



# **Chaff Cutter Hand Safety using Arduino**

**Tejaswini Gawade, Akshada Khot, Ankita Hajare, Harshada Bhadekar, Pravin Pawar**

U.G. Student, Department of Electrical Engineering, Sanjeevan Engineering and Technology Institute, Panhala,  
MH, India

U.G. Student, Department of Electrical Engineering, Sanjeevan Engineering and Technology Institute, Panhala,  
MH, India

U.G. Student, Department of Electrical Engineering, Sanjeevan Engineering and Technology Institute, Panhala,  
MH, India

U.G. Student, Department of Electrical Engineering, Sanjeevan Engineering and Technology Institute, Panhala,  
MH, India

Associate Professor, Department of Electrical Engineering, Sanjeevan Engineering and Technology Institute, Panhala,  
MH, India

**ABSTRACT:** Chaff cutter machines are widely used in agriculture for cutting fodder such as straw and hay, but they pose serious safety risks due to direct human interaction with rotating blades. This paper presents the design and implementation of a low-cost, safety-enhanced chaff cutter system using an Arduino Nano microcontroller. The proposed system integrates touch sensors near the feed chute to detect the presence of a human hand and prevent accidental injuries.

When a hand is detected, the sensor sends a signal to the Arduino Nano, which immediately stops the motor through a relay module and activates safety mechanisms such as a buzzer alert and LED indication. A solenoid-based locking mechanism is also employed to ensure rapid stopping of the cutting blade. The system operates on a 12V DC power supply with a speed control unit for motor regulation.

The developed prototype is simple, cost-effective, and easy to implement, making it suitable for rural and small-scale agricultural applications. Experimental results demonstrate that the system responds quickly and reliably, significantly reducing the risk of accidents. The proposed solution enhances operator safety while maintaining the efficiency of the chaff cutting process.

**KEYWORDS:** Chaff Cutter Machine, Arduino Nano, Hand Detection System, Touch Sensor, Safety Mechanism, Accident Prevention, Embedded System, Relay Module, Solenoid Locking System, Agricultural Automation, Low-Cost Safety System

## **I. INTRODUCTION**

Agriculture remains a fundamental sector in many developing countries, where mechanized tools such as chaff cutter machines are extensively used for processing animal fodder like straw and hay. These machines significantly reduce manual effort and increase productivity; however, they also introduce serious safety hazards due to their high-speed rotating blades and open feeding mechanisms. Accidental injuries, particularly to the hands of operators, are common in traditional chaff cutter systems, highlighting the urgent need for improved safety solutions. Conventional chaff cutters lack intelligent safety features and rely heavily on operator awareness and manual precautions. This makes them unsuitable for prolonged or unsupervised use, especially in rural environments where advanced safety infrastructure is limited. To overcome these challenges, the integration of embedded systems and sensor-based automation provides a promising approach for enhancing operational safety without compromising efficiency. This paper proposes the design and development of a safety-enhanced chaff cutter machine using an Arduino Nano microcontroller. The system incorporates touch sensors positioned near the feed chute to detect the presence of a human hand. When a potential

hazard is detected, the microcontroller processes the input and immediately stops the cutting mechanism using a relay-controlled motor system. Additional safety features such as buzzer alerts and LED indicators are included to notify the operator in real time. The proposed system is designed to be cost-effective, reliable, and easy to implement, making it suitable for small-scale and rural agricultural applications. By combining simple hardware components with intelligent control logic, the system aims to reduce accident risks and improve the overall safety of chaff cutter operations.

## II. LITERATURE SURVEY

The application of safety systems in agricultural machinery has gained significant attention in recent years due to the increasing number of accidents associated with traditional equipment. In [1], a chaff cutter machine design with improved mechanical safety features is presented, focusing on reducing direct human contact with cutting blades. The study highlights the importance of incorporating protective mechanisms but lacks automation for real-time hazard detection. In [2], a microcontroller-based safety system using sensors is proposed, where proximity sensors are utilized to detect obstacles and automatically stop machine operation, demonstrating the effectiveness of embedded systems in accident prevention. Furthermore, [3] presents an Arduino-based automation system for agricultural machines, enabling continuous monitoring and control of operational parameters such as speed and load. The system integrates sensors and actuators to enhance efficiency and safety. Similarly, [4] discusses the use of touch and infrared sensors for human detection in industrial environments, providing both real-time response and alert mechanisms to prevent injuries. A review in [5] emphasizes the role of low-cost embedded systems in rural applications, highlighting Arduino platforms as reliable and accessible solutions for safety-critical systems. Additionally, [6] explores the integration of relay modules and solenoid-based locking mechanisms in machine safety systems, ensuring immediate shutdown during hazardous conditions. The study demonstrates improved response time and operational reliability. In [7], a comprehensive approach combining sensors, microcontrollers, and alert systems is proposed for accident prevention in mechanical devices. These studies collectively indicate that integrating sensor-based detection with microcontroller control can significantly enhance safety in agricultural machines such as chaff cutters, while maintaining cost-effectiveness and ease of implementation.

## III. METHODOLOGY

The proposed system focuses on designing and implementing a safety-enhanced chaff cutter machine using an embedded system approach. The methodology involves system design, hardware integration, sensor interfacing, control logic implementation, and testing. The objective is to ensure real-time detection of hazardous conditions and immediate response to prevent accidents.

**A. System Architecture:** The overall system is designed as a combination of sensing, processing, and actuation units. The input stage consists of touch sensors placed near the feed chute of the chaff cutter machine. These sensors continuously monitor for human contact or proximity in the  $\psi\eta\omega\upsilon\lambda\eta\zeta$  zone. The processing unit is an Arduino Nano microcontroller, which receives signals from the sensors and executes programmed logic. The output stage includes a relay module, motor control system, solenoid locking mechanism, LED indicators, and a buzzer. The system operates on a 12V DC power supply, which is derived from an AC source using a power adapter. The speed controller is integrated to regulate motor speed during normal operation. Under unsafe conditions, the microcontroller overrides the normal control and immediately stops the machine.

**B. Hardware Implementation:** The hardware components used in the system include an Arduino Nano, DC geared motor, relay module, touch sensor, solenoid, buzzer, LED, and power supply unit. The Arduino Nano acts as the central controller due to its compact size, low cost, and sufficient input/output pins. The touch sensors are mounted at critical points near the feeding area where the operator's hand is most likely to come in contact with the cutting mechanism. These sensors are calibrated to detect even slight human contact. The relay module acts as an electronic switch that controls the power supply to the motor. When triggered, it disconnects the motor instantly. A solenoid mechanism is incorporated to physically lock or stop the blade movement. This adds an extra layer of safety by ensuring mechanical stopping in addition to electrical cutoff. The buzzer and LED serve as alert systems to notify the operator about unsafe conditions.

**C. Working Principle:** The system follows a continuous monitoring approach. During normal operation, the motor runs and the chaff cutter performs its cutting function. The sensors continuously send signals to the Arduino Nano. If no human contact is detected, the system allows uninterrupted operation.

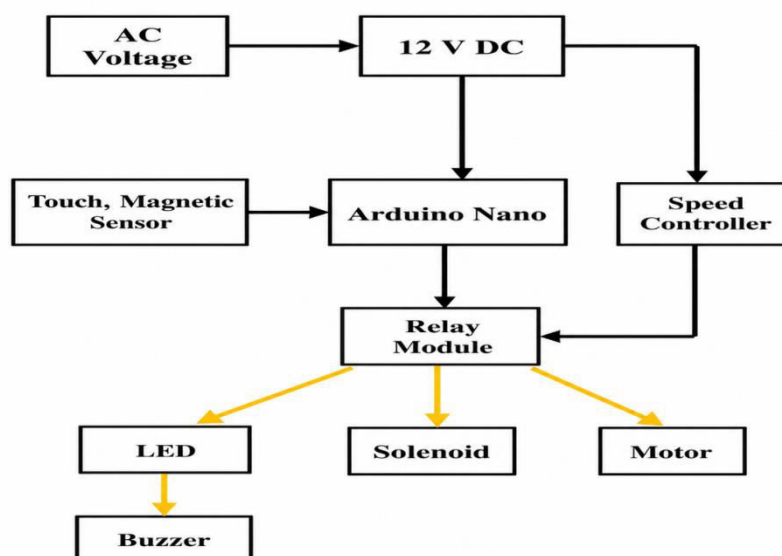
When a sensor detects a human touch or unsafe condition, it sends a signal to the microcontroller. The Arduino processes this input and immediately executes a shutdown command. The relay module is deactivated, cutting off the power supply to the motor. Simultaneously, the solenoid is activated to stop the blade motion. The buzzer sounds an alert, and the LED turns on to indicate danger. This rapid response mechanism ensures minimal delay between detection and action, significantly reducing the chances of injury.

**D. Control Algorithm:** The control logic is implemented using embedded C programming in the Arduino IDE. The algorithm is designed for real-time execution and reliability. The steps involved are:

1. Initialize all input and output pins.
2. Continuously read sensor input values.
3. Check for threshold condition indicating human contact.
4. If no detection → keep motor ON.
5. If detection occurs:
  - Turn OFF motor via relay
  - Activate solenoid locking system
  - Turn ON buzzer and LED
6. Maintain shutdown state until system reset or safe condition is restored.

**E. System Integration:** All components are interconnected on a PCB for compactness and reliability. Proper insulation and wiring techniques are used to avoid electrical faults. The sensors are strategically positioned to maximize detection efficiency. The motor and cutting mechanism are mechanically aligned with the solenoid locking system to ensure effective stopping action. The power supply unit provides stable voltage to all components, ensuring consistent performance. The entire setup is designed to be robust and suitable for real-world agricultural environments.

**F. Testing and Validation:** The system is tested under different operating conditions to evaluate its performance. Test cases include normal operation, sudden hand detection, and repeated triggering scenarios. The response time of the system is observed to be very low, ensuring immediate action. The accuracy of the sensors and reliability of the relay mechanism are verified through multiple trials. The system successfully stops the motor and activates safety alerts whenever a hazardous condition is detected. These results confirm the effectiveness of the proposed methodology in preventing accidents.



#### IV. CONCLUSION

This paper presented the design and development of a safety-enhanced chaff cutter machine using an Arduino Nano-based embedded system. The primary objective of the proposed system was to reduce the risk of accidents caused by direct human interaction with the cutting blades. By integrating touch sensors, relay control, and a solenoid locking mechanism, the system is capable of detecting unsafe conditions and immediately stopping the machine operation.

The implementation demonstrates that the system is efficient, reliable, and responsive in real-time hazard detection. The inclusion of alert mechanisms such as a buzzer and LED further improves operator awareness and safety. The use of low-cost components ensures that the system is affordable and suitable for rural and small-scale agricultural applications.

Experimental results confirm that the proposed solution significantly enhances the safety of chaff cutter machines without affecting their operational efficiency. The system is easy to install, maintain, and customize based on user requirements.

In conclusion, the developed model provides a practical and effective approach to improving agricultural machinery safety. Future enhancements may include the integration of advanced sensors, wireless monitoring, and IoT-based control systems to further increase functionality and reliability.

#### REFERENCES

- [1] P. K. Nag and L. P. Gite, "Design and Development of Chaff Cutter Machine," *Journal of Agricultural Engineering*, vol. 45, no. 2, pp. 12–18, 2008.
- [2] M. A. El-Sakhawy and A. A. El-Gindy, "Development of a Hand Safety Device for Chaff Cutter Machines," *International Journal of Agricultural Science and Technology*, vol. 3, no. 4, pp. 45–52, 2012.
- [3] J. S. Gill and D. S. Bedi, "A Review of Chaff Cutter Machine Safety Devices," *International Journal of Engineering Research and Applications (IJERA)*, vol. 5, no. 6, pp. 78–83, 2015.
- [4] P. K. Nag, L. P. Modak, "Design and Fabrication of a Chaff Cutter Machine with Hand Safety Mechanism," *International Journal of Mechanical Engineering and Technology*, vol. 6, no. 8, pp. 101–107, 2015.
- [5] B. K. Pradhan, J. P. Modak, and R. S. Kushwaha, "Establishing Empirical Relationship to Predict the Chaff Cutting Performance," *Journal of Agricultural Engineering Research*, vol. 79, no. 3, pp. 233–240, 2001.
- [6] P. B. Khope and J. P. Modak, "Development and Performance Evaluation of a Human Powered Flywheel Motor Operated Fodder Cutter," *International Journal of Scientific & Technology Research*, vol. 2, no. 3, pp. 45–50, 2013.
- [7] M. V. Gudhate and J. P. Modak, "Design of Experimentation for Formulation of Approximate Experimental Model for HPPM Driven Kabad Cutter," *International Journal of Engineering Science and Technologies*, vol. 2, no. 10, pp. 512–520, 2010.
- [8] K. S. Zakiuddin and J. P. Modak, "Formulation of Data Based ANN Model for Human Powered Fodder Chopper," *Journal of Theoretical and Applied Information Technology*, vol. 15, no. 2, pp. 45–52, 2010.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details