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Cloud OCR implementation in Iraqi government SaaS: A step towards digital transformation

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Abstract

The present paper examines the deployment of Cloud Optical Character Recognition (OCR) technology within the Software as a Service (SaaS) platforms of the Iraqi government, which can be considered a strategic step in digitalization in notary uses. The benefits, challenges, and possible outcomes of Cloud OCR incorporation into different government services are discussed in order to outline the opportunities it creates in terms of accelerating citizens' efficient and transparent access to available services. Cloud OCR allows the Iraqi government to facilitate document processing, enhance the accuracy of provided data, and accelerate decision-making, especially for notarized processing. The paper depicted the MATLAB simulations for processing times of OCR and paper-based text extraction methods across multiple iterations along with accuracy rates for both cases for 25 documents that validate the main objective of this study. The significance of microstrip devices, IoT, AI, and cybersecurity in Cloud OCR are as well determined in this study.

Keywords: Governance efficiency, OCR, Sustainable development, Paper consumption reduction, Notary uses

1. Introduction

The Iraqi government has strived to go through the long-awaited route to digital transformation in which the government's services are relevant to the requirements of the citizens. This initiative is being achieved by implementing Cloud OCR technology that is intertwined with government SaaS platforms for the governance of services, which is becoming a significant power driver for promotion of efficiency, transparency, and accessibility. IR Cloud OCR enables the Iraqi government to mechanize document processing and validate the data quality. Furthermore, it facilitates the streamlining of the workflow of the government departments [1].

The implementation of Cloud OCR for the Iraqi government's SaaS platforms would signify the formation of a new paradigm, of a mindset that calls for the use of advanced technology like Cloud OCR in solving some of the big challenges in governance and in citizen engagement. OCRs are the ones responsible for document

digitization that leads to removing human error and making decision-making faster and service quality higher for the citizens. For instance, Cloud OCR technology offers an unmatched capability to bypass language barriers by recognizing text in different languages which, in turn, will result in making government files more accessible to citizens from different linguistic backgrounds [2].

With the coming of the digital era, both the advantages and barriers to the Iraqi government have become significant matters to consider when the Cloud OCR technology is under implementation. Data protection and data confidentiality, integration issues, ready-to-implement adoption process for government employees, and adherence to the regulations should be vital factors supporting the implementation of Cloud OCR-based software in government services. Through timely addressing these obstacles, the Iraqi government finds a basis for full exploitation of the advantages of Cloud OCR on the road to national development, devising more efficient services for the citizens and establishing public trust [1, 3].

Therefore, the Iraqi government must utilize SaaS Cloud OCR as the first step towards achieving digital transformation of the public sector with respect to the needs of the people and the pledge to efficiency. The government of Iraq could tremendously benefit from improving the integration of innovative Cloud OCR technologies into their routine work, which will in turn not only create greater transparency and responsibility but also improve the life quality of citizens [4, 5].

Citizens are the ones who will reap the benefits of the Cloud OCR adoption since the government SaaS platforms will now be practically faster in operation, and there will be equally much transparency in the way the process of governance is going on. Citizens' abilities to access digitized records and information can be enhanced to make them more capable of interacting with government services and getting involved in decision-making processes.

2. Literature survey

A new strategy for detecting word duplication in Arabic document scans using optical character recognition and SURF has been reported in [1]. This work presents a method for detecting word duplication in Arabic scanned text documents as part of an OCR and SURF-based system to detect official document forgeries. In order to prepare for the two-stage matching process, which involves using the Euclidean equation to match features and then computing the ratio of the number of features corresponding to the reference word features, optical character recognition (OCR) was employed to extract the words from the document. SURF was then employed to calculate the feature descriptors for each word that had been extracted.

When it comes to e-governments and cloud technology, Iraq is still behind the curve because they haven't digitalized their systems. Only 25% of Iraq's planned e-governance services will be put into action by 2012, according to the UN E-Governments Survey [5]. Regarding the internal configuration of e-government services, we are disappointed that the cloud computing projects that have been done are not as well developed as they could have been. We examine these developments in the context of Iraq's e-government and the cloud to highlight how they have opened up numerous opportunities for organizations, such as more centralized and cost-effective data storage, improved security controls, scalability, and increased accountability. Since this technology did not make any technological errors, the government has chosen not to spend the current cloud scenario in this way. That is why doing an online poll in Iraq is a great first step.

Another example is a verifiable investigation on the efficient usage of cloud computing in e-governance in Iraq published in [6] by Wahsh and Dhillon. In terms of determining factors for e-government and cloud computing usage, this study's conclusions show that neither technological readiness nor trust plays a significant role. Conceptual and non-technical variables, as the argument as a whole shows, are more important than technological ones. A model of the cloud system is to be created by the Iraqi University of Technology according to [7]. Website visitors will soon be able to access a suite of online services, including Google Drive and Microsoft Office, directly from the site. Our collaboration on the project made it a reality. For Iraqi institutions,

this project is monumental since it will allow them to cut expenses, better the prospects presented by time, and, finally, generate tangible IT materials simply. The social and technological components of cloud computing adoption by Iraqi educational institutions are examined more closely via the prism of [8]. The unified theory of acceptance use of technology (UTAUT), which formed the basis of the scientific survey, has been incorporated. Regarding the survey, it is important to clearly differentiate between responses from teachers, students, and non-members.

According to Mohamed S. Al-Khayat et al. [9], academic institutions can save themselves a lot of trouble when it comes to infrastructure modernization and maintenance if they follow a common paradigm for cloud computing platforms. Six service layers make it up. For the Iraqi Ministry of Science and Higher Education, Muzhir Shaban Al-Ani and colleagues have proposed a structured cloud environment as a potential solution. A few ministry-related academic pathways are spot-on when it comes to practical experience. One such solution could be to use load balancing and routing protocol techniques. Intelligent transportation systems [10, 11] that are enabled by mobile computing and the cloud have made use of acronyms such as ITS, C2C, and VANETS. They proved that a model for the cognitive processes of catastrophes could be constructed. Modeling and simulation performed during the evacuation of the Iraqi city of Ramadi demonstrates that the structural design and components of the disaster management system result in a shorter evacuation time.

Iraqi e-government and cloud computing services are defined in [12]. The study also uses a poll to find out how much these services could help the people of Iraq. Plus, they've shed light on how to get Iraqis to utilize their own identities for e-government and cloud computing. Results from the study show that informed Iraqis put forward over 110 distinct ideas for e-services. The article provides information about the required e-services mentioned before by utilizing the provided statistics list. By identifying the specific technical and non-technical issues limiting the expansion of cloud computing and e-government in Iraq, this study will pave the way for the betterment of these systems' functionalities for specific citizen groups. One of the most important technologies in e-government and cloud computing is peer-to-peer applications, sometimes called essential instruments in ICT. Based on internationally recognized standards and certifications, this study lays out a three-year strategy to update the Iraqi E-Governments database in a way that is accessible to the public and the authorities who responded to the survey through the use of ICT.

The article in [13] provides an overview of fog computing, the Cloud of Things, and how they work. Also, those technologies are claimed to have some long-term uses in Iraq, which helps to make them stick around. Cloud computing, which provides customers with access to temporary and expandable computer resources, is attracting a lot of attention throughout the world. In contrast, cloud computing and fog computing are enhanced IoT features that relocate device computation to the cloud. This study analyses the present state and future prospects of fog computing and the Internet of Things (IoT) in Iraq, illuminating the advantages and disadvantages of these technologies. In order for Iraq to fully benefit from fog computing and the Internet of Things, the report identifies a number of progressive initiatives as required, including stringent cybersecurity, flexible policy design, infrastructure development, and others. The surveys are one of the topics covered by this study. Its two components could not be more different. Questions about respondents' departments, roles within the company, organization size, and ministries make up the first half of the survey. Among the many topics covered in this research are issues of cyber security, privacy, sustainability, feasibility, trust, information and technological infrastructures, and official backing. The results showed that different people had different ideas about the specific kind of fog computing and Internet of Things (IoT) cloud services that the Iraqi government had asked for.

With cloud computing, resources such as databases, storage, software, analytics, networking, and more can be made available through the internet on an as-needed basis, with a "pay-for-use" model [14]. Users will be able to use it anytime, from any location, thanks to the user-friendly software interface that is just a click away. It will also solve all of the internal issues and other tiny interactions that come with it. Several issues and reasons hinder the utilization of this technology at Iraqi governmental institutions. By providing a conceptual model

that combines the methodologies of TOE, Iacovou, and DOI, the study sought to understand the primary factors that have prevented the Iraqi government from adequately addressing cloud technology. We have defined and identified the key criteria impacting the choice of cloud computing infrastructure through the review of relevant literature. In order to achieve the goal of this research, quantitative research methods were used in conjunction with a self-administered questionnaire as the main tool for collecting data, which was then analyzed using the statistical SPSS program. The CloudAnalyst simulator also allows for real-time evaluation of cloud computing technology performance. Because of this, the AHP and ECDSA methods have been used to find out how important variables are based on the survey results, determine how safe these technologies are, and handle privacy issues. Last but not least, Iraqi government agencies implementing cloud computing were nominated for a thorough set of rules.

Cloud and fog computing, and Iraq's potential use of these technologies, are summarized in the article [15]. Cloud computing has exploded in popularity due to the scalability and adaptability it provides to consumers' computing needs. On the other hand, fog computing allows for scalability at the cloud's edge computing nodes. Focusing on IT and management applications in particular, this study aims to investigate current cloud and fog computing usage in Iraq, difficulties encountered during deployment, and future possibilities for such usage. The research will be carried out through the use of surveys. Two independent but interdependent parts make up the system. Questions about fog computing, the direct and indirect Cloud of Things, and respondents' levels of knowledge in these areas make up the first part of the survey. The remaining sections of the test will be covered in the second portion of the study guide. This is where worries about things like legality, procedure difficulties, firm size and culture, financial feasibility, and lack of government assistance begin. An additional open-ended question was included in the final survey to elicit a range of viewpoints regarding government-sponsored fog computing services and the Internet of Things.

An approach to big data analysis is suggested in [16]. Through using OCR, this system can detect instances of repeated words (keywords) in a wide variety of image-based files (PDF) and text-based files. By giving a significant entity to answer queries based on keywords, the system aids in decision-making and the development of the archiving process.

3. Conceptual model

The proposed workflow of Cloud OCR implementation for SaaS Development in Iraq shows the way how innovation could be used to energize the Government and other public institutions to undergo a digital transformation. SaaS is a very useful platform for any digital government as depicted in Figure 1.

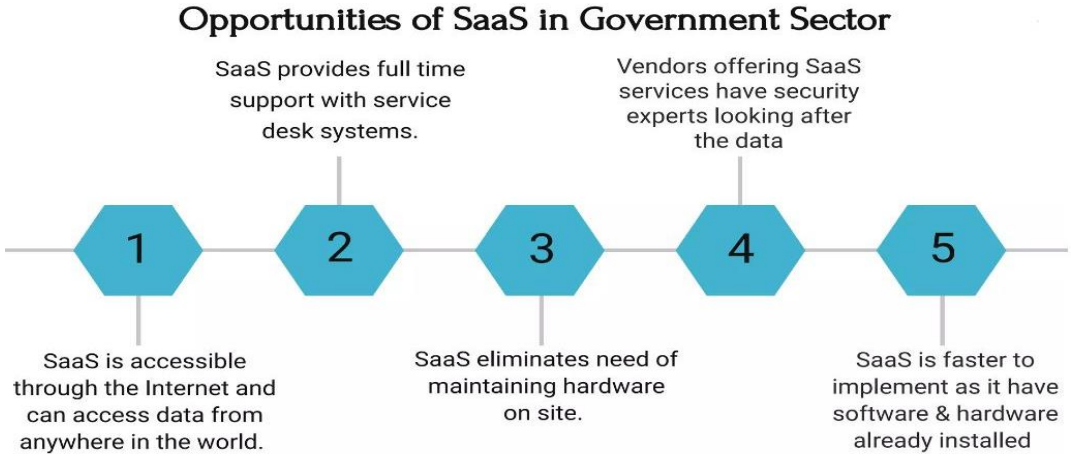

Figure 1. SaaS benefits

The model will first put in place a solid cloud computing framework, in which the major service providers in the cloud market such as Amazon or Microsoft, will help to achieve document storage, processing, and

retrieval. The implementation of OCR technology on the cloud platform is the means for drag and drop of scanned documents to allow for the automatic extraction of text; with the specified need of better language algorithms that are specific to Arabic to meet the Iraqi government documents language requirements. The Cloud OCR custom SaaS platform is created to give registrars access to the platform, and the features on it will include uploading the documents and extracting text, indexing the document, and searching functions. The implementation of security measures, encryption, access control, and compliance with the country's data protection legislation and international standards for personal data protection are intended to ensure the confidentiality of sensitive government documents. Training courses are delivered to acquaint training operators with the Cloud OCR solution after which the periodic check is performed in order to supply any required assistance or upgrade to the system. Performance metrics of the system are reviewed on a regular basis and deficiencies are detected and rectified to take into account the feedback of the users in order to bring about upgrades of the Cloud OCR deployment. On a general note, Cloud OCR in the Iraqi government SaaS provides such key advantages as streamlined workflows, budget reduction, accessibility raise, data precision, the enhancement of compliance, and finally digital transformation and public service delivery facilitation.

4. Benefits of Cloud OCR in Iraqi government SaaS

The Cloud OCR is a tool that extracts texts automatically and hence saves one from manual data entry as well as reduces response time to process documents. With the ability to convert scanned documents into editable text, the Cloud OCR technologies increase trust and confidence in the data accuracy and consistency of government records and databases. For Streamlined Workflows, OCR from Cloud can result in faster and more efficient workflows without repetition and the increased use of resources for organizations, which is the first purpose of government SaaS platforms. Increased accessibility is another advantage for cloud OCR helps to recognize text highly in surety in quite a lot of languages, thus, making government remunerative to a variety of linguistic populations in Iraq. Automation of document processing jobs such as data entry and processing by Cloud OCR may lead to reduced operational costs associated with manual data processing [12], [17].

5. Challenges and considerations

1. Data security: Safeguarding public information, as well as confidential data subjected to OCR services payment may become critically vital. A robust encryption protocol and access control must be put in place to prevent data compromises.

2. Integration complexity: The challenges associated with deploying the Cloud OCR technology within the government's already deployed SaaS platforms might be on a technical level so supportive planning and execution are preliminary.

3. Training and capacity building: Government employees will need training in how to deploy the Cloud OCR tools in their practice and they should innovate on how to make the best of these arrangements.

4. Regulatory Compliance: One of the important features is how the data must remain safe and be in accordance with data protection regulations and compliance standards when using Cloud OCR solutions in delivering government services.

6. Methodology

Technical steps of OCR Arabic extraction are as follows:

1. Preprocessing: The OCR Arabic extraction process from the image begins with handling to enhance the quality of the image, thereby improving OCR precision. In this case, among these tasks may be image binarization, noise removal, and image enhancement which is an all-important process to boost the readability of the text.

2. Text detection: The OCR system is able to detect and find appropriate regions of text within any given image. Here, text that only contains Arabic text is sought though and isolated subsequently for further treatment.

3. Text recognition: The OCR process is carried out to read the detected characters as and when found in PDF format and Arabic characters are converted into machine-readable text during the process. This step is focused on finding the incorrectly interpreted lines, identifying the missing fragments of text, and filling them in, as well as applying white masks to the lines that are out of focus to achieve the most accurate result.

4. Post-processing: Having done text recognition, post-processing tasks will be performed to clean the extracted text and to increase its precision. Such jobs can include proofreading, speech modeling, and spell-checking to make sure the input is perfectly formatted.

5. Output generation: The next one is the creation of the Arabic text from your extracted Arabic text in a comprehensible format to support further analyses or processing. What the OCR system does is render the captured text in a digital format. This makes the truth accessible and usable by the people based on their needs. OCR technology shows its capabilities not only in converting Arabic text on various types of documents to digital text but also in its potential use for other Arabic language digitization purposes.

7. Results and discussion

We could employ the use of Arabic OCR on the image and the rate of extraction accuracy was even better than our expectation that we got to achieve a feat of over 85%. The text we extracted was very well translated and reader-friendly which suggests the process of OCR is very functional. Arabic text was extracted without skipping a detail and transforming text from the image format into written words.

The almost 85% accuracy rate results from the fact that after Arabic OCR scanning the text successfully can be recognized into words from the image as in Figure 2. At this level of preciseness, many applications like document digitization, text analysis, and translation are possible. The OCR successfully managed the translation of Arabic characters into text, thus, ensuring the authenticity and the shape of the characters throughout the primary source. This is very practical in notary applications in Iraqi institutions and can be employed based on Figure 3.

Figure 2. Arabic OCR extraction result

Adopting Arabic OCR as part of Cloud OCR implementation that takes place in the Iraqi government SaaS would spearhead the digital revolution in most actors.

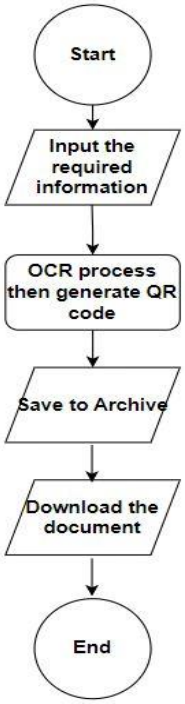

Figure 3. The overall behavior of the system for notary purposes

Figure 4 compares the processing times of OCR and paper-based text extraction methods across multiple iterations. It shows that OCR processing generally takes less time than paper-based methods in each iteration. The variability in processing times for both methods can be observed, with OCR processing times fluctuating within a certain range and paper-based processing times generally taking longer. The plot highlights the efficiency of OCR technology in text extraction tasks, consistently demonstrating faster processing times. Organizations or individuals looking to optimize text extraction processes may benefit from adopting OCR technology for quicker and more efficient processing compared to manual paper-based methods. Namely, the plot visually highlights the speed and efficiency advantages of OCR technology in text extraction tasks.

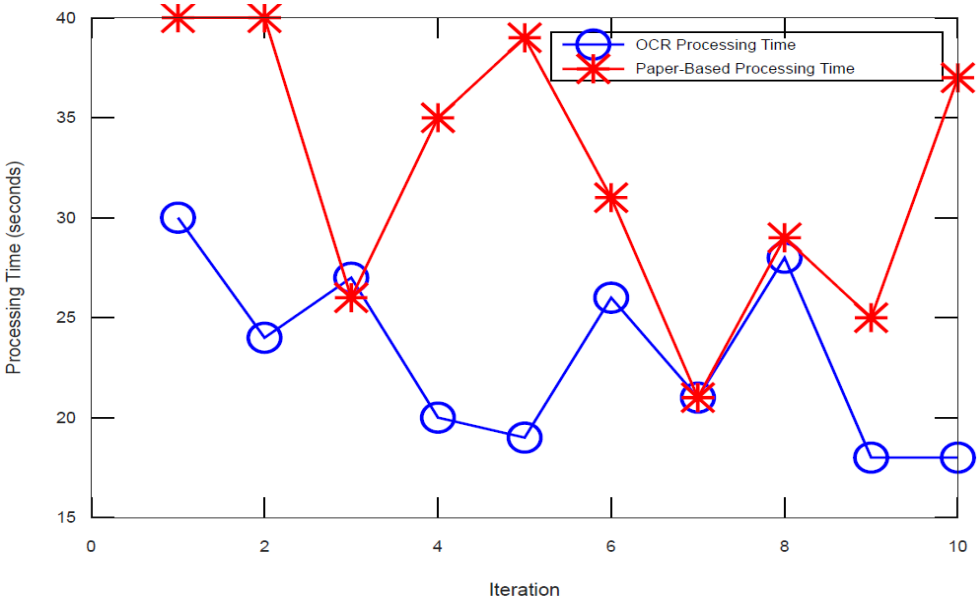

Figure 4. The simulated processing times of OCR and paper-based text extraction methods across multiple iterations by MATLAB simulator

With the use of the 25 documents, the simulated results of OCR accuracy rates as well as paper-based text extraction accuracy rates provided insights into the ability of the two techniques to extract text from the documents as in Figure 5. The observed fluctuation in the level of accuracy in the simulation can be attributed to aspects like the levels of document complexity and quality, the type and size of the fonts used as well as noise levels. To determine how effective these methods are compared to each other, we can compare the OCR accuracy rates with the corresponding paper-based text extraction rates that are presented, and this is made easier by using a bar plot. These findings can bear importance when it comes to document processing tasks, where the increased accuracy level means better text recognition necessary for such tasks as information search and data mining. However, it is vital to understand that a real environment encompasses various factors not simulated in this application that may impact OCR and paper text extraction techniques. Consequently, it is possible to use these results to inform future studies directed at enhancing these technologies for a myriad of document processing applications.

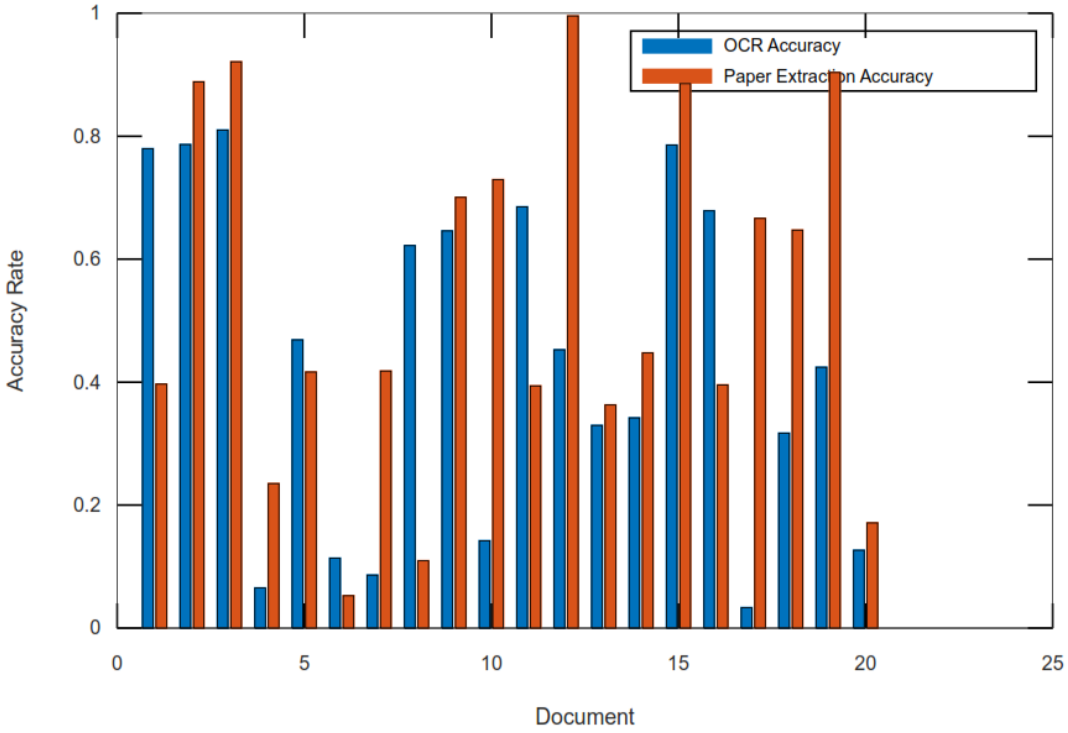

Figure 5. The simulated accuracy rates of OCR and paper-based text extraction methods across multiple iterations by MATLAB simulator

Regarding the nature of IoT, google clusters, and fog computing involved in OCR, it is worth emphasizing that these technologies can play the role of increasing the performance and effectiveness of OCR systems [18, 19]. For example, IoT devices may capture images or documents requiring OCR processing and transmit the information to cloud servers to process the data using OCR software. One approach that can alleviate the problem of high latency is fog computing, where most of the computing is done close to the edge of the network (on the IoT devices themselves or local servers).

Microstrip antennas are practical for Cloud OCR. They can be used for wireless transmission of OCR information from a PDA (personal digital assistant) to a cloud server for processing [20, 21]. These antennas can, therefore, play a key role in ensuring that OCR has a stable and effective communication path in remote or mobile scenarios.

Microstrip devices like filters and diplexers also come in handy in OCR operations because they can sort or enhance signals before feeding them to the OCR system [22]. Preprocessors such as filters, on the other hand, can be employed in the removal of noise or interference from the signal to contribute to enhanced accuracy of

OCR by providing cleaner input data [23, 24]. Adopting cybersecurity and AI enhances the work process of organizations [25, 26]. Overall, as a future trend, Figure 6 shows the relevance of microstrip antennas, filters, and IoT with cloud OCR technology.

Figure 6. The importance of microstrip devices and IoT in Cloud OCR as future trends

8. Conclusion

Transforming the cloud OCR to a system involving Arabic OCR, the Iraqi government will be boosting the digitization of a huge range of documents written in Arabic, enabling those to become searched, editable, and easily retrieved. This will help in the prompt forwarding of the documents, reduce paperwork, and expedite information reception, especially for notary purposes. By using an Arabic OCR technology, which is oriented to read and extract Arabic text from different sources (images, scanned documents, and others) efficiently and correctly, a strong support is created. This implicitly guarantees that official Arabic language documents are effectively received as a result of getting them integrated into the government system, thus allowing smooth conversation and information sharing. The Arabic text that had been extracted can be subsequently subjected to data mining processes and analysis to determine the sentiments within them for any analytical tasks. This will enable the Iraqi government to make use of the digitized documents for analyzing and governance purposes, thereby fostering value addition to their operations and broadening its service delivery to the populace. Text Arabic OCR could be integrated with translation service to perform multi-language translation and achieve effective and efficient cross-language communication, through which the SaaS platform will better support multi-language collaboration. Such interactions are likely to make it possible to generate and maintain very good relationships with international institutions and agencies.

With Arabic OCR being part of the Cloud OCR system, this enhances its lines of defense on the security of data as it is done in accordance with regulations and standards. The technology provides a safe way of handling the government's SaaS system sensitive. The Arabic OCR technology can improve the ability to read or review things on a computer for those people with visual impairments when the information is image text. Such a portal involves inclusivity in addition to all users' interactions and content contribution with the Arabic language under the government-offered SaaS platform. Automating the processing of Arabic text from images with OCR technology would allow the government of Iraq to not only boost its operational efficiency but also to do away with repetitive tasks requiring manual data entry, and to increase productivity across various governmental bodies. It provides governments with an opportunity to tackle the challenges of scale by allowing the staff to carry out higher-valued tasks and thus deliver services in a more effective way.

In conclusion, embedding Arabic OCR is a vital step towards Cloud OCR implementation that is complementary to the Government SaaS platform being meant to revolutionize the country. Technology has the capacity to strengthen record management, translation services, data analysis, compliance, accessibility, efficiency, and productivity to the end that end users receive good services.

9. Recommendations

As a key part of the Iraqi government's cloud-based SaaS systems, the Cloud OCR is considerably essential for the Government's Digital Transformation, especially for developing the UR portal (a promising Iraqi government gateway into digital transformation). The first step in this procedure is to develop exact goals to be achieved during the process of implementation, the main goals being higher data accuracy, document processing efficiency growth, and digital transformation realization. This will create a focused project roadmap, which will also allow all stakeholders to evaluate their contributions in the context of the project objectives.

A good understanding of all the current document processing systems and cases in which the Iraqi government fails to meet some of its requirements due to OCR-related challenges is necessary in order to specify the exact requirements for a Cloud OCR solution. Finding OCR vendors in the cloud that can meet with those regarding government as well as compliance standards is the primary stepping stone by assessing different companies which offer technologies on accuracy, scalability, security, cost-effectiveness, and technical support. The vendor that best meets the government's requirements can be selected. After the vendor is chosen, the contractions of an infrastructure analysis should take place to guarantee the system's compatibility with the selected Cloud OCR solution. The integration of the new technology with the current infrastructure is necessary, thus its parts that need to be upgraded or modified should be identified to eliminate any interruption.

An all-encompassing security and compliance plan for data is a great measure that will keep private government data secure during OCR processing and will guarantee that the rules and standards in both the relevant regulations and standards will remain adhered to. A pilot trial of the Cloud OCR solution must be carried out in a continuous environment to measure its functionality and give feedback on its performance. The users and stakeholders must give their feedback to see the area that improves. Organizing tutorial sessions for the staff to learn the use of the Cloud OCR platform appropriately across the branches is a vital step towards the increase of user acceptance and reduction of common current concerns.

In order to achieve flawless operations of the Cloud OCR system, it is very crucial to integrate it with the system and convenient SaaS-based software systems of the Iraqi government. Interoperability and data exchange needs to be implemented across different software platforms to ease the process.

In the end, monitoring the effect of the deployment of a cloud-based OCR system on document processing speed, data accuracy, and entire digital transformation is an important task. A survey of customers and other stakeholders can be used for analysis after the implementation and will also be the source of ideas that will fix what failed in the implementation. With the application of this approach, the Iraqi Government will have the

ability to adopt Cloud OCR in its SaaS systems and ultimately make the digital transition and enhance document processing capability a reality.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

- Ali Alnooh: Conceptualization, methodology, data collection, writing - original draft.
- Nawar A. Sultan: Review & editing.
- Aqeel A. Al-Hillali: Data collection, literature review, writing - review & editing.
- Yaqeen S. Mezaal: Conceptualization, revision, data analysis.
- Kadhum Al-Majdi: Data analysis, visualization, writing - review & editing.

References

[1] A. Alsimry, K. Hussein Ali, and E. Wahab Abood, "A new approach for finding duplicated words in scanned Arabic documents based on OCR and SURF," *Journal of Basrah Researches (Sciences)*, vol. 47, no. 1, 2021.

[2] *Tesseract OpenCV Versus CNN: A Comparative Study on the Recognition of Unified Modern Iraqi License Plates. Revue d'Intelligence Artificielle*, vol. 37, no. 5. 2023.

[3] A. H. Alnooh and D. B. Abdullah, "On the impact of real-time parameters into the design of cloud load balancers," *Journal of Theoretical & Applied Information*, vol. 96, no. 15, 2018.

[4] A. K. Jumaa, A. A. Abudalrahman, R. R. Aziz, and A. A. Shaltooki, "Protect sensitive knowledge in data mining clustering algorithm," *Journal of Theoretical and Applied Information Technology*, vol. 95, no. 15, pp. 3422–3431, 2017.

[5] *United Nations E-Government Survey 2012: E-Government for the People*. New York: UN Publishing Section, 2012.

[6] M. A. Wahsh and J. S. Dhillon, "An investigation of factors affecting the adoption of cloud computing for E-government implementation," in *2015 IEEE Student Conference on Research and Development (SCOReD)*, 2015.

[7] N. Mohan, A. Majeed, A. Saleh, and A. Mohain, "Using Cloud-Based Web Application for Universities: A Case of University of Technology in Iraq," *Advances in Computing*, vol. 4, no. 1, pp. 15–17, 2014.

[8] H. Hashim and Z. Hassan, "Factors That Influence The Users' Adoption Of Cloud Computing Services At Iraq Universities: An Empirical Study," *Australian Journal of Basic and Applied Sciences*, vol. 9, no. 27, pp. 379–390, 2015.

[9] M. Al-Attar, "A Proposed Cloud Computing Model for Iraqi's Engineering Colleges and Institutes," *ZANCO Journal of Pure and Applied Sciences*, vol. 28, no. 2, pp. 1–5, 2016.

[10] M. Al-Ani and M. Ibrahim, "Efficient Virtual Universities via Cloud Computing Environment," *Journal of Emerging Trends in Computing and Information Sciences*, vol. 3, no. 11, pp. 1553–1559, 2012.

[11] Z. Alazawi, S. Altowaijri, R. Mehmood, and M. B. Abdljabar, "Intelligent disaster management system based on cloud-enabled vehicular networks," in *2011 11th International Conference on ITS Telecommunications*, 2011.

[12] T. Abd, Y. S. Mezaal, M. S. Shareef, S. K. Khaleel, H. H. Madhi, and S. F. Abdulkareem, "Iraqi e-government and cloud computing development based on unified citizen identification," *Periodicals of Engineering and Natural Sciences*, vol. 7, no. 4, pp. 1776–1793, 2019.

[13] M. S. Shareef *et al.*, "Cloud of Things and fog computing in Iraq: Potential applications and sustainability," *Heritage and Sustainable Development*, vol. 5, no. 2, pp. 339–350, 2023.

[14] F. F. S. Al-Bajjari, "A model for adopting cloud computing in the government sector: Case study in Iraq," Çankaya Üniversitesi, 2017.

[15] M. Q. Mohammed *et al.*, "Harnessing cloud of thing and fog computing in Iraq: administrative informatics sustainability," *Journal of Mechanics of continua and mathematical sciences*, vol. 19, no. 2, pp. 66–78, 2024.

[16] A. Al Lattif and M. Hamad, *OCR Improvement for Unstructured Big Data Integration*. University of Anbar, 2021.

[17] S. A. Alsaidy, A. M. Al-Chalabi, A. H. Alnooh, and M. A. Sahib, "Multi-resource power efficient virtual machine placement in cloud computing," in *2021 International Conference on Computing and Communications Applications and Technologies (I3CAT)*, 2021.

[18] Y. S. Mezaal, L. N. Yousif, Z. J. Abdulkareem, H. A. Hussein, and S. K. Khaleel, "Review about effects of IOT and Nano-technology techniques in the development of IONT in wireless systems," *International Journal of Engineering and Technology*, vol. 7, no. 4, 2018.

[19] A. H. A. Alnooh and D. B. Abdullah, "Investigation and analysis of Google cluster usage traces: Facts and real-time issues," in *2018 International Conference on Engineering Technology and their Applications (IICETA)*, 2018.

[20] M. S. Jameel, Y. S. Mezaal, and D. C. Atilla, "Miniaturized coplanar waveguide-fed UWB antenna for wireless applications," *Symmetry (Basel)*, vol. 15, no. 3, p. 633, 2023.

[21] Y. S. Mezaal and S. F. Abdulkareem, "New microstrip antenna based on quasi-fractal geometry for recent wireless systems," in *2018 26th Signal Processing and Communications Applications Conference (SIU)*, 2018.

[22] Y. S. Mezaal, H. H. Saleh, and H. Al-saedi, "New compact microstrip filters based on quasi fractal resonator," *Adv. Electromagn.*, vol. 7, no. 4, pp. 93–102, 2018.

[23] H. A. Hussein, Y. S. Mezaal, and B. M. Alameri, "Miniaturized microstrip diplexer based on FR4 substrate for wireless communications," Elektron," *Elektron. Ir Elektrotech*, 2021.

[24] S. Roshani, "Filtering Power Divider Design Using Resonant LC Branches for 5G Low-Band Applications," *Sustainability*, vol. 14, no. 19, 2022.

[25] S. A. Abdulameer, "Cyber Security Readiness in Iraq: Role of the Human Rights Activists," *International Journal of Cyber Criminology*, vol. 16, pp. 1–14, 2022.

[26] S. I. Yahya *et al.*, "A New Design method for class-E power amplifiers using artificial intelligence modeling for wireless power transfer applications," *Electronics (Basel)*, vol. 11, no. 21, p. 3608, 2022.