e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

ROBOTIC CONTROL SYSTEM BASED ON OBJECT DETECTION & ACCIDENTAL ALERT SYSTEM

Akshay S. Utane[*1], Ritesh Hande [*2], Pranav Kale[*3], Prathmesh Joshi[*4], Arjun Mishra[*5]

[*1]Assistant Professor, Department of Electronics & Telecommunication Engineering, Prof. Ram Meghe Institute of Technology & Research, Amravati, Maharashtra, India.

[*2,3,4,5]Students, B.E, Electronics & Telecommunication Engineering, Prof. Ram Meghe Institute of Technology & Research, Amravati, Maharashtra, India.

DOI : https://www.doi.org/10.56726/IRJMETS55974

ABSTRACT

The integration of robotic control systems with advanced object detection and Accidental alert mechanisms represents a significant advancement in the realm of robotics and automation. This project focuses on developing a sophisticated robotic control system that leverages cutting-edge object detection algorithms to enhance the robot's environmental awareness and safety. Utilizing computer vision techniques, the system enables the robot to identify and localize various objects in its vicinity, facilitating intelligent navigation and interaction in dynamic environments.

In addition to object detection, the proposed system incorporates a robust Accidental alert system designed to preemptively identify potential collision risks. By continuously monitoring the robot's surroundings and analyzing real-time data, the Accidental alert system can promptly detect obstacles or hazards, triggering immediate corrective actions to avoid collisions and ensure the robot's safe operation.

Furthermore, the project explores the implementation of a user-friendly interface to facilitate easy configuration and customization of the robotic control parameters, enabling operators to adapt the system to specific application requirements effectively. The proposed robotic control system offers promising potential for a wide range of applications, including industrial automation, autonomous vehicles, and service robots, paving the way for safer and more intelligent robotic systems in various domains.

Keywords: Accidental Alert System, Arduino Nano, Driver Safety, Object Detection.

I. INTRODUCTION

In recent years, the integration of robotics and automation technologies has revolutionized various industries, ranging from manufacturing and logistics to healthcare and entertainment. As robotic systems become increasingly prevalent in our daily lives, there is a growing demand for advanced control mechanisms that can enhance their capabilities, safety, and efficiency. One of the critical challenges in developing intelligent robotic systems lies in enabling them to interact seamlessly with their environment, adapt to dynamic changes, and avoid potential hazards autonomously. [10]

Object detection and collision avoidance are fundamental aspects that significantly influence the performance and safety of robotic systems operating in complex and unstructured environments. [2] Traditional robotic control methods often rely on predefined paths or manual intervention, limiting their adaptability and responsiveness to unexpected situations. With the advent of sophisticated sensor technologies and machine learning algorithms, there is an opportunity to develop more intelligent and proactive robotic control systems capable of real-time object recognition and collision prediction. [7]

The primary objective of this project is to design and implement a robotic control system that leverages advanced object detection techniques and Accidental alert mechanisms to enhance the robot's navigation and safety capabilities. [9]

By integrating state-of-the-art computer vision algorithms, the system aims to provide the robot with the ability to identify and localize various objects, such as obstacles, pedestrians, and other vehicles, in its surrounding environment.

This enhanced environmental awareness will enable the robot to make informed decisions and navigate complex terrains more effectively, reducing the risk of collisions and enhancing operational efficiency.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

By continuously monitoring the robot's surroundings and analyzing real-time sensor data, the Accidental alert system will provide an additional layer of safety, ensuring the robot's safe operation in dynamic and unpredictable environments.

By continuously monitoring the robot's surroundings and analyzing real-time sensor data, the Accidental alert system will provide an additional layer of safety, ensuring the robot's safe operation in dynamic and unpredictable environments.

