iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** VI **Month of publication:** June 2023

DOI: https://doi.org/10.22214/ijraset.2023.53663

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

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 VI Jun 2023- Available at www.ijraset.com

Online Waste Management System

Kishore Babu[1], Suraj[2], Maskinder Singh[3], Prof. Sreedevi[4]
Department of Computer Science and Engineering, Adi Shankara Institute of Engineering and Technolog, Kalady, Kerala

Abstract: An online waste management system is a web-based platform designed to help manage waste collection, disposal, and recycling processes. This type of system can offer many benefits, including increased efficiency, reduced costs, and improved environmental sustainability. The system typically includes features such as scheduling waste pickups, tracking waste generation, monitoring waste disposal methods, and generating reports on waste management activities. This abstract provides an overview of online waste management systems, discussing their key features and benefits. It also explores the challenges associated with implementing such systems and suggests some best practices for achieving optimal outcomes. Overall, an online waste management system can help organizations reduce their environmental impact while improving their waste management processes.It Focuses on engaging customers and volunteers is a web-based platform designed to involve and motivate individuals to participate in waste management activities. This type of system can offer many benefits, including increased community engagement, improved recycling rates, and reduced waste generation.
Keywords: Sustainability, Scheduling

I. INTRODUCTION

Waste management is an increasingly critical aspect of environmental sustainability, with the proper management and disposal of waste being vital to preserving our planet's health. The amount of waste generated is continually increasing, making it more challenging to manage and dispose of waste effectively.

As such, there is a growing need for innovative waste management solutions that can help reduce waste generation, promote recycling, and encourage sustainable practices.

This project aims to design and develop an online waste management system that provides an innovative and convenient approach to waste management. The system aims to promote community involvement, encourage proper waste segregation, and improve recycling rates. The system will feature several essential functions, such as scheduling waste pickups, waste classification, educational resources, waste reduction challenges, volunteer opportunities, and interactive tools for tracking waste reduction progress.

The primary objective of this project is to create an online waste management system that is user-friendly, accessible, and effective in promoting sustainable waste management practices.

The system will be designed to engage and empower users to adopt more environmentally conscious behaviors, such as waste reduction, proper disposal, and recycling.

Overall, the development of an online waste management system is an important step towards promoting sustainable waste management practices and preserving our planet's health. The system aims to provide an innovative and convenient approach to waste management that is accessible to everyone and promotes community involvement. It is hoped that this project will contribute to the global effort towards creating a cleaner and more sustainable future for generations to come. It also includes a waste classification feature that is critical in promoting proper waste management practices. The waste classification feature enables users to classify waste into different categories, such as hazardous, electronic, organic, and recyclable. This feature aims to help users understand the proper disposal methods for each waste type and improve waste segregation efforts.

The system includes a comprehensive waste classification database that provides information on various types of waste and their appropriate disposal methods. Users can access this database through the system's user interface and use it to classify their waste accurately.

The waste classification feature is essential in promoting sustainable waste management practices and reducing the environmental impact of waste.

By helping users identify the correct disposal methods for each waste type, the system can help reduce the amount of waste sent to landfills and improve recycling rates. Additionally, the waste classification feature can also help organizations comply with environmental regulations and reduce the risk of environmental hazards associated with improper waste disposal.

II. RELATED WORKS

A New Smart Waste Managing System [1] H. Jabar, R. Hassan and A. S. Sadeq, in their research paper discussed The continuous growth of the generated volumes of waste and garbage grasps the attention of researchers and experts in various fields. The collection and management process of this massive and distributed amount of waste presents a challenge, as it needs to be collected and processed as fast as possible. The accumulated amounts of waste can be a fundamental source for emitting poisonous gases and producing toxic material to the soil which leads to deadly consequences for the environment and causes serious health issues for humans so it is critical to collect it as fast as possible. To handle this scenario, this study proposed an online waste management system to monitor the status of generated trash all-around smart cities then distribute and schedule available garbage trucks accordingly. The proposed solution provides a web-based system and a mobile application to manage the organization of these wastes and facilitate the garbage collection by the drivers. The proposed solution provides an 80% faster convergence system in comparison with traditional garbage collecting method. The mobile application makes the waste pick up easier for the drivers and enable them to use better roads. Therefore, garbage collection costs and efforts have been saved, while less consumed energy is required

