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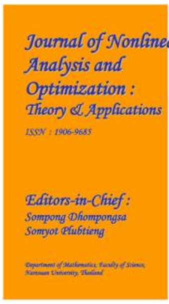

GRAIN DRYING TOWARDS SUSTAINABLE FARMING

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Abstract:
A Grain dryer is a device or system used to dry small quantities of Grain, also known as rice in its husked form. Grain drying is an important step in the process of producing rice, as it helps to reduce the moisture content of the Grain to a level that is suitable for storage and milling. Grain dryers are typically used by small-scale farmers or rice millers who do not have access to large-scale drying facilities. The efficiency and effectiveness of a Grain dryer depend on various factors, such as the type of dryer, the capacity of the dryer, the ambient temperature and humidity, and the initial moisture content of the Grain. Grain dryers can be designed and built in a variety of sizes and configurations to suit different drying needs and budgets. The proposed system dryer has two conveyor belts which transfers the grain to the mesh container and chamber box. By using Arduino UNO board and Arduino IDE software drying the grain using a 12V DC fan. Also maintaining proper temperature by using a temperature sensor and for monitoring purpose we used LCD display.
Keywords: Arduino UNO, conveyor belts, DHT11, L293D motor driver IC, Gear motors, Mesh Container, moisture sensor, LCD display, Voltage booster IC.

1.Introduction

Sarker et al. investigate the energy efficiency and rice quality of an industrial inclined bed dryer for drying freshly harvested paddy. The study assesses energy consumption, drying performance, and quality of the dried rice, including moisture content, milling yield, and grain breakage. Their results provide valuable insights into energy-saving possibilities and the impact on rice quality, crucial for optimizing post-harvest processes in rice production. Maintaining the drying air temperature below 39°C is advised to preserve rice quality while ensuring reasonable energy consumption. The paper provides a comprehensive review and analysis of control engineering applications in drying technology, focusing on optimizing processes, improving efficiency, and ensuring product quality. It discusses emerging trends in control engineering for drying technology and highlights the inefficiencies of traditional paddy drying methods, emphasizing the need for more effective alternatives due to increasing grain demand. Mechanical dryers are identified as faster and more continuous than sun drying, with pneumatic conveyor dryers offering lower energy consumption, better drying results, and higher capacity. The study determines that maintaining a temperature of 60°C and a loading weight of 150 grams is optimal for drying paddy grain based on experimental results. It also estimates the final moisture content (FMC) of paddy during drying, crucial for trade or storage at 15%wb, using temperature and humidity sensors (DHT11 and EE31) to calculate air humidity ratio and indicate paddy moisture reduction. An Arduino microcontroller processes sensor data, showing an average error of 4.3% compared to traditional moisture detection methods. Additionally, the research focuses on digitally simulating the dynamic behavior of conveyor-belt dryers used for removing moisture from wet raisins. It examines how material temperature and moisture content at the entrance, along with drying air temperature, affect material properties at the exit. The study finds that precise control is achievable with a Pi-feedback cascade temperature controller but is hindered when a delay-measuring sensor is introduced. Adding a simplified lead-lag feedforward controller improves control performance in the presence of the delay sensor. Furthermore, the paper proposes an innovative solution for rice grain drying in agriculture using an Arduino-driven system. This system combines technological accuracy with agricultural needs by maintaining a uniform drying environment with a precise temperature sensor and a nichrome heater. An air blower ensures even heat distribution, and the system has a drying capacity of 50 kilograms per operation. This technology integrates intelligent technology with traditional agricultural methods, addressing post-harvest challenges in rice production [1-6].

2. Proposed Method

To prevent heavy losses for farmers due to grain spoilage, an automated grain dryer system is proposed using an Arduino UNO board and various hardware components. The system incorporates a DHT11 sensor for measuring temperature and humidity, an LCD panel for displaying information, gear motors for conveyor belt movement, IR sensors for conveyor belt control, and a 12V DC fan for drying the grains. The drying process occurs in a chamber box equipped with a mesh container to prevent excess water and ensure efficient drying. The temperature sensor continuously monitors the chamber box temperature, providing real-time readings to the LCD display and the computer system. When the temperature exceeds a certain level, the 12V DC fan turns off, only turning on again when the temperature falls below the threshold. Compared to manual methods, this automated system offers consistent and uniform grain drying, reduces spoilage and quality degradation risks, and minimizes labor requirements. Utilizing the Arduino UNO board and open-source software code, the system is cost-effective and easily adaptable to different grain drying needs. This project showcases the potential of embedded systems in enhancing agricultural processes and mitigating post-harvest losses for farmers.

