iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** IX **Month of publication:** September 2023

DOI: https://doi.org/10.22214/ijraset.2023.55692

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IX Sep 2023- Available at www.ijraset.com

Object Fetching UAV using Autonomous Flight and Object Detection Algorithms

Aarya Harkare[1], Dr. Rupesh C. Jaiswal[2]
[1]Student, [2]Professor, Department of E&TC Engineering, SCTR's Pune Institute of Computer Technology, Pune, India

Abstract: Autonomous UAVs (Unmanned Aerial Vehicles) are being used in various applications around the world like surveillance and aerial security, construction, agriculture, delivery, etc. These applications require heavy duty UAVs with high payload capacity and long battery life. The aim of this project is to use the principles of autonomous flight and object detection for indoor autonomous flight with the target to fetch and deliver lightweight objects with minimum energy and time consumption to create a viable prototype for indoor applications like delivering objects to bedridden patients, smart home applications, warehouse management and more.

Keywords: UAV, PID, YOLO, Object detection, CPP, ROS, Autonomous Drone Operations, Whycon Detection, Darknet, OpenCV

I. INTRODUCTION

The realm of Unmanned Aerial Vehicles (UAVs) has witnessed remarkable advancements in outdoor applications, spanning surveillance to logistics. As the demand for UAVs expands to indoor settings, fresh challenges and prospects emerge, prompting innovative solutions. This research paper delves into indoor UAV operations, specifically focusing on the integration of autonomous flight and object detection algorithms to execute targeted actions within confined spaces. Indoor environments pose unique constraints on UAV operations, necessitating a delicate balance of maneuverability, perception, and navigation. Negotiating cluttered spaces, avoiding obstacles, and interacting with objects demand a sophisticated fusion of cutting-edge hardware and intelligent algorithms. This paper underscores the critical synergy of two pivotal components: autonomous flight and object detection. Autonomous flight empowers UAVs to navigate complex indoor spaces autonomously, optimizing routes for predetermined objectives. Meanwhile, object detection algorithms endow UAVs with the ability to discern and engage with specific objects, expanding possibilities to encompass tasks such as retrieval and delivery. As industries increasingly embrace robotics and automation, the potential applications of indoor UAVs grow apparent. From healthcare scenarios involving delivering essentials to the immobile, to enhancing smart homes and streamlining warehouse management, these UAVs present adaptable solutions. This research unravels the intricate amalgamation of autonomous flight and object detection[2], not only shedding light on technical nuances but also paving the way for a future where UAVs seamlessly coexist in indoor domains. The subsequent sections expound on methodologies, algorithms, and software driving the fusion of autonomous flight and object detection, offering insights into UAV capabilities within the intricate confines of indoor spaces. Also, the role of advanced tools required using ML and ESPs [11-80] are becoming important in recent applications, recognition and control.

II. PROPOSED WORK

A. Block Diagram

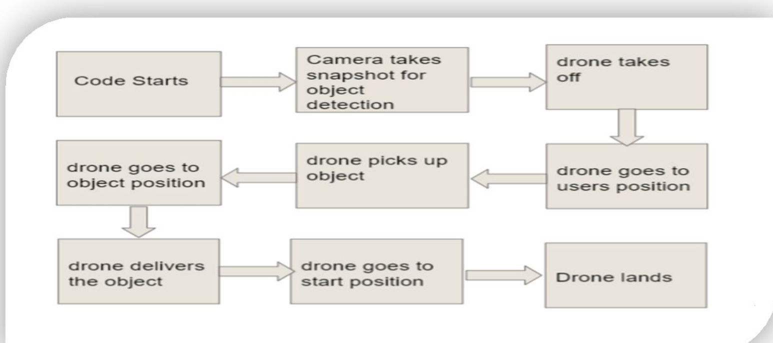


Fig. 1: Block Diagram of workflow

The proposed flow starts with the fish eye camera taking top view live footage of the area. One snapshot is taken for detecting the object and the another shot is taken for creating the coordinate map of the area for creating target coordinates and to give the negative distance to the drone to cover to reach its various target destinations. Once we have the target coordinates for the detected target object, they are fed to the ROS file containing the PID algorithm. The drone then starts its movement from 0,0,0 and reaches its target object. Once the target object is picked up by the drone (in this case using magnets) target coordinates for users position are fed to the ROS file. When the drone reaches the target user, the user would have to remove the object from the drone manually. When the user confirms the object has been removed, the drone returns back to its original position, lands and disarms.

