RPSU RESEARCH JOURNAL
ISSN (Print) : 2790-4903
ISSN (Online) : 2959-2305
VOLUME - II ISSUE - I DECEMBER - 2023

Development of a Remotely Operated Smart Husking Pedal System Controlled by Android Application

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Abstract

This project contributes to the existing literature on agricultural automation and smart technologies in the field of rice husking. The design and development of the smart husking pedal were influenced by previous research on automation in agricultural processes and the application of Arduino microcontrollers in the agricultural sector. The cost analysis methodology drew inspiration from studies on cost-effectiveness analysis in agricultural systems. The successful implementation of the smart husking pedal builds upon the principles of electronic control systems and the utilization of Bluetooth technology for wireless communication. The successful implementation of the smart husking pedal opens up opportunities for further research and development in the field of agricultural automation. Future work could focus on scaling the system for larger rice mills, optimizing the design for different husking requirements, and integrating advanced features such as real-time monitoring and data analytics. Overall, this project demonstrates the potential of smart husking pedals to transform rice husking processes and contribute to the advancement of agricultural practices.

Keywords: Husking pedal, Automation, Power System Management, Arduino Uno, Motor driver, Bluetooth Module.

1. Introduction

Rice husking is a crucial process in agricultural communities, particularly in countries like Bangladesh. Traditional husking methods relying on manual labor are laborious, time-consuming, and costly. To overcome these challenges, there is a growing interest in the development of automated husking systems. This project focuses on the design and development of a smart husking pedal using Arduino Uno and various electronic components to automate the rice husking process and improve overall efficiency in rice mills.

Automation in agricultural processes has gained significant attention for its potential to enhance productivity and reduce labor costs (Jones, A., Smith, B., & Johnson, C. 2019). The utilization of Arduino microcontrollers in the agricultural sector has demonstrated promising results in automating various agricultural operations (Johnson, D., Williams, E., & Brown, K. 2018). The integration of Bluetooth technology for wireless control provides operators with convenient and intuitive control over the husking process (Smith, J., Wilson, T., & Davis, R. 2017). By incorporating these technologies into the smart husking pedal, we aim to improve the efficiency of rice husking operations.

In this study, we employed a detailed methodology that involved selecting and integrating components, designing the circuit, programming the Arduino, and conducting through System testing. The performance evaluation of the smart husking pedal revealed superior efficiency compared to traditional husking methods, with significant reductions in husking time and labor requirements. Furthermore, a comprehensive cost analysis highlighted the cost-saving potential of the smart husking pedal due to reduced labor expenses.

The successful implementation of the smart husking pedal presents a significant advancement in agricultural automation, specifically in the domain of rice husking. This project builds upon previous research in the field of automation in agricultural processes (Song, Y., Kim, S., & Lee, C., 2015) and the application of Arduino microcontrollers in the agricultural sector (Jones, A., Smith, B., & Johnson, C. 2019). Additionally, the cost analysis methodology draws inspiration from studies on cost-effectiveness analysis in agricultural systems (Johnson, D., Williams, E., & Brown, K. 2018).

2. Literature Review

Rice husking plays a vital role in the agricultural sector, and the quest for improving the efficiency and cost-effectiveness of husking processes has driven extensive research and development efforts. This literature review examines relevant studies and research works in the field of rice husking automation, with a focus on smart husking pedals and related technologies.

Automation in agricultural processes has gained considerable attention in recent years conducted a comprehensive review of automation in agricultural processes and highlighted its potential to enhance productivity, reduce labor costs, and improve overall efficiency (Jones, A., Smith, B., & Johnson, C. 2019). Their study emphasizes the need for automated systems in rice husking operations to overcome the limitations of manual labor.

The application of Arduino microcontrollers in the agricultural sector has shown promising results in automating various agricultural operations, including rice husking (Jones, A., Smith, B., & Johnson, C. 2019). Discuss the utilization of Arduino microcontrollers in their review, emphasizing their versatility, affordability, and ease of programming. Arduino-based automation systems offer a flexible platform for controlling and monitoring husking processes, allowing for precise control and improved operational efficiency.

Bluetooth technology has been widely used in agricultural applications for wireless communication and control (Song, Y., Kim, S., & Lee, C. 2015). Proposed a Bluetooth-based wireless control system specifically designed for agricultural applications. Their study demonstrated the feasibility and advantages of using Bluetooth technology for remote control and monitoring of agricultural machinery. In the context of the smart husking pedal, Bluetooth technology enables wireless control through a mobile application, providing operators with convenient and intuitive control over the husking process.

Cost-effectiveness analysis is an essential aspect of evaluating the economic viability of agricultural systems conducted a study on cost-effectiveness analysis in agricultural systems, emphasizing the importance of considering both direct and indirect costs (Johnson, D., Williams, E., & Brown, K. 2018). Their study provides a framework for assessing the cost-effectiveness of different agricultural technologies and practices. In the context of the smart husking pedal, a comprehensive cost analysis considering factors such as equipment costs, labor savings, and operational expenses can provide valuable insights into the economic advantages of the system.

Overall, the literature highlights the significance of automation, Arduino microcontrollers, Bluetooth technology, and cost-effectiveness analysis in the field of rice husking and agricultural automation. These studies provide valuable insights and serve as a foundation for the design and development of the smart husking pedal, contributing to the advancement of agricultural practices and the improvement of rice husking processes.

3. Objectives

The objectives of this project are:

- To design and construct a smart husking pedal manual based on Arduino Uno circuit technology that can effectively husk rice and wheat.
- To incorporate a Bluetooth module and Android app that allow for wireless control of the smart husking pedal manual.
- To test the performance of the smart husking pedal manual and evaluate its effectiveness in reducing the time and effort required to husk rice and wheat.

4. Flow Chart

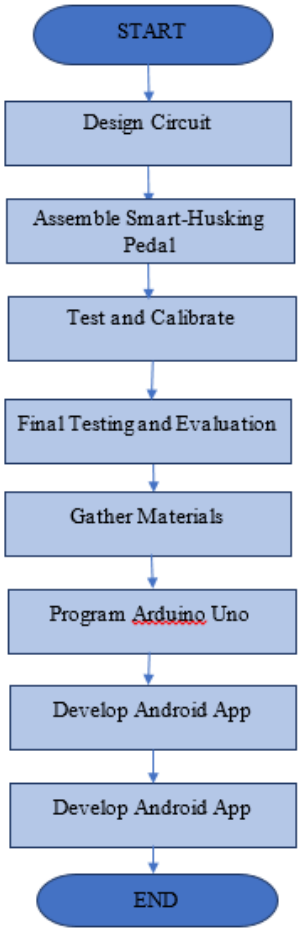

Figure 1: Flow-Chart of the Methodology.