Garbage management system [2] by R. Geethamani, P. Rakshana, P. Raveena and R. Ragavi explains the tremendous rise in population, an enormous number of wastes is getting piled up at different places. Overflow of trash in public places leads to an unhealthy society. This unhygienic environment creates a path for the easy spread of diseases to nearby people. It also deteriorates the beauty of nature. Thus Cleanliness becomes the need of the hour. Proper Waste Management has to be created for obtaining dirt and germ-free society. We need to apply some technology-based solution to resolve the wastes which are increasing day by day. This paper proposes a web-based, cost-effective garbage management system. With the introduction of this paper, we can reduce human effort and save time. We can also use the available resources efficiently. In this paper, the garbage management system is achieved by creating a webpage. In this one can log in as 5 kinds of users (admin, driver, people, buyer, distributor). Here the administrator has overall control of activities. The web app primarily aims at connecting people to the workforce. It also provides the best routes for garbage collectors, distributors, and stores the data in the database for future reference. Here a buyer can easily purchase the waste required for them.

Smart Waste Collection Monitoring and Alert System via IoT, by Z. Hisham Che Soh, M. Azeer Al-Hami Husa, S. Afzal Che Abdullah and M. Affandi Shafie, [3] The uncollected waste material when the waste bin is full is a common problem nowadays. Thus, an efficient waste management for the waste material is essential in ensuring a clean and green surrounding environment. This paper presents an Internet of Things (IoT) based Smart Waste Collection Monitoring and Alert System to monitor the waste material at the selected site of garbage collection area. The system is implemented using an ultrasonic sensor which is connected to Arduino UNO as to monitor waste bin garbage level. In this system, waste bin depth level will be sent via Arduino Ethernet Shield with an Internet connection to the Ubidots IoT Cloud. The Ubidots store the collected waste bin level data into the IoT database and display the waste bin depth level on an online dashboard for real-time visualization. The Ubidots Event manager invokes a notification alert to garbage collector mobile phone via a SMS when the waste bin is nearly filled for immediate waste collection. Therefore, the waste collection became more effective and systematic.

A CNN-Based Smart Waste Management System Using TensorFlow Lite and LoRa-GPS Shield in Internet of Things Environment proposed by MOHAMMAD TARIQUL ISLAM [4], Urban areas are facing challenges in waste management systems due to the rapid growth of population in cities, causing huge amount of waste generation. As the traditional waste management system is highly inefficient and costly, the waste of resources can be utilized efficiently with the integration of the internet of things (IoT) and deep learning model. The main purpose of this research is to develop a smart waste management system using the deep learning model that improves the waste segregation process and enables monitoring of bin status in an IoT environment. The SSD MobileNetV2 Quantized is used and trained with the dataset that consists of paper, cardboard, glass, metal, and plastic for waste classification and categorization. By integrating the trained model on TensorFlow Lite and Raspberry Pi 4, the camera module detects the waste and the servo motor, connected to a plastic board, categorizes the waste into the respective waste compartment. The ultrasonic sensor monitors the waste fill percentage, and a GPS module obtains the real-time latitude and longitude. The LoRa module on the smart bin sends the status of the bin to the LoRa receiver at 915 MHz. The electronic components of the smart bin are protected with RFID based locker, where only the registered RFID tag can be used to unlock for maintenance or upgrading purposes

Waste Classification and Segregation: Machine Learning and IOT Approach proposed by M. G. C. P, S. Yadav, A. Shanmugam, H. V and N. Suresh, [5]. proposed a fully automated waste management system to implement waste segregation. The method adopted is computer vision and deep learning paired with an internet of thing (IOT) system that is capable of segregating municipal waste into Organic and Recyclable waste. Eliminating manual segregation in the process of waste management significantly reduces the

risk to the health of municipal workers by preventing the contraction as well as the spread of transmissible diseases. Automation will also increase the speed while significantly reducing the cost of the waste segregation process. This study was conducted in order to ideate and bring to life innovative and sustainable ideas for effective waste management systems with little to no human intervention.

Intelligent garbage classification system based on deep learning put up by Q. Liao, [6] , This system uses the deep convolution neural network model to classify the garbage. In this paper, we performed the data set acquisition, data preprocessing, convolution neural network structure design, super parameter selection and training model to get the training results. We connected a whole set of program sub modules to complete the deep learning part of the garbage classification program and to realize the target function..