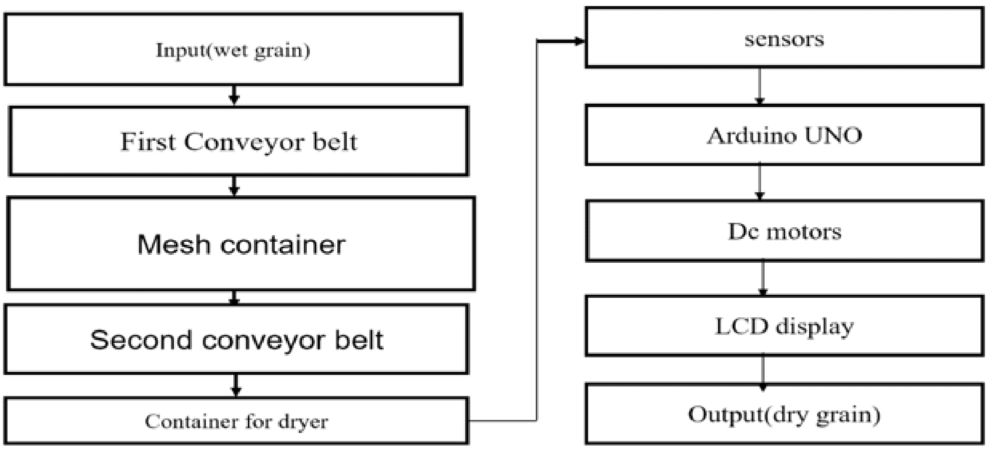

Figure.1. Block Diagram of Grain drying towards sustainable farming.

2.1ADVANTAGES OF PROPOSED SYSTEM

1. Low cost.
2. efficient working.
3. good market price for paddy.
4. seed germination.
5. Improved Quality of products.
6. Reduces the grain loss.
7. Reduces the human power.
8. Reduces the time for drying process.

3. Results and Discussion

3.1 DETAIL INFORMATION REGARDING CIRCUIT DIAGRAM

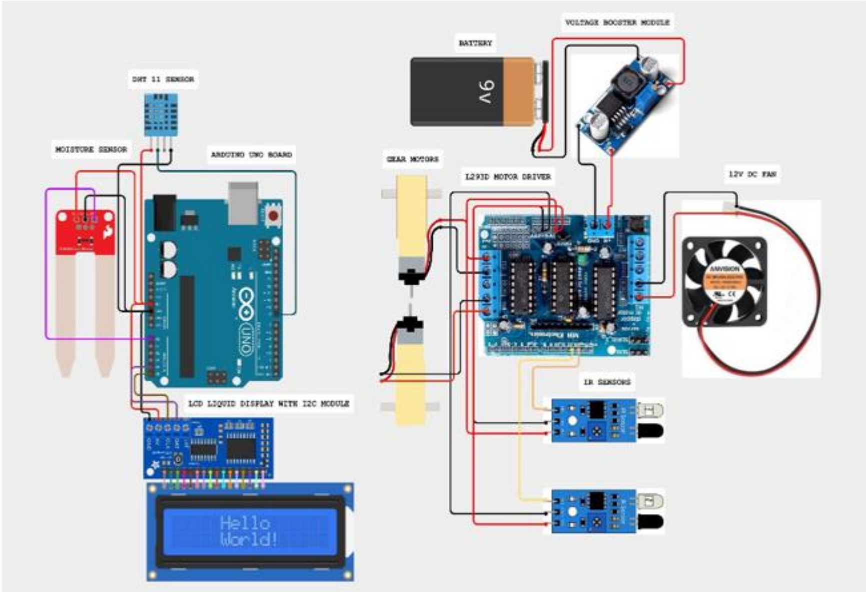

Figure.2. Project Schematic Diagram.

Explanation

The project requires several key components, including the Arduino UNO board, L293D motor driver, voltage booster module, 9V battery holder, 12V DC fan, DHT11 sensor, LCD display, moisture sensor, gear motors, and IR sensors. To assemble and operate the system correctly, follow these steps carefully:

Place the L293D motor driver on the Arduino UNO board. Connect Gear Motor 1 to M1 and Gear Motor 2 to M2 on the L293D motor driver.

Connect the moisture sensor to pin A0, the first IR sensor to pin A1, and the second IR sensor to pin A2. Also, connect the DHT11 sensor to pin 13.

For the LCD display, connect the SDA pin to A4 and the SCL pin to A5.

Note that pins A0, A1, and A2 are analog, while the Arduino UNO board has 13 digital pins, including some PWM pins.

Connect the 12V DC fan to M4 on the L293D motor driver.

Provide a 12V input to the L293D motor driver for accurate motor operation. Use the voltage booster module to boost the 9V input to 32V, adjusting the output voltage to 12V using the potentiometer knob.

Each sensor module requires a power supply and ground connection, which should be connected to the Arduino's 5V and ground terminals, respectively.

Before uploading the code to the Arduino UNO board using the Arduino IDE software, remember to remove the fuse from the L293D motor driver if you are providing a 12V input from the voltage booster module. If not, you can keep the fuse in place.

Following these steps precisely will ensure the proper integration and operation of all components in your project.

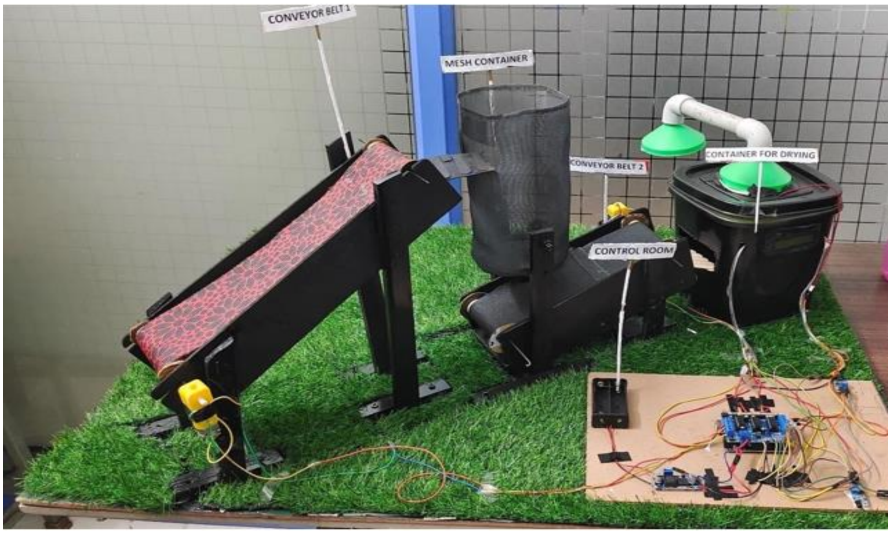

Figure.3. Final outlook of project.

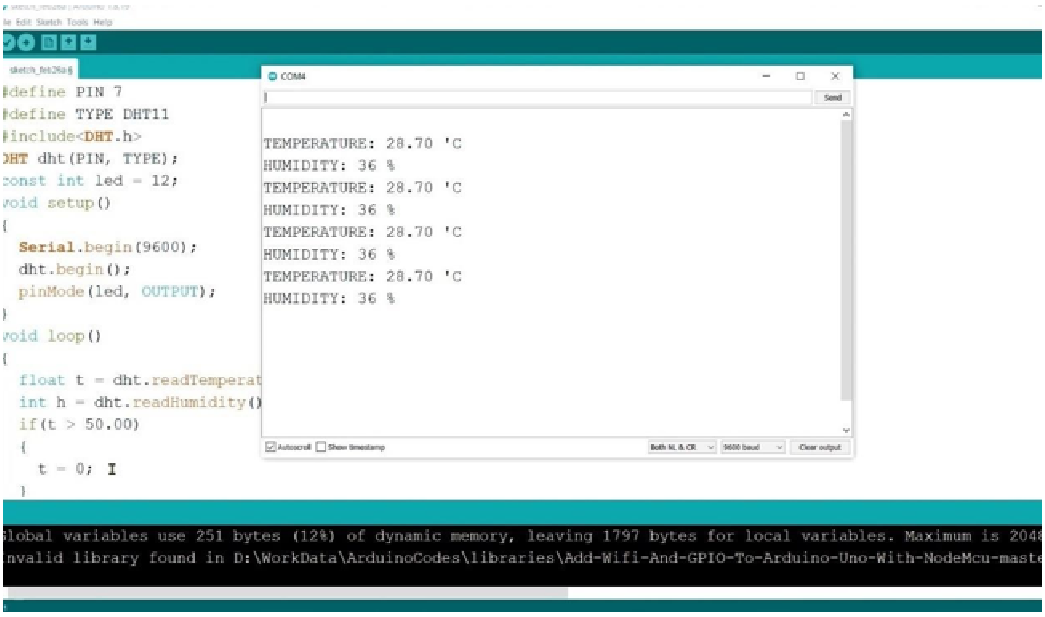

Figure.4. Temperature Sensor Serial Monitor results

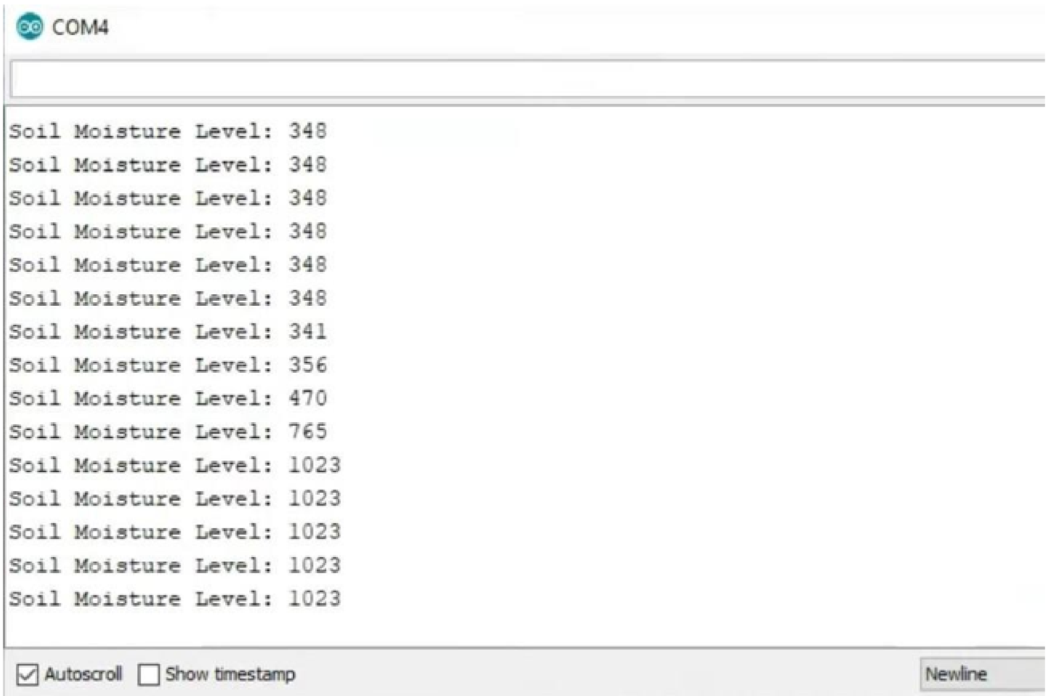

Figure.5. Moisture Sensor Serial Monitor results.

Figure.6. LCD Display output.

3.2 Advantages, Disadvantages and Applications

3.2.1 Advantages

Automation: Arduino microcontrollers enable precise regulation of temperature, humidity, and airflow in the paddy drying process, reducing manual intervention and ensuring consistent drying conditions for higher quality output.

Customization: Arduino-based paddy dryers can be programmed to accommodate different types of paddies, moisture levels, and drying requirements, allowing for flexibility and optimization based on specific crop varieties and environmental conditions.

Energy Efficiency: By monitoring and adjusting drying parameters in real time, Arduino-based paddy dryers can optimize energy usage, leading to cost savings and reduced environmental impact compared to traditional methods.

Data Logging and Analysis: Arduino microcontrollers can log data such as temperature, humidity, and drying time, enabling analysis to improve drying protocols, troubleshoot issues, and ensure consistent quality.

Cost-Effectiveness and Accessibility: Arduino microcontrollers are affordable and widely available, making them a practical choice for implementing smart control systems in paddy dryers. Additionally, the Arduino community provides ample support and resources.

Scalability and Integration: Arduino-based paddy dryers can be easily scaled up or integrated with other systems, allowing for flexibility in adapting to changing production needs or expanding operations.

Improved Quality and Shelf Life: With precise control over the drying process, Arduino-based paddy dryers can produce dried paddy with better quality and longer shelf life, reducing post-harvest losses and increasing market value.

Overall, Arduino-based paddy dryers offer several advantages over traditional methods, including improved automation, customization, energy efficiency, data management, and scalability, leading to higher productivity and reduced operational costs.

3.2.2. Dis-advantages

Technical Knowledge Requirement: Implementing an Arduino-based control system for paddy dryers requires a certain level of expertise in programming and electronics, which may be challenging for users unfamiliar with these areas.

Limited Expandability: While Arduino boards can be expanded with additional modules and shields, there are limitations in terms of the number of inputs/outputs and complexity of control systems that can be implemented, which could restrict the scalability of the system.

Sunlight Exposure: Direct sunlight can heat up sensors and affect their accuracy. It is advisable to use shields or covers to protect sensors from direct sunlight exposure.

Temperature Variations: Extreme temperatures can impact sensor performance. It is important to ensure that sensors are rated for outdoor use and have a wide operating temperature range to withstand fluctuations.

Environmental Factors: External factors such as severe weather conditions or environmental hazards can affect the system's performance and reliability, potentially impacting the drying process.

Risk of Malfunction: Like any electronic system, the proposed grain dryer is susceptible to malfunctions, which could disrupt the drying process and lead to potential grain loss.

3.3. Applications

Here are some key applications for the proposed grain dryer system:

Small-Scale Farming: The system provides a cost-effective solution for small-scale farmers to dry small quantities of grains without requiring large-scale drying facilities, benefiting farmers who cultivate rice or other grains.

Rice Milling: Rice millers can integrate the grain dryer system into their operations to ensure that rice

grains are dried to the optimal moisture content before milling, improving the quality and shelf life of the rice.
Research and Development: The system's development using Arduino technology showcases potential innovations in agricultural equipment, inspiring further research for improved and customized drying solutions for various crops and environments.
Environmental Monitoring: The system's sensor technology for temperature monitoring can be expanded for environmental monitoring applications, demonstrating its adaptability in controlling and monitoring environmental conditions in agricultural settings.
Educational Purposes: The system serves as an educational tool in agricultural engineering and technology courses, teaching students about grain drying principles, sensor technology, and Arduino-based control systems.
Overall, the proposed grain dryer system offers practical and versatile applications in agricultural settings, enhancing the efficiency and sustainability of grain drying processes.

4. Conclusion

The proposed project illustrates how grains can be efficiently dried after harvesting without any inconvenience or delay. The model provides a clear concept of how the system can be implemented on a large scale, maintaining the same idea and approach. Besides saving time for farmers, it demonstrates advanced technological control, where each aspect of the grain is measured and managed to achieve accurate and efficient results. The system is portable, user-friendly, and operates automatically, requiring no specialized expertise for operation. It is particularly suitable for small and medium-scale farmers who may not have access to expensive, technologically advanced dryers. The system eliminates the need for farmers to spread grains over large areas for sun drying, completing the drying process within a few hours in an automated manner.

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