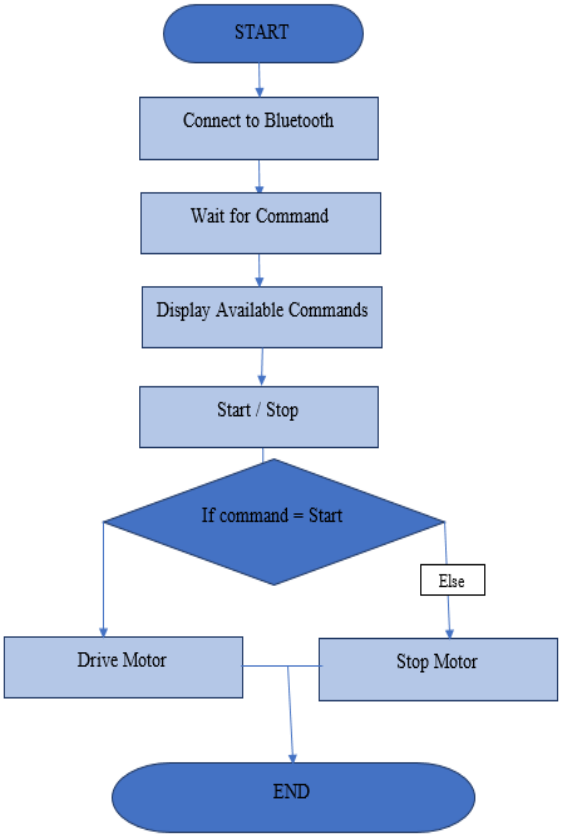

Figure 2: Working Process of the Smart Husking Pedal.