II. LITERATURE SURVEY

Shaikh Shakil A. et.al (2020) in their Research "Object Detection and Tracking using YOLO v3 Framework for Increased Resolution Video" they stated that This system is used for vehicle detection and tracking from the high-resolution video. It detects the object (vehicles) and recognizes the object comparing its features with the features of the objects stored in the database. If the features match, then object is tracked. There are two steps of implementation, online and offline process. In offline process the data in the form of images are given to feature extractor and then after to the trained YOLO v3 model and weight files is generated form the pre-trained YOLO v3 model. [2]

Mohanapriya S. et.al (2021) in their Research "Object and lane detection for autonomous vehicle using YOLO V3 algorithm" they stated that to detect the objects around an autonomous vehicle is very essential to operate safely. This paper presents to detect and classify the objects for assisting autonomous driving. In autonomous driving systems, the task of object detection itself is one of the most important prerequisites to autonomous navigation. Deep learning one of the computer vision tasks, perform object detection very effectively than compared to earlier methods and this project is to detect the objects like vehicles, persons, traffic lights, etc. In this work, an approach to object detection in deep learning that makes the bounding box for an image to predict is explored. Object detection is the method of detecting the objects present in a given image. Apart from detecting the number of objects present in an image it also specifies in which location that object is present in the image. [1]

Gotlur Karuna et.al (2023) in their Research "Motorcycle Crash Detection and Alert System using IoT " they stated that Motorcycle travel is considered the most dangerous mode of transport in the world. Reports suggest that the fatality rate of motorcycles is 212.7 deaths for every million miles travelled on motorcycles. Unlike other forms of travel like cars, buses, etc, motorcycles expose the rider to their surroundings. In cars, the frame protects the driver from hitting the road or falling out of the car. But motorcycles do not have such a possibility. Therefore, the best way to minimize fatalities in accidents is to have an alert system that can alert the emergency services when it detects an imminent crash. This is where the motorcycle crash detection and alert system comes into the picture. [9]

Mahendra Kanojia et.al (2019) in their Research "Internet of Things (IoT) based Robotic Car" they stated that An RC Car is a battery powered automatic car that can be controlled from a specific distance using a specialized remote or a mobile application using a mobile phone. IoT is connecting computers with smart objects, including semi and fully automatic robots. One can control the robot with the help of mobile or laptop through IoT and also can get the live streaming of video, can avoid accident using ultrasonic and distance sensors. It can shut down the vehicle's fuel system by simply clicking a button in the web user interface. Using an automation car can malfunction but RC robotic car will be controlled by humans to avoid malfunctions.[10]

III. METHODOLOGY

The proposed robotic control system integrates advanced object detection and Accidental alert technologies to enhance the capabilities and safety of robotic platforms in various applications. Utilizing state-of-the-art computer vision algorithms, the system enables the robot to perceive and understand its environment effectively, identifying obstacles, landmarks, and other relevant entities through onboard cameras and sensors.

Object detection enhances the robot's situational awareness, enabling intelligent navigation and interaction in dynamic environments. The system's robust Accidental alert mechanism preemptively identifies potential collision risks, utilizing real-time sensor data and predictive analytics to trigger immediate corrective actions, ensuring safe operation and minimizing accident risks.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

Designed with modularity and scalability in mind, the control architecture facilitates seamless integration with diverse robotic platforms and configurations. Leveraging sensor fusion techniques, machine learning algorithms, and adaptive control strategies, the system adapts to different operating conditions and application requirements, allowing operators to customize control parameters and optimize performance.

Block Diagrams -

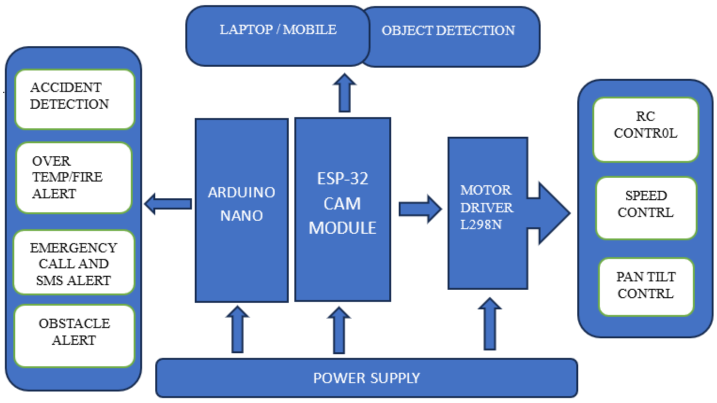

Figure 1 : System Block Diagram

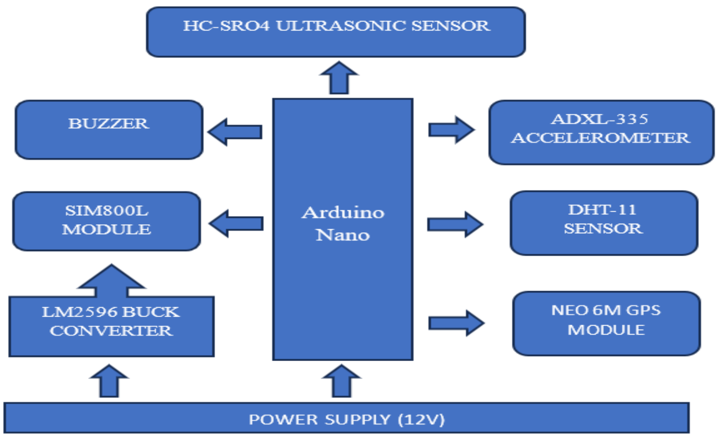

Figure 2 : Accidental Alert System

IV. IMPLEMENTATION

Circuit Diagram –

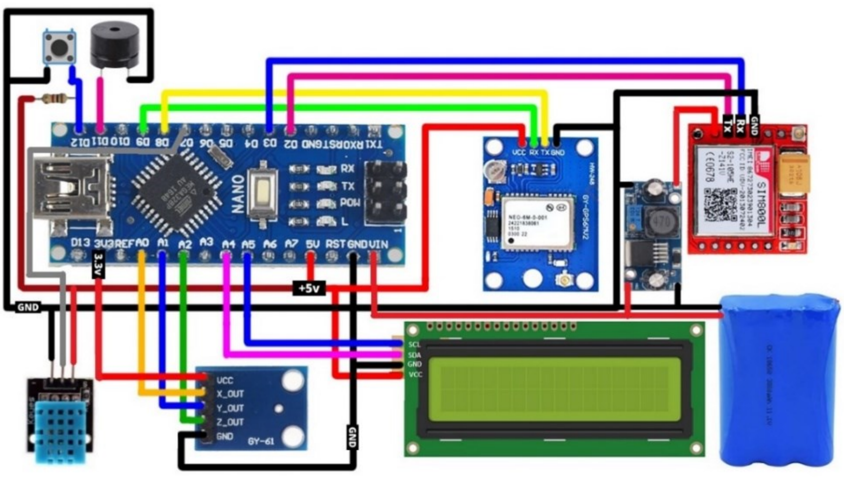

Figure 3: Circuit Diagram of Accidental Alert System.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

An Accidental Alert System plays a critical role in ensuring the robot's safety. It typically comprises sensors like accelerometers or collision sensors, a microcontroller for data processing, and an alert mechanism such as a buzzer or LED. Integrated into the project, it continuously monitors the robot's surroundings for potential accidents or collisions. Upon detection, it triggers alerts to notify users or autonomously halts the robot's movement to prevent damage or injury.

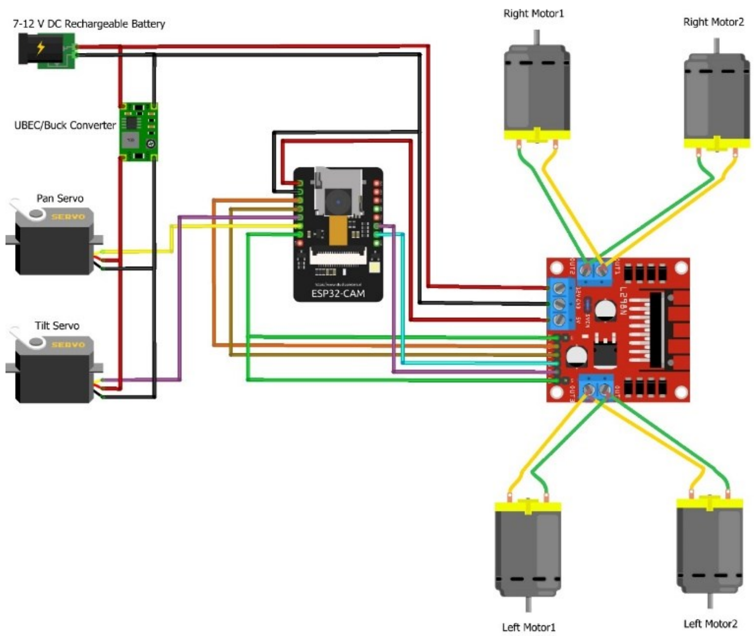

Figure 4: Pan – Tilt Circuit Diagram

A Pan-Tilt circuit enables the orientation adjustment of sensors or cameras to focus on detected objects. Integrated with object detection sensors, it facilitates real-time tracking of objects within the robot's field of view. Additionally, it collaborates with the accidental alert system, ensuring the robot's safety by swiftly reorienting sensors away from detected obstacles or triggering alerts to prevent collisions.

Experimental Setup –

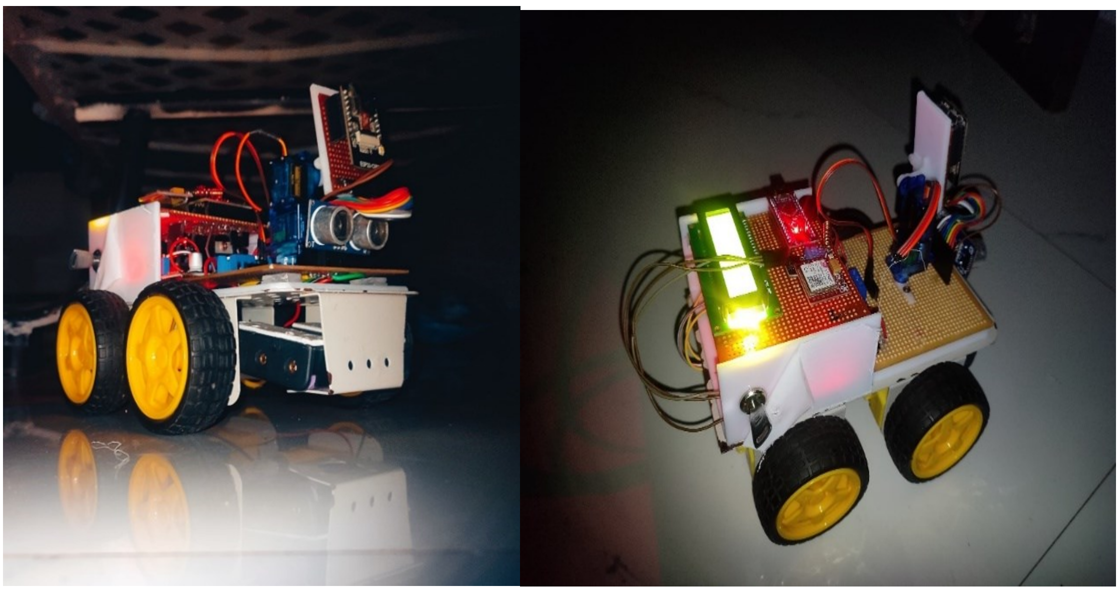

Figure 5: Front & Top View of Robotic Control System

In our project, we utilized the following hardware: an Arduino Nano, SIM 800L module, Neo 6m GPS Module, L298N Motor Driver, ESP32 CAM, Gear Motor, 18650 Battery, Servo Motor, LM2596 Buck Converter, and I2C LCD. Additionally, the software required for our project included Arduino IDE.

V. RESULTS AND OUTPUT

We have utilized the ESP32 CAM with the L298N motor driver for monitoring and controlling the bot. This allows for controlling its speed, Headlight brightness, and the camera's pan-tilt position via the IP address generated by the ESP32 CAM on a web server, providing a better user interface. Additionally, we have integrated object detection into the web server for enhanced functionality.

To further enhance the bot's capabilities, we have incorporated an Arduino Nano and an ultrasonic sensor. This setup notifies the user with a beep when the bot approaches an obstacle. Furthermore, we have integrated a SIM800L and a 6M GPS module to provide call and SMS alerts in case of accidental behavior by the bot. These alerts are triggered by sensors such as the ADXL335 accelerometer for Accidental detection and the DHT11 sensor for monitoring high temperature and humidity, which helps in detecting fire and other emergencies, ensuring the safety and improved performance of the bot.

Figure 5: Accidental Detection

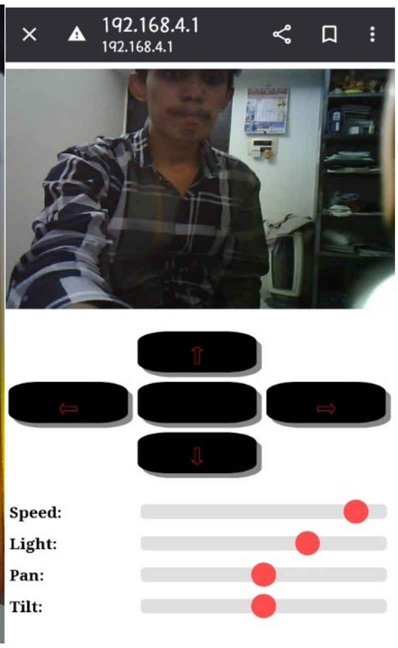

Figure 6: Pan-Tilt Web Page

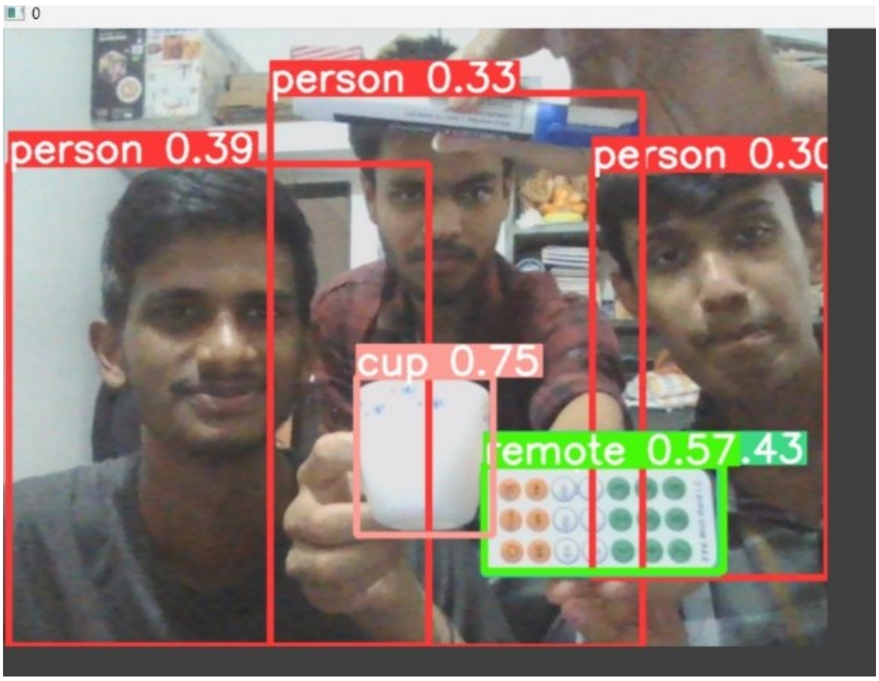

Figure 7: Object Detection

IRJMETS

e-ISSN: 2582-5208

International Research Journal of Modernization in Engineering Technology and Science

(Peer-Reviewed, Open Access, Fully Refereed International Journal)

Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

VI. CONCLUSION

The proposed robotic control system leverages advanced object detection and Accidental alert technologies to enhance the navigation, safety, and efficiency of robotic platforms across diverse applications. Integrating state-of-the-art computer vision algorithms, the system enables robots to perceive and understand their environment, identify obstacles, and interact intelligently in dynamic settings.

With a robust Accidental alert mechanism, the system preemptively detects potential collision risks, triggering immediate corrective actions to ensure safe operation and minimize accident risks. Designed for modularity, scalability, and adaptability, the control architecture facilitates seamless integration with different robotic platforms, allowing operators to customize control parameters and optimize performance.

Additionally, an intuitive user interface provides operators with real-time feedback and visualization tools for easy configuration and monitoring, ensuring smooth and efficient robotic operation.

VII. REFERENCES

[1] S., Mohanapriya & P., Natesan & P., Indhumathi & P., Mohanapriya & R., Monisha. (2021). “Object and Lane detection for autonomous vehicle using YOLO V3 algorithm” AIP Conference Proceedings. 2387. 140009.10.1063/5.0068836.

[2] A., Shaikh & Kureshi, Dr. (2020). “Object Detection and Tracking using YOLO v3 Framework for Increased Resolution Video. International Journal of Innovative Technology and Exploring Engineering. 9. 118- 125.10.35940/ijitee.E3038.049620.

[3] Panthati, Jagadeesh. (2022). “Traffic Object Detection and Distance Estimation Using YOLOv3. “ 10.4271/2022-28-0120.

[4] Givan, Daxton & Hanshaw, Noah & Choi, Heejun. (2022). “Application of Lane Navigation and Object Detection in a Deep-Learning Self-driving Car.” 10.1007/978-3-030-98012-2_63.

[5] Lim, Yuxiang & Tiang, Sew & Lim, Wei Hong & Wong, Chin Hong & Mastaneh, Mokayef & Chong, K. & Sun, Bo. (2024). “Object Detection in Autonomous Vehicles: A Performance Analysis.” 10.1007/978-981-99- 8498-5_21.

[6] Wang, Rui & Wang, Ziyue & Xu, Zhengwei & Wang, Chi & Liu, Qiang & Zhang, Yuxin. (2021). “A Real-time Object Detector for Autonomous Vehicles Based on YOLOv4. Computational Intelligence and Neuroscience.” 2021. 10.1155/2021/9218137.

[7] Monteadora Renzo (2022). ”Ros Based Self-Driving Rc Car with Tensorrt Integration In Reducing Behavioral Cloning Latency And Object Detection For Collosion Prevention.” 10.13140/RG.2.2.15364.60803..

[8] Hallan, Akul & Rawat, Shreya & Kumar, Sandeep & Ul-Haq, Ahsan & Gandhar, Abhishek. (2020). “Vehicle Accidental Alert System.” 24-30.

[9] Karuna, Gotlur & Kumar, Ram & Sai, Vadlapatla & Abhishek, Jula & Shashikanth, Mood & Kashyap, Burra. (2023). “Motorcycle Accidental Detection and Alert System using IoT.” E3S Web of Conferences. 391. 10.1051/e3sconf/202339101145.

[10] Kanojia, Mahendra & Gandhi, Niketa & Bangera, Kritik. (2019). “Internet of Things (IoT) based Robotic Car.”