerate the decomposition process, as it aims to work on all the factors that affect the duration of the decomposition, most notably moisture, and temperature. It makes that through an integrated Arduino system that controls these factors and monitors them. Three trials that tested the project were done. It was concluded that the Arduino system contributed to reducing the time of the decomposition to more than half the time it takes without the Arduino system as controlling temperature can reduce the duration from 12 weeks to 7 weeks and controlling moisture can reduce the duration from 7 weeks to 3 weeks. Therefore, we conclude that controlling both factors moisture and temperature can ensure the duration of decomposition of organic waste and thus the manufacture of organic fertilizer is faster and with high quality.

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