B. Creating a Whycon Detector to Capture the Location of the Drone

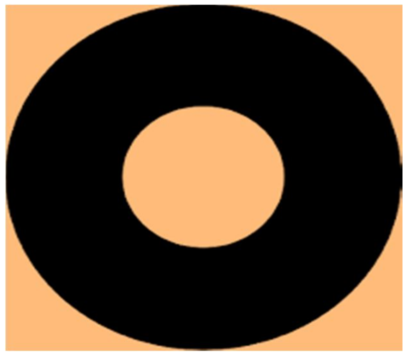
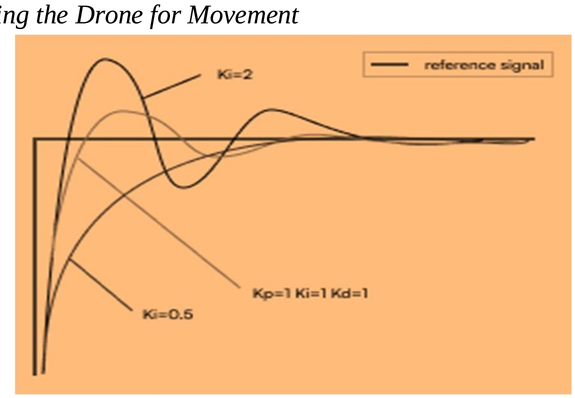


Fig. 2: Circular Whycon Marker

In the process of autonomously flying the drone[1] using its own coordinates and a set of target coordinates, the Whycon detection system uses the Whycon marker attached to the drone and the live camera feed to detect the drones coordinates with respect to the map of the room created by the algorithm[9]. With the drones coordinates, and target coordinates, the distance to be traveled in x, y and z directions can be calculated.

C. Writing a PID Algorithm and Tuning the Drone for Movement



Formula

$$v(t) = K_p e(t) + K_i \int e(t)\,dt + K_p \frac{de}{dt}$$

$v(t)$ = PID control variable

K_p = proportional gain

$e(t)$ = error value

K_i = integral gain

de = change in error value

dt = change in time

Fig. 3: PID algorithm and tuning

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IX Sep 2023- Available at www.ijraset.com

With the x and y distance calculated, the PID algorithm is used to feed the pitch, roll and throttle required to reach the destination. The pitch moves the drone in the y-axis, the roll moves the drone in the x-axis and the throttle moves the drone in the z-axis. The power should be maximum and the dampening minimum without causing turbulence to achieve maximum efficiency with which the drone travels to the destination coordinates. The integral value is determined by the offset of the drone with respect to its coordinates and adjusted accordingly to further refine the accuracy of the drone.

D. Fetching the Target Object Coordinates

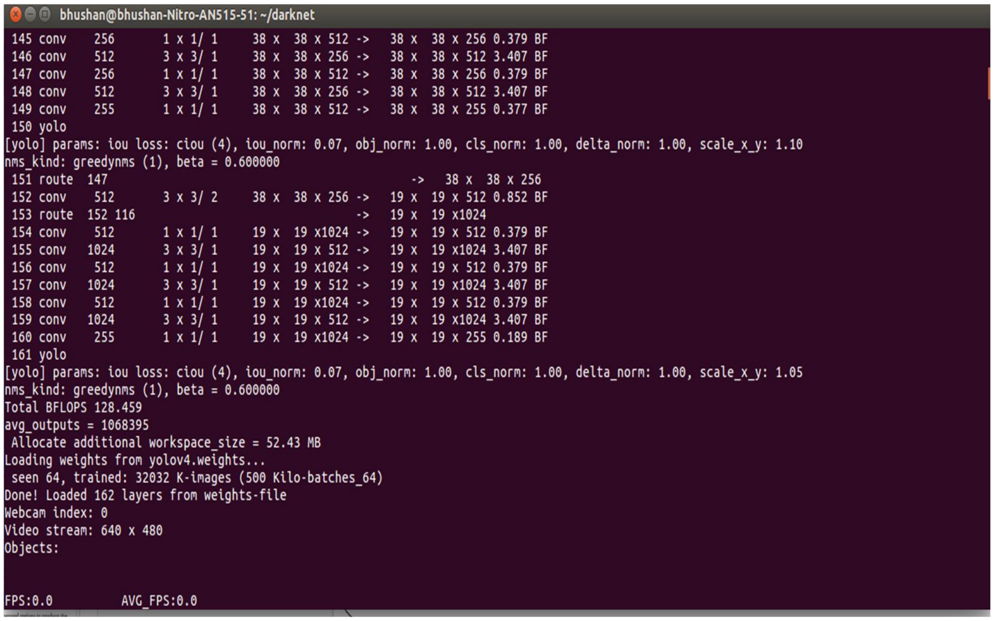


Fig. 4: Working of Darknet code

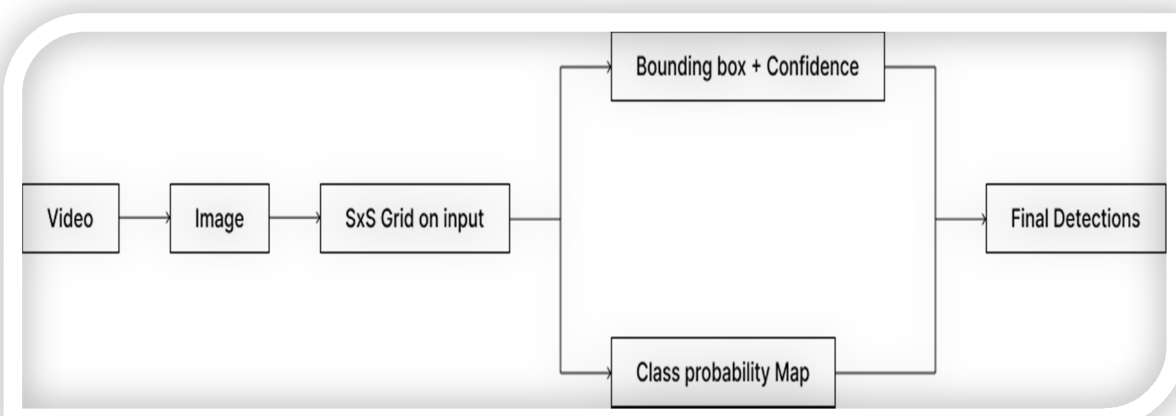


Fig. 5: Video data Processing stages

Using image captures from the live feed captured from the camera, the YOLO algorithm splits the image into a grid, creating m bounding boxes[10]. For each bounding box, the network outputs class probability and offset values. The target object is physically highlighted to further increase the accuracy of detection. The detected image is the run through the CPP algorithm used by the Whycon detector to fetch exact coordinates of the target object with respect to the coordinate map of the area.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IX Sep 2023- Available at www.ijraset.com

E. Delivering the Target Coordinates to the Drone

The result target coordinates are then set as the value for the variable “target_coordinates” used in the PID algorithm to provide real-time dynamic target coordinates to the algorithm.

F. Collecting the Object

Using two simple magnetic strips and a light object as the payload, The drone can attract the object and carry it as a payload. To increase the max weight of the target object increase the payload capacity of the drone (by adding more powerful motors and larger body for stability) and increase the strength of the magnets to support the weight of the object. In the current setting, a 10mg target object was used with the available hardware (drone)

G. Delivering the Target Object to the Target Destination.

Using the same object detection algorithm, the target destination is detected for the object to be delivered, which in this case was a person with a white cap on his head for easy recognition. The same algorithm is run again with different target coordinates. This step requires human intervention to remove the object from the drone.

H. Returning the Drone Back to its Original Position

The target coordinates are once again sent to the drone as 0,0,0 to return the drone to its original position.

III. RESULTS

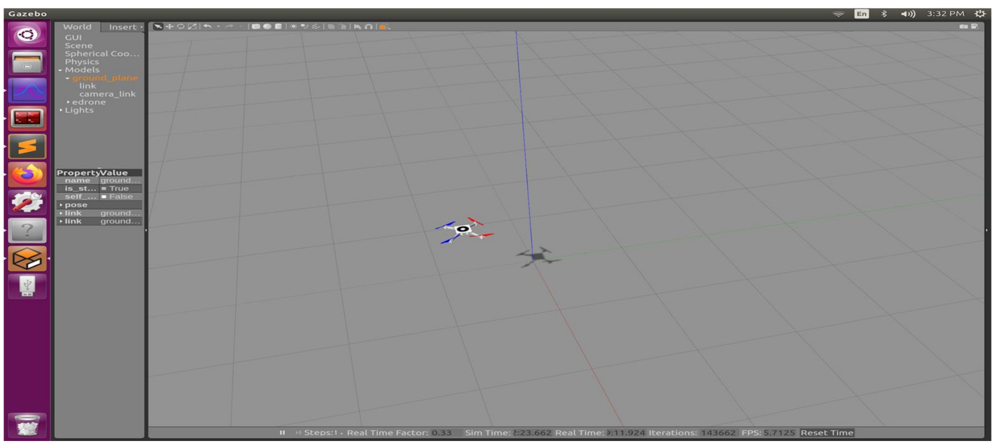


Fig. 7: Flight Simulation in Gazebo

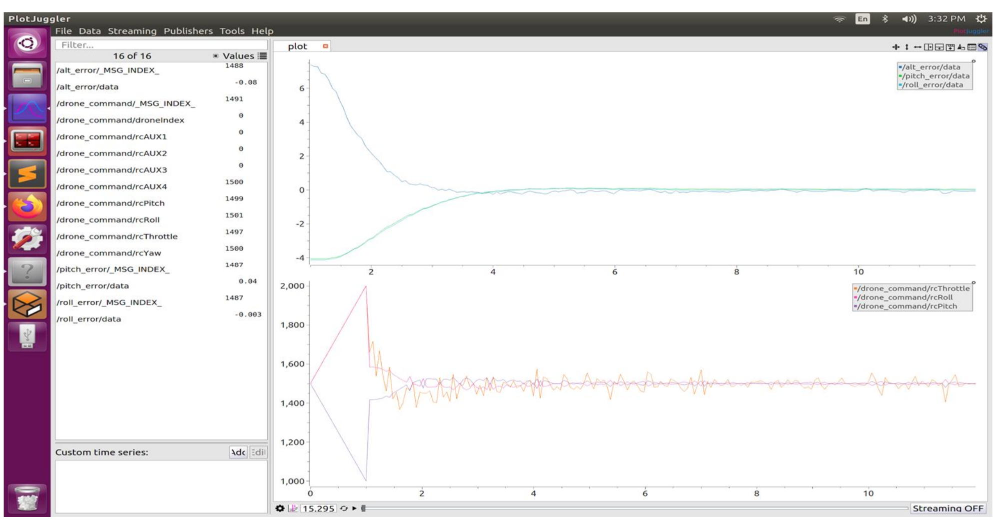


Fig. 8: PID Results of flight on PlotJuggler

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IX Sep 2023- Available at www.ijraset.com

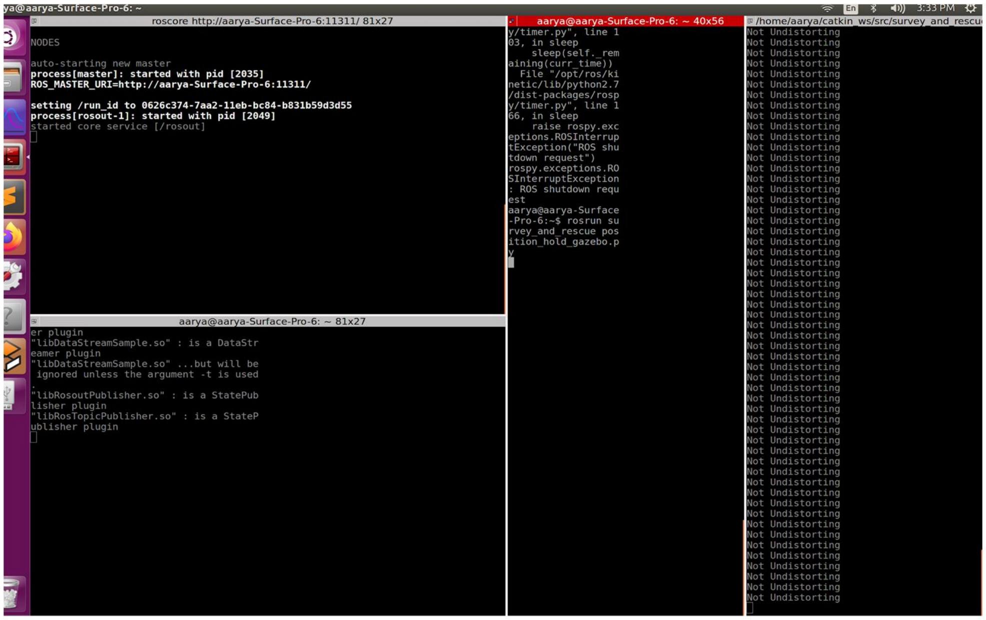


Fig. 9: Flight and Object detection script working

Simulation tests were conducted using Gazebo Simulation Software. The simulation settings provided an environment to conduct PID tuning and testing autonomous flight using dynamic target coordinates. The total displacement of the drone for each mission (flying to the target object, delivering the target object and returning to its original position) was 10.6m with total time spent being 8.34 seconds in flight time. Since the time to remove the object from the drone requires human intervention, the time required for that process was excluded from calculations.

IV. CONCLUSION

This project uses a combination of ROS and PID algorithm, Object Detection using Darknet, OpenCV and YOLO algorithms; to give a final product that is capable of:

1) Detect the object in a room and send the coordinates forward to the ROS of the drone
2) The drone further decides a path to traverse and executes the movement using specified PID algorithm
3) A further elongation of this project is to use magnets to attach target objects to the drone for delivery to target recipients.

The concepts in this project can be applied to generic smart homes, medical centers for bedridden patients, construction, warehouse management, etc. Depending on the application, the payload changes, thus the hardware requirements like the drone, quantity and quality of the camera and the system running the software would need to change.

V. ACKNOWLEDGEMENT

I would express my gratitude towards my mentor, Dr. R. C. Jaiswal for being of great support and guiding me through the research. His aid in algorithm design, calculations and presenting the paper were invaluable. His advice, professional acumen, and encouragement proved to be valuable guidance.

REFERENCES

[1] Sonar-Based Autonomous Navigation and Mapping of Indoor Environments Using Micro-Aerial Vehicles, https://scholarworks.rit.edu/cgi/
[2] Accurate indoor mapping using an autonomous unmanned aerial vehicle (UAV), https://arxiv.org/ftp/arxiv/papers/1808/1808.01940.pdf
[3] Autonomous Drone Using RPi, https://www.instructables.com/id/Autonomous-Drone-Using-RPi/
[4] Madawala Gama, S. Low Cost Aerial Mapping with Consumer Grade Drones. 37th Asian Conference on Remote Sensing,2016.
[5] Rudol, P. D. A UAV search and rescue scenario with human body detection and geolocalization. Advances in Artificial Intelligence, pp. 1-13,2007.
[6] I. Sa, S. H. Outdoor flight testing of a pole inspection UAV incorporating high speed vision. Springer Tracts in Advanced Robotics, pp. 107-121,2015.
[7] Forster,C, M. F. Continuous on-board monocular-vision-based elevation mapping applied to autonomous landing of micro aerial vehicles. Proc. IEEE International Conference on Robotics and Automation (ICRA),pp 111-118, 2015
[8] Saripalli, S. M. Vision-based autonomous landing of an unmanned aerial vehicle. Robotics and automation,Proceedings. ICRA'02. IEEE international conference on (Vol. 3, pp. 2799-2804). IEEE,2002

[9] Warehouse inventory management through autonomous drones using Whycon Marker Localisation System, International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE) Vol 8, Issue 8, August 2021

[10] Diwan, T., Anirudh, G. & Tembhurne, J.V. Object detection using YOLO: challenges, architectural successors, datasets and applications. Multimed Tools Appl 82, 9243–9275 (2023). https://doi.org/10.1007/s11042-022-13644-y

[11] Aarti Jagtap, R. C. Jaiswal, "A Review on the Prospects Engineering Management", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Mendeley : reference manager, Cite-Factor, Index Copernicus, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.538, Volume 11, Issue IX, pp. 218-223, September 2023, DOI: https://doi.org/10.22214/ijraset.2023.55635.

[12] Manasi Thonte, Jaiswal R.C., "Technical review on Synthetic Data Generation", International Journal "Gradiva Review Journal" (GRJ), UGC Care group-II journal, Open Access, Peer Reviewed, refereed and multidisciplinary Journal, Google Scholar, Scribd, ResearchGate, Scopus indexed, ISSN: 0363-8057; SJR Impact Factor:0.101, Volume 9, Issue VII, pp. 100-109, July 2023.

[13] Jaiswal R.C. and Dhas Himanshu, " A Technical Paper on Stock Prediction Using Machine Learning Algorithms", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Mendeley : reference manager, Cite-Factor, Index Copernicus, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.538, Volume 11, Issue V, pp. 5200-5208, May 2023.

[14] Jaiswal R.C. and Dhas Himanshu, " Survey Paper on Stock Prediction Using Machine Learning Algorithms", International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Mendeley Advisor Community, ISSN: 2582-5208; Impact Factor:7.868, Volume 05 Issue IV, pp. 2744-2749, April 2023.

[15] Jaiswal R.C. and Pranjali Desai, "Network Based Intrusion Detection System", International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Mendeley Advisor Community, ISSN: 2582-5208; Impact Factor:7.868, Volume 05 Issue III, pp. 3851-3857, March 2023.

[16] Jaiswal R.C. and Samiksha Baral, " Design & Development of Smart Electric Vehicle Safety Device by using IoT and AI", 2022 Fourth International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT), 26-27 December-2022, 15 March 2023 Published, DOI: 10.1109/ICERECT56837.2022.10059784,INSPEC Accession Number: 22810474.

[17] Jaiswal R.C. and Minal Tayde, " Face, Expression and Gesture Recognition & Compilation in Database", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Microsoft Academic, CiteSeerX, Publons Indexed, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue XII, pp. d714-d724, December 2022.

[18] Jaiswal R.C. and Shahul Patil, "Small Businesses Need Project Management", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.538, Volume 10, Issue XII, pp. 1532-1536, December 2022.

[19] Jaiswal R.C. and Prasad Malwadkar, " Smart Wellness Program", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Microsoft Academic, CiteSeerX, Publons Indexed, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue XII, pp. a22-a29, December 2022.

[20] Jaiswal R.C. and Nitin Dhevar, "Smart Home Surveillance System", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Microsoft Academic, CiteSeerX, Publons Indexed, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue XI, pp. d461-d468, November 2022.

[21] Jaiswal R.C. and Zeel Patel, " A Survey Paper on Big Data Analytics in Sales and Marketing", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Microsoft Academic, CiteSeerX, Publons Indexed, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue XI, pp. c420-c428, November 2022.

[22] Jaiswal R.C. and Niraj Sonje, " Deep Learning for Art Characterization ", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Microsoft Academic, CiteSeerX, Publons Indexed, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue XI, pp. a687-a694, November 2022.

[23] Jaiswal R.C. and Shivani Pande, " Microservices in Cloud Native Development of Application", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue X, pp. d170-d183, October 2022.

[24] Jaiswal R. C. and Chaitanya Srushti, " Helmet Detection Using Machine Learning", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 10 pp. d10-d17, October 2022.

[25] Jaiswal R. C. and Manasi Satpute, "Machine Learning Based Car Damage Identification", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 10 pp. b684-b690, October 2022.

[26] Jaiswal R.C. and Aryan Bagade, " Metaverse Simulation Based on VR, Blockchain, and Reinforcement Learning Model", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.538, Volume 10 Issue X, pp. 67-75, October 2022.

[27] Jaiswal R. C. and Atharva Agashe, " A Survey Paper on Cloud Computing and Migration to the Cloud", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 10 pp. a258-a265, October 2022.

[28] Jaiswal R. C. and Taher Saraf, " Stock Price Prediction using Machine Learning", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 9 pp. e33-e41, September 2022.

[29] Jaiswal R. C. and Ritik Manghani, "Pneumonia Detection using X-rays Image Preprocessing", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 9 pp. c653-c662, September 2022.

[30] Jaiswal R. C. and Apoorva Ushire, " Real Time Water Monitoring System Using NodeMCU ESMP8266 ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 9 pp. c1-c8, September 2022.

[31] Jaiswal R. C. and Firoz Saherawala, " Smart Glasses ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 8 pp. f393-f401, August 2022.

[32] Jaiswal R. C. and Asawari Walkade, " Denial of Service Detection and Mitigation ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. f108-f116, May 2022.

[33] Jaiswal R. C. and Fiza Shaikh, " Augmented Reality based Car Manual System ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. c326-c332, May 2022.

[34] Jaiswal R. C. and Tejveer Pratap, " Multiparametric Monitoring of Vital Signs in Clinical and Home Settings for Patients ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 5 pp. a701-a705, May 2022.

[35] Jaiswal R. C. and Sahil Nahar, "Recognition and Selection of Learning Styles to Personalize Courses for Students", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 9, Issue 2 pp. b235-b252, February 2022.

[36] Jaiswal R. C. and Rushikesh Karwankar, " Demand Forecasting for Inventory Optimization ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 12 pp. 121-131, January 2022.

[37] Jaiswal R. C. and P. Khore, " Exo-skeleton Arm ", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, Indexed In Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley : reference manager, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 12 pp. 731-734, December 2021.

[38] Jaiswal R. C. and Shreyas Nazare, " IoT Based Home Automation System", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 11 pp. 151-153, November 2021.

[39] Jaiswal R. C. and Prajwal Pitlehra, "Credit Analysis Using K-Nearest Neighbours' Model", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 5, pp. 504-511, May 2021.

[40] Jaiswal R. C. and Rohit Barve, "Energy Harvesting System Using Dynamo", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:7.95, Volume 8, Issue 5, pp. 278-280, May 2021.

[41] Jaiswal R. C. and Sharvari Doifode, "Virtual Assistant", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 10, pp. 3527-3532, October 2020.

[42] Jaiswal R. C. and Akshat Kaushik, "Automated Attendance Monitoring system using discriminative Local Binary Histograms and PostgreSQL", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 11, pp. 80-86, November 2020.

[43] Jaiswal R. C. and Danish khan, "Arduino based Weather Monitoring and Forecasting System using SARIMA Time-Series Forecasting", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 11, pp. 1149-1154, November 2020.

[44] Jaiswal R.C. and Param Jain, "Augmented Reality based Attendee Interaction at Events", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.429, Volume 8 Issue VI, pp. 1578-1582, June 2020.

[45] Jaiswal R.C. and Akash Pal, "Cosmetics Application Using Computer Vision", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 6, pp. 824-829, June 2020.

[46] Jaiswal R.C. and Jaydeep Bhoite, "Home Renovation Using Augmented Reality", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Impact Factor:5.87, Volume 7, Issue 6, pp. 682-686, June 2020.

[47] Jaiswal R.C. and Aashay Pawar, "Stock Market Study Using Supervised Machine Learning", International Journal of Innovative Science and Research Technology (IJISRT), Open Access, Peer Reviewed and refereed Journal , ISSN: 2456-2165; IC Value: 45.98; SJ Impact Factor:6.253, Volume 5 Issue I, pp. 190-193, Jan 2020.

[48] Jaiswal R.C. and Deepali Kasture, "Pillars of Object-Oriented System", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal , ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 589-591, Nov 2019.

[49] Jaiswal R.C. and Yash Govilkar, "A Gesture Based Home Automation System", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 501-503, Nov 2019.

[50] Jaiswal R.C. and Onkar Gagare, "Head Mounted Display", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 535-541, Nov 2019.

[51] Jaiswal R.C. and Nehal Borole, "Autonomous Vehicle Prototype Development and Navigation using ROS", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal, ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.177, Volume 7 Issue XI, pp. 510-514, Nov 2019.

[52] Jaiswal R.C. and Vaibhav Pawar, "Voice and Android Application Controlled Wheelchair", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Volume 6, Issue 6, pp. 635-637, June 2019.

[53] Jaiswal R.C. and Shreya Mondhe, " Waste Segregation & Tracking", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Open Access, Peer Reviewed and refereed Journal , ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:7.429, Volume 8, Issue 5, pp. 2085-2087, May 2019.

[54] Jaiswal R.C. and Shreya Mondhe, "Stock Market Prediction Using Machine Learning & Robotic Process Automation", Journal of Emerging Technologies and Innovative Research (JETIR), Open Access, Peer Reviewed and refereed Journal, ISSN-2349-5162, Volume 6, Issue 6, pp. 926-929, February 2019.

[55] Jaiswal R.C. and Samruddhi Sonare, "Smart Supervision Security System Using Raspberry Pi ", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162, Volume 6, Issue 4, pp. 574-579, April 2019.

[56] Jaiswal R.C. and Manasi Jagtap, "Automatic Car Fragrance Dispensing System", International Journal of Research and Analytical Reviews (IJRAR), ISSN-2349-5138, Volume 6, Issue 1, pp. 315-319, March 2019.

[57] Jaiswal R.C. and Sumukh Ballal, "Scalable Healthcare Sensor Network", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162, Volume 6, Issue 2, pp. 350-354, February 2019.

[58] Jaiswal R.C. and Samruddhi Sonare, "Multiple Camera Based Surveillance System Using Raspberry Pi", International Journal of Research and Analytical Reviews (IJRAR), ISSN-2348-1269, Volume 6, Issue 1, pp. 1635-1637, February 2019.

[59] Jaiswal R.C. and Reha Musale, "Application of Digital Signature to Achieve Secure Transmission", International Journal for Research in Applied Science & Engineering Technology (IJRASET),ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887, Volume 7 Issue II, pp. 150-153, February 2019.

[60] Jaiswal R.C. and Himanshu Mithawala, "Automatic Gate Monitoring System", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162, Volume 6, Issue 1,pp. 88-94, January 2019.

[61] Jaiswal R.C. and Bernard Lewis, "Dynamic Runway and Gate Terminal Allocation for Flights", Journal of Emerging Technologies and Innovative Research (JETIR), UGC approved Journal, ISSN-2349-5162, Volume 5, Issue 12, December 2018.

[62] Jaiswal R.C. and Sakshi Jain, "Text Search Engine",', Journal of Emerging Technologies and Innovative Research (JETIR), UGC approved Journal ISSN-2349-5162, Volume 5, Issue 11, November 2018.

[63] Jaiswal R.C. and Arti Gurap, "Design of Different Configurations of Truncated Rectangular Microstrip Patch Antenna For 2.4 GHz And 1.6 GHz ', Journal of Emerging Technologies and Innovative Research (JETIR),UGC Approved Journal, ISSN-2349-5162, Volume 5, Issue 10, October 2018.

[64] Jaiswal R.C. and Atharva Mahindrakar, " Mine Warfare and Surveillance Rover", International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887, Volume 6 Issue III, March 2018.

[65] Jaiswal R.C. and Saloni Takawale "Multi-Client Server Communication Enhancement through Intranet", International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653; UGC approved Journal, IC Value: 45.98; SJ Impact Factor :6.887, Volume 6 Issue 1, January 2018.

[66] Jaiswal R.C. and Nikita Kakade, "Skin disease detection and classification using Image Processing Techniques", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162; UGC approved Journal:5.87, Volume 4, Issue 12, December 2017.

[67] Jaiswal R.C. and Nikita Kakade, "OMR Sheet Evaluation Using Image Processing", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN-2349-5162; UGC approved Journal:5.87, Volume 4, Issue 12, December 2017.

[68] Jaiswal R.C. and Swapnil Shah, "Customer Decision Support System", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056; p-ISSN: 2395-0072; UGC approved Journal, SJ Impact Factor:5.181, Volume: 04 Issue: 10 | Oct -2017.

[69] Jaiswal R.C. and Ketan Deshpande, "IOT Based Smart City: Weather, Traffic and Pollution Monitoring System", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056; p-ISSN: 2395-0072; UGC approved Journal, SJ Impact Factor:5.181, Volume: 04 Issue: 10 | Oct -2017.

[70] Jaiswal R.C. and Vipul Phulphagar, "Arduino Controlled Weight Monitoring With Dashboard Analysis", International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653; UGC approved Journal, IC Value: 45.98; SJ Impact Factor:6.887, Volume 5 Issue XI November 2017.

[71] Jaiswal R.C. and Siddhant Sribhashyam, "Comparison of Routing Algorithms using Riverbed Modeler", International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), ISSN: (Online) 2278-1021; online) 2278-1021 ISSN (Print) 2319 5940; UGC approved Journal, Impact Factor 5.947Vol. 6, Issue 6, June 2017.

[72] Sameer Shukla, "Developing Pragmatic Data Pipelines using Apache Airflow on Google Cloud Platform", International Journal of Computer Sciences and Engineering (IJCSEOnline), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Cite-Factor, Research Gate, Academia, DPI Digital Library, ISSN: 2347-2693; SJ Impact Factor:3.802, Volume 10, Issue 8, pp. 1-8, Aug 2022, DOI: https://doi.org/10.26438/ijcse/v10i8.18

[73] Sameer Shukla., "Real-time Monitoring and Predictive Analytics in Healthcare: Harnessing the Power of Data Streaming", International Journal of Computer Applications (IJCA), Open Access, Peer Reviewed and refereed Journal, indexed in Google Scholar, Cross-Ref, ISSN: 0975–8887; Impact Factor:0.868, Volume 185 Issue 8, pp. 32-37,May 2023, DOI: http://dx.doi.org/10.5120/ijca2023922738

[74] Sameer Shukla, "Unlocking the Power of Data: An Introduction to Data Analysis in Healthcare", International Journal of Computer Sciences and Engineering (IJCSEOnline), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Cite-Factor, Research Gate, Academia, DPI Digital Library, ISSN: 2347-2693; SJ Impact Factor:3.802, Volume 11, Issue 3, pp. 1-9, Mar 2023, DOI: https://doi.org/10.26438/ijcse/v11i3.19

[75] Sameer Shukla, "Streamlining Integration Testing with Test Containers: Addressing Limitations and Best Practices for Implementation", International Journal of Latest Engineering and Management Research (IJLEMR), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open J-Gate, Cite-Factor, Research Gate, Ulrich web, Cabell's Directory, ISSN: 2455-4847; SJ Impact Factor:3.460, Volume 08, Issue 3, pp. 19-26, Mar 2023, DOI: https://doi.org/10.56581/IJLEMR.8.3.19-26

