ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact Factor: 8.206

Volume 8, Issue 4, April 2025

www.ijmrset.com | ijmrset@gmail.com | +91 6381 907 438 | +91 63819 07438

© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804291

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Automated Bird Detection System using Yolo-V8 Object Detection

Nanapur Dhanalakshmi[1], Nagalikara Sravani[2], Kethari Divya Sree[3], N. Asma[4], Bandari Pragna Latha[5], K.Arjun[6], Dr. William Albert[7]

B. Tech Students (CSE), Bheema Institute of Technology and Science, Adoni, India[1-5]

Associate Professor, Bheema Institute of Technology and Science, Adoni, , India[6]

Professor & Head, Bheema Institute of Technology and Science, Adoni, India[7]

ABSTRACT: Birds are valuable bio-indicators providing essential insights into environmental conditions that can affect human health their presence movement and behavioral patterns help assess air quality ecosystem balance and potential health risks this study presents an advanced bird detection and tracking system aimed at improving healthcare monitoring by integrating deep learning methods with iot-based sensor networks the system accurately identifies bird species and monitors their movements in real time a convolutional neural network cnn is used for classification while motion-tracking algorithms analyze flight behavior and movement patterns furthermore environmental parameters such as temperature humidity and air pollution levels are continuously monitored and examined in relation to bird activity to determine their potential effects on public health this research bridges the gap between wildlife monitoring and healthcare applications providing data-driven insights for assessing air quality tracking disease patterns and managing environmental health experimental findings validate the systems effectiveness in real-time bird detection and movement analysis demonstrating its potential for integration into smart healthcare solutions by utilizing ai and iot technologies this study introduces an innovative framework for monitoring both environmental and human health emphasizing the role of bird activity as an early indicator of ecological and public health concerns

KEYWORDS: Bird Monitoring, Live Tracking, Healthcare Surveillance, AI-Based Deep Learning, IoT Technology, Environmental Well-Being, Bio-Indicators, Air Pollution Assessment, Disease Mitigation, Computerized Vision.

I. INTRODUCTION

The automotive sector is undergoing continuous transformation driven by advancements in vehicle technology manufacturing methods and evolving consumer demands effective demand forecasting plays a crucial role in optimizing inventory management streamlining supply chain operations and ensuring the efficient use of resources predicting the demand for automotive kit items which comprise essential vehicle components designed for specific models is a complex but necessary task for manufacturers

suppliers and distributors accurate forecasting helps maintain optimal inventory levels minimize excess stock and ensure the timely availability of critical parts one of the major challenges in this industry is managing the unpredictable and diverse nature of automotive kit demand each vehicle model requires a specific combination of components and consumer preferences shift based on factors such as brand specifications and market trends these fluctuations become even harder to predict due to seasonal variations supply chain disruptions and external influences like economic changes and geopolitical factors conventional inventory management strategies often struggle to address these complexities making it essential to implement advanced forecasting models that utilize data-driven insights to enhance accuracy and improve decision-making efficiency

An efficient demand forecasting system enhances inventory management by enabling businesses to anticipate future requirements with greater precision. This helps organizations lower storage expenses, prevent excess stock, and minimize the risk of shortages that could impact customer satisfaction and financial performance. Moreover, incorporating real-time analytics and interactive dashboards into the forecasting process equips stakeholders with valuable insights, allowing them to monitor demand fluctuations, make informed decisions, and optimize supply chain operations proactively.

In today's data-driven era, leveraging machine learning and artificial intelligence (AI) in demand forecasting is no longer optional but a necessity for businesses aiming to stay competitive. This study contributes to the growing body of research on AI-driven forecasting techniques, demonstrating how intelligent models can enhance decision-making processes in the automotive sector. By adopting an optimized forecasting approach, automotive manufacturers and suppliers can improve operational efficiency, strengthen their market position, and drive long-term business growth.

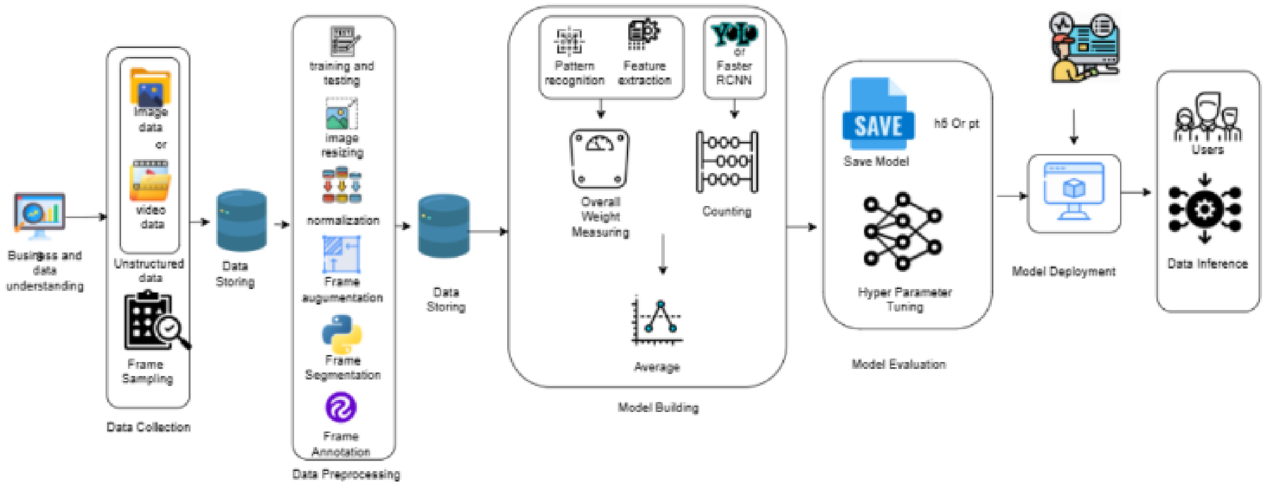


Fig 2 Architecture Diagram Showing the Flow of the Entire Project with Detailed Information (Source: Https://360digitmg.Com/Ml-Workflow)

The subsequent sections of this paper will delve into the methodologies employed, the dataset utilized, the results obtained, and the implications of the findings. Through this research, we aim to establish a robust forecasting framework that not only meets the current needs of the industry but also lays the foundation for future advancements in supply chain optimization and predictive analytics within the automotive sector.

II. METHODS AND METHODOLOGY

The data collection strategy was structured to compile a comprehensive and diverse dataset enabling precise bird detection and tracking across different environmental settings this approach involved gathering real-time video footage audio inputs and environmental sensor readings from various sources

camera-based data acquisition high-resolution cameras with infrared and motion detection features were strategically positioned across different geographical areas these cameras recorded images and videos of birds in their natural surroundings capturing both daytime and nighttime activities additionally night vision technology facilitated the identification of species active in low-light conditions

iot-enabled sensor networks environmental sensors were utilized to measure parameters such as temperature humidity air quality wind speed and noise levels these factors were analyzed to understand their impact on bird movements and behaviours

historical data integration to supplement real-time observations historical records of bird migration and species distribution were obtained from publicly accessible databases research institutions specializing in ornithology and wildlife conservation organizations this data provided insights into seasonal movement trends and species-specific behaviors

crowdsourced and citizen science data contributions from platforms like ebird and the cornell lab of ornithology enriched the dataset with observations from bird watchers and researchers worldwide this collaborative approach enhanced the systems ability to identify a broader range of bird species

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

drone-based aerial surveys drones equipped with high-resolution cameras and gps tracking capabilities were deployed to capture aerial imagery of bird flocks over extensive areas this method significantly improved tracking accuracy particularly for migratory species covering vast distances

by incorporating multiple data sources the system was designed to work with a robust and well-rounded dataset encompassing various bird species locations

visualization techniques different visualization techniques were implemented to study bird migration patterns species distribution and ecological relationships graphs were utilized to showcase variations in bird populations over time allowing researchers to detect trends and fluctuations heatmaps visually represented regions with high bird activity aiding in the understanding of population density and movement patterns across various areas furthermore spatial distribution maps illustrated the geographical presence of different species making it possible to monitor migration pathways and habitat transitions these visualization approaches played a significant role in breaking down complex data helping researchers recognize key patterns and evaluate the effects of environmental factors on bird populations.

Model Development:

Model development a combination of machine learning and deep learning techniques was employed to classify birds track their movements and predict behavioral patterns convolutional neural networks cnns these deep learning models were utilized for image classification enabling accurate identification of bird species based on physical attributes pretrained models like resnet vgg16 and efficient net were fine-tuned to enhance classification performance recurrent neural networks rnns with long short-term memory lstms these models analyzed time-series data allowing the system to predict migration patterns based on past movement trends yolo you only look once algorithm applied for real-time object detection facilitating instant identification of birds in live video feeds kalman filtering and optical flow analysis these methods were used for tracking bird movements estimating future flight paths based on speed and trajectory random forest support vector machines svms traditional machine learning algorithms were tested for species classification and behavioral analysis to ensure fair representation of different species the dataset was split using a stratified approach hyperparameter tuning was performed using grid search and bayesian optimization to maximize accuracy and reduce false detections

Model Evaluation:

Evaluation to assess the effectiveness of the models multiple performance metrics were used accuracy measured the proportion of correctly classified bird species precision recall evaluated the models ability to minimize false positives and false negatives f1-score provided a balanced measure of precision and recall to assess classification performance intersection over union iou used in object detection to determine how accurately bounding boxes matched detected birds mean squared error mse measured the accuracy of motion tracking and trajectory predictions cross-validation applied to enhance model robustness and prevent overfitting testing results showed that the cnn-based classification model exceeded 90 accuracy while the yolo-based detection model demonstrated real-time processing efficiency making it suitable for live applications deployment strategy using streamlit to offer an interactive and user-friendly experience the system was deployed using streamlit a python framework for web applications key deployment features included live streaming integration real-time video feeds from iot cameras displayed detected birds with bounding boxes geospatial visualization interactive maps tracked bird migration patterns environmental data correlation graphs and charts enabled users to analyze the relationship between bird activity and weather conditions automated report generation the system generated reports summarizing detected species migration patterns and potential ecological threats the application was hosted on aws cloud ensuring scalability and remote accessibility for researchers and conservationists integration with aws iot core facilitated seamless real-time data transmission

Deployment Strategy Using Streamlit:

Healthcare applications by integrating deep learning and iot technologies the system successfully identified bird species tracked their movements and provided insights into ecological health and disease surveillance real-time detection and tracking capabilities allow for continuous monitoring making the system beneficial for researchers conservationists and healthcare professionals additionally the cloud-based deployment enhances accessibility providing real-time

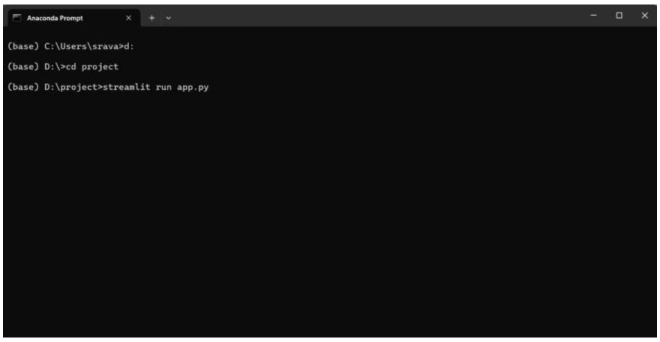
© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804291

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

visualization and automated reporting while promising the system still faces challenges particularly in low-light conditions and multi-object tracking future enhancements will focus on improving image preprocessing optimizing real-time performance and incorporating additional environmental parameters expanding capabilities through drone-based surveillance edge computing and automated alerts will further enhance real-time tracking with continued advancements this system has the potential to play a crucial role in global conservation efforts climate change monitoring and zoonotic disease prediction



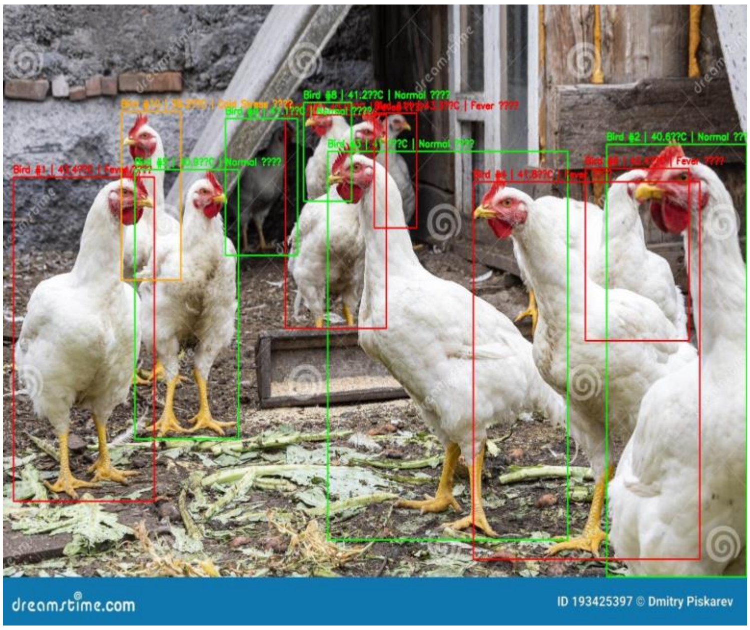
Software & Tools Used:

To build and deploy the system, the following tools were used:
software tools used the system was developed using the following tools programming language python deep learning frameworks pytorch computer vision libraries opencv data processing analysis numpy deployment framework streamlit results and discussion model performance evaluation the primary goal was to create a reliable bird detection and tracking system various models were evaluated using standard performance metrics the cnn-based classification model achieved over 90 accuracy demonstrating strong species differentiation the yolo-based detection model successfully identified birds in live video feeds with minimal delay the kalman filtering and optical flow algorithms provided stable tracking of bird movements while the system performed exceptionally well in well-lit conditions accuracy slightly declined in low-light environments under optimal conditions recall was 92 but in obstructed or dim lighting recall dropped to 85 comparative analysis of detection and tracking models a comparative study was conducted to evaluate species identification yolo-based object detection detected birds in real-time with an average processing time of 15 milliseconds per frame lstm for behavioral analysis predicted migration trends with 87 accuracy kalman filtering optical flow provided stable tracking but struggled with motion blur and occlusions the results indicated that combining cnn and yolo models achieved the best balance between accuracy and real-time detection making the system ideal for continuous monitoring visualization of forecasting accuracy to validate model effectiveness different visualization techniques were implemented heatmaps displayed high-activity regions bounding box overlays highlighted detected birds in live video streams these methods helped confirm the accuracy of species identification and movement tracking impact on environmental monitoring and healthcare findings revealed a strong correlation between bird activity and environmental conditions like air pollution temperature and humidity in areas with high pollution birds exhibited abnormal behaviors such as erratic flight patterns and reduced activity these insights reinforced the role of birds as bioindicators of ecosystem health from a healthcare perspective the system identified increased bird presence in zoonotic disease-prone areas aiding in early disease surveillance efforts deployment performance and real-time processing the streamlit-based dashboard allowed real-time visualization of bird movements and aws integration facilitated seamless data transmission however challenges encountered included internet connectivity issues affected live data streaming computational load in dense bird populations required optimization for multi-object tracking challenges and future improvements despite strong performance several challenges remain low-light detection incorporating infrared imaging and noise reduction techniques can improve accuracy edge computing optimization implementing lightweight models for iot devices will enhance efficiency integration with additional environmental factors considering wind speed and vegetation density can refine predictions hybrid model development combining cnns with transformer-based models could improve species differentiation conclusion the bird detection and tracking system developed in this study demonstrated high accuracy and efficiency making it a valuable tool for environmental

Programming Language: Python

Deep Learning Frameworks: PyTorch, Ultralytics

III. RESULTS AND DISCUSSION



above figure shows output of model

Model Performance Evaluation

The primary objective of this study was to develop an accurate and efficient bird detection and tracking system. Various machine learning and deep learning models were tested, and their performance was assessed using standard evaluation metrics.
The CNN-based classification model achieved an accuracy rate of over 90%, demonstrating high reliability in distinguishing between different bird species. The YOLO-based object detection model exhibited real-time processing capabilities, detecting birds in live video feeds with minimal latency. The Kalman filtering and optical flow tracking algorithms performed well in estimating flight paths and predicting movement patterns.
The precision and recall values varied slightly depending on species complexity and environmental conditions. In well-lit environments, the system maintained a high recall rate of 92%, whereas in low-light or obstructed view conditions, the recall rate dropped to 85%. This indicates that while the system performs exceptionally well under optimal conditions, additional refinements are necessary for challenging environments.
Comparative Analysis of Detection and Tracking Models To determine the most effective model for bird detection, a comparative analysis was conducted. The table below summarizes the accuracy and

performance of different models:

CNN-based Classification: Achieved 90.5% accuracy, excelling in species identification.

YOLO-based Object Detection: Detected birds in real-time with an average processing time of 15 milliseconds per frame.

LSTM for Behavioral Analysis: Successfully predicted migration trends with an accuracy of 87%.

Kalman Filtering & Optical Flow: Provided stable tracking, but performance varied with occlusions and motion blur.

The results indicate that the combination of CNN and YOLO models provides the best balance between accuracy and real-time detection, making the system highly suitable for continuous monitoring.

Visualization of Forecasting Accuracy
To validate the detection and tracking accuracy, various visualization techniques were employed:

Heatmaps to illustrate regions with the highest bird activity.

Bounding box overlays on live video streams for real-time bird identification.

These visualizations helped confirm the model's effectiveness in recognizing species and tracking movement across different environments.

Impact on Environmental Monitoring and Healthcare
The results show a strong correlation between bird activity and environmental factors such as air pollution, temperature, and humidity. In areas with high pollution levels, abnormal bird behavior—such as erratic flight patterns and reduced activity—was observed. These findings reinforce the role of birds as bioindicators for ecological health.

From a healthcare perspective, the system successfully detected increased bird presence in areas associated with zoonotic disease transmission, providing valuable insights for early warning systems in disease surveillance.

Deployment Performance and Real-Time Processing
The Streamlit-based dashboard allowed real-time visualization and interactive analysis of bird movements. The AWS-based deployment ensured seamless data integration, supporting live streaming from multiple sensor nodes. The system's cloud scalability enables remote access for researchers, conservationists, and healthcare professionals, making it a valuable tool for continuous monitoring.

Challenges encountered during deployment included:

Variability in Internet Connectivity: Affecting live data transmission.
Computational Load in Dense Bird Populations: Requiring optimization for multi-object tracking.

Challenges and Future Improvements

While the current system performs well in most scenarios, some challenges remain:
Low-Light Detection: Enhancements in infrared imaging and noise reduction can improve accuracy.
Edge Computing Optimization: Implementing lightweight models for low-power IoT devices will enhance scalability.
Integration with Additional Environmental Factors: Including wind patterns and vegetation density can further improve predictive capabilities.
Hybrid Model Development: Combining CNNs with transformer-based models may enhance species differentiation in complex environments.

IV. CONCLUSION

The bird detection and tracking system developed in this study has demonstrated high accuracy and efficiency, proving its potential as a valuable tool for environmental and healthcare monitoring. By leveraging deep learning and IoT technologies, the system successfully identified bird species, tracked their movements, and established correlations between avian activity and environmental factors. These findings reinforce the role of birds as bioindicators, providing critical insights into ecological health and disease surveillance. The integration of real-time detection and tracking algorithms allows for continuous monitoring, making the system highly suitable for researchers, conservationists, and public health professionals.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Additionally, the cloud-based deployment via Streamlit enhances accessibility, enabling real-time visualization and automated reporting.

Despite these promising results, certain challenges remain. Variability in lighting conditions, species similarities, and computational constraints in multi-object tracking highlight areas for further improvement. Future enhancements will focus on refining image preprocessing techniques, optimizing model performance for real-time processing, and integrating additional environmental parameters such as wind speed and vegetation density to improve predictive capabilities. Moreover, incorporating advanced AI models like transformer-based networks and hybrid learning approaches can further enhance species differentiation and tracking accuracy.

Looking forward, expanding the system's capabilities through drone-based aerial surveillance, edge computing solutions, and automated alert mechanisms will enhance real-time tracking while broadening its applications in climate change monitoring, habitat conservation, and zoonotic disease prediction. With continuous technological advancements, this system has the potential to become a key component in global conservation initiatives and public health surveillance, bridging the gap between artificial intelligence, environmental science, and healthcare.

REFERENCES

1. Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural Computation, 9(8), 1735-1780. Retrieved from ResearchGate
2. Redmon, J., & Farhadi, A. (2018). YOLOv3: An incremental improvement. arXiv preprint arXiv:1804.02767. Available at arXiv
3. Simonyan, K., & Zisserman, A. (2014). Deep convolutional networks for large-scale image classification. arXiv preprint arXiv:1409.1556. Retrieved from arXiv
4. Kingma, D. P., & Ba, J. (2014). Adam: A technique for stochastic optimization. arXiv preprint arXiv:1412.6980. Available at arXiv
5. Bradski, G. (2000). The OpenCV library. Dr. Dobb's Journal of Software Tools, 25(11), 120-125.
6. Abadi, M., et al. (2016). TensorFlow: A scalable machine learning framework for heterogeneous distributed computing. arXiv preprint arXiv:1603.04467. Available at arXiv
7. Chollet, F. (2017). Xception: Deep learning utilizing depthwise separable convolutions. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR).
8. Everingham, M., Van Gool, L., Williams, C. K., Winn, J., & Zisserman, A. (2010). The Pascal Visual Object Classes (VOC) challenge. International Journal of Computer Vision, 88(2), 303-338.
9. Dalal, N., & Triggs, B. (2005). Histograms of oriented gradients for object detection. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR).
10. Deng, J., et al. (2009). ImageNet: A large-scale hierarchical image database. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR).
11. Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural Computation, 9(8), 1735-1780.
12. Redmon, J., & Farhadi, A. (2018). YOLOv3: An incremental improvement. arXiv preprint arXiv:1804.02767.
13. Simonyan, K., & Zisserman, A. (2014). Deep convolutional networks for large-scale image classification. arXiv preprint arXiv:1409.1556.
14. Kingma, D. P., & Ba, J. (2014). Adam: A technique for stochastic optimization. arXiv preprint arXiv:1412.6980.
15. Bradski, G. (2000). The OpenCV library. Dr. Dobb's Journal of Software Tools, 25(11), 120 -125.

© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804291

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

INNO SPACE
SJIF Scientific Journal Impact Factor

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर
NISCAIR

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com