Smart Waste Management and Classification System for Smart Cities using Deep Learning proposed by M. K. Hasan, M. A. Khan, G. F. Issa, A. Atta, A. S. Akram and M. Hassan, [7], For modern city environments to be renewable and clean, waste management and recycling are essential. Solid waste management, disposal, and recycling are issues in many Pakistani cities, particularly Karachi and Lahore. The combination of the IoTs and deep learning offers a modular technique to data categorization and real-time examining. This article illustrates a capable “Smart trash management and categorization system” based on the “internet of things (IoT)” and DL. The article provides an architectural idea for a microchips-based garbage bin that uses numerous measuring instruments to connect with the method to gather wastes as quickly as possible. The “Internet of Things (IoT)” is used in the suggested data monitoring solution to offer real-time data control. In addition, in this smart waste management and categorization scheme, a waste classification model based on convolutional neural networks was deployed. This waste classification technique will be used to sort rubbish into several categories at the waste-collecting plant to increase recycling. This proposed system offers complete trash management and recycling solution in smart cities, from waste collection to waste management and classification.

Garbage classification system based on artificial intelligence and Internet of Things proposed by X. Yi, Y. Liang and H. Peng [8], The existing garbage classification system has some problems such as poor classification effect, high classification cost and difficult management. In order to solve these problems, this paper proposes a garbage classification system that can manage multiple garbage cans simultaneously and classify them accurately in real time. The system deploys the improved MobileNet V2 network model on the low-cost K210 module, and adopts the method of first object recognition and then garbage classification to classify the garbage images read by the camera. At the same time, the system collects environmental information such as temperature and humidity, overflow situation, and air quality of the garbage cans through sensors, then summarizes the classification information and environmental information at the terminal, and finally uploads the aggregated information to the cloud through the NB module. After physical tests, the system can classify garbage with an accuracy rate of more than 90%, run at a maximum speed of 12 frames per second, and can monitor environmental information in real time, which has certain practical value.

Garbage Recognition and Classification System Based on Convolutional Neural Network VGG16 put up by H. Wang,, [9] , To study the application of deep learning in the field of environmental protection, the convolutional neural network VGG16 model is used to solve the problem of identification and classification of domestic garbage. This solution first used the OpenCV computer vision library to locate and select the identified objects and preprocessed the images into 224×224 pixel RGB images accepted by the VGG16 network. Then after data enhancement, a VGG16 convolutional neural network based on the TensorFlow framework is built, by using the RELU activation function and adding BN layer to accelerate the model's convergence speed, while ensuring recognition accuracy. This project finally classifies domestic garbage into recyclable garbage, hazardous garbage, kitchen waste and other garbage. After actual tests, the correct classification rate of the garbage classification system based on VGG16 network proposed in this paper is 81.1%, the result meets the needs of daily use.

Design and Development of Smart Waste Management System put up by Q. Liao, [10] , Waste management has now become a necessary practice in all countries around the world. India generates approximately 65 million tons of garbage every year. The main challenge is to manage this waste. Conventional systems are not efficient to manage this much amount of waste. IoT can play a dominant role in handling waste and making any country greener and more efficient. Time to Time disposal of waste is important and if ignored can be a health hazard. The current system for waste disposal in local areas for small and densely populated cities is inactive which causes garbage to spread all over the area. The rate of garbage generation is higher than garbage disposal. It is required to manage and dispose of the waste for a sustainable and clean country. This paper presents an IoT-enabled Waste management system for the collection of garbage. The system consists of smart garbage bins made using Ultrasonic sensors, NodeMCU, and a Global Positioning System (GPS) module. The ultrasonic sensor detects the level of garbage in the dustbin and notifies the garbage collection authorities when the dustbin is full.

The SMS and email notification are sent using If This Then That (IFTTT) and ThingSpeak the online digital automation platforms. A mobile application is created using the Massachusetts Institute of Technology (MIT) app inventor where the authorities can see

the status of the dustbin and an optimized shortest route to be followed by the garbage collector truck for garbage collection and disposal. The proposed system is economical, practical, easy to use, and requires minimal human interaction.

