IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 5, May 2024

DOI: 10.17148/IARJSET.2024.11558

AI-Powered Smart Visitor Digital Platform

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Abstract: This project is a visitor management application developed using the Tkinter library in Python. The main functionality of the application is to capture and process images of various ID documents, such as Aadhaar Cards, PAN Cards, Driving Licenses, and Voter IDs. The application utilizes Optical Character Recognition (OCR) to extract relevant details from the captured images, including the visitor's name, document number, gender, and date of birth, and stores this information in a MySQL database. This application generates the digital badge which is unique for each visitor and is used to track check-in and check-out times via QR code scanning. The application includes voice assistance functionality to guide the user through various stages. Additionally, the service provides reporting and data analysis capabilities, allowing users to view visitor statistics, such as daily, weekly, and monthly visitor numbers per category, and perform cluster analysis for identification trends and patterns. Overall, this project demonstrates the integration of computer vision, data processing, and database management techniques to create a comprehensive visitor management system with a variety of reports to work with, making it a valuable tool for organizations requiring effective management and tracking of visitors.

Keywords: Visitor, AI, Management, Automated

I. INTRODUCTION

In today's thriving business world, planning isn't just important to control tourists; It's a way of working. Allow us to present our solution; the AI-powered Smart Visitor Digital Platform. This cutting-edge platform revolutionizes the visitor management process by integrating state-of-the-art technologies to simplify and improve the visitor experience. Using AI algorithms and a wide range of technical tools, our platform optimizes efficiency and it can change. It allows you to scan different types of ID cards. Create personalized digital badges for an easy and secure check-in and check-out process. Using Python, Tkinter, OpenCV, Tesseract OCR, and MySQL connector technologies, our platform uses state-of-the-art tools to ensure validity and reliability. Extract information from ID cards like Aadhaar, PAN, Drivers License, and Like Voters ID, our platform eliminates manual data entry errors. Yet by generating and emailing badges for each visitor, our platform enhances security systems and guarantees the check-in/check-out experience. Our platform is a user-centric offering to navigate the interface with options, such as selecting departments, real-time facial recognition, and scanning QR codes for use with performance improvements.

II. LITERATURE REVIEW

OCR

Optical Character Recognition (OCR) is a technology that enables the conversion of text in images, scanned documents, or PDFs into machine-readable and editable text formats. OCR systems use advanced algorithms and machine learning techniques to analyze and recognize characters, words, and text patterns within digital images or documents. The process typically involves several steps, including image preprocessing, text detection, character recognition, and post-processing [14].

Tesseract

Tesseract is an open-source optical character recognition (OCR) engine developed by Google. It is widely used for extracting text from images, including scanned documents, photographs, and screenshots. PDF documents. It uses advanced algorithms and machine learning techniques to recognize characters and words in different languages. Tesseract OCR can be integrated into applications to enable text recognition capabilities, making it useful for tasks like digitizing printed documents, extracting text from images, and processing scanned receipts or invoices.

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With its accuracy and versatility, Tesseract OCR has become a valuable tool for document processing, data extraction, and text mining applications [4].

Open CV

OpenCV has since evolved into a comprehensive toolkit with a vast array of functionalities for image and video processing, object detection and tracking, facial recognition, augmented reality, and more. OpenCV (Open Source Computer Vision Library) is a powerful open-source library for computer vision and machine learning tasks. OpenCV supports multiple programming languages, including Python, C++, and Java, making it accessible to a wide range of developers. With its extensive documentation and active community, OpenCV has become a go-to tool for researchers, developers, and enthusiasts working on computer vision projects [5].

K-means clustering

K-means clustering is a widely used unsupervised machine learning algorithm for partitioning a dataset into K distinct, non-overlapping clusters. The algorithm starts by randomly initializing K centroids, which represent the mean or center of each cluster. Then, each data point is assigned to the nearest centroid based on a distance metric, such as Euclidean distance. After assigning all data points to their closest centroids, the algorithm recalculates the new centroids as the mean of the data points in each cluster. This process of reassigning data points and updating centroids iterates until convergence, where the cluster assignments and centroids stabilize, or a maximum number of iterations is reached. The goal of K-means clustering is to minimize the sum of squared distances between each data point and its assigned cluster centroid, thereby creating compact and distinct clusters. K-means remains a widely used algorithm for various applications, including customer segmentation, image compression, anomaly detection, and exploratory data analysis [1].

Tkinter GUI

Tkinter GUI (Graphical User Interface) is a standard Python interface to the Tk GUI toolkit, which is a cross-platform toolkit for creating desktop applications with graphical user interfaces. Tkinter provides a wide range of widgets and tools for building user-friendly interfaces, such as buttons, menus, text boxes, and canvases. With its simplicity and integration into the Python standard library, Tkinter has become a popular choice for developing GUI applications in Python. It allows developers to create desktop applications with a consistent look and feel across different operating systems, making it a versatile tool for creating user interfaces for various types of applications [8].

III. METHODOLOGY

- **Creating the user interface:** The code starts by creating a graphical user interface (GUI) using the Tkinter library. It has various widgets like access fields for name, phone number, email, department selection checkbox, and more. There are buttons for capturing and processing images, displaying statistics, and other functions.

- **Utility Functions:** Several utility functions are defined to perform tasks such as checking if the string is English, printing the description, and using CLAHE (Contrast Limited Adaptive Histogram Equalization) for image enhancement.

- **Database Connection:** The code establishes a connection with a MySQL database. The interactive library. The database credentials and settings are stored in a separate dictionary.

- **Document Description Extraction:** When an image is captured and processed, the code performs Optical Character Recognition (OCR) using the Pytesseract library. Depending on the type of document identified (Aadhaar card, PAN card, driving license, or voter ID), the code extracts pertinent information such as name, document number, date of birth, and gender by using terminology daily.

- **Data Insertion:** The extracted information, along with the captured image, visitor's department, phone number, email, and accuracy (calculated by comparing the extracted name with the given name) is inserted into the SQL database through SQL queries.

- **Digital Badge Generation:** The code generates a digital badge image for the visitor, along with their name, phone number, time of arrival, and QR code with visitor information Using PIL (Python Imaging Library) and qrcode library in the badge.

- **Email sending:** The generated digital badge image is attached to the email, which is sent to the email address provided by the visitor.

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- **QR Code Scanning:** The code uses the available QR code scanning functionality through cv2 (OpenCV) and pyzbar libraries. Once the QR code is detected, the visitor information is retrieved from the database based on the scanning code, and the visitor is verified or verified accordingly.

- **Visitor tracking:** The code keeps track of visitor arrival and departure information in the database, including entry and exit times.

- **Statistics and Visualization:** The code provides functionality to display statistics and visualization of visitor data. It can generate plots for the number of visitors per department, and the grouping of departments based on the number of visitors.

- **Voice messaging:** The code includes voice messaging capabilities using the pygame and gTTS (Google Text-to-Speech) libraries. Create audio messages to provide users with information and instructions during visitor registration.

- **Feedback Email:** The code allows visitors to send a feedback email after their visit, and provides a link to an online form for them to provide feedback.

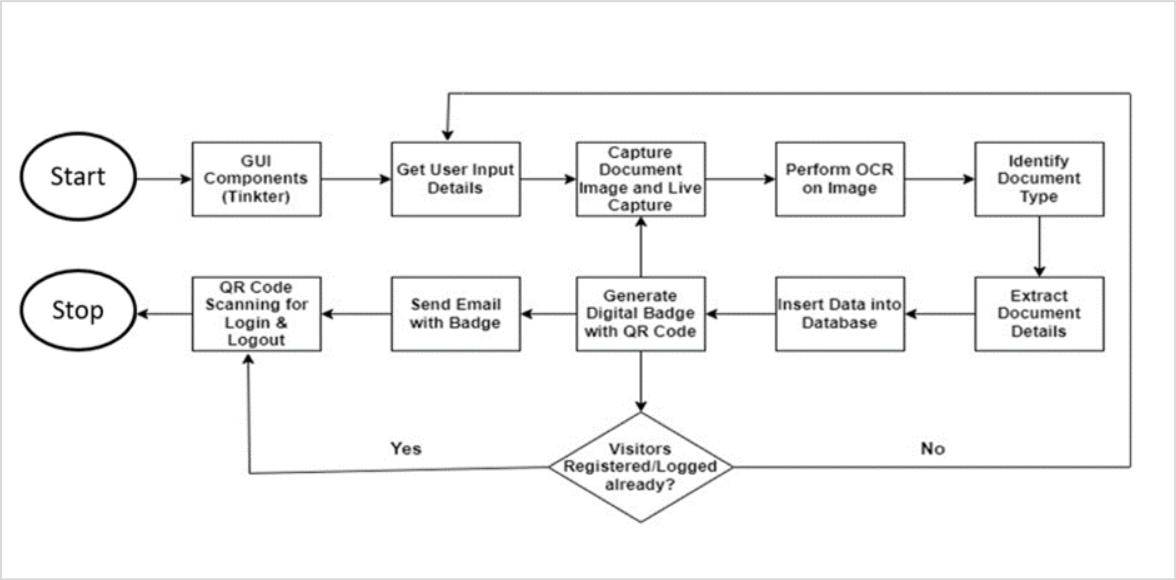

Fig. 1 Flow chart of AI-Powered Smart Visitor Digital Platform

IV. ALGORITHMS AND TECHNIQUES USED

- **Optical Character Recognition (OCR) using Tesseract OCR:** The platform uses the Tesseract OCR engine to extract text from images of identity documents such as Aadhaar cards, PAN cards, driver's licenses, and voter IDs.

- **Regular Expressions**: Various regular expressions are used to identify patterns and extract specific information from the OCR output, such as document numbers, names, dates of birth, and gender.

- **Contrast Limited Adaptive Histogram Equalization (CLAHE):** This image processing technique is used to enhance the contrast of captured images for better OCR results.

- **QR Code Generation and Decoding:** The platform generates QR codes for visitor badges using the qrcode library and decodes QR codes from live video frames using the pyzbar library.

- **Face Detection:** OpenCV's built-in face detection algorithms, such as Haar Cascade Classifiers, are used to detect faces in live video frames for facial recognition purposes.

- **K-Means Clustering:** The K-Means clustering algorithm from the sci-kit-learn library is used to group departments based on the number of visitors for statistical analysis and visualization.

- **Email Sending:** The smtplib and email.mime libraries are used to send emails with digital visitor badges and feedback forms.

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- **Graphical User Interface (GUI)**: The Tkinter library is used to create the graphical user interface (GUI) for the application, including buttons, input fields, and image displays.

- **Text-to-Speech:** The gTTS (Google Text-to-Speech) library is used to convert text into speech for providing voice instructions and feedback to visitors.

- **Data Visualization:** The matplotlib and pandas libraries are used for data visualization, creating plots, and displaying statistics related to visitor data.

- **Database Management:** The MySQL database is used for storing visitor information, badge details, and log entries, with the mysql.connector library facilitating the database connectivity and operations.

These algorithms and techniques cover various aspects of the platform, including image processing, pattern recognition, clustering, machine learning, data visualization, and user interface development.

V. RESULTS

A. Creating a graphical user interface (GUI) using the Tkinter library

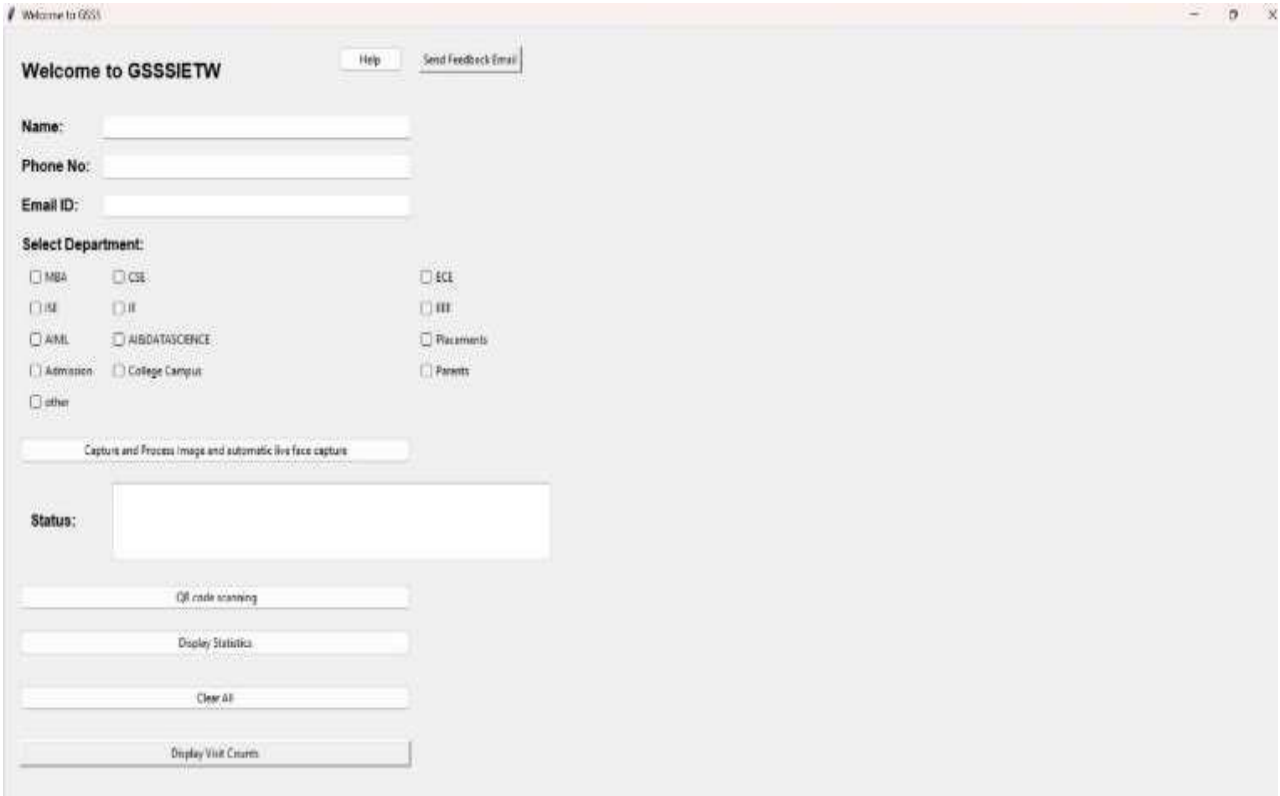

Fig. 2 Main Dashboard

IDCardScannerApp, which acts as the main implementation of the ID card scanning system. Starts Pygame module for sound effects. As a parent window and its title. Defines attributes such as width and height for the application window shape. Inserts a font for use in the application.

Starts database configuration (db_config) for future use Configure the application window background column status_text, departments,face_cascade,selected_department, badge_creation_time, phone_entry, email_entry, and visitors_entry. validate_phone_number method binds the phone details widget, presumably when entering numbers to secure the phone.

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B. Display Statistics

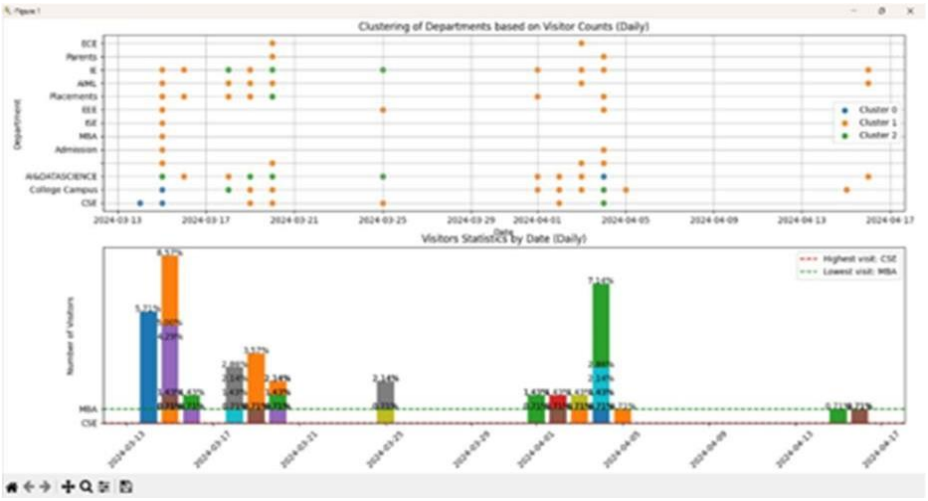

Fig. 3 Daily representation of visitor counts

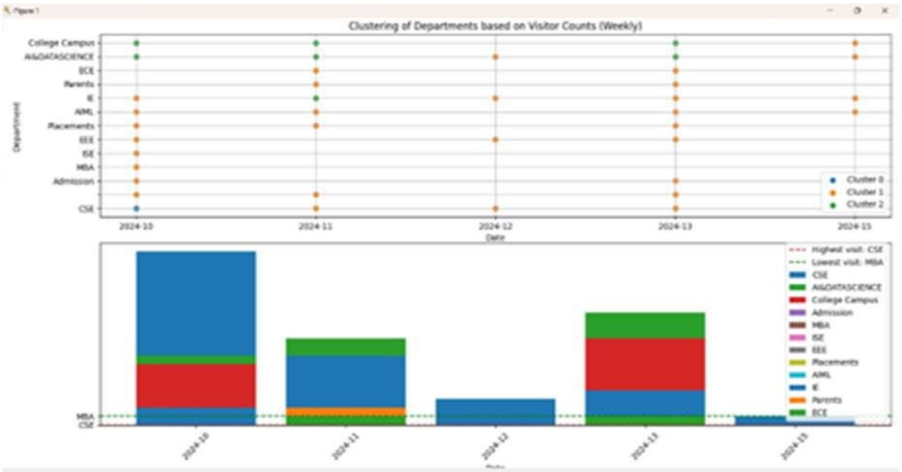

Fig. 4 Weekly Representation of visitor counts

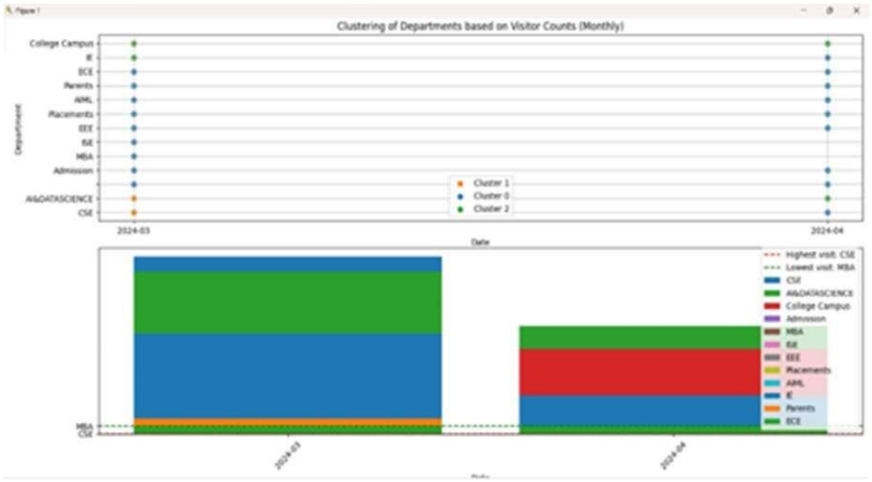

Fig. 5 Monthly representation of visitor counts

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It retrieves visitor statistics from the database in each category for different periods (daily, weekly, and monthly). Queries are defined for each time interval (daily, weekly, monthly) to capture visitor information. This method iterates through each interval, processing the relevant query and retrieving the data. The retrieved data is converted into pandas DataFrame for easy manipulation. K-Means clustering is used in different clusters in cluster division based on the number of visitors. Show all visitors, the section with the highest number of visits and the section with the lowest number of visits are counted. Matplotlib is used to visualize the graph. Two subplots are created for groups based on visitor numbers and another for statistics in particular. Scatter plots are used to show group results, while bar plots are used to show basic statistics. Percentage lines are added to the bar plot, indicating the percentage of visitors to each department.

C. QR Code Scanning

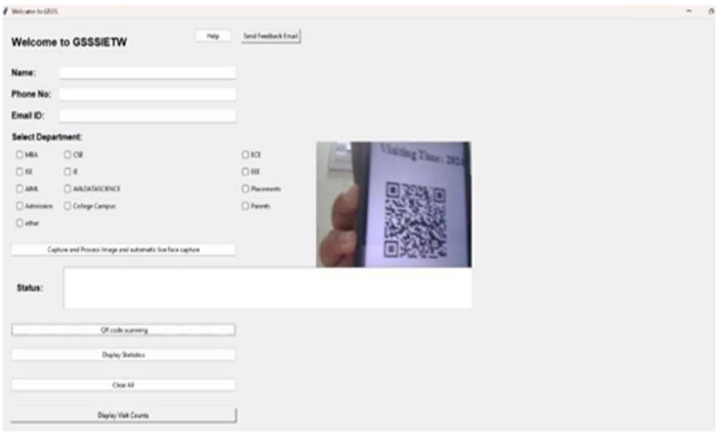

Fig. 6 QR code scanning

Handle the check-in:
The unique code is required from the visitor's badge. It checks the visitor's information (name, phone number, etc.) The visitor records the time and date of the visitor's current check-in when the visitor's badge is created with a new one he or she uses its role. Stores the check-in time of visitors detected by the scanning code in the visitor_check_ins dictionary.

Handle the check-out:
They scan the unique code from the visitor's badge to check out. Creates a message indicating when the visitor will leave and updates the status with this message. Updates the departure time for visitors identified by the scanning code. It updates the current logout time with the current date. visitors, enhancing security, and providing a seamless check-in/check-out experience.

D. Sending Email

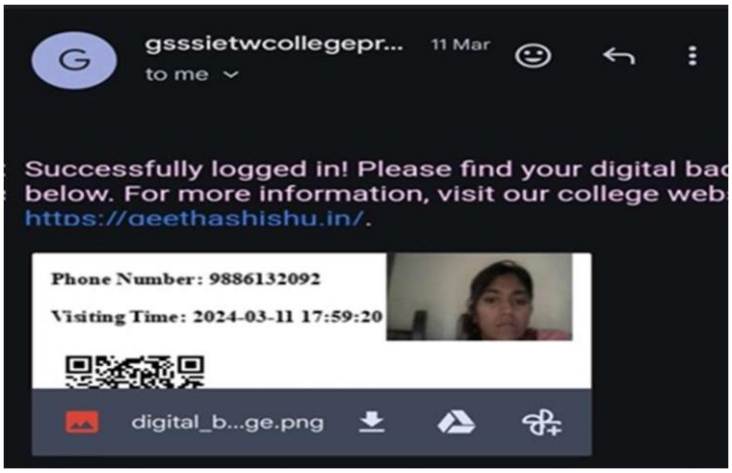

Fig. 7 Sending Email with a digital badge

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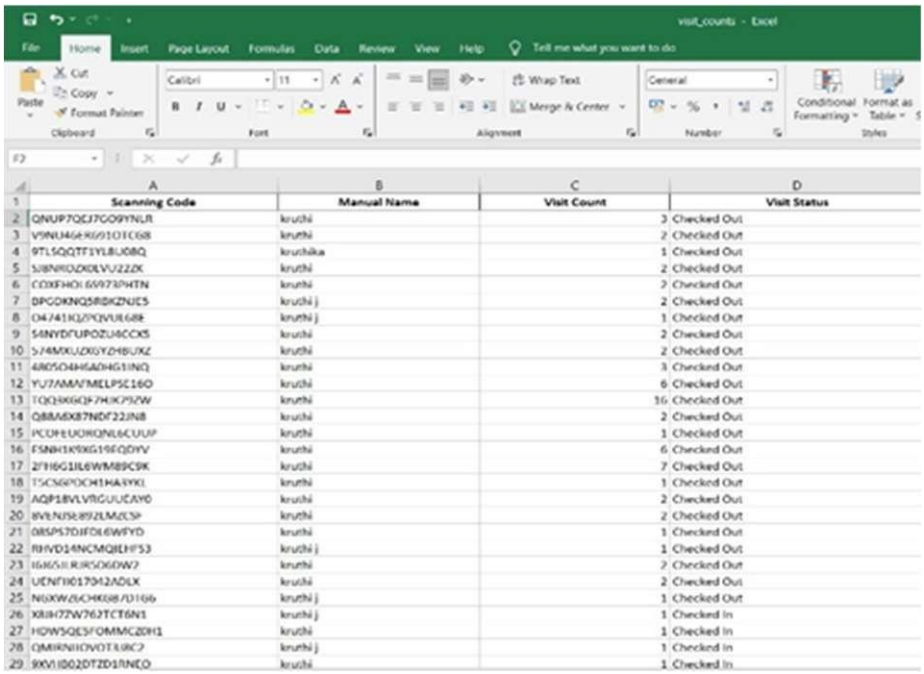
This includes details such as the visitor's name, phone number, and visiting time, which are obtained as parameters of the function. A unique scanning code is generated for the visitor using random characters from uppercase letters and digits. This code serves the purpose of identification and tracking. The visitor's name, phone number, scanning code, and the current timestamp are inserted into a MySQL database table named "visitor_badge" using the SQL INSERT operation. This allows for the visitor details to be stored in the database. The visitor's information, including their name, phone number, and scanning code, is combined into a string. This string is then encoded into a QR code usingthe qrcode module. The generated QR code is subsequently pasted onto the badge image. A"Thank you for visiting" message is added to the badge below the QR code, expressinggratitude to the visitor.

E. Visitor Log Analysis: Spreadsheet Overview



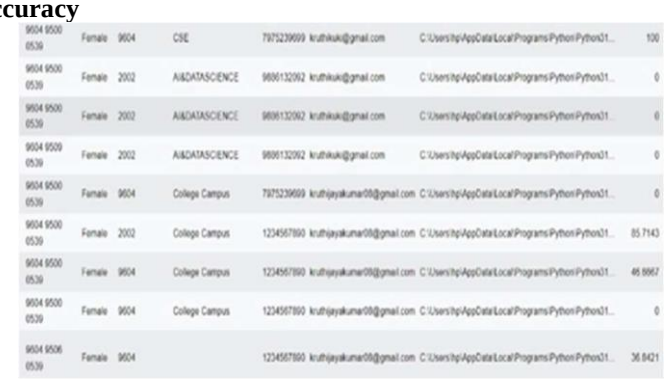
	A	B	C	D
1	Scanning Code	Manual Name	Visit Count	Visit Status
2	QNUP7QEJ7GO9YNLR	kruthi	3	Checked Out
3	V9NU4G4K6910TCG8	kruthi	2	Checked Out
4	9TL5QQTF1YL8U0BQ	kruthika	1	Checked Out
5	5J8NRODX0LVUZZJK	kruthi	2	Checked Out
6	CDXFHOL6V97JPHTN	kruthi	2	Checked Out
7	DPGDKNQ5R8KZNJE5	kruthi j	2	Checked Out
8	O4741KJ2PQVUL6BB	kruthi j	1	Checked Out
9	S4NYDTUPOZU4CCX5	kruthi	2	Checked Out
10	574MXUZK0YZH8UXZ	kruthi	2	Checked Out
11	4R0SO4H6A0HG3INQ	kruthi	3	Checked Out
12	YU7AMA7MELP5C16O	kruthi	6	Checked Out
13	TQQHX6QF7HJCP5ZW	kruthi	16	Checked Out
14	Q8BA6X87NDT22JN8	kruthi	2	Checked Out
15	PCDHEUORQNL6CUUP	kruthi	1	Checked Out
16	FSNBK1K9XG19EQDYV	kruthi	6	Checked Out
17	2TH6G1IL6WM89C9K	kruthi	7	Checked Out
18	T5CS6PQCH1HA9YKL	kruthi	1	Checked Out
19	AQP18VLVRGUUCAY0	kruthi	2	Checked Out
20	8VLNI5E89ZLMJC5P	kruthi	2	Checked Out
21	08SPS7DIFDL6WFYD	kruthi	1	Checked Out
22	R9VD14NCMQ8EHF53	kruthi j	1	Checked Out
23	I6I65JERJR5O6DW2	kruthi	2	Checked Out
24	UENTI017942ADLX	kruthi	2	Checked Out
25	N6XWZLCHK6I8JD16b	kruthi j	1	Checked Out
26	X8IH7ZW762TCT6N1	kruthi j	1	Checked In
27	HDW5QE5FOMMCZDH1	kruthi	1	Checked In
28	QMIRNIICIVOTEURC2	kruthi j	1	Checked In
29	9KVII002DTZD1INEO	kruthi	1	Checked In

Fig. 8 Excel spreadsheet

Excel spreadsheet which contains the information about the number of visitors visiting the campus. It includes:

1. Scanning code - This column displays unique scanning codes, possibly associated with individual visitors.
2. Manual Name - This column lists names, presumably of people associated with scanning codes.
3. Visit Count - This column shows the number of times each person checked in or out.
4. Login Status - This column displays everyone's current login status whether they checked in or checked out.
5. This data tracks visitor information such as how many times they have logged in and out, as well as the status of their current visit.

F. Calculating the accuracy



9604 9500 0539	Female	9604	CSE	7975239699	kruthiuk@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 100
9604 9500 0539	Female	2002	AI&DATASCIENCE	9606132092	kruthiuk@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 0
9604 9500 0539	Female	2002	AI&DATASCIENCE	9606132092	kruthiuk@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 0
9604 9500 0539	Female	2002	AI&DATASCIENCE	9606132092	kruthiuk@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 0
9604 9500 0539	Female	9604	College Campus	7975239699	kruthijayakumar08@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 0
9604 9500 0539	Female	2002	College Campus	1234567890	kruthijayakumar08@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 85.7143
9604 9500 0539	Female	9604	College Campus	1234567890	kruthijayakumar08@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 46.8867
9604 9500 0539	Female	9604	College Campus	1234567890	kruthijayakumar08@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 0
9604 9506 0539	Female	9604		1234567890	kruthijayakumar08@gmail.com	C:\Users\hp\AppData\Local\Programs\Python\Python31... 36.8421

Fig. 9 Calculating the Accuracy

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It takes two strings, extracted_name, and Name, whichrepresent the extracted name and the provided name, respectively. It splits the extracted_name into lines and processes both strings by removing spaces and converting them to lowercase for comparison. It iterates over each character in each line of the extracted_name and compares itwith the corresponding character in the processed Name. It counts the total number of matching characters and the total maximum length of the strings.

VI. CONCLUSION

Based on the detailed project documentation provided, the AI-Powered Smart Visitor Digital Platform is a comprehensive and innovative solution for visitor management. The platform leverages state-of-the-art technologies, including artificial intelligence, computer vision, optical character recognition (OCR), and database management, to streamline and enhance the visitor experience. The key features and functionalities of the platform include an automated visitor check-in process by scanning various types of ID cards, such as Aadhaar, PAN, driver's license, and voter ID, using OCR techniques. Generation and email delivery of personalized digital badges for the visitor. Implementation of QR code scanning for efficient visitor tracking and real-time facial recognition for added security.

Intuitive graphical user interface (GUI) with voice messaging capabilities, providing a user-friendly experience and guidance for visitors.Comprehensive database management system for storing visitor information, tracking entries and exits, and generating insightful statistics and visualizations.Integration of feedback collection mechanisms, allowing visitors to provide feedback via email forms, contributing to continuous improvement of the platform.Utilization of various Python libraries and modules, including Tkinter, OpenCV, Tesseract OCR, MySQL, Pygame, and more, to develop a robust and feature-rich application. Overall, the AI-powered Smart Visitor Digital Platform presents a comprehensive solution that leverages cutting-edge technologies to revolutionize the visitor management process. By automating tedious tasks, enhancing security, providing real-time tracking, and offering a seamless user experience, this platform has the potential to significantly improve visitor management in various industries, such as corporate offices, educational institutions, and government facilities.

VII. FUTURE ENHANCEMENT

- SMS Notifications with Digital Badge and Feedback Form: When a visitor checks in, generate a digital badge (e.g., QR code, barcode, or image) containing their details and a unique visitor ID.Sending an SMS to the visitor's registered mobile number with the digital badge attached or a link to download/view the badge and the form to send their feedback after the check-out.

- Cloud Integration: Implement cloud-based storage and retrieval of visitor data, enabling remote access and centralized management of visitor records across multiple locations or branches.

- Real-time Location Tracking: A feature to display the real-time location of visitors on a map or floor plan of the premises. This can be achieved through a web-based interface or a mobile app, allowing authorized personnel to monitor visitor movements.

- Web Application or Mobile App: Converting the desktop application into a web application or a mobile app could make it more accessible and convenient for users. This would also enable remote visitor management and monitoring.

ACKNOWLEDGMENT

We would like to extend our sincere gratitude to the Department of Computer Science and Engineering (CSE) for their unwavering support and encouragement throughout the creation of this project. The resources, expertise, and opportunities provided by the department have been invaluable in shaping the content and ensuring its quality. We are also deeply grateful to the dedicated team at the Internet of Things (IoT) Lab for their assistance and collaboration. Their insights and technical assistance have been instrumental in developing the concepts and technologies discussed in this paper.

Additionally, we would like to thank **Ms. Shyleshwari M Shetty** and **Dr. Manjuprasad B**, for their contributions and support at various stages of this project. This paper would not have been possible without the guidance, resources, and encouragement provided by the CSE department and IoT lab. We are truly grateful for their support and proud to be a part of such a dynamic and innovative community.

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REFERENCES

[1]. Tabianan, Kayalvily, Shubashini Velu, and Vinayakumar Ravi. "K-means clustering approach for intelligent customer segmentation using customer purchase behavior data." Sustainability 14, no. 12 (2022): 7243.
[2]. Nguyen, Thi Tuyet Hai, Adam Jatowt, Mickael Coustaty, and Antoine Doucet. "Survey of post-OCR processing approaches." ACM Computing Surveys (CSUR) 54, no. 6 (2021): 1-37.
[3]. Kelly, Sloan, and Sloan Kelly. "Basic introduction to pygame." Python, PyGame and Raspberry Pi Game Development (2016): 59-65.
[4]. Reading Text the Image using Tesseract [Online], available at https://www.geeksforgeeks.org/reading-text-from-the image-using-tesseract/, accessed on[Dec 2023].
[5]. Widodo, Catur Edi, Ketaki Adi, and Rahmad Gernowo. "Medical image processing using Python and open CV." In Journal of Physics: Conference Series, vol. 1524, no. 1, p. 012003. IOP Publishing, 2020.
[6]. How to Send Email in Python: SMTP & API Methods[Online], available athttps://mailtrap.io/blog/python send-email/, accessed on[Jan 2024].
[7]. How to install Python 3.10.0 on Windows 11[online] available at https://youtu.be/JJQW3GPnzQ8?si=kWoAa2DE Bv83v3Em, accessed, accessed on [Nov 2023].
[8]. Moore, Alan D. Python GUI Programming with Tkinter: Design and build functional and user-friendly GUI applications. Packt Publishing Ltd, 2021.
[9]. Rivera, Jose Naldrix D. "VMS Support: A mobile-based support to computerized visitor management system." Software Impacts 8 (2021): 100056.
[10]. Sumathi, C. P., T. Santhanam, and G. Gayathri Devi. "A survey on various approaches of text extraction in images." International Journal of Computer Science and Engineering Survey 3, no. 4 (2012): 27.
[11]. Kaur, Manpreet, Jasdeep Kaur, and Jappreet Kaur. "Survey of contrast enhancement techniques based on histogram equalization." International Journal of Advanced Computer Science and Applications 2, no. 7 (2011).
[12]. Adjetey, Charles, and Kofi Sarpong Adu-Manu. "Content-based image retrieval using Tesseract OCR engine and Levenshtein algorithm." International Journal of Advanced Computer Science and Applications 12, no. 7 (2021).
[13]. de Langen, Joska. "Sending emails with python." Real Python 21 (2021).
[14]. Mori, Shunji, Ching Y. Suen, and Kazuhiko Yamamoto. "Historical review of OCR research and development." Proceedings of the IEEE 80, no. 7 (1992): 1029-1058.
[15]. Sureswaran, R., Hussein Al Bazar, O. Abouabdalla, and Ahmed M. Manasrah. "Active E-mail system protocols monitoring algorithm." In TENCON 2009-2009 IEEE Region 10 Conference, pp. 1-6. IEEE, 2009.
[16]. OpenCVTutorialinPython[Online], available at https://www.geeksforgeeks.org/opencv-python-tutorial/, accessed on [Dec 2023].
[17]. GenerateQRCodeusingqrcodeinPython [Online], available https://www.geeksforgeeks.org/generate-qr-code-using-qrcode-in-python/ accessed on [Feb 2024].
[18]. Chavda, Harsh N., Sakshi P. Bhavsar, Jaimin N. Undavia, Kamini Solanki, and Abhilash Shukla. "Attendance System Using Face Detection and Face Recognition." In International Conference on Information and Communication Technology for Competitive Strategies, pp. 351-361. Singapore: Springer Nature Singapore, 2023.
[19]. Li, Yunyao, Rajasekar Krishnamurthy, Sriram Raghavan, Shivakumar Vaithyanathan, and H. V. Jagadish. "Regular expression learning for information extraction." In Proceedings of the 2008 conference on empirical methods in natural language processing, pp. 21-30. 2008.
[20]. Tiwari, Sumit. "An introduction to QR code technology." In 2016 International Conference on Information Technology (ICIT), pp. 39-44. IEEE, 2016.

