AN INVESTIGATION ON ARTIFICIAL INTELLIGENCE IN SMART CITIES FOR ON-DEMAND VEHICLE AUTOMATIC SYSTEMS.

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ABSTRACT

As a result of the implementation of AI, the process of city planning has become significantly more automated and standardised. People who live in urban areas are more likely to be exposed to novel ideas for resolving issues and making preparations for anticipated difficulties in advance. It is anticipated by specialists that by the year 2050, more than seventy percent of the world's population will reside in urban areas. In light of this, there is an urgent requirement for a public transport system in metropolitan areas that is not only user-friendly but also ecologically friendly and highly efficient. This in-depth analysis takes a look at fifty publications that have been examined by experts in the field and cover the subject of urban mobility through the use of artificial intelligence, the internet of things, and information and communication technologies from the years 2015 to 2024. The seriousness and accuracy with which the articles were presented were the primary factors that led to their selection. Their primary objective is to enhance the performance of traffic signals in real time by doing research on intelligent routing systems, prediction algorithms, and other areas connected to this area of study. There is optimism that the introduction of self-driving cars would extend the range of available modes of transportation, enhance the effectiveness of public transportation, and make roads safer for everyone. The fact that this is the case is evident for a variety of reasons, not the least of which are those that have already been mentioned. It is necessary to include artificial intelligence into smart cities and urban mobility before these areas can even begin to address the myriad of challenges that they face.

Keywords: Intelligent Transport Systems, IoT, Smart Cities, Sustainable Urban Design, Traffic Forecasting.

INTRODUCTION

AI refers to a collection of tools that enable robots to behave in a manner that is comparable to that of humans in terms of learning, thinking, reasoning, making decisions, creating things, and improving their performance in various areas. In addition to being able to comprehend human languages, which makes communication simpler, artificial intelligence that possesses vision intelligence is also able to locate and organise items. By 2050, experts predict that almost 75% of the global population will reside in urban regions (Maddikunta et al., 2022). Smart city building is necessary to make megacities more livable and sustainable for years to come, even though

some of these cities have already solved the problem of large-scale traffic management. The transportation industry has been revolutionised by artificial intelligence, which has improved the efficiency of several systems. Technological advancements have significantly enhanced transportation efficiency. These advancements encompass data processing and analytics, predictive modelling, self-driving cars, traffic optimisation and simulation, and the development of personalised travel plans. A large amount of data from a variety of sources can be analysed using machine learning algorithms, which can then be used to identify patterns, make predictions about how traffic will move in the future, and determine the most effective ways to manage it. Artificial intelligence technologies enable self-driving cars to swiftly navigate their environment, assess their surroundings, and make informed decisions. Artificial intelligence has developed traffic simulation models that accurately reflect real-world traffic operations. This simplifies the testing and improvement of traffic control systems. Artificial intelligence is significantly impacting the expansion of the transportation business in various ways. There are many challenges that Intelligent Transportation Systems (ITS) need to overcome, such as the requirement for real-time processing, the fact that they are complicated, the fact that people do not want them, issues over privacy, high computing costs, security dangers, and the requirement to safeguard data. The researcher ought to consider at least each of these issues. It is possible that artificial intelligence systems will still have difficulty predicting when buses will arrive in real time, even when they have access to a substantial amount of suitable data. Due to the fact that buses do not always arrive at the same time, this is the case. However, real-time processing necessitates the employment of rapid algorithms, which can be challenging to implement in settings with limited resources. Due to the fact that it creates problems regarding privacy, public acceptability, and security hazards, artificial intelligence requires precise regulations for how to handle data as well as stringent security measures. Artificial intelligence has the potential to assist us in resolving the many problems that arise as a result of the expansion of cities. The ability to automate activities, make predictions, and do real-time data analysis are all areas in which it shines. There are many issues that need to be resolved, such as pollution, transportation, and the dearth of goods and services that are within reasonable price ranges. Experts predict that by 2050, the majority of people worldwide will live in urban areas. A more sustainable urban environment is possible with the help of AI, which can enhance people-centered transportation and planning options (Belaïd et al., 2023).

BACKGROUND OF THE STUDY

The article titled “Artificial Intelligence in Smart Cities for On-Demand Vehicle Automatic Systems” explores the various ways in which artificial intelligence is supporting smart transportation systems. This article is written with the intention of laying the framework for the study that will follow (Toli & Murtagh, 2020). In turn, these solutions are helping to ease the difficulties of traffic bottlenecks and wasteful travel in cities that are in the process of growing in proportion to their population. The application of machine learning (ML) and AI has the potential to make smart cities friendlier and secure for their residents. The introduction of self-

driving cars, the management of traffic congestion, and dynamic routing are some of the options that are accessible to choose from. Protecting the privacy of individuals, establishing the types of infrastructure that are necessary, and making certain that these technologies are available to everyone are all things that need to be done in order to make cities more ecologically friendly and prosperous in the future. An important part of the process of developing artificial intelligence is the establishment of “smart cities”, which are cities that make use of data and smart technology to solve problems in cities. Smart cities are developing in order to address the challenges that cities face. The ever-increasing demands of people who reside in metropolitan areas are putting a significant amount of strain on the current transport networks. This strain is placing a tremendous lot of strain on the existing transport networks. It is common knowledge that cities in the modern world are known for a wide range of problems, including traffic congestion, pollution, hazardous conditions, and wasteful use of resources. In response to these concerns, the concept of “smart cities” has arisen as a new standard for urban planning. For smart cities to achieve its goals of better city administration and infrastructure and higher quality of life for its residents, state-of-the-art digital technologies must be implemented. A key component of intelligent transportation solutions and on-demand autonomous driving systems, AI has emerged as a result of this revolution. There are few parts of this shift as important as this. There are many examples of how artificial intelligence has transformed the transportation business. Some of these examples include the ability of cars to perceive what is going on around them, the ability to make judgements in the moment, and the ability to interface with the infrastructure of smart cities. Computer vision, machine learning algorithms, and predictive analytics are the technologies that make it viable to entirely automate the driving process. Through the implementation of this technique, not only are things made more secure, but they are also made more cost-effective. Several technical breakthroughs, such as the Internet of Things (IoT), 5G connection, and cloud computing, have made it possible for infrastructure and autos to communicate with one another. This is a significant development. By using this connection, which makes it possible for urban services and autos to work together, it is conceivable to establish a connected ecosystem for mobility that is both intelligent and ecologically benign. This is a concept that is feasible (Khavarian-Garmsir & Sharifi, 2022).

PURPOSE OF THE RESEARCH

The primary objective of the research being conducted on artificial intelligence (AI) for smart city on-demand vehicle systems is to improve the safety of traffic flow and the efficiency of self-driving cars, as well as to improve them for the environment. Using real-time data, artificial intelligence is able to estimate demand, adjust routes on the fly, coordinate cars, control traffic signals, and make it easier for autonomous fleets to work together. The work is done with the goal of improving the customer experience while having less of an impact on the environment. Vehicles that are capable of driving themselves and are powered by artificial intelligence have the potential to significantly cut down on the number of accidents and incidents that are caused by human error. Autonomous vehicles are equipped with artificial intelligence, which enables

them to see, detect things that are nearby, and adjust to new circumstances. This feature enables them to steer clear of any hazards and drive in a secure manner. However, the implementation of AI on a wide scale poses additional challenges, despite its potential benefits for smart cities. There is widespread adoption of smart city technologies simply because they are ubiquitous and make things more enjoyable.

LITERATURE REVIEW

There is a significant demand for transportation services, and the vehicle sector is expanding at an astounding rate all over the world. In the day-to-day lives, the fact that the automobiles are equipped with the most recent technology and a wide variety of entertainment alternatives is a significant advantage. A study on road safety was conducted by the World Health Organisation (WHO), which came to the conclusion that by the year 2030, automobile accidents would be the leading cause of death as well. When it comes to the management of traffic in their communities, the majority of companies that construct smart cities run into difficulties (Herath & Mittal, 2022). Because of this, they concentrate on reducing the amount of time it takes to travel. Additionally, they work to make roads safer in order to reduce the number of accidents that occur, which are two of the most significant issues with ITSs. Creating dynamic traffic control scenarios that make use of intelligent technology to shift automobiles around to alleviate any traffic jams or bottlenecks that may be occurring is the primary focus of the majority of these studies. It is possible to identify a solution to the issue of human engagement in vehicle ad hoc networks (VANETs) by connecting sensors and physical remote access devices to a network of automobiles through the internet. The fact that VANET nodes move around quite a bit complicates this issue. One potential solution to this issue is to connect sensors and remote access devices to the network of automobiles (Dehkordi et al., 2021).

RESEARCH QUESTION

What is the impact of intelligent infrastructure on vehicle automatic systems for smart cities?

RESEARCH METHODOLOGY

Research design

An analysis of quantitative data was carried out using SPSS version 25. The researchers employed the odds ratio and the 95% confidence interval to assess the magnitude and direction of the statistical link. The researchers determined a statistically significant criterion at $p < 0.05$. A detailed analysis clarified the primary characteristics of the data. Data obtained through surveys, polls, and questionnaires, accompanied with data processed by computing methods for statistical purposes evaluation, are frequently assessed using quantitative methods.

Sampling

Research participants completed questionnaires to supply data for the study. Utilising the Rao-soft tool, researchers ascertained that the study comprised 657 individuals. Researchers disseminated 896 questionnaires to the public. The researchers obtained 823 replies, omitting 45 due to incompleteness, yielding a final sample size of 778.

Data and Measurement

The study mostly utilised data gathered from a survey with a questionnaire. The participant's essential demographic information was initially requested. Participants were subsequently given a 5-point Likert scale to evaluate both online and offline channels. The researchers rigorously analysed several resources, especially internet databases for this secondary data collection.

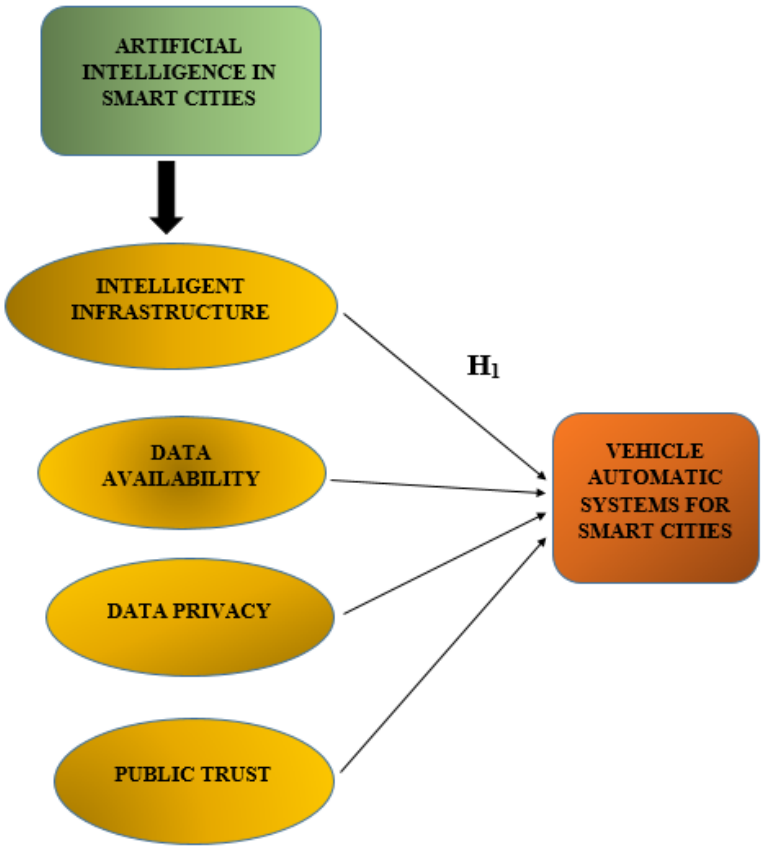
Statistical Software

The statistical analysis was performed utilising Excel and SPSS version 25.

Statistical Tools

In order to comprehend the basic features of the data, descriptive analysis was used. Using ANOVA, the researcher must examine the data.

CONCEPTUAL FRAMEWORK



RESULTS

Factor Analysis: A common application of Factor Analysis (FA) is to ascertain the presence of latent variables within observable data. In the absence of readily discernible visual or diagnostic indicators, it is customary to employ regression coefficients to provide ratings. In FA, models are crucial for success. The objectives of modelling are to identify errors, intrusions, and evident correlations. The Kaiser-Meyer-Olkin (KMO) Test is a method for evaluating datasets generated by multiple regression investigations. They confirm that the model and sample variables are representative. The data exhibits duplication, as indicated by the figures. Reduced proportions facilitate comprehension of the data. The KMO output ranges from zero to one. If the KMO value ranges from 0.8 to 1, the sample size is deemed sufficient. These are the allowable limits, as per Kaiser;

The subsequent approval requirements established by Kaiser are as follows:

A pitiful 0.050 to 0.059, below average 0.60 to 0.69

Middle grades often fall within the range of 0.70-0.79.

With a quality point score ranging from 0.80 to 0.89.

They marvel at the range of 0.90 to 1.00.

The results of Bartlett's test of sphericity are as follows: approx. chi-square

df=190

sig.=.000

This verifies the authenticity of assertions made just for sampling purposes. Researchers utilised Bartlett's Test of Sphericity to determine the significance of the correlation matrices. The Kaiser-Meyer-Olkin measure of 0.974 indicates that the sample is adequate. Bartlett's sphericity test yields a p-value of 0.00. A favourable result from Bartlett's sphericity test indicates that the correlation matrix is not an identity matrix.

Table 1. Testing for KMO (Kaiser-Meyer-Olkin) and Bartlett's Sampling Adequacy Measured: 0.974.

KMO and Bartlett's Test[a]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.974
Bartlett's Test of Sphericity	Approx. Chi-Square	6850.175
	df	190
	Sig.	.000
a. Based on correlations		

The significance of the correlation matrices was then determined using Bartlett's Test of Sphericity. A sample size of 0.974 is considered adequate according to the Kaiser-Meyer-Olkin test. The researchers determined a p-value of 0.00 using Bartlett's sphericity test. The incorrectness of the correlation matrix was proven by the statistically significant result of Bartlett's sphericity test.

INDEPENDENT VARIABLE

Artificial Intelligence In Smart Cities: The ability of artificial intelligence to give immediate safety precautions and warnings makes the general population significantly safer. By linking sensors and cameras to a remote server augmented with artificial intelligence at the local level, cities can monitor potential risks, natural disasters, public safety issues, and suspicious activities (Fabregue, 2024). An artificial intelligence smart city integrates AI into every aspect of its infrastructure, services, and administration to enhance the quality of life for its citizens by making them more productive, ecologically conscious, accessible, and generally healthy. To realise their full potential, smart cities must make significant use of AI. Using artificial intelligence, public transit systems can function more efficiently, natural resource management can be improved, government can be improved, life can be improved, the economy can be boosted, and people can have greater power. When used in the management of transportation and traffic, artificial intelligence has the potential to result in improved traffic flow, reduced congestion, and enhanced public transportation systems. Both the use of fuel and the pollution of the air should decrease as a result of these adjustments in the long run. The process of making decisions based on data is becoming an increasingly important component of statistical analysis and predictive modelling. This trend is due to the fact that AI is capable of sifting through vast amounts of data in order to identify patterns and make the most efficient use of resources. The combination of all of these factors has a role in making smart cities more resilient over time (Barragán Vargas et al., 2022).

FACTOR

Intelligent Infrastructure: The term "intelligent" or "smart" infrastructure refers to the utilisation of technology in order to enhance the efficiency and efficacy of the services provided by infrastructure. The technological layer that it utilises can either be incorporated into the plans for brand-new infrastructure or retrofitted into systems that are already in place (Ullah et al., 2023). In its most basic form, infrastructure intelligence reveals how adversaries organise and execute cyberattacks. With the help of this data, businesses are able to uncover significant information regarding attack campaigns by giving information about the strategies and operations of their adversaries. The purpose of intelligent traffic management systems is to monitor the conditions of the traffic area using sensors and to make adjustments to the lights and other signals in order to maximise the flow of traffic. This method can reduce both traffic congestion and air pollution. Intelligent water management systems primarily use sensors to monitor water consumption and detect leaks. Four pillars support this structure: data, analytics, feedback, and adaptability. These are the four primary components. A smart system cannot run without data, and a smart infrastructure cannot function without it either. Information is essential to the operation of both. It is possible that data centres will be reorganised to place a greater emphasis on artificial intelligence operations. Additionally, advancements in AI software and hardware may result in operations that are more cost-effective and energy-efficient. Using these results, executives may begin the process of preparing their infrastructure for the next generation of artificial intelligence in the company (Bokhari & Myeong, 2023).

DEPENDENT VARIABLE

Vehicle Automatic Systems For Smart Cities: A fully autonomous vehicle is capable of handling all aspects of the driving procedure without any assistance from a human driver, even if it is equipped with controls that are designed for a human driver. During the process of creating automobiles, various businesses may give different characteristics a higher priority, depending on whether or not they are beneficial to conventional drivers (Arora et al., 2023). The four primary classifications of automation systems are integrative automation, programmable automation, adaptable automation, and fixed automation. The advantages and differences of each type will be discussed in the following paragraphs. As a result of the fact that automated systems can combine a variety of driver aid technologies, including adaptive cruise control, lane positioning, parking assist, and traffic jam assist, the driver is required to constantly analyse the road ahead to be prepared to take prompt action to guarantee safety. The use of intelligent vehicular automation is applied for the aim of managing and protecting autos. Additionally, it has the potential to improve the pilot's skills to manage the vehicle. Before the driving guidance system may be widely applied in automobiles of the future, it is very necessary that certain concerns be resolved. In the realm of vehicle control issues, the most recent theoretical and experimental work is considered to be state-of-the-art. Sensor issues present a substantial challenge for driver assistance systems, which already face a number of challenges. In the past, sensor-driven automobiles had a high rate of failure; however, the advancement of technology has solved a significant number of these issues. Any person who operates an autonomous vehicle

is required to have a comprehensive understanding of the numerous human aspects that are involved. Through the utilisation of technologies that are embedded with electronics and multi-agent systems, the intelligent vehicle automation system is able to function (Maddikunta et al., 2022).

Relationship Between Intelligent Infrastructure and Vehicle Automatic Systems For Smart Cities: The intelligent infrastructure needs to be of a high quality and properly integrated with the system as a whole in order for smart city autos to be able to operate independently. When applied to urban areas, the term "intelligent infrastructure" refers to the integration of both physical and digital technologies that enable real-time communication, the collection of data, and the connection of individuals, automobiles, and other urban settlements. The term "cloud computing" encompasses a wide range of technologies, including but not limited to energy-efficient charging stations, sensors for the IoT, intelligent traffic lights, 5G networks for communication, and cloud computing platforms. Autonomous vehicles will be able to navigate large urban regions in a manner that is safe, environmentally friendly, and saves time thanks to the collaborative efforts of these systems (Belaïd et al., 2023). A consequence of this is that autonomous cars are able to function in particular conditions. In order to ensure that self-driving cars carry out their functions correctly, it is essential for them to keep a heightened awareness of the world that is immediately surrounding them. Among the various ways in which smart infrastructure serves this requirement is through the collection and transmission of vital data on a wide variety of useful topics. These topics include traffic, conditions on the roads, pedestrian activities, and weather patterns, amongst many others. Intelligent traffic management systems have the potential to quickly adjust the relevant signals, hence lowering the amount of traffic congestion. These systems are powered by the IoT and AI. If this is put into effect, for example, there will be a reduction in the amount of traffic. In addition, sensors that are strategically placed along the roads can provide real-time warnings to autonomous vehicles about potential hazards brought on by traffic. Without this infrastructure, self-driving cars would be unable to navigate and make judgements because of their limited data collection capabilities. This would significantly limit their ability to make decisions. It would be extremely detrimental to their progress if this were to occur (Herath et al., 2022).

Following the aforementioned debate, the researcher put forth the subsequent hypothesis to assess the correlation between Intelligent Infrastructure and Vehicle Automatic Systems for Smart Cities.

"H_{01}: There is no significant relationship between Intelligent Infrastructure and Vehicle Automatic Systems for Smart Cities."

"H_1: There is a significant relationship between Intelligent Infrastructure and Vehicle Automatic Systems for Smart Cities."

Table 2. H1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	39588.620	254	5657.534	1037.698	.000
Within Groups	492.770	523	5.452		
Total	40081.390	777			

The result is significant in this study. Statistical significance is attained with a p-value of .000 (below the .05 alpha criterion), and the F value is 1037.698. This indicates that researchers may endorse the alternate interpretation. ***"H_1: There is a significant relationship between Intelligent Infrastructure and Vehicle Automatic Systems for Smart Cities"*** is accepted and reject the null hypothesis.

DISCUSSION

Aspiring to provide individuals with the knowledge, abilities, and tools they require is the ultimate objective of ethical AI programs for the future generation of civilisation. In the long run, the economy and society will be more equitable and sustainable if influential people and officials are able to succeed in advocating for increased use of artificial intelligence. Among the many challenges that contemporary cities must face, some of the most important ones include pollution, healthcare, privacy and security, energy consumption, and a great deal more. Before compiling a comprehensive list of artificial intelligence technologies and the most significant applications of these technologies in smart city locations, the researchers conducted an exhaustive assessment of the relevant literature. Among the many applications of artificial intelligence that can be found in smart cities, there are a lot of significant differences. The term "intelligent mobility" refers to a subfield of artificial intelligence that aims to simplify people's lives by enhancing transport networks, minimising traffic bottlenecks, and other similar initiatives. For the most part, autonomous vehicles and intelligent traffic management systems are the components that make up smart mobility. On the other hand, smart environmental projects that make use of smart technology enable individuals to monitor the levels of pollution in the air and water, manage trash, and work towards sustainability by making more efficient use of resources and causing less damage. Smart governance makes use of artificial intelligence to improve the efficiency of government operations, accelerate decision-making, and better satisfy the requirements of citizens. This is occurring in a number of ways, one of which is through the utilisation of chatbots and other artificial intelligence virtual assistants to connect individuals with their political representatives. On the other hand, smart economy projects make use of artificial intelligence for a variety of purposes, including the prediction of financial trends, marketing to individuals, and the identification of suitable candidates for employment and the promotion of innovative ideas. There are a number of different ways in

which digital efforts, telemedicine services, and artificial intelligence work together to improve the health, safety, and convenience of individuals. The smart people initiatives, on the other hand, are designed to provide people in the region with the information, abilities, and resources they require in order to participate in urban redevelopment efforts and reap the benefits of such efforts. The vast majority of the time, this is accomplished through projects that are led by the community or through programmes that instruct individuals on how to make effective use of digital resources.

CONCLUSION

People in urban areas are beginning to communicate with one another using these forward-thinking and novel methods of communication. Different types of pneumatic tubes are able to detect changes in the internal pressure of the vehicle while it is in close proximity to the vehicle. The words are now used in traffic data to show the average speed of vehicles and the number of cars on the road. For the purpose of gathering information regarding traffic, an increasing number of individuals are employing scanning video cameras equipped with Radio-Frequency Identification (RFID). Video cameras are carefully deployed throughout the architecture of the network in order to offer more accurate information regarding the flow of traffic. The collection and management of disposal data is accomplished through the use of a wide variety of techniques, such as mobile applications, conventional signs for traffic, and radio broadcasts. In a nutshell, they are one-of-a-kind municipal funding with the objective of enhancing the literacy rates of young people and acknowledging the significant contributions they make by providing them with access to a vast amount of knowledge through the many components of the smart society project. As connected computerised Autonomous Vehicles bring all of these components together, autonomous vehicle control systems will be a significant development that will significantly improve the approaching decade. Concurrently, a plethora of communication-related characteristics must be gathered in order to construct a network flow model that might aid in geographical control and management. Thanks to AI's quick development, the idea of smart cities is now within reach. By addressing problems that are common in cities, smart cities can raise living standards as a whole. The six main types of smart towns are examined in this study: smart citizens, smart ecology, smart mobility, smart governance, and smart living. The goal is to identify the most important uses of AI solutions, the challenges they encounter, and the possible future directions they could grow. The analysis of relevant literature covered the years 2021–2024. This section provides a detailed analysis of smart city concepts as they pertain to many different areas. Environmental consciousness, a sensible government, economic conditions, mobility, and individuals themselves are all examples of such factors. Analysing the uses, difficulties, and possible futures of AI in each industry can yield a lot of new information. Smart cities stand to gain from AI in many ways, such as increased production, higher quality of life for city dwellers, less waste, and more creative thinking. A wide range of situations can benefit from AI. One method to employ AI technologies

responsibly and equitably is to tackle problems like the digital divide, security, compliance, and ethical complications.

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