III. PROPOSED METHODOLOGY

The project will begin with a thorough requirement analysis phase, where all the necessary features and functionalities of the waste management system will be gathered. This will involve discussions with stakeholders and potential users to understand their needs and expectations. Once the requirements are clear, the system design phase will commence. A high-level architecture will be created, outlining the various components and modules of the system and how they interact with each other. Considerations will be made for scalability, maintainability, and extensibility of the system.

Next, the data modeling phase will take place, where the database schema will be designed. This will involve identifying the entities, attributes, and relationships between them. Django models will be created based on this schema to represent the data in the application. Concurrently, the user interface design phase will begin, where wireframes or mockups of the user interface for both customers and volunteers will be created. The goal is to design intuitive and user-friendly interfaces that enable easy navigation and interaction. With the preliminary work completed, the actual development phase will commence. The Django project will be set up, including the installation of necessary dependencies and configurations. The project structure will be created, the database will be configured, and static files and media storage will be set up. User registration and authentication functionality will be implemented using Django's built-in authentication system. This will allow users to sign up as either customers or volunteers and ensure a secure login process.

The system will allow customers to upload images of the areas to be cleaned using a file upload mechanism. Django's FileField or ImageField will be integrated to handle the file uploads. Server-side validation will be implemented to ensure the uploaded files meet the required criteria. A machine learning algorithm will be trained to analyze the uploaded images and detect the type of waste present. The trained model will be integrated into the Django project, enabling automatic waste type classification.

Volunteers will be able to view all the cleanup requests and their associated details. A view in Django will be created to fetch the waste detection results for each request and display them to the volunteers. Django's templating system will be utilized to render the results in a visually appealing and informative manner. A chat system will be implemented, allowing customers and volunteers to communicate in real-time.

Libraries such as Django Channels or Socket.IO will be used to handle the real-time messaging functionality. Each cleanup request will have its own chat room, facilitating secure communication.

Security will be a top priority throughout the development process. Proper authentication, authorization, and input validation techniques will be implemented to protect user data and prevent common web vulnerabilities. Thorough testing will be conducted to ensure all features work as expected. Unit tests will be written to verify the functionality of individual components, and integration and system testing will be performed to validate the entire system. Once testing is complete, the application will be deployed to a web server or a cloud hosting platform.

The server environment will be configured, and any necessary services, such as a database server, will be set up. User training will be provided to customers and volunteers to ensure they can effectively use the system. Feedback from users will be collected and incorporated into the system to make necessary improvements. Maintenance will be an ongoing process, including monitoring performance, addressing reported issues, applying security patches, and adding new features as required. Throughout the project, flexibility will be maintained to accommodate changes or refinements as needed. The methodology will be iterative, allowing for continuous improvement and adaptation based on the progress and feedback received.

IV. TECHNOLOGIES USED

A. Python-Django

First and foremost, the project will be developed using the Python programming language. Python provides a versatile and powerful environment for web development, making it a popular choice for building robust applications. It offers a wide range of libraries and frameworks that facilitate the development process. One of the essential technologies you will use is Django. Django is a high-level Python web framework that simplifies the development of complex web applications. It provides a set of tools, libraries, and conventions that help with tasks like URL routing, handling HTTP requests and responses, and interacting with databases. Django follows the Model-View-Controller (MVC) architectural pattern, which promotes separation of concerns and enhances code maintainability

B. HTML,CSS and Javascript

HTML and CSS are fundamental technologies for creating the user interface of your application. HTML (Hypertext Markup Language) is responsible for structuring the web pages, while CSS (Cascading Style Sheets) is used for styling and layout. These technologies allow you to design visually appealing and responsive user interfaces.

JavaScript is another key technology that will be used to enhance the user experience and add interactivity to your application. JavaScript is a client-side scripting language that enables dynamic behavior on web pages. With JavaScript, you can implement features such as real-time updates, form validation, and asynchronous data fetching.

C. Machine Learning

Machine learning libraries will play a crucial role in your waste management system project. Libraries such as TensorFlow, Keras, or OpenCV provide pre-built tools and models for machine learning and image processing tasks. These libraries will enable you to train and deploy a machine learning algorithm that analyzes the uploaded images and detects the type of waste present. This feature will automate the waste classification process and enhance the efficiency of your system.

For implementing the real-time chat system, you can utilize technologies like Django Channels or Socket.IO. Django Channels is a library that enables WebSocket support in Django, allowing bidirectional communication between the server and clients. Socket.IO is a JavaScript library that provides real-time communication capabilities for web applications. These technologies will enable customers and volunteers to communicate seamlessly within the application.

Database management is another critical aspect of your project. Django supports multiple databases, including PostgreSQL, MySQL, and SQLite.

You will need a database management system (DBMS) to store and manage the data related to customers, volunteers, cleanup requests, and chat messages.

D. SQLite

SQLite is well-suited for smaller-scale applications or projects where simplicity and portability are essential. It offers good performance and supports the SQL (Structured Query Language) standard, allowing you to interact with the database using standard SQL queries.

Django, being a versatile web framework, provides built-in support for multiple databases, including SQLite. You can configure your Django project to use SQLite as the backend database by specifying the necessary settings in the project's configuration file (settings.py).

Django's ORM (Object-Relational Mapping) allows you to define database models using Python classes and seamlessly interact with the SQLite database.

With SQLite, you can store and retrieve various data related to your waste management system, such as customer and volunteer details, cleanup requests, waste detection results, and chat messages.

SQLite provides robust data integrity and concurrency control mechanisms, ensuring that your data remains consistent and safe during concurrent access.

While SQLite is a suitable choice for smaller projects, it may have limitations in terms of scalability and concurrent user access compared to more robust database systems like PostgreSQL or MySQL. If your project grows in size or requires extensive concurrent access, you may consider migrating to a different database system that better suits your needs.

E. Heroku (Deployment)

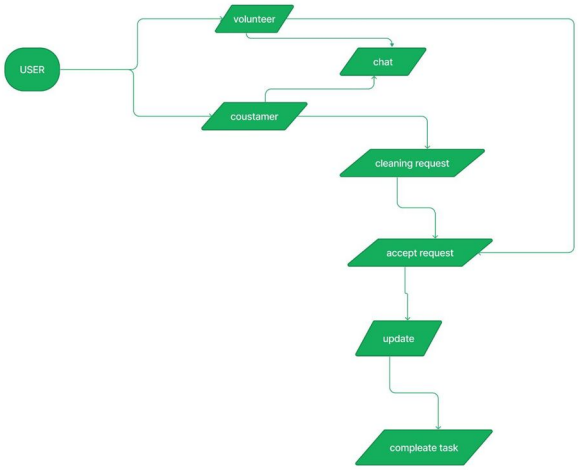
When it comes to deployment, you can consider various platforms. Heroku, AWS (Amazon Web Services), and DigitalOcean are popular choices for hosting Django applications. These platforms offer easy deployment processes, scalability, and additional services that can enhance the performance and availability of your application.

Ensuring the security of your waste management system is crucial. You can utilize SSL certificates for secure communication over HTTPS, implement proper user authentication and authorization mechanisms, and follow security best practices. Additionally, there are security plugins and libraries available for Django that can help protect against common web vulnerabilities.

Employing version control, such as Git, is highly recommended. Version control systems allow you to track changes, collaborate with team members, and manage different versions of your codebase effectively.

