M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
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ISO 9001:2015 Certified Institution
Thalavapalayam, Karur – 639 113.

A Minor Project Report

on

INTELLIGENT ANIMAL DETECTION AND COLLISION PREVENTION SYSTEM FOR SAFER ROADWAYS

Submitted by

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M. KUMARASAMY COLLEGE OF ENGINEERING

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THALAVAPALAYAM, KARUR-639113.

MAY 2025

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BONAFIDE CERTIFICATE

Certified that this Report titled **"INTELLIGENT ANIMAL DETECTION AND COLLISION PREVENTION SYSTEM FOR SAFER ROADWAYS "** is the bonafide work of **ABINAYA DEVI.N (927622BEE001), AYYAPPAN.A (927622BEE010), HARIHARAN.S (927622BEE037), JANARATHINABABU.A (927622BEE304)** who carried out the work during the academic year (2024-2025) under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other project report.

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DECLARATION

We affirm that the Minor Project IV report titled "**INTELLIGENT ANIMAL DETECTION AND COLLISION PREVENTION SYSTEM FOR SAFER ROADWAYS "** being submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical and Electronics Engineering** is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produce smart technocrats with empirical knowledge who can surmountthe global Challenges.
- ✓ Create a diverse, fully-engaged, learner - centric campus environment toprovide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and ElectronicsEngineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and also allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuouslearning for their success in the chosen career.

PROGRAMME OUTCOMES(POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions:

Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge andunderstanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Electrical and Electronics Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyze and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real-world problems.

Abstract (Key Words)	**Mapping of POs and PSOs**
Real-time Monitoring , Computer Vision, Deep Learning, Sensor Integration, Automated Safety System, Traffic Safety , Wildlife Protection	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2, PSO3

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We offer our wholehearted thanks to our Minor project coordinator **Mrs.R.Indhumathi M.E., Assistant Professor, Department of Electrical and Electronics Engineering,** for her constant encouragement, kind co-operation and valuable suggestions for making our project a success.

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ABSTRACT

The escalating demand for automated surveillance and monitoring solutions has spurred significant advancements in the field of com puter vision, particularly in object detection. This paper introduces a novel real-time animal detection system that seamlessly integrates sophisticated deep learning algorithms with tangible hardware feedback mechanisms. At the core of this system lies the You Only Look Once (YOLO) model, a state-of-the-art object detection framework renowned for its computational efficiency and high accuracy in identifying objects within visual data. The system is designed to process live video streams captured by a standard camera, analyzing each frame in real time to detect the presence of animals on roadways. Upon successful identification of an animal within the camera's field of view, a digital signal is instantaneously transmitted to an Arduino microcontroller, a versatile and widely used platform for embedded systems. This signal acts as a trigger for a series of pre-programmed hardware responses orchestrated by the Arduino. Specifically, the microcontroller activates an audible alarm to provide an immediate warning, illuminates a red light for clear visual indication, and prompts a connected speaker to broadcast a verbal announcement stating "animal detected." This comprehensive alerting mechanism ensures that the detection of an animal is not only recorded digitally but also communicated effectively through multiple sensory channels. The development of this project is motivated by the growing need for automated animal detection in various practical applications, including roadway safety measures, preventing animal-vehicle collisions, and wildlife conservation efforts. To validate the efficacy and practicality of the proposed system, its performance is rigorously evaluated, focusing on two key metrics: the accuracy of animal detection under various environmental conditions and the system's responsiveness in providing real-time alerts. The results of this evaluation underscore the system's potential as a dependable and immediate alerting solution for the presence of animals, contributing to safer roadways and enhanced collision prevention strategies.