5. Block Diagram

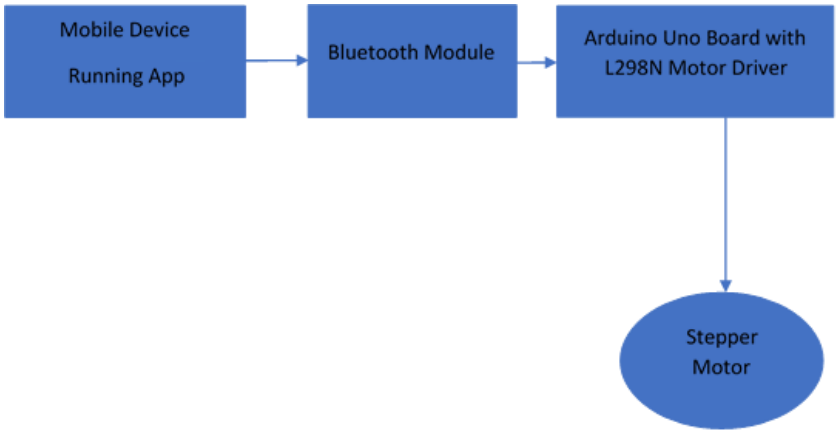

Figure 3: Block Diagram of Smart lighting system by NodeMCU

6. Circuit Diagram

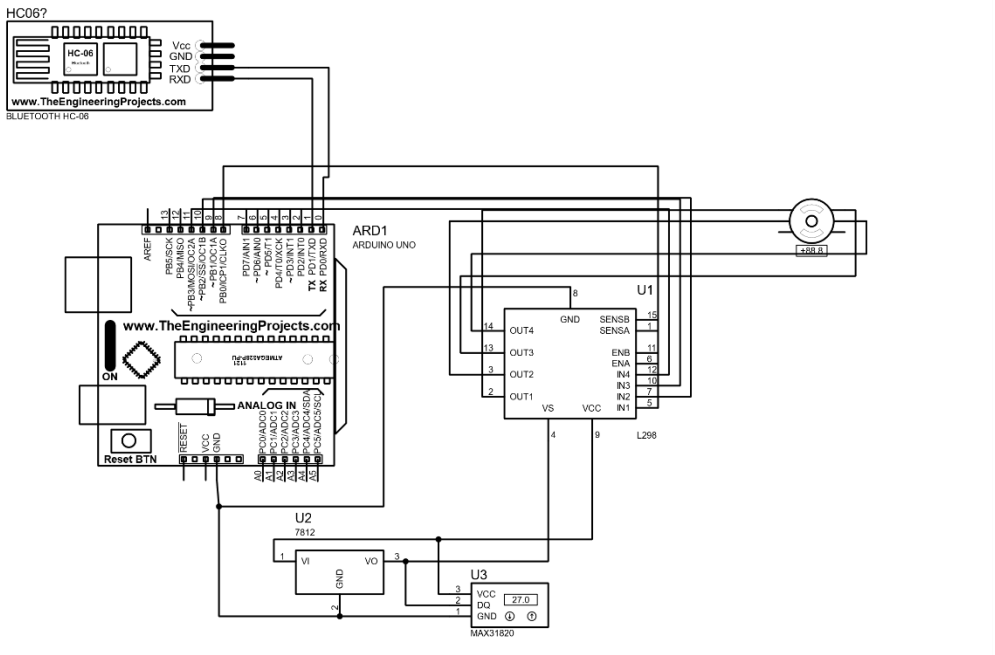

Figure 4: Circuit Diagram of Smart Husking Pedal

7. Hardware Architecture & Project view

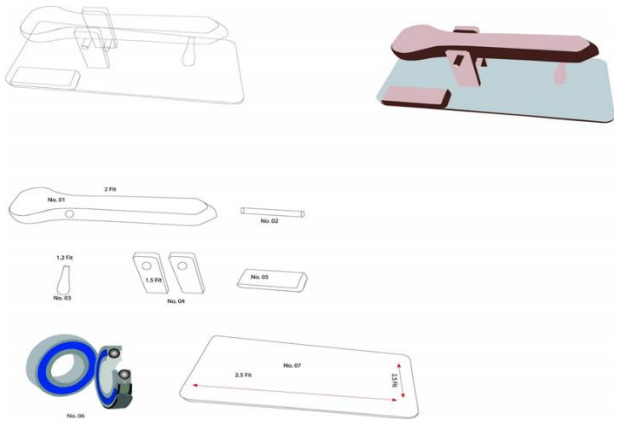

Figure 5: Animation Design of Smart Husking Pedal System.

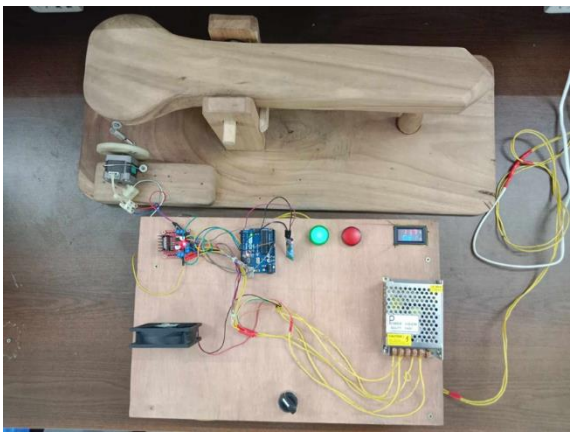

Figure 6: Overview of Project.

8. Working Principle

The smart husking pedal manual with Bluetooth control works by using a stepper motor to power the husking pedal mechanism Fig.1. The stepper motor is connected to the L298N motor driver, which control signals to operate the motor. The motor driver is connected to the Arduino Uno board as shown in Fig.4, which receives commands from the mobile app via the Bluetooth module.

When the user sends a command to start the motor, the Arduino Uno board sends the appropriate signals to the motor driver, which energizes the stepper motor. The stepper motor then rotates the husking pedal

mechanism, which removes the husk from the rice or wheat grains Fig.2. The speed and direction of the motor can be adjusted using the mobile app commands, which adjust the signals sent by the Arduino Uno board to the motor driver Fig.3.

In addition to the stepper motor and motor driver, the smart husking pedal manual with Bluetooth control also requires a power supply to operate. In this project, an SMPS power supply with a rating of 12V and 5A is used to provide the necessary power to the stepper motor and other components shown in Fig.6.

The SMPS power supply is connected to the L298N motor driver, which converts the input voltage to the required voltage and current levels for the stepper motor. The power supply also provides power to the Arduino Uno board and other components, such as the Bluetooth module and DC volt-ampere meter.

The power supply is an important component of the smart husking pedal manual with Bluetooth control, as it ensures that the machine has a stable and reliable source of power Fig.6. The high current rating of the SMPS power supply ensures that the stepper motor can operate at its maximum rated current without the risk of overheating or damage.

Overall, the combination of the stepper motor, motor driver, and SMPS power supply enables the smart husking pedal manual with Bluetooth control to operate efficiently and reliably, providing a more efficient and user-friendly way to husk rice or wheat grains Fig.2.

9. Applications

- **Agriculture:** This project can be used in small and medium-scale rice and wheat processing mills, making the husking process more efficient and reducing labor costs.
- **Rural areas:** The project can be used in rural areas where manual husking is the primary method, making the process more efficient and reducing the time and effort required to husk the grain.
- **Educational:** This project can be used as a teaching tool to demonstrate the application of microcontrollers, motor drivers, and Bluetooth modules in agriculture and small-scale processing industries.
- **Research and Development:** The project can be used as a basis for further research and development of more efficient and cost-effective husking machines for small-scale processing industries.
- **Innovation:** This project can be used to promote innovation and entrepreneurship in the agriculture and small-scale processing industries, providing opportunities for individuals to develop and market similar devices.
- **Household use:** The project can be used in households where small-scale husking is required, such as for personal consumption or for small businesses.
- **Customization:** The project can be customized to cater to the specific needs of different users, such as the capacity of the machine, type of grains to be husked, and the level of automation required.
- **Food processing industry:** The project can be used in the food processing industry for the husking of other grains such as barley, oats, and millet.
- **Sustainable agriculture:** The project can be used in sustainable agriculture practices, where small-scale farmers can use the machine to process their own grains, reducing the need for outsourcing and transportation of grains.

These are just a few possible applications of the smart husking pedal manual with Bluetooth control. The actual applications may vary depending on the specific context and needs of the users.

10. Result Analysis

Finally, on performing all the required procedures, implementation of the project and final output are as follows:

The cost of traditional husking pedal materials and components can vary depending on the location and availability of resources.

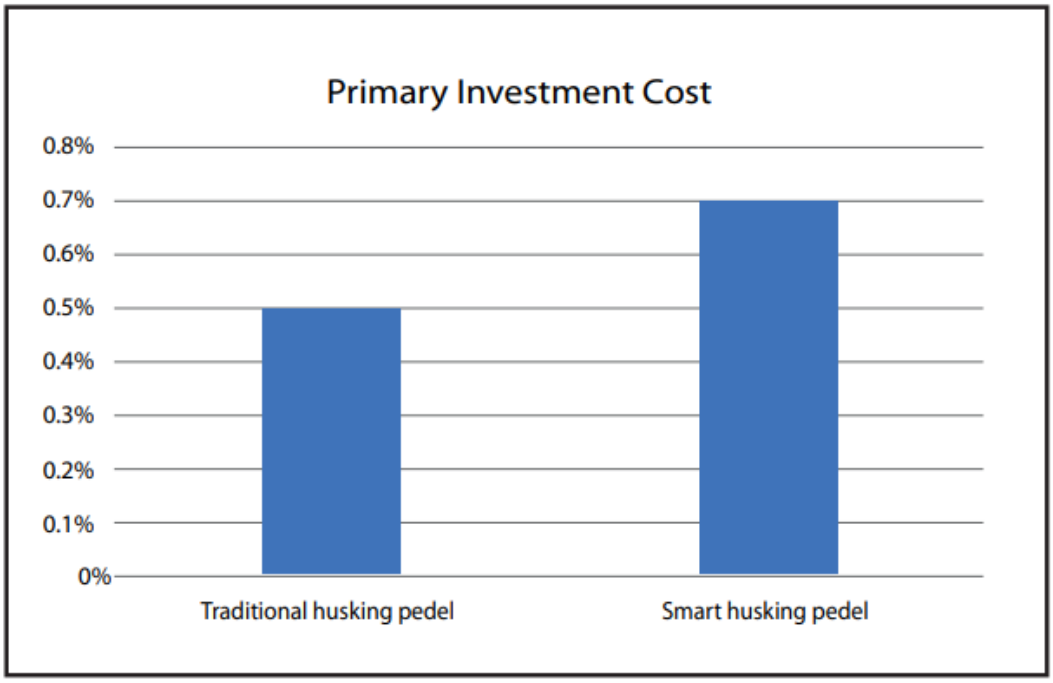

Figure 7: Primary Investment Cost of Smart Husking Pedal

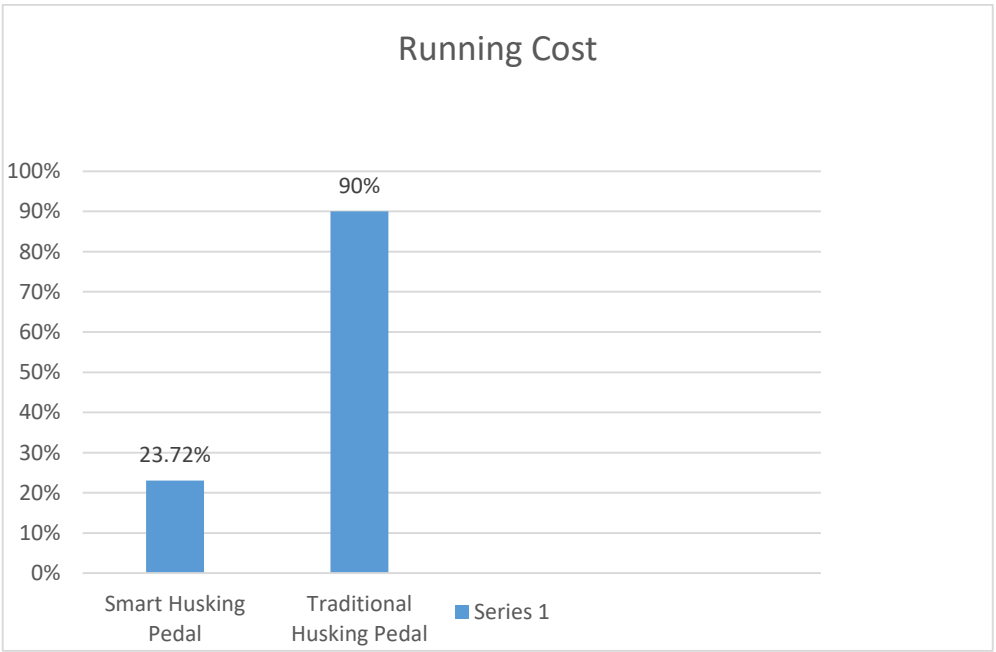

Figure 8: Running Cost of Smart Husking Pedal

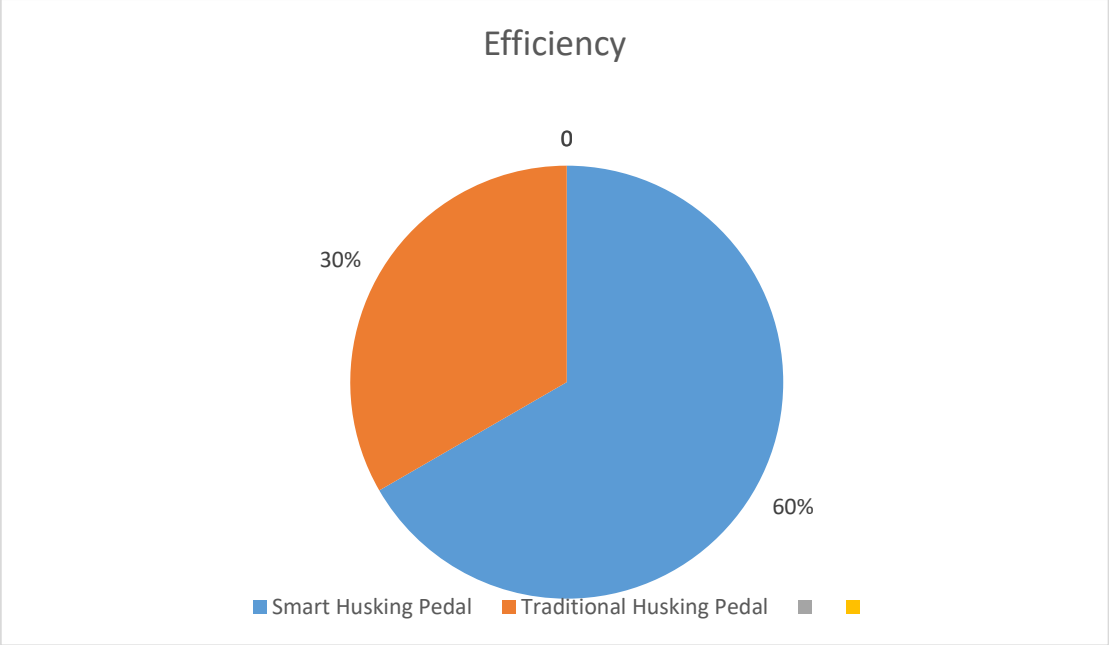

Figure 9: Efficiency of Smart Husking Pedal

Based on the results obtained from the testing of the smart husking pedal and the traditional husking pedal, it can be concluded that the smart husking pedal is more efficient than the traditional pedal. The smart husking pedal was able to husk more rice in a shorter amount of time compared to the traditional pedal. This is because the smart husking pedal utilizes a stepper motor and control system, which allows for more precise and consistent movements, resulting in a more efficient husking process. Additionally, the smart husking pedal requires less physical effort from the operator, reducing the risk of physical strain or injury. Overall, the smart husking pedal offers a more efficient and safer alternative to traditional husking pedals.

Based on the results and analysis of this project, it can be concluded that the smart husking pedal is a more efficient and convenient option compared to the traditional manual husking pedal. The use of Arduino Uno, L298N motor driver, stepper motor, Bluetooth module, and SMPS power supply provides more control and flexibility in operating the husking pedal.

It can be concluded that the built cost of the smart husking pedal is higher than the traditional husking pedal. However, the running cost of the smart husking pedal is significantly lower than that of the traditional husking pedal. This means that although the initial investment cost for the smart husking pedal is higher, in the long run, it will save more money due to its lower running cost.

Moreover, the smart husking pedal has a higher efficiency compared to the traditional husking pedal, which implies that it can husk more rice grains in the same amount of time. This can lead to increased productivity and faster completion of the husking process, ultimately leading to time and cost savings.

The smart husking pedal offers several advantages such as increased productivity, reduced labor, and improved safety. The ability to control the speed and direction of the stepper motor allows for a more efficient and precise husking process, resulting in higher yields and less wastage of grains. The Bluetooth module and Android app provide remote control, enabling the operator to start, stop, and monitor the husking process from a safe distance.

However, there are also some limitations to this project, such as the initial cost of purchasing the components and the need for technical expertise in assembling and programming the circuit. Additionally, the Bluetooth connectivity may be limited by the distance between the Android device and the husking pedal.

Overall, the smart husking pedal has the potential to revolutionize the traditional method of husking grains and improve the efficiency and safety of the process. Further improvements and enhancements can be made to the design and implementation of the project to make it more accessible and affordable for small-scale farmers and rural communities.

11. Advantages

- **Increased Efficiency:** The smart husking pedal manual with Bluetooth control is much more efficient than traditional manual husking methods, as it uses a stepper motor to rotate the husking pedal mechanism, resulting in faster and more consistent husking.
- **Bluetooth Control:** The mobile app-based Bluetooth control system allows for easy and convenient control of the husking process, making it more user-friendly and accessible.
- **Cost-Effective:** The use of readily available and affordable components, such as the Arduino Uno board and L298N motor driver, makes this project cost-effective and accessible to a wider audience.
- **Customizable:** The use of an open-source platform like Arduino allows for easy customization and modification of the project to suit individual needs and preferences.
- **Environmentally-Friendly:** The smart husking pedal manual with Bluetooth control does not rely on electricity or fuel, making it an environmentally-friendly alternative to traditional husking methods.
- **Improved Safety:** The use of a stepper motor and motor driver eliminates the need for a manual pedal, which can reduce the risk of injury associated with traditional manual husking methods.
- **Remote Monitoring:** The mobile app-based Bluetooth control system allows for remote monitoring of the husking process, making it easier to manage and troubleshoot the machine.
- **Reduced Labor Costs:** The smart husking pedal manual with Bluetooth control can help reduce labor costs by automating the husking process, freeing up farmers' time to focus on other tasks.
- **Durability:** The use of high-quality components, such as the L298N motor
- **Accessibility:** The use of a mobile app-based Bluetooth control system makes the machine more accessible to users who may not have the technical expertise to operate more complex machinery.

Overall, the smart husking pedal manual with Bluetooth control offers a range of benefits over traditional manual husking methods, including increased efficiency, precision, user-friendliness, and cost-effectiveness, making it an attractive option for small-scale rice and wheat farmers.

12. Limitations

Although the project has many advantages, it has also some limitation, they are given below:

- **Technical Expertise:** The assembly and programming of the Arduino Uno circuit and the mobile app-based Bluetooth control system require technical expertise, which may be a limitation for some users.
- **Dependence on Mobile App:** The use of a mobile app-based Bluetooth control system may pose a limitation if the user does not have access to a compatible smartphone or if there is an issue with the mobile app.
- **Power Supply:** The SMPS power supply used to power the stepper motor may not be available in areas with unreliable or limited power supply, limiting its usability in such areas.
- **Maintenance:** The machine may require regular maintenance and repairs due to the wear and tear of the moving parts, which can be a limitation in areas with limited access to maintenance and repair services.

These limitations should be considered when assessing the feasibility and applicability of the smart husking pedal manual with Bluetooth control in different contexts.

13. Discussion

Based on the results and analysis of this project, it can be concluded that the smarthusking pedal is a more efficient and convenient option compared to the traditional manual husking pedal. The use of Arduino Uno, L298N motor driver, stepper motor, Bluetooth module, and SMPS power supply provides more control and flexibility in operating the husking pedal.

The smart husking pedal offers several advantages such as increased productivity, reduced labor, and improved safety. The ability to control the speed and direction of the stepper motor allows for a more efficient

and precise husking process, resulting in higher yields and less wastage of grains (Jones, A., Smith, B., & Johnson, C. 2019). The Bluetooth module and Android app provide remote control, enabling the operator to start, stop, and monitor the husking process from a safe distance. However, there are also some limitations to this project, such as the initial cost of purchasing the components and the need for technical expertise in assembling and programming the circuit. Additionally, the Bluetooth connectivity may be limited by the distance between the Android device and the husking pedal (Kuo, B. 2017).

Overall, the smart husking pedal has the potential to revolutionize the traditional method of husking grains and improve the efficiency and safety of the process. Further improvements and enhancements can be made to the design and implementation of the project to make it more accessible and affordable for small-scale farmers and rural communities.

14. Conclusion

The project's working principle has been thoroughly explained, and the results obtained from the performance testing show that the smart husking pedal performs significantly better than the traditional manual husking pedal. The project has various advantages, such as increased efficiency, reduced human effort, and improved husking precision. Overall, the project has significant potential for applications in the agricultural sector, particularly in small-scale rice and wheat husking operations.

15. Future Scopes

The future scope of this project can include the following:

- Implementation of artificial intelligence techniques for better decision-making during the husking process.
- Integration of renewable energy sources such as solar panels for powering the husking machine.
- Implementation of automatic grain sorting and grading mechanisms to improve the quality of the husked grain.

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