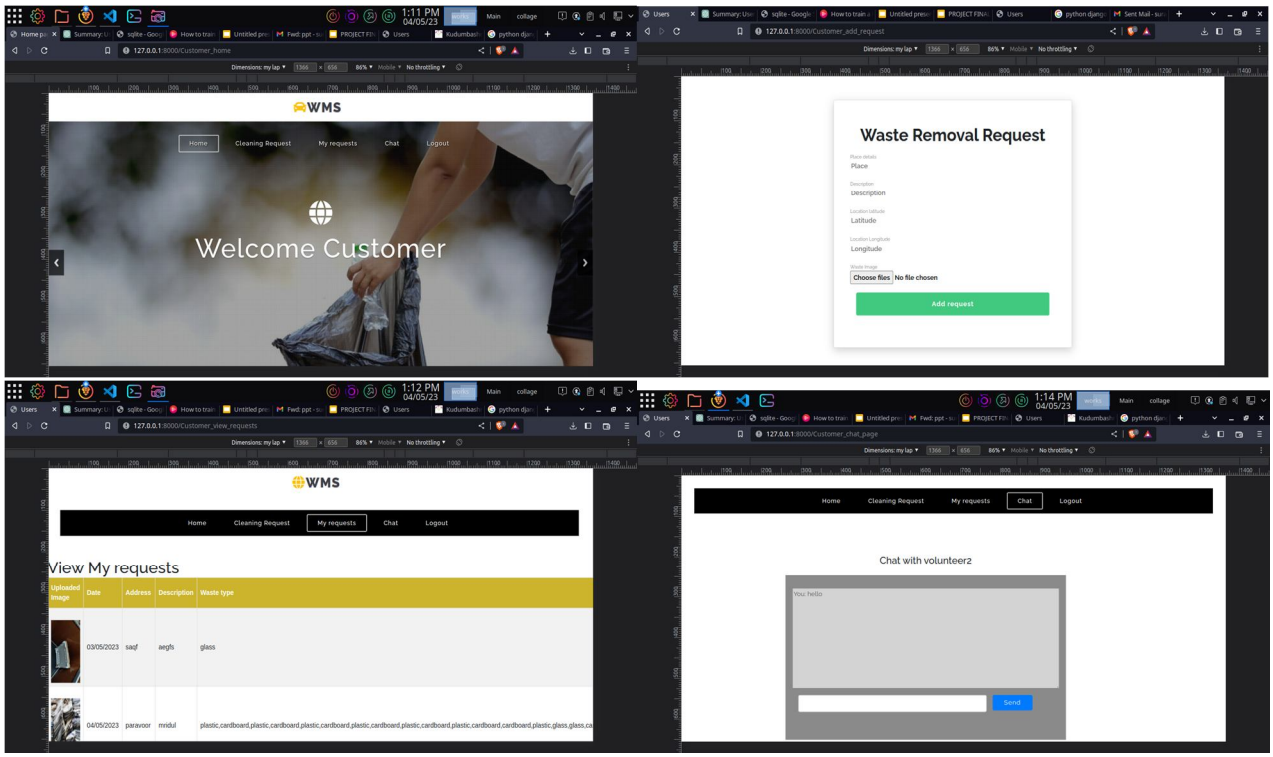
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VI Jun 2023- Available at www.ijraset.com

V. ARCHITECTURE



The structure has mainly two portions, that are the navigation part and a section containing room list and 3D models . The 3D models are built with the parameters extracted from the map of the building , which is used to create a list of rooms to provide in the menu displayed in UI.This information is passed on to the navigation section where we are building virtual environment matching to the real world .Now through the UI user will choose a destination from the room list .This will be send to the navigation section where using proper parameters , it will display the virtual path to the user via the navigation presenter.
The UI of the app consists of a menu which contains the room list , through which the user can select one room. Then a toggle line will appear guiding the way towards the destination.Destination and source will be marked using a blue coloured box.

VI. RESULT



VII. CONCLUSION

The waste management system project built using Python Django offers an effective solution for managing waste cleanup requests and facilitating communication between customers and volunteers. The system incorporates various technologies and functionalities to streamline the process of waste management.

By leveraging the power of Django, the project provides a robust and scalable framework for web development. Django's built-in authentication system ensures secure user registration and login, allowing customers and volunteers to access the system with confidence.

The integration of machine learning algorithms enhances the efficiency of waste classification. By analyzing uploaded images, the system automatically detects the type of waste present, reducing the manual effort required for waste identification.

The real-time chat system implemented within the application fosters seamless communication between customers and volunteers. This feature enables users to exchange information, coordinate cleanup activities, and address any concerns or queries promptly.

SQLite serves as the database management system, providing a lightweight and easy-to-manage solution for storing and retrieving application data. While suitable for smaller projects, it's important to consider the scalability and concurrent access requirements when planning for future growth. Throughout the project, a strong emphasis is placed on security. Proper authentication, authorization, and input validation techniques are implemented to protect user data and prevent common web vulnerabilities. Additionally, SSL certificates and security best practices are employed to ensure secure communication between users and the application. In summary, the waste management system project offers a comprehensive solution for efficient waste management, leveraging technologies such as Python, Django, machine learning, real-time chat, and SQLite. It not only simplifies the process of waste cleanup but also enhances user experience, fosters collaboration, and contributes to a cleaner and more sustainable environment. With proper maintenance and continuous improvement, the system has the potential to make a significant impact in waste management efforts.

VIII. FUTURE ENHANCEMENTS

Geographic Information System (GIS) Integration: Integrate GIS technology to enhance the system's functionality by incorporating mapping and geospatial data. This would allow users to visualize the areas in need of cleanup on a map, prioritize tasks based on location, and provide insights into waste hotspots or trends in different areas.

Mobile Application: Develop a mobile application version of the waste management system. This would enable users to access the system conveniently from their smartphones, making it easier to submit cleanup requests, upload images, and engage with the chat system. Mobile push notifications could also be utilized to provide updates and reminders to users.

Gamification Elements: Introduce gamification elements to encourage and reward user engagement. For example, users could earn points, badges, or achievements for actively participating in cleanup activities or successfully completing cleanup tasks. This can help motivate users and foster a sense of competition and community involvement.

Waste Tracking and Analytics: Implement a waste tracking and analytics component to monitor and analyze the collected waste data. This could involve tracking the volume and types of waste collected, generating reports and statistics, identifying patterns or trends, and providing insights for waste management planning and decision-making.

Integration with Local Waste Management Authorities: Establish integration with local waste management authorities or organizations. This would enable seamless sharing of information, such as pickup schedules, recycling guidelines, or disposal locations, and allow for better coordination between the waste management system and official waste management initiatives in the area.

.

IX. ACKNOWLEDGEMENT

We are very thankful to the Department of Computer Science and Engineering of Adi Shankara Institute of Engineering and Technology for permitting us to work on the topic “Waste Management System”. We truly express our gratitude to Prof. Sreedevi, Department of CSE, ASIET for giving constant support and guidance.

REFERENCES

[1] H. Jabar, R. Hassan and A. S. Sadeq, "A New Smart Waste Managing System," 2020 International Conference on Computer Science and Software Engineering (CSASE), Duhok, Iraq, 2020, pp. 209-214, doi: 10.1109/CSASE48920.2020.9142068.

[2] R. Geethamani, P. Rakshana, P. Raveena and R. Ragavi, "Garbage Management System," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 1190-1192, doi: 10.1109/ICACCS51430.2021.9441922.

[3] Z. Hisham Che Soh, M. Azeer Al-Hami Husa, S. Afzal Che Abdullah and M. Affandi Shafie, "Smart Waste Collection Monitoring and Alert System via IoT," 2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE), Malaysia, 2019, pp. 50-54, doi: 10.1109/ISCAIE.2019.8743746.

[4] N. C. A. Sallang, M. T. Islam, M. S. Islam and H. Arshad, "A CNN-Based Smart Waste Management System Using TensorFlow Lite and LoRa-GPS Shield in Internet of Things Environment," in IEEE Access, vol. 9, pp. 153560-153574, 2021, doi: 10.1109/ACCESS.2021.3128314..

[5] M. G. C. P, S. Yadav, A. Shanmugam, H. V and N. Suresh, "Waste Classification and Segregation: Machine Learning and IOT Approach," 2021 2nd International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2021, pp. 233-238, doi: 10.1109/ICIEM51511.2021.9445289.

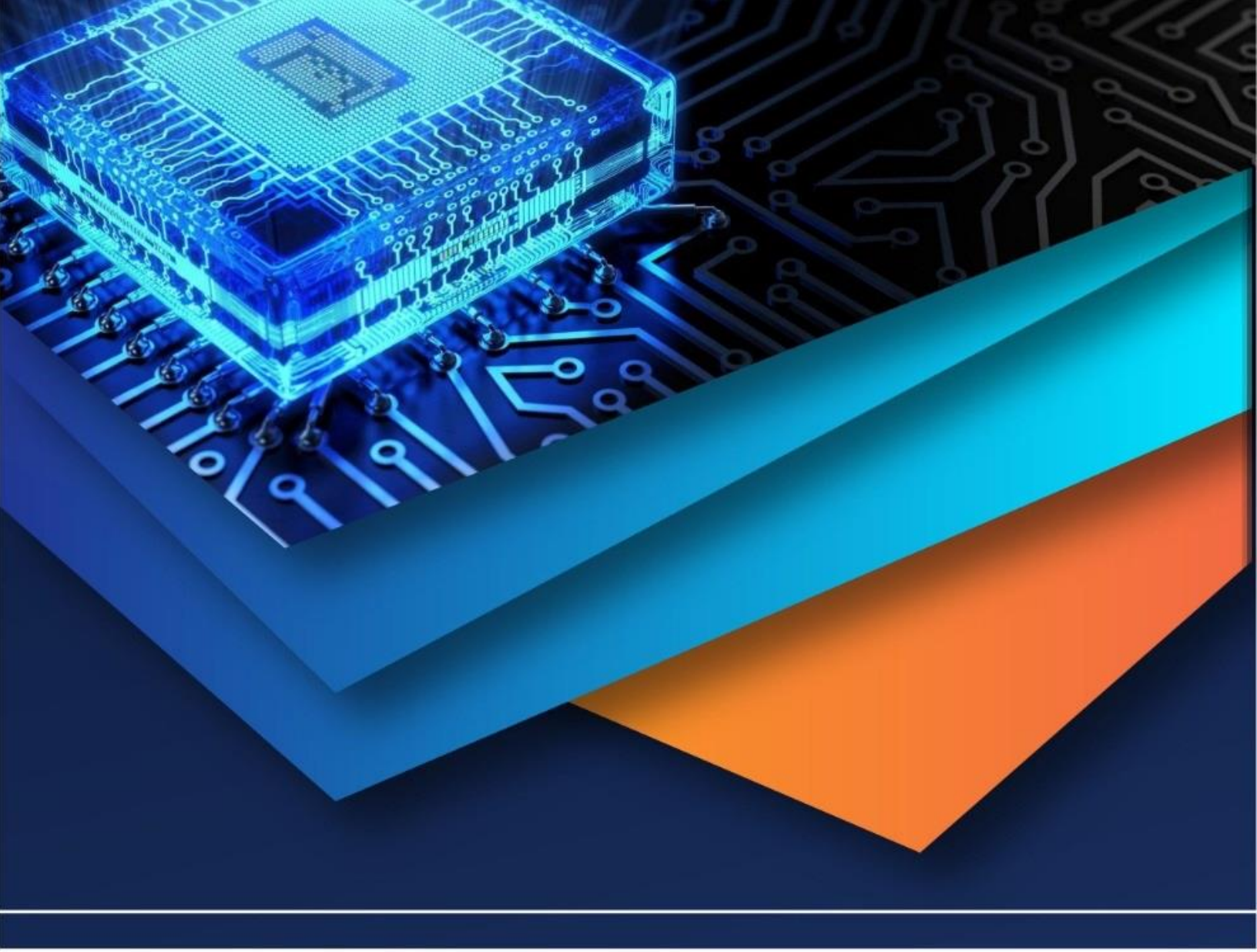
[6] Q. Liao, "Intelligent garbage classification system based on deep learning," 2022 4th International Conference on Intelligent Control, Measurement and Signal Processing (ICMSP), Hangzhou, China, 2022, pp. 952-955, doi: 10.1109/ICMSP55950.2022.9858982.

[7] M. K. Hasan, M. A. Khan, G. F. Issa, A. Atta, A. S. Akram and M. Hassan, "Smart Waste Management and Classification System for Smart Cities using Deep Learning," 2022 International Conference on Business Analytics for Technology and Security (ICBATS), Dubai, United Arab Emirates, 2022, pp. 1-7, doi: 10.1109/ICBATS54253.2022.9759087.

[8] X. Yi, Y. Liang and H. Peng, "Garbage classification system based on artificial intelligence and Internet of Things," 2022 International Conference on Artificial Intelligence and Computer Information Technology (AICIT), Yichang, China, 2022, pp. 1-5, doi: 10.1109/AICIT55386.2022.9930306.

[9] H. Wang, "Garbage Recognition and Classification System Based on Convolutional Neural Network VGG16," 2020 3rd International Conference on Advanced Electronic Materials, Computers and Software Engineering (AEMCSE), Shenzhen, China, 2020, pp. 252-255, doi: 10.1109/AEMCSE50948.2020.00061.

[10] P. Jain, T. Chaudhary and S. Gajjar, "Design and Development of Smart Waste Management System," 2023 International Conference on Communication System, Computing and IT Applications (CSCITA), Mumbai, India, 2023, pp. 199-203, doi: 10.1109/CSCITA55725.2023.10104960.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY