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Research Article

An Integration of Machine Learning with e-government: Challenges and Future Trends

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Abstract
The tremendous rise of data and information and the increase in computer processing in e-governments has significantly changed how the government makes decisions relying on advanced technologies. Machine Learning (ML) is a technology that can handle huge data and classification for statistics or even more complex purposes, such as data analysis and decision making. The applications of ML are being used to improve the current state of e-government services by reducing processing times, lowering costs, and increasing citizen satisfaction. However, this technology still confronts a number of obstacles that obstruct its use in e-government applications, both for improving e-government systems and for increasing e-government-citizen interactions. This paper aims to address and analyse the impact of the use of ML in e-government, and also to see the feasibility of this technology in the e-services provision in developing countries, the Kurdistan Region of Iraq (KRI) in particular. In addition, it highlights the challenges that impact the integration of advanced technology with e-government and discourses on future trends. The main contribution of this paper is that it helps organizations better understand their approaches to machine learning, allowing them to make more informed decisions about how to employ developed technology in the e-government system.

Keywords: Smart government, E-government, Technology challenges, Citizen satisfaction.

Abstrak

Peningkatan data dan informasi yang luar biasa dan peningkatan pemrosesan komputer di e-government telah secara signifikan mengubah cara pemerintah membuat keputusan dengan mengandalkan teknologi canggih. Machine Learning (ML) adalah teknologi yang dapat menangani data besar dan klasifikasi untuk statistik atau bahkan tujuan yang lebih kompleks, seperti analisis data dan pengambilan keputusan. Aplikasi ML digunakan untuk meningkatkan status layanan e-government saat ini dengan mengurangi waktu pemrosesan, menurunkan biaya, dan meningkatkan kepuasan warga. Namun, teknologi ini masih menghadapi sejumlah kendala yang menghambat penggunaannya dalam aplikasi e-government, baik untuk meningkatkan sistem e-government maupun untuk meningkatkan interaksi e-government-citizen. Makalah ini bertujuan untuk mengatasi dan menganalisis dampak penggunaan ML dalam e-government, dan juga untuk melihat kelayakan teknologi ini dalam penyediaan layanan elektronik di negara-negara berkembang, Wilayah Kurdistan Irak (KRI) pada khususnya. Selain itu, menyoroti tantangan yang berdampak pada integrasi teknologi canggih dengan e-government dan wacana tentang tren masa depan. Kontribusi utama dari makalah ini adalah membantu organisasi lebih memahami pendekatan mereka terhadap pembelajaran mesin, memungkinkan mereka untuk membuat keputusan yang lebih tepat tentang bagaimana menggunakan teknologi yang dikembangkan dalam sistem e-government.

Kata Kunci: Pemerintahan cerdas, E-government, Tantangan teknologi, Kepuasan warga.

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1. Introduction

In recent years, as the population increased globally and dramatically, and hence, the data and the data processing get more and more complicated. Therefore, new technologies will be necessary and the explosion of digital data has become a fact, and the ability of the public and private sectors to collect and analyse it has greatly risen. This led to a new age of data digitization, as well as a new trend known as Electronic Government (E-government). E-government cannot be defined as simply digitizing information services and publishing them online, but should take into account improving service quality to make them more accessible, efficient, and effective. It should also take into account the potential for multichannel service delivery to enable all stakeholders to choose the best channel for the services they need (Shareef, M. S., 2012). E-government is deemed to be an important part of any country that wants to grow its economy by connecting with as many investors as possible through various digital channels and simplifying procedures to make it easier for investors to get started on the right investment path in various industrial and commercial fields. As a result, providing personnel in government institutions with information, skills, laws, rules, and regulations to support e-government implementation policies is critical, but the role that technology plays in this area is more critical (Shareef, S. M., et. al. 2012). Recently the developed countries' numerous aspects of social life, such as production and consumption, interpersonal interactions, labour and behaviour, are being restructured as a result of the rapid development of digital technologies, including digital communication, infrastructure, and other innovative technologies. ICTs and technical revolution also offer new possibilities for "smart government" transition and better, more comprehensive management of government institutions. Smart government can be defined as the management of government business processes with the use of advanced and intelligently networked information and communication technologies for the service provided to its citizens effectively and efficiently. Technologies such as AI, the internet of things, robotics, big data, high-speed internet, and 5G mobile networks, play an increasingly important role in government institutions.

Despite the fact that many governments have made significant expenditures, particularly in developing countries, we believe most e-government programs, have failed to offer the transformative environment required for successful execution. As a result, any country's process of adopting the concept of e-government must include integrated elements, such as a body responsible for proposing, monitoring, and following up on the implementation of e-government legislation and policies, and, because the e-government system includes a huge amount of data and complex processes, a committee has to be conducted that contributes to decision-making in the process of implementing technical projects along with a clear structure of new technological development.

When someone mentions the data in the e-government system, it's clear that digitizing, processing, analysing, and storing, these datasets is impossible without the assistance of advanced technology. We believe that Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) are the key to processing the data in e-government. AI is the process of making computers into intelligent machines by utilizing their learning and perceptive skills (Kononenko, I., 2001; Russell, & Norvig, 2016). ML is a broad phrase that refers to a variety of algorithms used in areas including natural language processing, data mining, image processing, and predictive analytics. It's also known as "algorithms," and the terms "artificial intelligence" and "automatic decision-making" are often used interchangeably. More governments will be able to engage in the creation of such apps in many governmental sectors as a result of machine learning (European Parliament 2019).

Despite increased efforts by the Iraqi and Kurdistan Regional governments to integrate new technology such as ML and encourage employees to use and accept E-government services, the adoption rate is likely to remain low. Barriers and perceived benefits, such as lack of technology skills, content, design, social status, language, disparities in competence and abilities, differences in network access, differences in motivation, and other factors, may impact the adoption rate. However, research studies have demonstrated that putting user requirements at the centre of the creation of electronic public services is a smart method to promote involvement (Shareef, et. al. 2012). The amount of citizen satisfaction is a crucial metric for determining whether or not a product will be used and adopted on a wide scale. The rest of the paper is organized as below: In section 2 the literature review will be provided, section 3 the application of ML in e-government are provided. Section 4 illustrates some of the current e-services in the KRG. The challenges that influence the adoption of advanced technology will be addressed in section 5. In section 6 concludes the paper with some future trends and suggestions.

2. Literature Review

Many of the reviewed literature do not specifically describe digital transformation or digitization (SAP. 2017). However, a review of several sources on the subject allows for the identification of the major characteristics of this phenomenon. The term "transformation" is frequently used to describe a significant change, modernisation effort, or innovation, such as the incorporation of digital technologies into government business processes, service delivery models, and culture, and the reform of how the government performs basic functions and governs. While some researchers believe that transformation will occur as a consequence of increased usage of digital technology, others

contend that transformation will occur as a result of doing things fundamentally differently (Deloitte 2018) rather than "doing things incrementally better". On the other hand, Digitization is the process of converting real items or qualities into digital representations. We might, for example, scan a paper document and store it as a digital file (e.g., PDF). To put it another way, digitization is the process of transforming a non-digital object into a digital representation or artefact. Computerized systems can therefore be used in a variety of scenarios. When a measurement is transformed from a manual or mechanical reading to an electronic reading, this is an example from manufacturing (Gupta, 2020). The literature frequently associates digital government transformation with the use of certain technologies in government, such as block chain, the Internet of Things, or Artificial Intelligence (AI).

Given the massive volume of governmental data, we may assume that innovative technologies are required in the public sector to achieve its objectives. ML took off in the 1990s (Sebastiani, 2002), and was initially utilized in the field of Statistical Science, where attempts have been made to teach a computer how to play games. ML algorithms were developed during this time period for a number of uses, including speech recognition and offering data-driven answers to perplexing queries (Mitchell, 2006). The advancement of machine learning is critical in a variety of sectors, including cybersecurity and scientific discoveries, as well as a variety of corporate domains (Huang, & Liu, 2014). It also can aid in the identification of important components with yet-to-be-defined interrelationships, and hence can be used to reduce the complexity of social phenomena that are linked to policy issues. Predictive modelling, in this context, is described as the examination of huge data sets to draw conclusions or uncover important correlations that may be utilized to better forecast future occurrences (Guszcza, 2008). The research examines the development process of AI systems auditing in light of the benefits and limitations that have been recognized (Omoteso, 2012). The authors (Qian & Medaglia, 2019) identified the barriers to AI adoption in the public sector as seen by major people. They examined a case of IBM Watson adoption in public healthcare in China using the theoretical lens of framing to map how three groups (government policymakers, hospital managers/doctors, and information technology (IT) firm managers) perceive the challenges of AI adoption in the public sector. The findings showed that different groups have different perspectives on the challenges, which can be contradictory.

E-government portals are becoming a massive source of information and services. In developed and developing countries, citizens are using government portals and the number of users is increasing as the country develops. Whenever a citizen needs to see information on a portal, the information they need is stored in a database of various underlying search engines. Identifying the most relevant underlying search engine, which is likely to contain useful information for citizens' questions, can be a challenging task. Kumar, Singh, and Kumar (2015) used a genetic algorithm to suggest an approach for selecting the right meta-search engine for the user query and compared it to the existing algorithm. The goal of search engine selection is to increase efficiency by delivering a query to just the underlying search engines that are likely to be beneficial. The difficulty of receiving irrelevant query results drives the selection process. They said that if the data is ranked, it will be simple to find relevant information.

The effective fusion of ML algorithms and digital text is currently altering how governments use data to aid them. The Global Pulse Big Data program of the United Nations is developing a natural language processing algorithm in Indonesia. It allows the government to track food costs in real-time and get a head start on unforeseen price rises by identifying tweets that mention the pricing of staple foods like beef, poultry, onions, and peppers (UN Global Pulse, 2014). Data that is more complicated than text can be mined for useful information using machine learning techniques. (Gebru et al. 2017) describe how a Stanford team built a ML model to extract elements from Google Street View images in 200 US locations to assess socioeconomic characteristics. This model has been shown to be more accurate at forecasting household income, and as a result, it can not only lower the cost of labour-intensive door-to-door surveys of consumer satisfaction, but also assist in addressing the lag in demographic changes between polls. The public sector can benefit from ML by automating various labour-intensive data processing and analysis tasks. This will improve the effectiveness and speed of government services and efforts. Predictive ability is another advantage of ML. The fact that the impacts of a new policy are not known until it is implemented is a significant barrier when creating policy. Policymakers use a variety of methods to solve this issue, including policy trials, statistical model development, and comparisons of similar policies in other countries. As a result, policymakers can foresee a policy's effects before adopting it, which supports their adoption decisions. For instance, following the COVID-19 pandemic, a system of algorithms was used in Qatar to forecast how the lockdown policy would affect COVID-19 cases, assisting in the creation of a social restriction policy (Said et al, 2020).

3. Methods

Machine learning applications and E-government

Progress in the coordination of AI algorithms has aided in the development of decision-making systems with high accuracy and reliability. Many countries and governments in the twenty-first century are considering and intend to invest in AI. The countries that include an AI section in their national strategic documents or have specific AI-focused strategic documents include the UK, Belgium, Germany, and other countries (Barcevičius, et. al. 2019).

Belgium is one notable example, where the government launched AI4Belgiu (mhttp://www.ai4belgium.be/), a community-led initiative to help people and organizations take advantage of the opportunities presented by AI, and Germany incorporated an AI hub under the national program for the formation of innovation ecosystems (www.de-hub.de). A significant network of digital businesses and research institutions are brought together in the region by the hub in Karlsruhe. The UK has implemented a program to encourage the advancement of AI, particularly in the industry sector. As a result, academics and consulting corporations are becoming increasingly interested in researching AI and its branches used in governments.

Although there are many different approaches to the interdisciplinary science of AI, advances in ML and deep learning (DL) are causing a paradigm change in almost every area of the tech industry. Machine learning is a subset of AI; the applications of ML are being used to improve the current state of e-government services by reducing processing times, lowering costs, and increasing citizen satisfaction. The enormous data availability and the field's requirement for policy prediction underpin machine learning's potential in the public field. Machine learning has already shown promise in improving the efficacy and precision of a variety of decision-making processes, including tax evasion, mortgage approval, and the identification of terrorist activity (Huamaní, et al., 2020; Pérez, et al., 2019). This technology has the unmatched computational power to extract information from unstructured data, including texts, images, videos, and blogs, as well as high-dimensional data. Governments now have access to a huge amount of data that is gathered by public institutions for transactions, registration, and record-keeping. Due to their massive processing size and unstructured nature, these raw data, however, frequently do not exist in a comprehensible form for conventional statistics models (Ubaldi, 2013). Thus, the development of ML in data processing and analysis could assist in releasing the value of the data, automating tedious processes, understanding the wants of the citizens, and thereby supporting creative services.

In addition, ML forecasts on social service needs can aid in maximizing the distribution of scarce social resources. New York University created a ML model of homeless family shelter entry and length of stay to research the likelihood of re-entry and the possibility that a homeless family will stay for an extended period of time. The model's findings assist shelters in understanding the need for beds at any given time, enabling them to allocate resources more effectively based on anticipated needs (Hong et al., 2018). In various situations of decision-making, including predictive police, smart city planning, and judicial adjudication, governance by such algorithmic prediction is becoming more and more ingrained (Abdul, et al., 2018). The study by Meijer et al. (2019) reveals how the use of ML enables the computer to identify the geographical pattern of past criminal activity and predicts where crime may occur in the future automatically and with high accuracy. Additionally, there has been a rise in interest in using ML systems to forecast judicial outcomes. With the use of natural language processing technologies and prediction algorithms, Medvedeva's team (2020) was able to automatically forecast future judgments with an average accuracy of 75%, providing a solid foundation for the decision.

Additionally, a variety of ML models are being used to categorize data from social media sites like Facebook and Twitter into specified categories (Patil, et. al. 2017) As noted by (Ghosh, et. al. 2016) ML techniques such as support vector machines and word feature selection (SVM + FS) can be used to analyse citizen reports, such as danger detection signs reports even employing social media reports or even for real danger detections - reports. ML is no longer just about the technical domain, but also has enormous potential effects on every part of our society due to the exponential rise in algorithm-assisted judgments in public policy that can significantly alter people's rights, interests, and aspirations. For the public sector, the tourist industry can act as a tourism reference by anticipating visitor arrivals. Economic development may benefit from the use of ML approaches and more specific data for instance travel by road/air, habitation, and art) (Chang, & Tsai, 2017). In New Zealand, ML models are utilized in the cattle industry for the estimation of livestock biosecurity as well as for a wide range of applications in disease risk modelling policy and planning (Hollings, et. al. 2017). Even though it was demonstrated by (Wilbanks, & Topol, 2016) and (Lachana, et. al. 2018) that significant efforts are being made globally in the areas of healthcare, water pollution, and air pollution. By turning huge data into valuable information through advanced technology, E-government could achieve its next-generation toward data-driven and evidence-based decisions and policymaking. A requirement for the public sector to achieve its objectives might be regarded as an advanced procedure when taking into account the enormous amount of massive, open, and linked governmental data. E-government services have recently been used by many governments in a variety of departments and numerous independent applications. Even though many studies have been done to improve e-government services, very few of them referred to the use of developments in AI and ML in the automation of e-government services. Therefore, there is still a pressing need to handle e-government needs and issues using cutting-edge AI approaches and algorithms.

4. Results

E-services in Kurdistan Region of Iraq

Iraqi Kurdistan has recently improved government services and public needs by using ICT as a tool. In order to

carry out IT projects in conjunction with diverse public and private sectors, the Kurdistan Regional Government (KRG) has established a department of IT (DIT) in the council of ministers. By the end of 2002, the public was familiar with the KRG's website, which was run by the department of foreign relations in the KRG (Shareef, & Arreymbi, 2013). The website was set up as the government Info-structure and created as a portal for all of the internal and external public to get information on the news and activities of the government. However, the development of innovative technology across the globe encouraged government administrations to take active actions toward the use of technology in services provided electronically. The regional government has always placed a premium on the government's contribution to rebuilding Kurdish society as well as improvements to the nation's infrastructure, services, political freedom, and daily lives. The regional administration is the driving force behind the national e-government initiative. It seeks to increase the effectiveness and efficiency of government services by raising the standard of service delivery to its citizens and other stakeholders. In order to change government and offer its citizens services effectively and efficiently, KRG has recently turned to ICT. As a consequence, the (DIT) has taken steps to implement e-government since 2007. Numerous initiatives have been involved, as illustrated in Table 1.

Table 1 E-services implemented by the Department of IT

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
MS Windows& Offices	2005	DIT	Completed	The DIT has distributed MS Office applications to government institutions to use genuine and professional applications
IT Academy	2007	DIT	Completed	Launching this academy was the first step toward e-government, which aims to train citizens and government workers to increase their IT skills and grow the local human resource base.
iOpenKRG	2007	DIT/Innovazione Italia	postponed	Using fiber optics to connect and communicate with all ministries.
IT Strategy	2009	DIT/ Price Waterhouse Coopers	Completed	This strategy is intended to help the government create an IT strategic plan and a project implementation road map.
Electronic ID card	2016	DIT/Microsoft company	suspended	This card replaces the ration card in the future and contains information about its person.
Biometric System	2016	DIT/Independent High Electoral Commission (IHEC)	On Progress	This system is used for quick biometric identification in such a way that if the biometrics of any citizen is given to the system, it can determine whether that person is on the government payroll or not.
Khizmat	2018	DIT/ Completed	On Progress	This project is about a statically portal for government service that includes many services such as; the issuance of driving licenses, investments in the area, education, further education, and all necessary information.

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
Modernization of Public Procurement System in KRI	2018	DIT/ Korea International Cooperation Agency (KOICA)	On Progress	This project is consulting services, the creation of e-procurement systems, and IT along with capacity-building courses.
MS Windows& Offices	2005	DIT	Completed	The DIT has distributed MS Office applications to government institutions to use genuine and professional applications

In 2007, the (DIT) has been working on a number of projects, one of which was the government staff electronic ID card project, which had a budget of $4.712, 031 and was intended to provide 600,000 KRG employees with standard, professional, biometric, and smart ID cards. However, they were only able to provide 6,000 IDs, and the project has been suspended (Shareef, & Arreymbi, 2013). The other project, known as "E-government," was (IOpenKRG), which had a budget of ($3,535,206) and was launched in 2007. It was suspended two years later, in 2009, with the stated goal of "implementing ICT as a tool to facilitate and enhance better government services and enhance citizens' life through electronic public services." KRG-IT infrastructure and strategy was another project that was underway (Shareef, & Arreymbi, 2013), with a budget of $3,500,000, this project planned to create IT strategies for KRG ministries over the course of the following five years. In actuality, the project was successful despite not having received KRG's approval. Also, the IT academy project aimed to train and educate KRG staff members in order to improve their IT-related skills with budget of ($ 4,250,000) with KOICA cooperation. In addition, KRG had a contract with Microsoft to purchase (MS Windows) and office License for ($6,826,832) before establishing (DIT) in 2005, as yet known these licenses all expired without providing any benefits to the KRG. Although, above mentioned projects have not yet been officially finalized by the government. It can be deduced that the overall cost of the (DIT) projects was around 16 million dollars over a period of five years, and the failure of those IT projects can be identified.

However, recently some of the ministries proposed and implemented e-services individually to facilitate the services that they provide to their people. According to the interview conducted with IT persons in the ministries and the DIT, we observed a number of initiatives, some of which began in 2016 or later in 2021. There are many instances of governments using digital technology; the most related ones are shown in Table 2.

Table 2 E-services implemented by Ministries of the KRG

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
Electronic Visa	2016	Ministry of Interior	Completed in 2016	Through this project companies, NGOs, visitors, UN organizations, visitors, and others are allowed to ask for a Kurdistan visa online.
Asan Services	2017	(Sinam) company	Not Completed	Through the project to construct Public Service Centre, the ministry would have new hubs with ICT platforms to deliver e-administration services.
E-service	2020	Ministry of Interior	Completed in 2020	Citizens are allowed to travel within the city or between cities during quarantine time.
Digital driver's license and vehicle registration system.	2021	Ministry of Interior	Completed in 2022	It is a digital system used by the Ministry of Interior to renew citizens' driving licenses in a new and modern way, as well as to renew and register vehicles annually throughout Kurdistan.

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
Vaccination System	2021	Ministry of Health	Completed in 2021	Before administering the vaccine, they are allowing citizens to register for vaccination.
Kurdistan E-Residency System	2019	Ministry of Interior	completed	Visitors have to apply for a Card of Residence through this form if they want to stay and/or extend their visit to the Kurdistan Region.
Traffic violations' system	2018	Ministry of Interior	completed	Erbil's General Traffic Directorate started putting a system for checking on moving vehicle infractions, like speeding and running red lights.
Legislation database	2020	Ministry of Justice	Completed in 2021	A database containing all of the laws, legislations, directives, declarations, regulations, justifications, and recommendations that are in effect in the region.
Student Platform	2021	ME/SPU	Completed in 2021	An online platform for transferring students among universities, colleges and departments.
e-parwarda	2016	ME/Soft max Company	Completed in 2019	Complete platform for EMIS Education management information system it has three main part School(school building information and store system , HR, Student (include student personal information and marking an calculation system in additional of administration part
e-wana	2019	ME/Soft max Company	Completed in 2019	Platform contain recorded set of all lessons for all subjects from Grade 1 to 12 in 5 languages (Kurdi Sorani , Arabic, English, Turkish and Srics also Kurdish Badinani
e-correction	2018	Directorate of Examinations \ ME	2018	Offline application for scanning and calculation General Examination for Grad 12 for four brunches (Scientific , Literary , Vocationally , and Islamic study
Soma Publishing	2018	Directorate of Examinations \ ME	2019	Portal for announcing student answer sheet for General examination Grade 12
Kurdistan Financial Management System	2020	Ministry of Finance and Economy	On progress	This system is to digitize the process of demanding expenses from the KRG agencies. All requested expenses must be submitted through this system to the Ministry of Finance and Economy. Even all supplements for requested expenses are attached to this system and through the same system the requester is informed of the latest decision of the Ministry of Finance and Economy.
customs electronic system (manifest system)	2017	Ministry of Finance and Economy:	partially completed in 6 customs	This project will automate all customs transactions and be directly connected to the general directorate of customs to review daily and

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
		computer systems com.		monthly statistics of import-export transactions.
Document Management System	2018	MHE	Completed	A Web application to manage all the income and outcome Documents and letters throughout the MHE
Finance Management System	2018	MHE	Completed	To manage all finance tasks and transactions related to MHE
Student Information System	2018	Dottech	Completed	To register all the students records in the public universities
Language Center	2018	MHE	Completed	Manage and controlling the process of applying to the language centers in the public universities
Zanko Line	2012	MHE/MediaTech	Completed	To manage the process of admission in the public universities
Qualifications Equalization	2017	MHE	Completed	To manage the process of qualifications equalization of those students who studied abroad.
Private Study	2020	MHE/Dottech	Completed	To manage all the administrative tasks that related to the private Universities
Scholarship	2021	MHE	Completed	To record students information who are in the process of studying abroad.
Digital judicial system	2020	Ministry of Justice	Completed	The digital judicial system is used to organize the work of the judiciary and connected all branches of the judiciary to the Ministry of Justice
Kurdistan Electronic Public Contracting System	2020	Ministry of Planning	On progress	The Kurdistan E-Public Procurement System is a channel for all public contracting and tendering processes in the KRG.
Information management system of relatives of martyrs, Anfal victims and political prisoners.	2020	Ministry of Martyrs and Anfal Victims.	On progress	This system is generally used in the Ministry of Martyrs and Anfal Victims to manage the affairs of the Ministry in the matter of paying financial entitlements to the families of martyrs, Anfal victims and political prisoners.
Registration system for coronavirus vaccine	2020	Ministry of Health	Completed	This system is used for online registration for the coronavirus vaccine

Project Name	Implementing Year	Cooperated Company/Ministry	Status	Project Details
Coronavirus test result retrieval system.	2020	Ministry of Health	Completed	This system is used to retrieve the results of the coronavirus test and is supervised by the Ministry of Health.
Smart electricity meters.	2019	Ministry of Electricity	On progress	Smart electricity metering system is used to measure, monitor and control electricity in the Kurdistan Region.

Although there are more projects, we chose not to include them in our work due to the sake of national security and a lack of knowledge regarding these projects and the information we learned from interviewees. In the meantime, the DIT recently created an official website (www.gov.krd) under name of (Khizmat, https://services.gov.krd) to provide e-services to the citizens in the public and private sectors. The aim of this portal is to transform governments' services digitally. In this regards, the DIT was organized a conference jointly with Huawei Telecommunications Equipment Company titled "From Concept to Reality". The conference held on Thursday 10th March 2022 about the KRG's digital transformation in Erbil. The main topics of the event included the idea of government digital transformation and how the digitalization process should be planned by noting potential difficulties and obstructions, as well as the impact of digital transformation on the government and how it can assist it in achieving sustainable development. Huawei demonstrated cutting-edge ICT solutions developed to meet the demands of both the public and private sectors. In addition, Huawei presented some new ideas and important develop technologies that can help the government to use these technologies to make systems more effective and efficient. In addition, apart from the web-based application, the KRG started to create a mobile-based application (KRG Services) for Android and recently will be created for iPhone alike. Furthermore, this app allows secondary school students (12th grade) to apply directly to the universities, colleges or/and departments that they desire based on their average marks. Also, this app lets citizens know the electricity bills, traffic fees, water bills, property taxes, and car annuity payments. Currently, only the electricity bills, traffic fees, and Zankoline services are available. The purpose of this simple app is to make it easier for Kurdistan citizens to get acquainted with all the services of the Kurdistan Regional Government through one app.

Despite these efforts, it has been observed that the KRI's e-services were implemented without a strategic plan for implementation. E-services have been prepared and implemented by the DIT on an individual basis, as well as by the ministries. As a result, these implementations ultimately cannot be added to the integration stage in the future. These issues have the potential to worsen the integration process. The government will have a major problem as a result of having to start over and reconstruct these projects in order to integrate them to reach a one-stop-shop (Shareef, et.al. 2012). Considering everything, it will become apparent that there are no such E-government administrations in the KRI. However, the government recently decided that any E- projects in the region must be implemented in collaboration with the DIT.

5. Discussion

The challenges of using ML in government services

Data analysis is a process that takes place in ML in order to create or train models. It is prevalent everywhere and holds enormous value in everything from self-driving cars to Amazon product recommendations. According to the most recent research, the global ML market is anticipated to grow at a Compound Annual Growth Rate (CAGR) of 42.8% from 2018 to 2024, (Columbus, 2020). This process has significantly increased the need for ML experts. Also, Jobs involving AI and ML have seen a strong growth rate of a CAGR of 44.06% between 2017 and 2024, and the sector is constantly expanding. Although it is a difficult and complex process, a vocation in ML offers high job satisfaction, fantastic growth, and an amazing income. Any project strongly depends on data. Beginners can easily locate data from any online data science community platform such as; Kaggle, the UCI ML archive, and other sources for practical machine learning. For instance, if you conduct real-world case studies in order to solve business issues, you will need to use web scraping or (web data extraction) to gather the data (in this case ML engineers need to harmonize with domain experts to collect the data). After the data have been collected, it needs to be organized and stored in a database. This requires knowledge of (Big data) or data engineering which is crucial in this case.

Even though the utilization of ML has a great impact on the data processing in government, there are restrictions that are mostly brought on by the type of data being analysed and may produce false results. Given that there are no set procedures to be followed, a variety of procedures must frequently be evaluated, and the amount of data may be enormous, both the creation of ML model and the processing of the data may take a large amount of time. Machine learning experts confront many challenges while trying to understand ML techniques and build an application from scratch. The main challenges that ML utilization in government faces are connected to the type and the quality of data (Ritheesh, 2020). Choosing a learning algorithm and learning the model using part of the

collected data are the two crucial steps in every machine learning project. Therefore, as human beings, we have a tendency to make mistakes, which might cause problems. Making the incorrect model choice, or using bad data could be faulted in this case. The complexity of ML tasks increases if we take into account heterogeneity and unstructured data as well as the availability of several regional languages. The first difficulty is a lack of related data for processing, while the second is that sometimes there is too much data produced, which causes issues with information overload. The majority of machine learning engineers use these procedures while developing an application. 1) Data collection 2) Data cleaning 3) Feature engineering 4) Analysing patterns 5) Training the model and Optimization 6) Deployment. Many machine learning practitioners can perform all steps; they may lack the skills for utilization. Bringing their good applications into production has become one of the main challenges because of a lack of practice, reliance problems, low understanding of underlying models with the business, understanding of business problems, and unstable models (Aurélien, 2019).

Machine learning is no longer limited to the technological field and has enormous possible effects on many facets of our society. Based on the literature review, it is clear that ML can have a significant positive impact on society. However, there are still many issues surrounding it that need to be resolved, including those related to explainability, fairness, and institutional challenges (Gunning, et. al. 2020 & Guenduez, et. al. 2019). These issues have the potential to worsen existing issues. In spite of this, the tech world has begun a discussion concentrated on the gravity of the aforementioned. However, the majority of study has either been focused on a technical perspective or the uses in the private sector. Given that the two sectors' reliance on political control as opposed to market forces is different in terms of ownership, administrative culture, and relative reliance.

Despite the fact that Machine Learning has the potential to improve society in many ways, there is still plenty of evidence to suggest that discrimination against specific racial or ethnic groups and individuals, whether deliberate or inadvertent, remains a problem. For example, Amazon developed an AI hiring tool to rank candidates and decide who to hire. However, the technology learned to automatically disregard women's resumes for technical positions like software engineers, reducing women's chances of landing such positions (Kodiyan, 2019). Nevertheless, bias typically does not result from algorithm design; rather, it is inherited by algorithms from historical data, which incorporates biases left over from past human decision-making and culture. Hence, the latent discrimination and traditional gender ideology that are captured in the data that the algorithm learns from serve as the source of this type of prejudice (Leavy, et al., 2020). The resumes of company employees, mainly men, were an important source of data used to train the AI recruiting system. The existing male dominance in the workplace is naturally reflected in this gender inequality that is embedded as a data imbalance. The algorithm continuously maintained this tendency because it has been researched; this indicates that algorithms frequently preserve the status quo rather than advancing without human interference (Alexopoulos, et. al. 2019). Strong policies and safeguards on data security and privacy are essential for ML applications in e-government services. However, there are still issues that prevent the development of specific data security and privacy standards, such as issues with citizen trust in government, transparency, and other technical challenges associated with creating and operating secure systems. Insufficient Infrastructure (Prove, 2022) is another challenge of using ML. For instance, to use machine learning effectively, you need to be able to process enormous amounts of data. The amount of work frequently overwhelms legacy systems, which then fail. If your infrastructure is equipped to handle machine learning, you should check that. If it cannot, you have to upgrade, adding hardware support and flexible storage. A summary of some challenges of using ML in government services is illustrated in table 3.

Table 3 Summaries of challenges of using ML in government services

Challenges	Descriptions	References
Ethical issues	Fairness, Bias, and Discrimination, Explainability, Transparency, and Accountability, Institutional Challenge,	(Kodiyan, 2019). (Leavy et al., 2020). (Gunning, et. al. 2020 & Guenduez, et. al. 2019).
Quality of data	We as a human being, we have a tendency to make mistakes, which might cause problems. Making the incorrect model choice or using bad data could be faults in this case.	Ritheesh, 2020
Insufficient data and expertise of AI in non-technical professions	In non-technical positions such as procurement officials, policymakers, and department heads, public employees frequently lack basic data and AI expertise.	Kaplan, 2016
lack skills for utilization	Due to a lack of experience, dependency issues, a poor understanding of the underlying business models and	Aurélien, 2019

Challenges	Descriptions	References
	unstable models putting their acceptable applications into production has become one of the major hurdles.	
Mainstream implementation of AI	Contrary to popular belief, which holds that technology is the main barrier, technical concerns are only a small part of the work at hand. Nevertheless, this is the piece that is easiest to address. Organizations' deeply ingrained cultures and operating procedures need to be adjusted before AI can be fully employed.	Baek et al., 2016; Wirtz, et. al. 2018
Acquisition of relevant data and Merging different ML techniques	Acquiring relevant data. Data must be processed before being sent as input to the appropriate algorithms based on various algorithms. This has a big effect on the outcomes that can be expected.	RF Wireless World, 2012
Interpretation of the findings	Finding out how well ML algorithms work requires a lot of interpretation of the data. Although a ML system can correctly extract findings, their interpretation may not be accurate and is prone to human error.	Sommer & Paxson, 2010
AI Skills	Performance evaluation and AI expertise are in short supply. Even while learning information management is a rather threatening process, it can be difficult to develop the necessary abilities to put AI technological advancements into practice.	Osoba & Welser, 2017
Challenges; fairness, privacy, interpretability, and safety	These challenges could obstruct the development and wide application of machine learning, which could have significant economic consequences.	Borrellas, 2021
Information Saturation	Big data and computational capacity are less effective together since ML methods need to be able to ignore and remove data in order to have a finite and realistic calculation time.	Marasco, & Kontokosta, 2016

The use of developed technology such as ML has already altered how people live, work, and interact, also with the action that has just begun. However, the very same technologies that could make billions of people's lives better, healthier, and more productive are also posing new problems for individuals and governments across the globe. Recent affairs have shown how developed technology is transforming how we think about national security, privacy, and possibly even the democratic process itself. These events range from election interference to data cracks and cyber assaults. Understanding how a decision is formed and spotting bias is a difficult task due to the complexity of ML algorithms. To inspire ML to take a larger role in the decision-making, coming up with solutions to address these issues is fundamental. It is important to address the ambiguity, Explainable Artificial Intelligence (XAI), which goals to allow human users to comprehend, passably trust, and successfully manage the evolving generation of artificially intelligent partners, was developed to solve the opacity (Gunning, 2019). Also, the uncontrolled, poorly built algorithms have the possible to have far-reaching negative effects, frequently affecting the most susceptible elements of society. In order to evaluate algorithmic systems, public authorities urgently require a practical framework (European Parliament, 2019). The idea of adopting algorithm impact assessments to ensure their responsibility is gaining swiftness (Moss, et al, 2020). In order to make sure that ML advances in a direction that is advantageous to society, more study and experience are required to create a standard structure and application.

In addition, the Coronavirus duration has highlighted the crucial part that ML plays in enabling quick policy decisions based on real-time data analysis and forecast. However, as mentioned above, the public sector continues to exhibit hesitation toward or a lack of aptitude for embracing the advent of the ML epoch. The United Nations has proposed nine key props for the transformation of developed technologies like machine learning (UN survey, 2020), prioritization of structural culture changes within government, the implementation of new legal frameworks, and the growth of new capacities within individuals. Training public employees, starting with the top policymakers and working their way down, will be the simplest way to enable the adoption of cutting-edge technologies. Emerging training initiatives can enhance public officials' ML-related knowledge, abilities, and attitudes.
In order to enable government institutions to be able to initiate and implement the developed technology be proactive regarding developing responsible ML by employing ethicists, establishing review boards, and devising mitigation techniques early in product creation and deployment. To evaluate the effectiveness of new initiatives,

use evidence-based analysis. Encourage remote or hybrid employment to increase the technical talent pool's geographic opportunities. Also, the government authorities have to form partnerships with institutions of higher education, academics, technical institutions, online course providers, or businesses that offer personalized learning or certificate programs to train current and future employees. Expand professional development programs for technical and non-technical employees and embrace lifelong learning. In addition, the government has to establish proper guidelines for data collection and analyses to enhance ML algorithms. Reforming the government's purchasing procedures, and creating an innovative culture within the institution. Using pilot programs to less riskily introduce innovation and determine secure methods for expanding pilot initiatives to the entire organization.

6. Conclusion

Artificial Intelligence, particularly Machine learning, and e-government as a combined issue have lately attracted research interest in a series of studies. The use of ML in e-government has enormous potential because it opens up a large range of services and applications that could be made accessible to and helpful to the general population. The goal of this paper is to address and analyse the impact of the use of ML in e-government, and also to identify the challenges associated with the use of ML technology as well as pinpoint ML future trends in both public and private sectors. Additionally, emphasized the feasibility of this technology in the e-services provision in developing countries, particularly Kurdistan Region of Iraq (KRI), and explore the feasibility of implementing ML solutions in future trends. In order to remedy this, a thorough review of related works of literature and interviews was conducted with IT persons in the KRG ministries have been carried out. The findings revealed that ML can be used to analyse the huge amounts of data in government. The quality of the data and the necessity for human interpretation of the results, which could result in inaccurate results, may restrict the benefits that ML can offer to governments. The two key steps in every ML project are selecting a learning algorithm and training the model using some of the gathered data. Because of this, we have a propensity to make mistakes as humans that could lead to issues. In this situation, choosing the wrong model or using subpar data may be blamed. Also, there are still many challenges surrounding it that need to be resolved, including those related to explainability, fairness, and institutional challenges.

This paper also showed that over 2016 diverse services in many fields are tested in Kurdistan Regional Government's institutions. Although many e-services were implemented, however, most of the e-services are initiated and implemented individually by government agencies, there is no strategic plan that all government institutions cooperate to implement a robust e-government system. In addition, the citizen has no idea about these services; this is due to the lack of citizen awareness, along with the digital divide. In this regard, the government authorities have to form partnership with institutions of higher education, academics, technical institutions, online course providers. Also, the businesses that offer personalized learning or certificate programs and train current and future employees along with the citizen awareness programme. The success of ML-based e-government is significantly influenced by each of these factors, both collectively and individually. For the purpose of developing the ML vision and policies for e-government, this may ask for the collaboration of all stakeholders concerned from the public sector or the private sector. This all-inclusive method of looking at ML e-government can provide a springboard for more research and activity in this exciting area. We believe the future research aims the creation the framework for addressing the huge data in government ML's problems, such as the heterogeneity of the data and the integration of data sets from various government institutions, getting good quality data, is one area that needs more investigation.

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