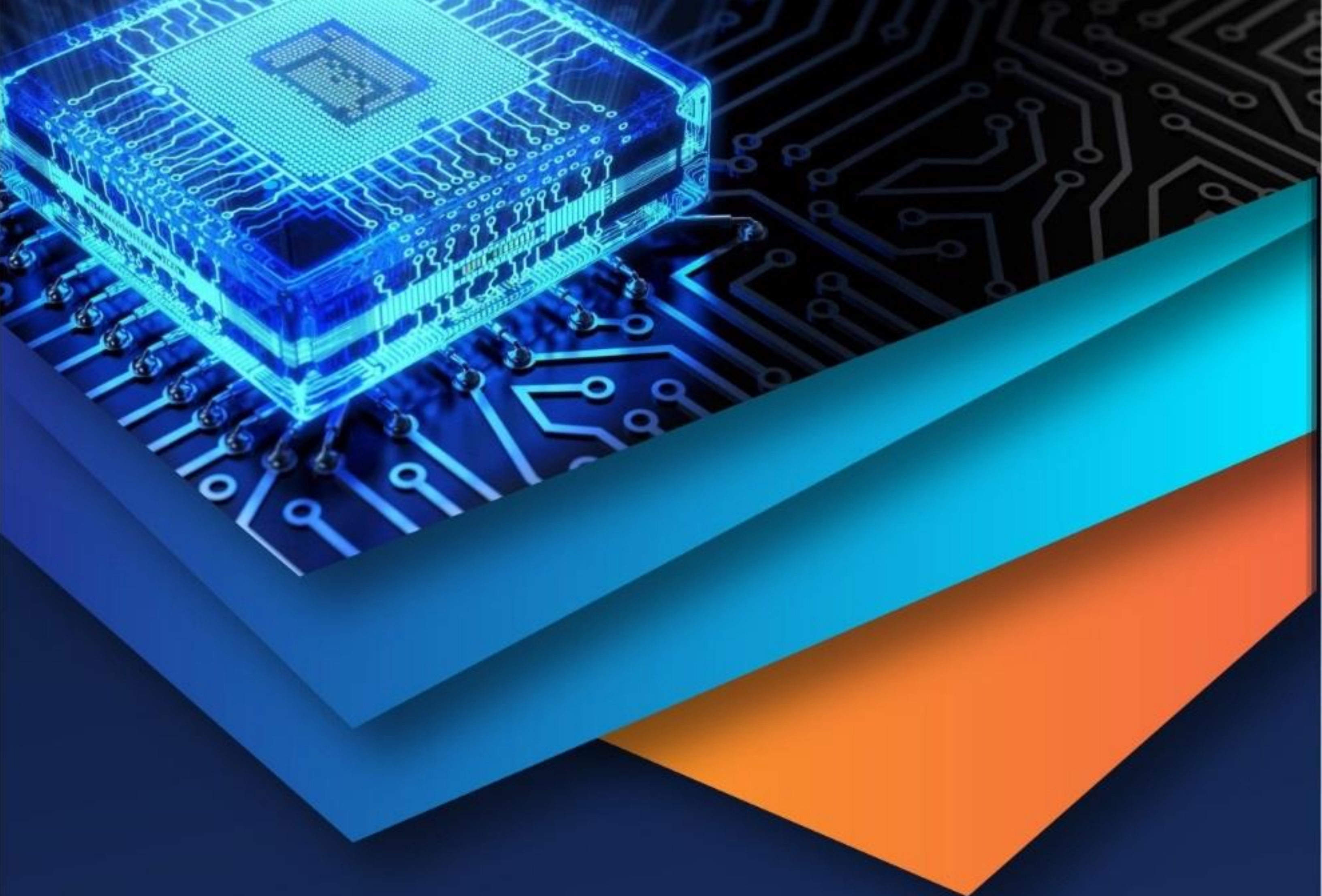
[76] Sameer Shukla, "Data Visualization with Python Pragmatic Eyes", International Journal of Computer Trends and Technology (IJCTT), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open Access, Cite-Factor, Research Gate, Ulrich web, Cabell's Directory, ISSN: 2231-2803; SJ Impact Factor:7.460, Volume 67, Issue 2, pp. 12-16, Feb 2019, DOI: https://doi.org/10.14445/22312803/IJCTT-V67I2P103

[77] Sameer Shukla, "Examining Cassandra Constraints: Pragmatic Eyes", International Journal of Management, IT & Engineering (IJMIE), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open Access, Cite-Factor, Research Gate, Open J-Gate, Cabell's Directory, ISSN: 2249-0558; SJ Impact Factor:7.119, Volume 9, Issue 3, pp. 267-287, Mar 2019

[78] Sameer Shukla, "DEBUGGING MICROSERVICES WITH PYTHON", The IIOABJ Journal, Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open J-Gate, Cite-Factor, Research Gate, Ulrich web, Cabell's Directory, ISSN: 0976-3104; SJ Impact Factor:3.460, Volume 10, Issue 2, pp. 32-37, 2019

[79] Sameer Shukla, "Exploring the Power of Apache Kafka: A Comprehensive Study of Use Cases suggest topics to cover", International Journal of Latest Engineering and Management Research (IJLEMR), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open J-Gate, Cite-Factor, Research Gate, Ulrich web, Cabell's Directory, ISSN: 2455-4847; SJ Impact Factor:3.460, Volume 08, Issue 3, pp. 71-78, Mar 2023, DOI: https://doi.org/10.56581/IJLEMR.8.3.71-78

[80] Sameer Shukla, "Enhancing Healthcare Insights, Exploring Diverse Use-Cases with K-means Clustering", International Journal of Management, IT & Engineering (IJMIE), Open Access, Peer Reviewed and refereed Journal, Google Scholar, Scribd, Open Access, Cite-Factor, Research Gate, Open J-Gate, Cabell's Directory, ISSN: 2249-0558; SJ Impact Factor:7.119, Volume 13, Issue 8, pp. 60-68, August 2023



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY