

Original Article

Animal Repellent Using AVR Microcontroller Atmega328 Design and Development of a Microcontroller-Based Sound Repellent System

C.A. Rajoba¹, R.C. Pawar², S.A. Harge³, S.R. Patil⁴

^{1,2,3,4} Department of Electronics, Smt. Kasturbai Walchand College of Arts and Science, Sangli, Maharashtra

Manuscript ID:
CSJ-2026-020512

Volume 2

Issue 5

Pp. 60-64

October 2026

ISSN: 3067-3089

Submitted: 09 Sept. 2026

Revised: 17 Sept. 2026

Accepted: 06 Oct. 2026

Published: 31 Oct. 2026

Correspondence Address:

C.A. Rajoba,
Department of Electronics, Smt.
Kasturbai Walchand College of Arts and
Science, Sangli, Maharashtra
Email: chandanaarajoba106@gmail.com

Quick Response Code:



Web: <https://csjour.com/>



DOI: 10.5281/zenodo.22953591

DOI Link:

<https://doi.org/10.5281/zenodo.22953591>



Creative Commons



Abstract

The present work presents the design and development of an animal repellent system using the ATmega328 AVR microcontroller. The system is intended to reduce animal intrusion in agricultural fields and other protected areas by generating sound through a speaker. The major components include an ATmega328 microcontroller, a 16 MHz crystal oscillator, reset circuit, battery-voltage monitoring circuit, 16×2 LCD, MOSFET driver circuit, sound amplifier, speaker, and 12 V battery. The microcontroller acts as the main control unit and controls the sound-generation circuit. Battery voltage is monitored through a voltage-divider circuit and the system status is displayed on the LCD. The MOSFET driver controls the sound amplifier, which drives the speaker. The present system provides a simple, low-cost, portable, and energy-efficient approach for reducing animal intrusion. The prototype can be further improved by adding motion sensors, automatic activation, wireless monitoring, solar charging, and data logging.

Keywords: Animal repellent, ATmega328P, AVR microcontroller, MOSFET driver, sound amplifier, battery monitoring, agricultural protection, embedded system.

Introduction

Animal intrusion is a common problem in agricultural fields, especially in regions located near forests and wildlife habitats. Animals such as wild boars, monkeys, deer, birds, and other wildlife may enter agricultural fields and damage crops. Such intrusion can result in financial losses for farmers, reduced agricultural productivity, and damage to irrigation systems and farm equipment. [11][12][14]

Traditional protection methods include fencing, manual monitoring, firecrackers, physical barriers, and the use of watchmen. These methods may require continuous human effort and may not provide reliable protection throughout the day and night. Some methods may also be harmful to animals, human beings, and the environment. Therefore, an economical and practical electronic system is required to reduce the need for continuous monitoring. Embedded systems and microcontroller technology provide a suitable platform for developing automatic animal repellent systems. A microcontroller can control a sound-generation. [11][12]

circuit, display system information, and monitor the condition of the power supply. In the present system, the ATmega328 AVR microcontroller is used as the central control unit. It controls a MOSFET driver and sound amplifier, to generate repellent sound through a speaker. A 12 V battery is used as the power source, and a voltage divider is used to monitor the battery voltage.

The present system is designed as a low-cost prototype that can be used in agricultural fields and other protected areas. Its effectiveness depends on the selected sound frequency, sound intensity, animal species, environmental conditions, and installation location. [11] Agricultural fields located near forests and wildlife areas are frequently affected by animal intrusion. Animals entering fields may destroy crops, consume agricultural produce, and damage irrigation systems and other farm equipment. Farmers may need to monitor their fields continuously, which increases labour requirements and reduces productivity. [12].

Existing protection methods may be expensive, difficult to maintain, or unsuitable for continuous operation. Manual monitoring also becomes difficult during night-time and adverse weather conditions. Hence, there is a need for a simple system that can operate for long periods, reduce human effort, and provide an audible deterrent.

The ATmega328 is suitable for this application because it is economical, programmable, and capable of controlling electronic circuits. It can receive battery-voltage information, operate the display, and control the sound-generation unit. Battery monitoring also helps the user identify low-power conditions and maintain reliable operation. The proposed system therefore focuses on portability, low cost, simple operation, and easy maintenance. [13]

Creative Commons (CC BY-NC-SA 4.0)

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-ShareAlike 4.0 International Public License, which allows others to remix, tweak, and build upon the work no commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

How to cite this article:

Rajoba, C. A., Pawar, R. C., Harge, S. A., & Patil, S. R. (2026). Animal Repellent Using AVR Microcontroller Atmega328 Design and Development of a Microcontroller-Based Sound Repellent System. *Computer Science Journal*, 2(5), 60–64. <https://doi.org/10.5281/zenodo.22953591>

Literature Review

Research on animal and pest repellent systems.[1] Has investigated ultrasonic sound, audible sound, motion sensors, microcontrollers, and solar-powered operation. Reported the development of an ultrasonic system for repelling and detecting rat pests. Such systems demonstrate the usefulness of electronic sound based deterrents for pest management.[10]

A discussed a solar powered pest repellent system, indicating that renewable energy can improve the operating duration of field deployed devices. Frastiya et al. developed an Arduino-based automatic bird pest repellent system using a PIR sensor, showing that movement-based activation can reduce unnecessary power consumption. Prasetyo et al. described a pest detection and repellent device based on Arduino Uno and a PIR sensor.[2]

Other studies have considered Arduino-based bird repellents [5], solar-cell-powered pest repellent systems [6], motion based wild boar repellent devices [7], and ESP32 based pest-control prototypes [8]. Variable frequency ultrasonic generators have also been investigated for rodent repulsion [9]. Other studies have considered Arduino-based bird repellents, solar cell powered pest repellent systems, motion based wild boar repellent devices, and ESP32-based pest-control prototypes.

Variable frequency ultrasonic generators have also been investigated for rodent repulsion. These studies indicate that microcontrollers, sound-generation circuits, sensors, and renewable power can be combined for agricultural protection.[9]

The present work differs in its focus on a simple ATmega328 based sound repellent system with battery voltage monitoring, LCD status display, MOSFET switching, sound amplification, and speaker output. The design is intended as a low-cost prototype and provides a base for future integration of motion sensing, wireless communication, and solar charging.[8]

The main objective of this research is to design and develop an animal repellent system using the ATmega328 AVR microcontroller.

The specific objectives are:

1. To design a microcontroller-based animal repellent system.
2. To generate sound using a sound amplifier and speaker.
3. To control the sound-generation circuit using the ATmega328 microcontroller.
4. To monitor the battery voltage using a voltage-divider circuit.
5. To display battery voltage and system status on a 16×2 LCD.
6. To develop a low-cost and energy-efficient animal repellent system.
7. To reduce the requirement for continuous human monitoring.
8. To test the working performance and stability of the developed prototype.

Hypothesis

Null Hypothesis: The present ATmega328 based animal repellent system does not significantly improve the prevention of animal intrusion in agricultural fields.

Alternative Hypothesis: The present ATmega328 based animal repellent system can help reduce animal intrusion in agricultural fields by generating sound through a controlled speaker system.

The hypothesis can be evaluated through controlled prototype testing and, where feasible, field observations comparing animal visits before and after installation.

Methodology

The present system is developed using an embedded-system design approach. The methodology includes circuit design, component selection, hardware assembly, software programming, prototype development, and experimental testing. The ATmega328 is used as the main control unit. It receives battery-voltage information through a voltage divider and controls the sound-generation unit through a MOSFET driver circuit. The research follows an experimental design. A prototype is developed and tested under controlled conditions. The testing evaluates microcontroller operation, LCD display, battery monitoring, MOSFET switching, sound generation, power consumption, and system stability. Purposive sampling is used for selecting a suitable testing location and testing conditions. Testing may be conducted during morning, afternoon, evening, and night periods.

Research Tools and Components

Hardware components:

- ATmega328 AVR microcontroller
- 16 MHz crystal oscillator
- Reset circuit
- 16×2 LCD
- Voltage-divider circuit• 12 V battery
- MOSFET driver circuit
- Sound amplifier
- Speaker
- Resistors and capacitors
- Connecting wires
- Breadboard or PCB
- Power-supply components

Software and measurement tools:

- Arduino IDE or suitable AVR programming software
- Embedded C programming language
- Proteus, if simulation is performed
- Serial monitor, if required
- Multimeter for voltage measurement

System Design

The system contains a reset circuit, crystal oscillator, battery-voltage monitoring circuit, 16×2 LCD, MOSFET driver, sound amplifier, speaker, and 12 V battery. The reset circuit restarts the microcontroller when required. The crystal oscillator supplies

the clock signal. The voltage divider reduces the battery voltage to a safe measurement level. The LCD displays the battery voltage and system status. The MOSFET driver switches the sound amplifier, and the amplifier drives the speaker.

Software Development

The embedded software initializes the microcontroller, configures input and output pins, initializes the LCD, reads the battery voltage, processes the voltage information, displays the voltage and status, and controls the MOSFET driver. The program continuously monitors system operation and activates the sound-generation circuit according to the programmed operation.

Working Principle

When the system is switched on, the 12 V battery supplies power to the circuit. The ATmega328 starts operating with the help of the 16 MHz crystal oscillator. The battery voltage is measured through the voltage-divider circuit. The reduced voltage is read by the microcontroller and displayed on the LCD.

The microcontroller sends a control signal to the MOSFET driver. The MOSFET switches the sound amplifier according to the programmed operation. The amplifier increases the sound signal and supplies it to the speaker. The speaker produces sound waves intended to discourage animals from entering the protected area. The system continues operating while sufficient battery power is available.

Block Diagram

The block diagram represents the flow of power, control signals, battery-voltage information, and sound generation. The ATmega328 is the central control unit. The reset circuit and crystal oscillator support microcontroller operation. The voltage-divider circuit supplies battery information. The LCD provides user feedback. The MOSFET driver and sound amplifier form the output stage that drives the speaker. The 12 V battery supplies the required power to the system.

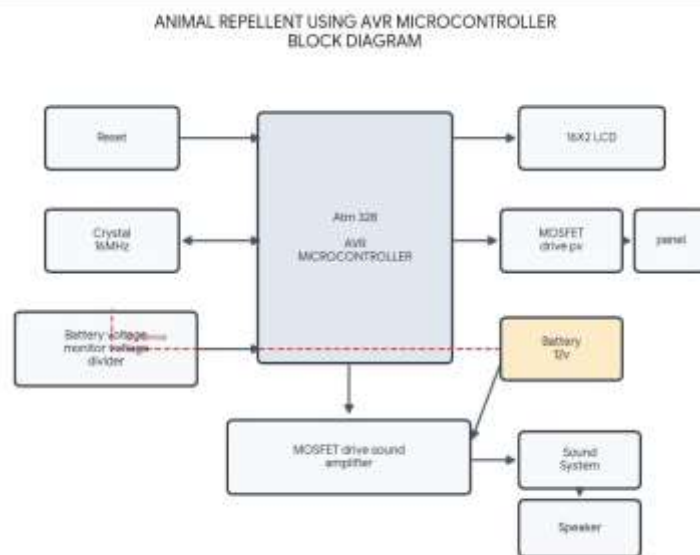


Fig. 1. Block diagram of the proposed animal repellent system.

Circuit Diagram

The circuit diagram consists of the ATmega328P AVR microcontroller, crystal oscillator, reset circuit, LCD interface, battery-voltage monitoring circuit, MOSFET driver, sound amplifier, and speaker. The crystal oscillator is connected to the microcontroller to provide the clock signal, and the reset network is used to restart the controller. The battery-voltage monitoring section uses a voltage-divider arrangement. The divider reduces the 12 V battery voltage to a suitable level for measurement by the microcontroller. The measured value is processed and displayed on the 16x2 LCD. The output section contains the MOSFET driver and sound amplifier. The microcontroller provides the control signal to the driver. The MOSFET switches the amplifier, and the amplifier drives the speaker. Resistors, capacitors, and diodes are used in the driver and amplifier sections for biasing, filtering, switching, and signal conditioning. The battery supplies power to the amplifier and other required circuits. The exact component values and pin connections should be verified from the final Proteus schematic or assembled hardware before final submission.

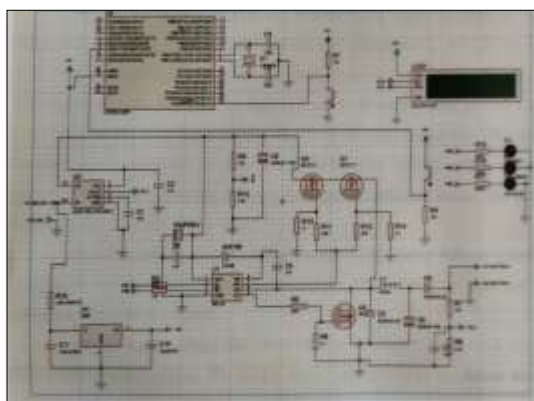




Fig. 2. Circuit diagram of the proposed animal repellent system.

Hardware Development

Hardware development begins with the selection of suitable components. The ATmega328 is selected because of its low cost, simple programming, and sufficient input-output pins. The crystal oscillator and reset circuit are connected to the microcontroller. The voltage-divider circuit is designed for monitoring the 12 V battery voltage. The LCD is connected to display system information.

The MOSFET driver circuit is assembled to control the sound amplifier. The amplifier is connected to the speaker for sound generation. After connecting all components, the circuit is checked for loose connections, incorrect wiring, short circuits, and power-supply polarity. The prototype is initially assembled on a breadboard. After successful testing, it can be transferred to a PCB for improved reliability and portability.

The following parameters are considered during testing:

- Microcontroller operation: proper execution of the program.
- LCD operation: correct display of battery voltage and system status.
- Battery monitoring: accurate and stable voltage measurement.
- MOSFET operation: proper switching of the amplifier.
- Sound amplifier: suitable amplification of the sound signal.
- Speaker operation: generation of sound.
- Power consumption: battery current and operating time.
- System stability: continuous operation without failure.

If field testing is possible, the number of animal visits before and after installation may be recorded. The observations should be collected ethically and without causing harm to animals.

Results And Discussion

The expected result of the developed prototype is proper operation of the ATmega328 control unit, correct display of battery voltage and system status on the LCD, successful switching of the MOSFET driver, and generation of sound through the amplifier and speaker. The battery voltage monitoring circuit is expected to provide information about the power supply condition. This information can help the user identify a low-battery condition and plan recharging or battery replacement. The MOSFET driver is expected to provide controlled switching of the sound amplifier, while the amplifier is expected to deliver a sufficiently strong signal to the speaker. The practical effectiveness of the system cannot be concluded only from circuit operation. It must also be evaluated under field conditions because animal response depends on species, distance, sound frequency, sound intensity, environmental noise, habituation, weather, and installation location. Therefore, field observations over a longer period are recommended before claiming a definite reduction in animal intrusion.

Conclusion

The present animal repellent system using the ATmega328 AVR microcontroller provides a simple and economical approach for reducing animal intrusion in agricultural fields. The ATmega328 controls the system operation, while the voltage divider circuit monitors the 12 V battery voltage. The 16x2 LCD displays battery voltage and system status. The MOSFET driver controls the sound amplifier, which drives the speaker to generate the repellent sound.

The system is compact, easy to operate, and suitable as a low-cost prototype. It can reduce the need for continuous human monitoring. However, the effectiveness depends on sound frequency, sound intensity, animal species, environmental conditions, and installation location. Actual field testing is required to validate the level of animal-intrusion reduction.

Recommendations And Future Scope

The present system can be improved by adding a motion sensor to detect animal movement automatically. PIR or ultrasonic sensors can be used for automatic activation. Different sound frequencies can be generated for different animal species. Solar panels can be added to improve battery charging and backup. Wireless monitoring using GSM, Bluetooth, or Wi-Fi can provide remote status information. A data-logging system can record animal movement and operating conditions. A weatherproof enclosure can protect the circuit from dust and moisture.

Acknowledgment

The authors express their sincere gratitude to the Department of Electronics, Smt. Kasturbai Walchand College of Arts and Science, Sangli, Maharashtra, for providing the facilities, guidance, and academic support necessary for carrying out this work. The authors are thankful to all faculty members, colleagues, and technical staff whose encouragement and valuable suggestions contributed to the successful completion of the project.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. R. W. P. Andalas, S. Habib, W. Prastia, M. D. Faisal, M. F. Pasaribu, and D. Corio, "Development of an ultrasonic system for repelling and detecting rat pests in boarding houses," *Jurnal Teknologi Elektro*, vol. 15, no. 1, pp. 24–29, 2024, doi: 10.22441/jte.2024.v15i1.005.
2. M. Afiq et al., "Solar-powered pest repellent system," *Evolution in Electrical and Electronic Engineering*, vol. 3, no. 1, pp. 243–251, 2022.
3. Frastiya, I. Roza, and A. A. Nst, "Alat pengusir hama burung otomatis berbasis Arduino (ATmega328) menggunakan sensor PIR," *Journal of Electrical and System Control Engineering*, vol. 8, no. 2, pp. 238–245, 2025, doi: 10.31289/jesce.v8i2.12862.
3. N. A. Prasetyo, M. Syamsu, and S. A. Arman, "Design and development of pest detection and repellent device based on Arduino Uno using PIR (Passive Infrared Receiver) sensor," *Journal of Computer Science Advancements*, vol. 2, no. 5, pp. 285–296, 2024, doi: 10.70177/jzca.v2i5.1326.
4. Adhitya, "Prototype pest repellent bird in the ricefield based Arduino Uno," *E-JPTE: Jurnal Elektronik Pendidikan Teknik Elektronika*, vol. 7, no. 3, 2018, doi: 10.21831/e-jpte.v7i3.14018.
4. Syauqi, A. Rosadi, and T. Haryanti, "Prototipe pengusir hama tanaman padi berbasis Arduino Uno dengan energi alternatif solar cell," *Jurnal Ilmiah Computing Insight*, vol. 2, no. 2, 2020.
5. T. Yulianti, S. Samsugi, P. A. Nugroho, and H. Anggono, "Rancang bangun pengusir hama babi menggunakan Arduino dengan sensor gerak," *Jurnal Teknik dan Sistem Teknologi*, vol. 2, no. 1, pp. 21–27, 2021.
6. M. A. Rajagukguk, G. Santoso, S. Hani, and I. Mubarak, "Rancang bangun perangkat hama serangga menggunakan sensor passive infrared receiver dan sensor ultrasonik berbasis mikrokontroler ESP32," *Prosiding SNAST*, pp. A26–A34, 2022.
9. M. A. A. Rahman et al., "Design and development of a variable ultrasonic frequency generator for rodents repellent," *Smart Agricultural Technology*, vol. 7, p. 100414, 2024, doi: 10.1016/j.atech.2024.100414.
10. K. L. Lew, I. Bukhori, A. Krishnan, and C. Z. Zheng, "Design and implementation of an Arduino-based ultrasonic device for humane dog repellent," *International Journal on Robotics, Automation and Sciences*, vol. 7, no. 3, 2025, doi: 10.33093/ijoras.2025.7.3.16.
11. J. Bishop, H. McKay, P. Parrot, and J. Allan, "Review of International Research Literature Regarding the Effectiveness of Auditory Bird Scaring Techniques," *DEFRA*, 2003.
12. M. Bomford and R. H. O'Brien, "Sonic deterrents in animal damage control: A review of device tests and effectiveness," *Wildlife Society Bulletin*, vol. 18, pp. 411–422, 1990.
13. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 6th ed., Prentice Hall, 1996.
14. J. Coleman and E. Spur, "Farmers' perceptions of bird damage and control in arable crops," *New Zealand Plant Protection Society*, 2001.
15. H. Frings, "Sound in vertebrate pest control," *Proceedings of the Vertebrate Pest Conference*, vol. 2, pp. 50–56, 1964.
16. Goatee, T. (2003). <http://www.fullnet.com/u/tomg/gooteepc.htm>. Retrieved 6th July, 2005.
17. Hamer shock, D M (1992). "Ultrasonic as a Method of Bird Control" *Flight Dynamics Directorate*, Wright Patterson AFB, OH, 42.
18. Kerns, J. D. (1985). "Evaluation of the effectiveness of the,, Ultrasonic ET" ultrasonic device as a means of cliff swallow control" In: Werneck, P.P. *Effects of ultrasonic, visual*.