CHAPTER 1
LITERATURE REVIEW

Paper 1

Title: **A Practical Animal Detection and Collision Avoidance System Using Computer Vision Technique**

Author: S. Sachin Sharma, Dharmesh Shah

Year: 2016

Inference:

One serious problem that all the developed nations are facing today is death and injuries due to road accidents. The collision of an animal with the vehicle on the highway is one such big issue which leads to such road accidents. In this paper, a simple and a low-cost approach for automatic animal detection on highways for preventing animal-vehicle collision using computer vision techniques are proposed. A method for finding the distance of the animal in real-world units from the camera mounted vehicle is also proposed. The proposed system is trained on more than 2200 images consisting of positive and negatives images and tested on various video clips of animals on highways with varying vehicle speed. As per the two-second rule, our proposed method can alert the driver when the vehicle speed is up to 35 kmph. Beyond this speed, though the animal gets detected correctly, the driver doesn't get enough time to prevent a collision. An overall accuracy of almost 82.5% is achieved regarding detection using our proposed method.

Paper 2

Title: Enhancing Road Safety: Detection of Animals on Highways During Night

Author: Parkavi K , Agniv Ganguly, Ashesh Banerjee, Shivansh Sharma, Keshav Kejriwal

Year:2025

Inference:

Animals on highways at night can create serious accidents that put both human and wildlife

lives in danger. Conventional monitoring systems are rendered useless due to poor visibility and inadequate lighting, emphasizing the necessity for a sophisticated detecting system. Using YOLOv5, a cutting- edge object detection algorithm, this study presents a way to identify animals on highways at night and reduce collisions. To improve image quality in low-light circumstances, the model uses pre-processing techniques such as Contrast Limited Adaptive Histogram Equalization (CLAHE) and a robust Retinex model. This enhancement enables YOLOv5 to achieve improved detection accuracy on enhanced photos, increasing its effectiveness in spotting animals in low-light situations. YOLOv5 offers quick, highly accurate detection in contrast to conventional techniques like infrared and thermal imaging, which frequently lack the resolution for accurate species identification. The model, trained on a broad dataset, performed well, with a precision of 0.923, recall of 0.773, mean average precision (mAP50) of 0.802, and mean average precision (mAP50-95) of 0.567, demonstrating its competence in spotting animals in normal nighttime circumstances. Despite the model's good performance in normal low-light situations, problems still arise in unfavorable conditions including rain, fog, and dense foliage, which can lower detection accuracy. This study aims to improve road safety and aid to wildlife conservation by minimizing highway collisions. Subsequent endeavors will center on enhancing the model's resilience to withstand harsh circumstances and further diminish the likelihood of accidents.

Paper 3

Title: Smart Vision-Based Vehicle Collision Avoidance System for Wildlife Animals

Author: Shruti Rathi, Sayali Gajghate, Sharvari Gijre, Simran Barbate, P. R. Selokar

Year:2020

Inference:

India is the country that does not have proper maintenance of the road, over 95% of the people use road transportation. With the increase in accident rates and poor road quality across the country, the good health of public roads is of utmost importance. Another serious problem that

the country is facing includes death and injuries due to road accidents. The collision of an animal with the vehicle on the highway is one such big issue that leads to such road accidents. The pothole detection and wildlife collision avoidance application proposed enables the driver to receive information about the potholes on the roads. The application can be integrated into the vehicle so as to alarm the driver in the form of a visual signal and audio signal. It also helps in wildlife management in the surrounding area of human passages to establish safe ways for animals to cross transportation infrastructures.

Paper 4

Title: Intelligent Systems Using Sensors and/or Machine Learning to Mitigate Wildlife–Vehicle Collisions

Author: Irene Nandutu, Marcellin Atemkeng, Patrice Okouma

Year:2022

Inference:

Worldwide, the persistent trend of human and animal life losses, as well as damage to properties due to wildlife–vehicle collisions (WVCs) remains a significant source of concerns for a broad range of stakeholders. To mitigate their occurrences and impact, many approaches are being adopted, with varying successes. Because of their increased versatility and increasing efficiency, Artificial Intelligence-based methods have been experiencing a significant level of adoption. The present work extensively reviews the literature on intelligent systems incorporating sensor technologies and/or machine learning methods to mitigate WVCs. Included in our review is an investigation of key factors contributing to human–wildlife conflicts, as well as a discussion of dominant state-of-the-art datasets used in the mitigation of WVCs. Our study combines a systematic review with bibliometric analysis. We find that most animal detection systems (excluding autonomous vehicles) are relying neither on state-of-the-art datasets nor on recent breakthrough machine learning approaches. We, therefore, argue that the use of the latest datasets and machine learning techniques will minimize false detection and

improve model performance. In addition, the present work covers a comprehensive list of associated challenges ranging from failure to detect hotspot areas to limitations in training datasets. Future research directions identified include the design and development of algorithms for real-time animal detection systems. The latter provides a rationale for the applicability of our proposed solutions, for which we designed a continuous product development lifecycle to determine their feasibility

Paper 5

Title: An Animal Detection and Collision Avoidance System Using Deep Learning

Author: Atri Saxena, Deepak Kumar Gupta, Samayveer Singh

Year:2020

Inference:

All over the world, injuries and deaths of wildlife and humans are increasing day by day due to the huge road accidents. Thus, animal–vehicle collision (AVC) has been a significant threat for road safety including wildlife species. A mitigation measure needs to be taken to reduce the number of collisions between vehicles and wildlife animals for the road safety and conservation of wildlife. This paper proposes a novel animal detection and collision avoidance system using object detection technique. The proposed method considers neural network architecture like SSD and faster R-CNN for detection of animals. In this work, a new dataset is developed by considering 25 classes of various animals which contains 31,774 images. Then, an animal detection model based on SSD and faster R-CNN object detection is designed. The achievement of the proposed and existing method is evaluated by considering the criteria namely mean average precision (mAP) and detection speed. The mAP and detection speed of the proposed method are 80.5% at 100 fps and 82.11% at 10 fps for SSD and faster R-CNN, respectively.

CHAPTER 2

PROPOSED METHODOLOGY

2.1 BLOCK DIAGRAM

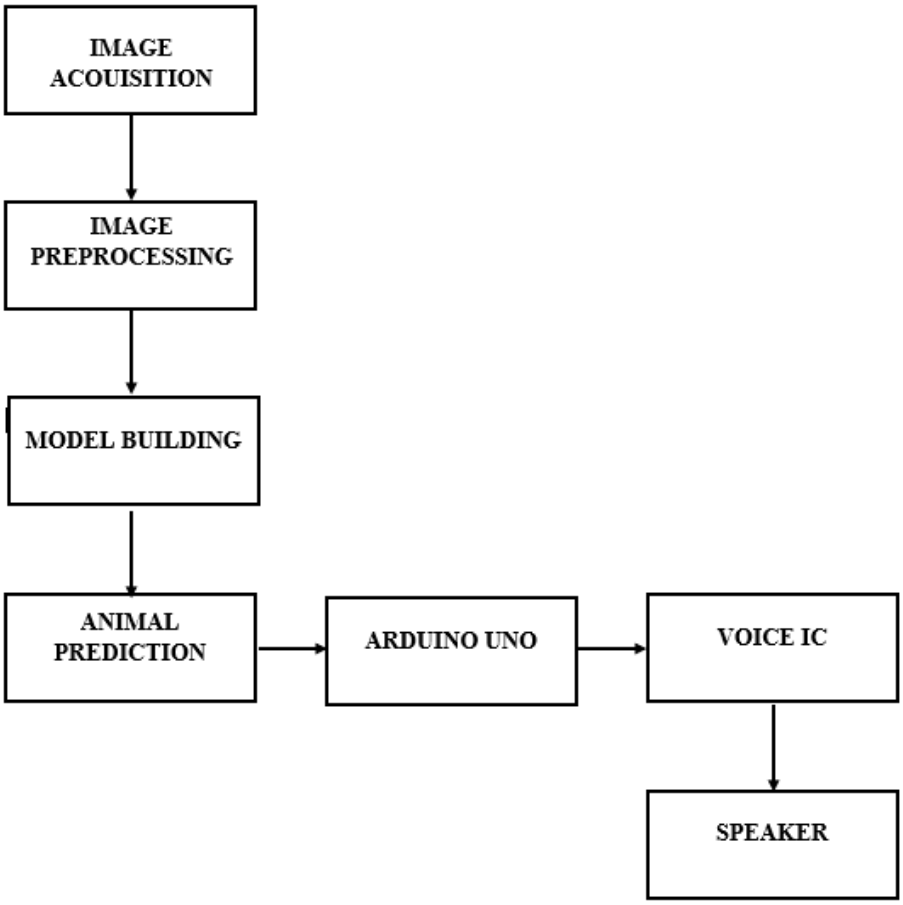

Fig 2.1 Block Diagram

2.2 DESCRIPTION

The Intelligent Animal Detection and Collision Prevention System for Safer Roadways is designed to enhance road safety by detecting animals in real time and preventing potential collisions. This system integrates computer vision and deep learning techniques, specifically utilizing the YOLO (You Only Look Once) model, a highly efficient object detection framework known for its speed and accuracy. The system analyzes live video streams captured through a standard camera installed along roadways, processing each frame to identify animals within its field of view. Once an animal is detected, a digital signal is transmitted to an Arduino microcontroller, triggering a series of hardware responses, including an audible alarm, a red warning light, and a speaker announcement stating "Animal detected." These multi-sensory alert mechanisms increase driver awareness, providing sufficient time to react and reducing the likelihood of accidents caused by animal crossings. The advantages of this system include real-time detection enabled by YOLO's speed, high accuracy in object identification, autonomous operation that eliminates the need for manual monitoring, immediate feedback through hardware alerts, and adaptability for detecting different animal species or triggering customized alerts. Future improvements may include integrating additional sensors such as thermal or motion detectors, enabling remote monitoring via network connectivity, designing protective enclosures for increased environmental durability, optimizing power consumption for deployment in remote locations, and fine-tuning the YOLO model for more precise animal identification. The system finds applications in roadway safety measures by preventing animal-vehicle collisions, wildlife conservation efforts by minimizing fatalities, and smart traffic management through intelligent surveillance. By combining AI-based object detection with embedded systems, this project presents an innovative solution for safer roadways and wildlife protection, ensuring timely alerts and proactive collision prevention.

2.3 PROJECT-TOTAL COST

S.NO	COMPONENTS	QUANTITY	COST (In Rupees)
1	Arduino Uno	1	650
2	Step-Down Transformer	1	600
3	Display	1	300
4	Relay	1	200
5	APR33A3 – Voice Module	1	850
6	Speaker	1	500
7	LED Light	1	200
		Total	**3300**

2.1 COST ESTIMATION TABLE

CHAPTER 3

HARDWARE AND SOFTWARE

3.1 HARDWARE DISCRIPTON :

1.Arduino Uno :

Arduino is a single-board microcontroller to make using electronics in multidisciplinary projects more accessible. The hardware consists of an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller. Arduino boards can be purchased pre-assembled or as do-it-yourself kits. Hardware design information is available for those who would like to assemble an Arduino by hand. It was estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced.

Fig 3.1 Arduino Uno

2. Step-Down Transformer :

A step-down transformer reduces high voltage to a lower level while maintaining frequency. It consists of primary and secondary windings wrapped around a magnetic core, with the secondary having fewer turns. When AC flows through the primary coil, it generates a magnetic field that induces a lower voltage in the secondary coil. Widely used in power distribution, electronics, industrial machinery, and safety isolation, it ensures efficient energy transfer and prevents electrical hazards.

Its benefits include automatic operation, high accuracy, energy efficiency, and reliable voltage reduction, making it crucial for modern electrical systems.

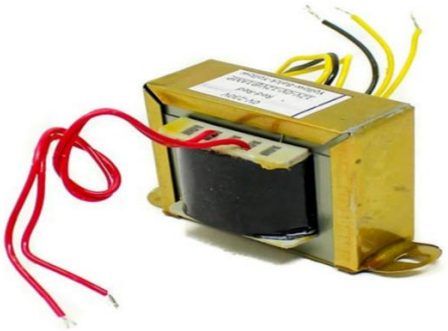

Fig 3.2 Step-down Transformer

3. Display :

A display is an output device that visually presents information, images, or videos using various technologies. Common types include LCD (Liquid Crystal Display), LED (Light-Emitting Diode), and OLED (Organic LED), each differing in brightness, energy efficiency, and colors accuracy. Displays are used in smartphones, TVs, computer monitors, and digital signage, allowing users to interact with digital content. Advanced displays support touch functionality, high refresh rates for smooth visuals, and resolutions ranging from HD to 8K for enhanced clarity

Fig 3.3 Display

4. Relay :

A relay is an electrically operated switch that controls circuits using low-power signals. It works by using an electromagnet to open or close contacts, enabling automation and high-

power control. Commonly used in automotive, industrial, and home automation systems, relays provide circuit isolation, reliability, and overload protection, making them essential in electrical applications. Additionally, relays contribute to energy efficiency by reducing unnecessary power consumption, making them valuable in smart systems and modern electronics.

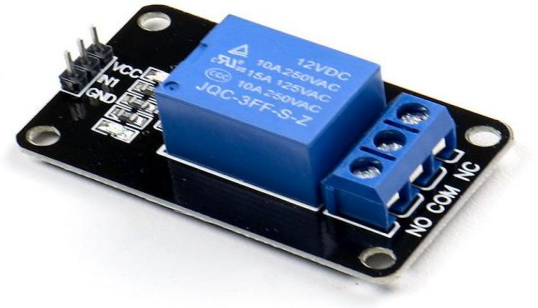

Fig 3.4 Relay

5. APR33A3 – Voice Record and Playback Module :

The APR33A3 is a voice record and playback module with built-in flash memory that allows up to 680 seconds of audio storage across 8 channels. It operates on 3V to 6.5V, featuring a microphone amplifier, ADC, and DAC for clear sound processing. Widely used in automated voice systems, security alerts, and interactive devices, it offers low power consumption, easy integration, and reliable audio playback for embedded applications.

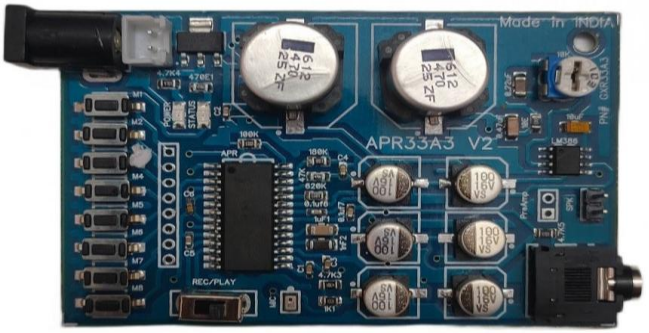

Fig 3.5 APR33A3 – Voice Record and Playback Module

3.2 SOFTWARE DISCRIPTON :

Programming Language: Python

This system is developed in Python, leveraging its powerful libraries for computer vision, deep learning, and hardware interfacing. It integrates Ultralytics YOLO for object detection, OpenCV for image processing, and serial communication for interaction with an Arduino microcontroller.

Software Components:

- YOLO Model (Ultralytics YOLO): A deep learning-based framework trained to detect animals in real time.
- OpenCV for Image Processing: Captures live video, processes frames, and overlays bounding boxes and labels for detected objects.
- Serial Communication (PySerial): Sends signals to an Arduino microcontroller for activating hardware alerts (alarm, light, voice announcement).
- Python Programming: Serves as the core language to implement all functionalities efficiently.

Operational Workflow:

- The system captures real-time video using OpenCV.
- YOLO processes each frame and identifies animals with high accuracy.
- If an animal is detected, a bounding box appears on the screen, and a serial signal is sent to the Arduino.
- The Arduino activates an alarm, red light, or voice warning to alert nearby vehicles and pedestrians.
- A delay mechanism ensures optimized alert handling, preventing redundant warnings.

Advantages of the Software System:

- Real-time animal detection improves safety on roadways.
- Deep learning integration enhances accuracy for detecting multiple animal species.
- Automated communication with hardware enables immediate response actions.
- Customizable threshold settings optimize sensitivity and reduce false detections.

CHAPTER 4

RESULT AND DISCUSSION

4.1 HARDWARE KIT

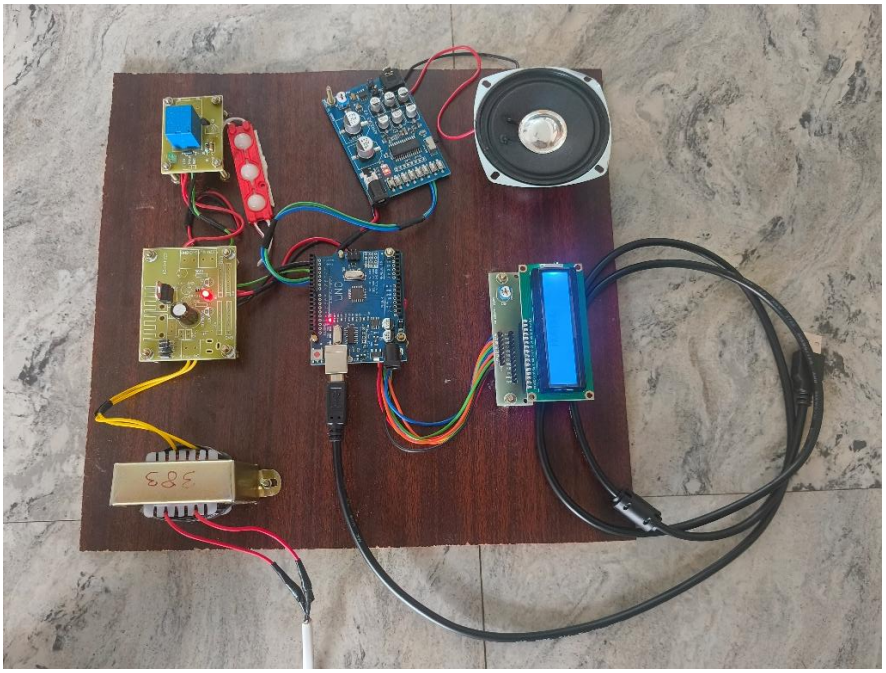

Fig 4.1 Hardware kit

4.2 WORKING

The Intelligent Animal Detection and Collision Prevention System operates by continuously capturing video frames using a USB webcam, which are processed in real time through OpenCV. Each frame is then analyzed by a YOLO deep learning model, specifically trained to detect animals like dogs. When an animal is detected, the system overlays a bounding box and label on the video output, providing a visual confirmation. To prevent unnecessary repeated alerts, a debouncing mechanism evaluates whether an alert should be triggered based on previous detections and time intervals. If a new alert is required, a serial signal is transmitted to an Arduino microcontroller, which activates hardware notifications such as a buzzer, red LED light, and a speaker announcement to warn nearby vehicles and pedestrians. These alerts enhance driver awareness and minimize the risk of animal-vehicle collisions. The system continues monitoring and processing frames in an infinite loop, ensuring uninterrupted functionality until manually stopped by the user. This automated approach combines computer vision, artificial intelligence, and embedded systems, offering a reliable and efficient solution for roadway safety, wildlife protection, and intelligent traffic management.

CHAPTER 5

CONCLUSION

This paper presents the design and implementation of a real-time animal detection system integrated with hardware alerts to enhance roadway safety. By leveraging the power and efficiency of the YOLO deep learning model, the system accurately identifies animals in live video streams, allowing for timely intervention. The integration of an Arduino microcontroller enables immediate physical notifications through an alarm, a red light, and a voice announcement upon detection, ensuring effective communication of potential hazards. The proposed system offers several advantages over existing methods, including real-time detection enabled by YOLO's speed, high accuracy in object identification, autonomous operation that reduces the need for manual monitoring, immediate feedback through hardware alerts, and potential customization to detect other objects or trigger different types of alerts. While the current implementation showcases the core functionality, there are several avenues for improvement. These include exploring compatibility with different microcontroller platforms, refining alert logic to minimize false positives, integrating remote monitoring and control for enhanced usability, optimizing power consumption for deployment in remote locations, improving environmental robustness by designing protective enclosures, and fine-tuning the YOLO model for more precise animal identification. In conclusion, this intelligent animal detection and collision prevention system demonstrates the potential of combining deep learning-based object detection with embedded systems to create practical and responsive solutions for real-world applications. The system represents a significant step toward automated monitoring and immediate notification of animal presence, contributing to improved roadway safety, enhanced wildlife conservation efforts, and reduced collision risks.

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