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Table of Content

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THE INTEGRATION OF ARTIFICIAL INTELLIGENCE IN COMPUTER NETWORK TECHNOLOGY

Musa Alam
Malaysian Institute of Information Technology Universiti Kuala Lumpur, Kuala Lumpur, Malaysia.

Abstract: With the continuous development of science and technology, people are increasingly dependent on network communication. Under this trend, current network technology and simple data computing functions can no longer meet people's requirements, and artificial intelligence has increasingly become the main trend in the innovation and development of computer network technology. The application of artificial intelligence to computer network technology can further improve network security and network management and monitoring levels. The article analyzes the defects existing in network technology and the application of artificial intelligence in computer network technology.
Keywords: Artificial intelligence; Computer network technology

1 INTRODUCTION

Artificial intelligence has penetrated into every corner of life. In people's lives and work, more and more intelligent electronic products have appeared and occupied an important position. The most common ones are smartphones and smart TVs. Artificial intelligence has an unprecedented and far-reaching impact on human society. It is not only one of the driving forces of the fourth industrial revolution, but also an inevitable necessity for the development of the information society. At the same time, new requirements for computer network technology have also emerged, and it has become possible to apply artificial intelligence to network security, supervision and management.

2 OVERVIEW OF ARTIFICIAL INTELLIGENCE TECHNOLOGY

Artificial intelligence is a comprehensive subject that involves many aspects, including computer network technology, psychology and even philosophy. It is a challenging compound high-tech. Its purpose is to allow machines to imitate people and humanize their intelligence by simulating people's consciousness, behavior, thinking, etc. It is to allow machines to do intelligent work that only people could do in the past in life and work, to complete some complex and Mechanical, high-risk, etc. work. The autonomous learning ability of artificial intelligence technology, when applied to computer networks, can enhance the identification and analysis capabilities of data information, and better realize data integration and resource sharing among users. It uses logical reasoning mode to fuzzify information, which can improve the level of computer network processing data information and serve mankind in a more efficient and humane way.

3 PROBLEMS EXISTING IN NETWORK TECHNOLOGY AT THIS STAGE

In an information networked society, the Internet is filled with massive information. With the popularization and application of information networks in the whole society, the Internet will become larger and larger. The security of network information, rationalization of the network, and humane supervisors and management will continue to attract people's attention.

3.1 Network Security

With the development of information technology, e-commerce, electronic money and online mobile payment have become mainstream, and as a result, cyber crimes have gradually increased. To protect users' network information security, it has become inevitable to strengthen the computer's protection system. 1) Vulnerabilities in computer network operating systems. In computer networks, network security risks caused by vulnerabilities caused by operating system errors are common. Today's operating systems, whether Windows or iOS, have security vulnerabilities. The operating system occupies a relatively important position in the entire computer network. Due to the loopholes in the system itself and the influence of various factors, some computer network security problems have been caused. Different types of devices and different versions of the same device will have different security vulnerabilities. It is precisely the existence of loopholes in computer operating systems that allow some criminals to take advantage of them. 2) Malicious viruses that exist in computer networks. Computer viruses are specially-written programs that are highly infectious, destructive, and capable of self-replication. Viruses typically spread through hardware devices and network data. Viruses invading computer networks can cause computer operation speed to drop sharply, system resources to be

severely damaged, paralysis of the operating system in a short period of time, information and passwords, etc. to be maliciously changed and destroyed, resulting in the loss of data and files, and computer crashes. Or hardware damage, etc. 3) The openness of the network and malicious attacks. In the era of big data, any user on the Internet can easily access information on the Internet, making it easy to obtain information about a company or even an individual. In this network environment, it is inevitable that the network will be invaded or maliciously attacked. Without strict regulations on the openness of network information and a strict protection system, computers may often be subject to malicious attacks.

3.2 Network Management

Network management refers to monitoring, controlling and recording the status and usage of network resources so that the network can operate effectively and provide users with a certain level of electronic information services after integration and analysis. In the era of big data, huge amounts and types of data are generated every day. The ever-increasing amount of data information is the source of big data aggregation and integration. However, as the amount and type of data information continue to increase, how can computers mine useful information and apply it to information security and management to promote the improvement of computer network security management levels. How to correctly and effectively process big data and apply it to human life still requires continuous exploration.

3.3 Network Monitoring

Computer networks have been popularized and penetrated into all levels of society, bringing convenience to society but also causing security and management problems. Some people are paid but do nothing, which not only consumes company resources, but also affects the company's efficiency, leaks company secrets, and even loses the company's important customer resources. Using network monitoring and integrating it with the enterprise's internal management mechanism can effectively improve work efficiency. But the problem that comes with it is that users feel that their privacy has been violated and they feel insecure. People feel that they are living in a world without personal privacy.

4 APPLICATION OF ARTIFICIAL INTELLIGENCE IN COMPUTER NETWORK TECHNOLOGY

As people rely too much on the Internet, they urgently need more intelligent services. The application of artificial intelligence in computer network technology has become possible and applicable to various fields, better improving the level of network technology.

4.1 Artificial Intelligence Applied to Computer Network Security

Because the phenomenon of cybercrimes is gradually increasing, in order to protect users' network information security, it is necessary to strengthen the computer protection system, improve the system's information acquisition and information processing capabilities, and establish a more sensitive system to realize automatic collection, diagnosis and processing of data. Analysis in order to respond to problems quickly and timely to ensure the normal operation of the computer system. Therefore, the application of artificial intelligence will become inevitable. Artificial intelligence summarizes the behavioral patterns of different modes and proposes an intelligent automatic protection method, which potentially protects your computer.

Such as the current intelligent firewall system. Traditional firewalls use a one-by-one matching algorithm, which requires a large amount of calculation and is inefficient. The smart firewall is smarter and smarter. It uses statistics, memory, probability and decision-making methods to determine the probability of whether it is malware by analyzing huge data samples. Intelligently identify malicious data traffic, effectively block malicious data attacks, effectively cut off malicious viruses or attacks, and guard against malicious attacks. There is also the intelligent anti-spam scam call, which intelligently compiles a list of malicious calls through the analysis of big data and user feedback. When such calls call your phone, your mobile phone system will automatically prompt the user to refuse to answer such calls.

4.2 Artificial Intelligence Applied to Network Management

Artificial Intelligence Agent technology refers to distributed artificial intelligence, that is, a program that simulates human behavior and relationships, has certain intelligence, and can run autonomously and provide corresponding services. Nowadays, artificial intelligence Agent technology has been widely used in daily life. Agent technology can actively provide users with the information they want to know, or proactively notify users of relevant information. It can proactively guide various standardized and programmed processes or progress plans, process and evaluate various work progress reports, and centrally integrate and process and analyze various data so that it can be presented to people more intuitively. It has the characteristics of autonomy, initiative, interactivity, etc., and it can serve users in a more intelligent way. Users can also rely on Agent technology to selectively and permanently delete certain personal

information, protect their privacy, and manage their network information. It can even be applied to companies and society to manage network resources in a more humane way. Based on network management protocols, the importance of artificial intelligence in network management has been recognized. People are gradually using intelligent management technology in the five network management functional areas of effectiveness management, configuration management, billing management, performance management, and security management.

4.3 Artificial Intelligence Applied to Network Surveillance

Network data resources are very large and discontinuous, and it is difficult to find the inherent laws in them through conventional data analysis. In this case, artificial intelligence is used to make accurate judgments on the effectiveness of data resources. Relying on artificial intelligence, based on the analysis of big data, intelligently select useful information, discard information that has no practical use, and deeply explore the potential value of information. Finally, valuable information is obtained and delivered to users, which can effectively save users' time and improve efficiency.
Conclusion: In summary, with the continuous development of artificial intelligence and the continuous expansion of its applications in many fields, while bringing convenience to society, we must also pay attention to the simultaneous development of the width and depth of artificial intelligence. The application of artificial intelligence in computer network technology is mainly reflected in intelligent Agent technology, network monitoring and management, and network information security, which can effectively improve the security of user data and ensure the normal operation of the user's system. Continuously strengthen the intelligence of artificial intelligence, improve its degree of intelligence, improve network security, promote the improvement of network management and monitoring levels, and achieve innovative and sustainable development of computer networks.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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RIGOROUS INVESTIGATION INTO THE IDENTIFICATION OF MALFUNCTIONS IN THE AIR CONDITIONING AND REFRIGERATION SYSTEMS OF URBAN RAIL VEHICLES

Calm Reay
Department or Electrical Engineering and Computer Science, Idaho State University, Pocatello, ID, USA.

Abstract: The air-conditioning and refrigeration system is an important part of urban rail vehicles. The comfort of the train environment is mainly guaranteed by the air-conditioning and refrigeration system. If the unit's cooling capacity decreases or fails to cool down frequently, it will seriously affect the service quality and quality of the vehicle. Safety. This paper studies the fault diagnosis of air conditioning and refrigeration systems of urban rail vehicles, discusses the characteristics of fault diagnosis of air conditioning and refrigeration systems of urban rail vehicles, summarizes several common fault phenomena and causes of air conditioning and refrigeration systems of urban rail vehicles, and uses refrigerant leakage Taking a fault as an example, a diagnostic simulation scheme is proposed.
Keywords: Urban rail vehicles; Air conditioning and refrigeration systems; Cause analysis; Fault diagnosis

1 INTRODUCTION

At present, most urban rail vehicles in our country have been air-conditioned. As an important equipment to improve the indoor environment, air-conditioning equipment will suffer from various failures during its operation, such as refrigerant leakage, compressor wear, and condensation fan overload protection, condenser and evaporator are clogged, etc., if not dealt with in time, the air conditioning operating parameters will deviate from the normal values for a long time, the cooling capacity of the entire unit will decrease or no cooling will be caused, which will have a certain impact on vehicle operation and maintenance, and affect the passenger comfort[1]. In view of this, this article will analyze the causes of air conditioning and refrigeration system failures and propose corresponding maintenance measures, aiming to reduce the occurrence rate of failures and reduce maintenance costs during the operation of the air conditioning and refrigeration system.

2 OVERVIEW OF AIR CONDITIONING AND REFRIGERATION SYSTEMS FOR URBAN RAIL VEHICLES

The air-conditioning and refrigeration unit of urban rail vehicles includes components such as a compressor, axial flow condensing fan, dryer, evaporator, condenser, expansion valve and high-pressure protection device, forming a closed refrigeration cycle system that works together to exert the refrigeration effect. It is an important system to ensure the comfort of the internal environment of urban rail vehicles[2-3]. In addition, the evaporator element in the refrigeration system can also reduce the humidity of the air in the environment. Under normal circumstances, in order to avoid large changes in the environment of the entire carriage due to the failure of the air conditioner in one carriage, urban rail vehicles usually install an air conditioning unit at the front and rear of each train. The air-conditioning units of urban rail vehicles use evaporative compression refrigeration, which is liquid vapor refrigeration.

3 CHARACTERISTICS OF FAULT DIAGNOSIS OF AIR CONDITIONING AND REFRIGERATION SYSTEMS

The air conditioning and refrigeration system of urban rail vehicles is a complex whole composed of multiple subsystems. It is composed of main components such as evaporators, compressors, condensers, and some ancillary devices. The components are organically combined and operate in coordination with each other[4]. Any refrigeration system If the subsystem in the air conditioner fails, the air conditioner will not be able to perform its cooling function normally. The complexity of the refrigeration system determines that the causes of failures are also complex.

3.1 Complexity

There are many reasons for the failure of air conditioning and refrigeration systems, such as refrigeration cycle blockage, insufficient air volume, refrigerant leakage, excessive refrigerant charging, etc., which lead to many types of failures, such as the unit cannot cool or the cooling effect is poor, and the condenser condenses. Scale, evaporator failure, compressor failure, etc., the causes and phenomena are complicated[5].

3.2 Intersectionality

One fault cause of the air conditioning and refrigeration system of urban rail vehicles may produce multiple fault phenomena, or one fault phenomenon may have multiple causes. The causes and phenomena of faults generally show overlap.

3.3 Mutual Influence

In the entire air conditioning and refrigeration system fault diagnosis process, characteristic parameters are an important reference basis, but a single characteristic parameter cannot be used to characterize the occurrence of the corresponding fault, because the occurrence of a fault usually causes changes in several parameters, and at the same time, a Changes in parameters will also affect changes in other parameters[6].

4 TYPICAL FAULTS OF AIR CONDITIONING AND REFRIGERATION SYSTEMS OF URBAN RAIL VEHICLES

There are various faults in the air-conditioning and refrigeration system of urban rail vehicles during the entire operation process. Several common fault types are analyzed below.

4.1 The Air Conditioning Unit Makes Loud Vibration and Noise

When urban rail vehicles are running, the air-conditioning unit vibrates and makes loud noises. After diagnosis, it is found that it is usually caused by the looseness of the return air inlet cover or the air-conditioning cover support rod and the noise generated by the vibration of the ventilator in the air-conditioning unit. An inspection and analysis of the replaced ventilator revealed that the main cause of the fan noise was minor damage to some ventilator motor bearings.
For the problem of high vibration and noise of the air conditioner, the author believes that the following measures can be taken to solve it: first, strengthen the control of the fan quality; second, strengthen the maintenance procedures, regularly check the ventilator and air conditioner return air cover; finally, adjust the installation of the air conditioner cover support rod method and the locking method of the return air vent cover.

4.2 Refrigerant Leakage

Refrigerant leakage failures are common in urban rail vehicle air conditioning and refrigeration systems. The air conditioning and refrigeration system components of urban rail vehicles are usually made of copper. Due to long-term operation, blisters and cracks may appear on the pipelines, which will eventually evolve into cracks. However, refrigerant leakage is mostly caused by system valve failure or poor welding of the evaporator and condenser pipelines of the refrigeration system. The refrigeration system pipelines need to be repaired in time and recharged with refrigerant in accordance with specifications.

4.3 Evaporator and Heat Exchange Coil are Clogged

On urban rail vehicles, after the evaporator of the air conditioning and refrigeration system has been operated for a long time, the heat exchange coil will be blocked due to excessive dust or other pollution, which will affect the circulation of the refrigerant and the heat exchange effect, resulting in a reduction in cooling air volume and long-term Down, it will affect the function and life of the entire air conditioning system.

4.4 The Condenser is Scaled and has Poor Heat Dissipation.

The compressor pressure failure of the air conditioning unit is not only related to the inlet air temperature, but also related to the cooling air inlet volume of the condenser. If the heat dissipation and exhaust air of the air conditioner condenser is blocked and the exhaust air volume is reduced, it will also cause poor heat dissipation of the air conditioner condenser, resulting in a high-pressure failure and shutdown of the air conditioner compressor during operation.

5 URBAN RAIL VEHICLE AIR CONDITIONING AND REFRIGERATION SYSTEM FAULT DIAGNOSIS SIMULATION SCHEME

The various components of the air conditioning and refrigeration system of urban rail vehicles are closely related, work together and influence each other. During the diagnosis and simulation process, in order to ensure the singleness and pertinence of fault characteristics, if you want to find one of the fault characteristics, you must keep other components operating normally. The refrigerant leakage fault simulation method is as follows: Use FLOWMASTER to simulate the fault, mainly by changing the simulated refrigerant charge. When the air conditioning and refrigeration system fails, select the parameter with the most obvious change, that is, the parameter with the highest sensitivity to the fault. Find out the change rules between refrigeration system faults and characteristic parameters, analyze the characteristic

parameters of the refrigeration system, and finally determine the cause of the failure of the air conditioning and refrigeration system.

In the refrigerant leakage fault, the condensing wind speed is kept at 5 m/s, the evaporator air volume is 500 m3/h, and the compressor speed is 1 700 r/min. In order to simulate refrigerant leakage, the original refrigerant 15 kg is gradually reduced. Each single fault includes 6 different fault degrees, the leakage degrees are 10%, 20%, 30%, 40%, 50% and 60% respectively. As the refrigerant charge gradually decreases, the corresponding refrigerant leakage degree It also gradually becomes serious. The suction pressure and discharge pressure parameters of the compressor both decrease and change significantly. This solution shows that both the suction pressure and discharge pressure are sensitive to refrigerant leakage; contrary to the pressure parameters of the compressor, in Under the influence of refrigerant leakage, the suction temperature and discharge temperature of the compressor both show an upward trend. It can be seen that the temperature parameters are also sensitive to refrigerator leakage. The leakage of refrigerant leads to insufficient liquid supply to the evaporator and a decrease in cooling capacity. At the same time, the system's heating energy efficiency ratio COP also decreases significantly, indicating that the cooling capacity is weakened when refrigerant leaks.

6 CONCLUSION

Of course, there are many faults that occur during the operation of the air conditioning system, and it is impossible to analyze and summarize all types of faults. This article mainly discusses the characteristics of fault diagnosis of the air conditioning and refrigeration system of urban rail vehicles based on the working principle of the air conditioning and refrigeration system of urban rail vehicles, and Several common fault phenomena and causes of air conditioning and refrigeration systems of urban rail vehicles are summarized, and a simulation scheme for refrigerant leakage fault diagnosis of air conditioning and refrigeration systems is particularly listed.

At present, my country does not have relatively mature and complete system diagnostic software in the field of HVAC and refrigeration. There is also little research on fault diagnosis of the air conditioning and refrigeration system in the carriage. There are still many problems in fault diagnosis of the air conditioning and refrigeration system of urban rail vehicles. Some studies use VC++6.0 language to edit the human-machine interface of air conditioning and refrigeration systems. They have a rich, expert-level knowledge system, and can also reason about some uncertain fuzzy information, and can intuitively query common fault information. Improve work efficiency. In future research, more analysis and research on this diagnostic system can be carried out.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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DESIGN AND IMPLEMENTATION OF MULTI-MODE WIRELESS INTELLIGENT INTERNET OF THINGS

Ahmed Boussaid
Department of Electronics and Communication Engineering, MLR Institute of Technology, Hyderabad, India.

Abstract: With the rapid development of the Internet of Things and the updating and iteration of various standard protocols and technologies, most of the current Internet of Things IOT systems are designed for network distribution and access interconnection based on a specific wireless protocol. There are few solutions that can Adaptive supports intelligent networking and interconnection between different link layers. In this regard, a universal, intelligent and adaptive networking solution is proposed. Based on the IOT physical layer such as BLE and WIFI, this solution adaptively selects the optimal network protocol stack and deploys it to establish a mesh network, intelligently detects the status of the wireless environment, automatically identifies and quickly establishes and interconnects LLC networks and ad-hoc networks. Equipment manufacturers or service providers can use this solution to quickly make the equipment they provide intelligent and quickly connect to the Internet of Things, greatly shortening the development cycle of their products, and ensuring the stability and stability of their Internet of Things equipment and services. safety. The self-organizing network has good stability, high scalability, strong compatibility with other wireless devices, and high information security and reliability of network node devices. It also supports two independent network protocol stacks, each built on different physical above the link layer, it can meet different application scenarios.
Keywords: 6LoWPAN; Route-over; Mesh-under; Babel

1 INTRODUCTION

According to statistics, 10 billion microcontroller chips have been used in the field of Internet of Things every year in recent years. With the huge market demand for Internet of Things equipment and services in the industrial field and general consumer field, it is necessary to provide high-quality, reliable and stable Internet solutions. And devices, connecting millions or even tens of millions of smart devices to the Internet and interconnecting them is a problem that needs to be researched and solved. In industry and academia, IoT protocol standards are also a highly valued issue. The rapidly changing mobile network technology and the rapid evolution of microcontroller chips and M2M have also accelerated the development of IoT technology. Currently, international mobile chip and equipment manufacturers invest a lot of resources in the research of IOT technology and products every year, and will invest more in research and development in the IOT field in the future.

Due to the rapid development of the Internet of Things, different standard protocols and technologies have also been proposed by different standards committees, including IEEE, IETF and ITU. These standards broadly cover the entire network protocol stack at the data chain saw layer, network routing protocols, session layer protocols, and application layer protocols. These standards are designed to meet the specific needs of the IOT ecosystem, including management and security. For different geographical scopes and low power consumption, link layer protocol standards include IEEE 802.15.4, IEEE802.11[1-4], Bluetooth Low Energy[5-7], Zig bee Smart Energy[8], etc. ; Aiming at the mobility and volatility of wireless devices, routing protocol standards include RPL, Babel, batman-adv, CORPL, etc. In order to better support the transmission of IPV6 data in low-power and high-volatile IOT networks, network layer encapsulation protocols include 6LoWPAN [9-10], 6TiSCH, IPV6 over Bluetooth Low Energy, etc. In view of the diversity and security of IoT applications, application layer protocols include MQTT, SMQTT, COAP, XMPP, etc.

Due to the continuous updating and iteration of various standard protocols and technologies, the solutions proposed by various equipment manufacturers, chip manufacturers, and cloud service providers are also different. Most of them are designed for specific wireless modules and data link layers. Internet networking solutions have poor scalability and difficulty in deployment, poor mobility, poor support for the diversity of cloud services and application functions of the Internet of Things, and insufficient compatibility and security. In view of the various needs and challenges of IoT devices and services, this paper proposes a universal and efficient IoT intelligent networking system. Based on the IOT physical layer such as BLE and WIFI, this solution adaptively selects the optimal network protocol stack and deploys it to establish a mesh network. It has high device reliability, high scalability of the self-organizing network, and is compatible with interaction with other wireless devices. It is highly flexible and can support different IoT application scenarios, including smart meters, consumer wearable devices, home security alarms, factory video surveillance, geological research, energy management, disaster prediction, etc., and ensures the security of network services.

1.1 Overall Solution Framework

In the current IoT ecosystem, there are multiple link layer and network layer standards, as well as IOT application requirements in various fields, including low-power data monitoring and high-throughput remote streaming media monitoring. This article proposes a general and intelligent adaptive networking solution that can intelligently detect the

status of the wireless environment, automatically identify and quickly establish and interconnect LLC networks and ad-hoc networks. Equipment manufacturers or service providers can quickly use this solution to It can effectively make the provided equipment intelligent and quickly connect to the Internet of Things, greatly shortening the research and development cycle of its products, and ensuring the stability and security of its Internet of Things equipment and services. This solution supports two independent network protocol stacks at the same time, each of which is built on a different physical link layer and can meet different application scenarios. The overall framework is shown in Figure 1.
In low-power, volatile wireless ad hoc networks, low-frequency MCU-based sensors and actuators are commonly used as input and output devices. The object layer of these devices is generally based on low-power devices such as BLE, Zig bee, and Z-Wave [11]. Wireless module, so this IoT solution provides a 6LoWPAN-based network protocol stack to support the LLN network. Among them, RPL is mainly based on the routing algorithm of the LLN network to ensure that device nodes can access data to the Internet. 6LoWPAN is mainly to enable IPV6 data packets to be transmitted in the physical layer with short transmission packet lengths such as LLN, thereby carrying out the IPV6 packet header Compression and encapsulation. For example, the maximum frame length of IPV6 is 1 280 bytes, while the maximum frame length of IEEE802.15.4 is 270 bytes, and the frame length of BLE may be smaller.

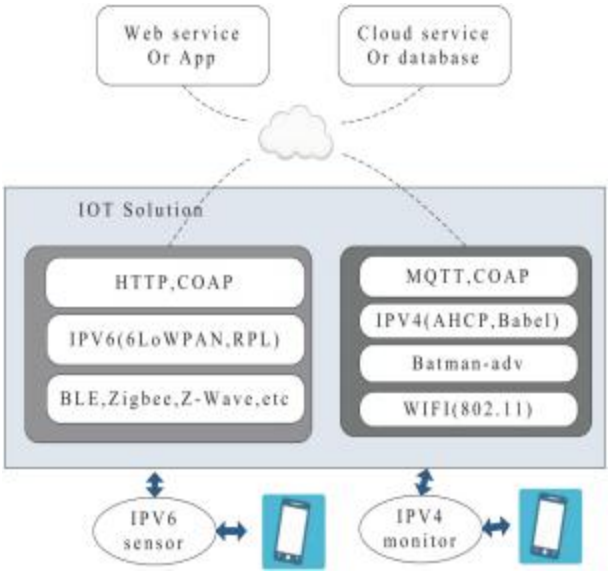

Figure 1 Overall solution framework

In wireless ad hoc networks with long transmission distances and high throughput, most of the device nodes of these networks use wireless modules such as IEEE802.11. This type of ad-hoc has wider coverage, higher stability, and higher throughput rate, and can meet the needs of Remote monitoring of streaming media and other service needs. This IoT solution also provides a network protocol stack based on IEEE802.11 to support WiFi ad-hoc [12-16] network. Among them, AHCP is ad-hoc network configuration management, which solves the IP management and allocation problems in mesh network nodes. Babel works on the lay3 layer and can provide a distance vector-based routing algorithm to avoid deadlocks. Batman-adv works on the lay2 layer. It is a distance vector-based routing algorithm that is transparent to upper-layer protocols and applications. This solution introduces the AES encryption protocol from the data link layer and TLS and TDLS from the data transmission layer to ensure the security and confidentiality of data interaction.

1.2 Network Protocol Stack Layered Structure Diagram

This IoT solution can adaptively support intelligent networking and interconnection between different link layers, and integrates two independent network protocol stacks.
After the system is started, the IOT platform will start two completely independent protocol stacks to meet different application scenarios and service needs, and speed up the establishment of LNN and ad-hoc networks. The WIFI wireless module will search for wireless signals in the environment and establish a WIFI ah-hoc network according to the IBSS protocol. After receiving the message that the network interface is successfully established, AHCP quickly allocates network IP resources to ensure the uniqueness of the IP address in the mesh network node and Used to identify devices at the lay3 layer, Babel will exchange HELLO, IHU, and Update messages through the WIFI wireless module and generate routing table information based on the Bellman-ford shortest path algorithm to prepare for subsequent more efficient and stable sending and receiving of UDP/TCP packets. The startup and establishment of the BLE wireless module is similar to the WIFI module. The LLN network is generated from the establishment of the data link layer. The IPV6 address is automatically configured and generated by the global uniqueness of the MAC address without the participation of protocol standards such as AHCP. RPL is specifically for wireless devices. A network routing protocol developed for mobility and volatility. But when the system has no data to transmit, the module can quickly enter sleep mode to save power consumption. When data needs to be sent and received, the module can quickly

wake up and perform data processing. The two wireless modules form independent wireless self-organizing networks and are interconnected. The adaptive configuration will select a more stable data transmission method to access the Internet based on the surrounding environmental noise.

2 ROUTING MECHANISM

The network routing method of the 6LoWPAN system based on the LLN network is the routing table forwarding mechanism of lay3. 6LoWPAN is between layer 3 and layer 2 in the OSI network model. It is an adaptation encapsulation layer and is mainly used to compress, segment and reassemble IPV6 data packets. When the data packet passes through each HOP, 6LoWPAN will reassemble the data packet uploaded by the MAC into a complete IPV6 packet and deliver it to Layer 3. Layer 3 will choose whether it needs to be handed over to the upper layer application for processing or processed again based on the destination address of the IPV6 data packet. Find the next hop HOP of the target IP for forwarding. Based on WIFI ad-hoc network routing methods include router-over and mesh-under, which respectively correspond to Babel in layer 3 and batman-adv in layer 2 of the IoT solution. The IOT platform integrates two routing algorithms for WIFI ad-hoc. Equipment manufacturers and IoT service providers can choose a more appropriate method according to specific application needs and scenarios. This provides flexible function choices and scenarios for upper-layer applications and services. Adaptation. batman-adv refer to Figure 2. UDP / TCP data packets are determined by layer 2 of the next hop HOP MAC address of the target machine. The data link layer does not need to hand over the data to the layer 3 network layer for decision-making - whether it needs to be processed by itself or to look up the IP routing table and select One-hop HOP avoids leaving decision-making to the layer 3 network layer, so the transmission efficiency is higher, but the stability is lacking.

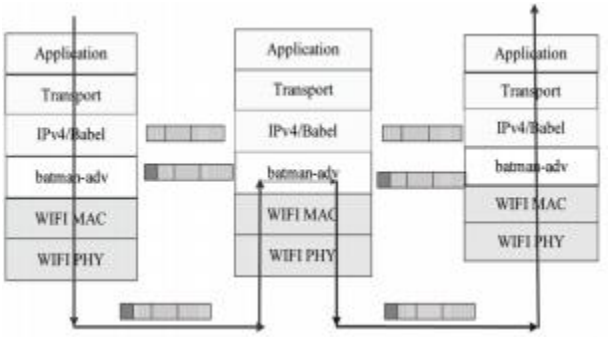

Figure 2 Mesh-under routing algorithm based on WIFI ad-hoc network

Babel Refer to Figure 3. UDP / TCP data packets pass through each network node, and the data link layer data will be handed over to the layer 3 network layer for decision-making - whether it needs to be processed by itself or to look up the IP routing table and select the next hop HOP. Due to the gap between the source device and the destination device The layer 3 network layer of any node will participate in data forwarding, so the stability is higher, but the transmission efficiency is lower than layer 2.

When the WIFI ad-hoc network environment is good, the effect of mesh-under routing will be better than that of route-over. When the WIFI ad-hoc network environment has a lot of noise, the effect of choosing route-over will be better than mesh. -under. This solution counts the message delivery success rate and the quality of the air interface environment in a certain period of time in the past, and adaptively switches to a better routing method to ensure the reliability of message transmission and the stability of system response.

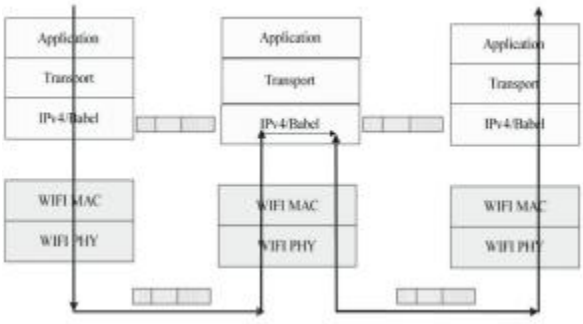

Figure 3 Route-over routing algorithm based on WIFI ad-hoc network

3 ROUTING ALGORITHM PERFORMANCE ANALYSIS

This system performs experimental comparison of the performance of route-over and mesh-under routing algorithms in the same channel noise environment. The basic parameters of the experiment are shown in Table 1.

Table 1 Basic experimental parameters

Project	Parameter
IP layer packet length	1 500 bytes
MAC layer MTU length	100 bytes
Total number of mesh nodes	3, 6, 9
Hop series	Level 1-9 Jump
number of fragments	15
route-over routing algorithm	Babel
mesh-under routing algorithm	batman-adv

According to the size of the MTU length of the MAC layer, the IP layer packet is divided into 15 fragmented packets through the Layer 2 layer. The number of nodes in the wireless ad hoc network of the mesh network is 3 to 9 respectively. Experiments show that different HOP hop levels The success rate of IP packet transmission is as shown in Figure 4.

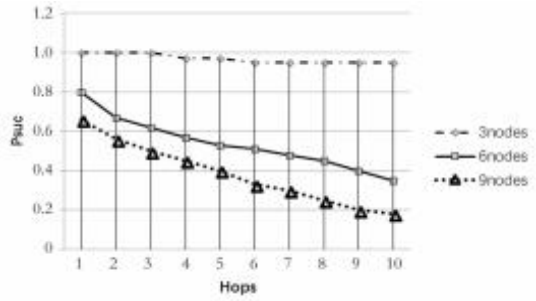

Figure 4 IP packet sending success rate of batman-adv routing algorithm

It can be seen from the analysis results that when the number of nodes in the mesh network gradually increases, the IP packet transmission success rate of both routing algorithms decreases significantly. This is because the channel has more competition points and the channel noise is relatively large, which reduces the individual The success rate of nodes seizing the channel. In addition, when the number of Hop levels in the communication path gradually increases, the IP packet transmission success rate of batman-adv also decreases. Compared with Babel, although the increase in network channel competition and conflicts also reduces the IP packet transmission success rate, the communication path The gradual increase in the number of medium Hop levels does not have much impact on the transmission success rate of IP packets. This is mainly because each hop in the route will reassemble the packet and return it to the IP layer for next routing selection. The packet probability of each level of Hop returns to 1. Therefore, the route-over routing algorithm is better than the mesh-under routing. The algorithm is more stable and robust, but the disadvantage is that each level of Hop point in the routing must support the complete Lay3IP protocol stack, and each fragmented packet needs to be assembled, routed, and disassembled of the IP message. The operation of the package increases the CPU MIPS, memory resource requirements, current power consumption, etc. of the jump point. Therefore, the route-over routing algorithm has certain requirements on the hardware configuration and power supply life of the devices in the Internet of Things.

4 CONCLUSION

A universal, intelligent and adaptive wireless module networking solution is proposed. Based on the IOT physical layer such as BLE and WIFI, this solution adaptively selects the optimal network protocol stack and deploys it to establish a mesh network. This self-organizing network has good stability, high equipment reliability, and high scalability, and is compatible with other wireless devices. Interactive compatibility is strong. This solution can intelligently detect the status of the wireless environment, automatically identify and quickly establish and interconnect LLC networks and ad-hoc networks, support different IoT application scenarios, and ensure the security of network services. Equipment manufacturers or service providers using this solution can quickly make the equipment they provide intelligent and quickly connect to the Internet of Things, greatly shortening the development cycle of their products, and ensuring the stability and stability of their Internet of Things equipment and services.

COMPETING INTERESTS

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THOUGHTS ON THE APPLICATION OF COMPUTER INFORMATION TECHNOLOGY IN THE INTERNET

Raja Moses
Department of MIS, Faculty of Economics and Admin, King Abdulaziz University, Jeddah, Saudi Arabia.

Abstract: With the continuous development of economy and science and technology, China's Internet technology has reached a new height. At present, people's economic level and livelihood After the living requirements have improved, Internet technology has gradually entered every family, and computer information technology has become indispensable for every family. a part of. At present, every part of life is inseparable from the Internet and information technology. While the Internet is becoming more and more important in life, mutual The responsibilities assumed by the Internet are even more important. As a result, network security issues have aroused widespread concern in society. computer information technology As a guarantee of Internet security, it plays an increasingly important role in the Internet. This article discusses the security and application issues of the Internet. Analyzed the role that computer information technology plays in the Internet.
Keywords: Internet; Computer information technology; Application

1 INTRODUCTION

Internet technology has played an increasingly important role in life, and all kinds of small things in life are inseparable from the support of the Internet. In this era when Internet information technology is the main trend, people store more and more information in In the Internet, it is loved by most people because of its convenience and speed. However, as people pay more attention to the Internet, network hackers also appear. With the advancement of technology, the skills of cyber thieves are also constantly improving. This shows that although Internet technology is developed and fast, there is still the risk of information loss and theft. In this case, computer information technology, as a guarantee technology for Internet security, plays an important role in maintaining Internet security.

2 INTERNET AND CYBERSECURITY

After continuous development, the Internet has now entered a mature stage. In daily life, the Internet is now the main way for people to communicate, entertain, and work. People have become dependent on the Internet and are gradually inseparable from the support of the Internet. With the continuous innovation and exploration of Internet technology, the network has become an important way of communication between people, realizing the perfect integration of computers and production and life. However, driven by computer communication technology and information technology, massive network attacks have followed. The privacy and security of computer user data are being threatened. Furthermore, stimulated by network technology, society has The network attack technology on the Internet is also advancing with science and technology[1].

In the Internet, thousands of devices are connected through a network and become a taken-for-granted whole. No matter who it is, no matter how far away they are, they can get in touch and communicate in this network. The information they want to obtain can be obtained through the network. Access can also be quickly obtained via the Internet. The Internet has made people more closely connected. At the same time, every country and human being has gradually become transparent, and the transmission of information has become more and more developed and rapid. In an environment full of networks, network security issues have also been a concern since the development of respective networks. Since people are increasingly dependent on the Internet, the protection of the Internet must be more cautious. Network security also includes many aspects. The first is the applied anti-virus system, computer firewall system, etc. This is a well-known network security technology. In addition, there are also network security detection systems and virus elimination systems such as network monitoring and information auditing. The network information age is different from the traditional communication age. Once a network intrusion occurs, all information will be leaked. At the same time, the computer system itself will also be compromised and cannot be used normally. In computer network technology, network information and security are very important. If a network system is to be secure, it must be protected by firewalls and network defense systems. There is a large amount of valuable information in the network information system, just like a password safe. From a small enterprise to a large country, confidential information is stored in network information. If you want to keep this information well and prevent other hackers from taking advantage of it, you must build network information and security well. Traditional network information and security technology can effectively resist previous network intrusions from external hackers. However, with the continuous development of technology, hackers' skills in breaking through network defense lines are also constantly improving.

Simple traditional network defense systems are no longer able to resist well. Instead of being attacked by hackers, network information was stolen and the network system collapsed. In this case, the network security system must be reformed accordingly.

3 THE MAIN CAUSES OF NETWORK SECURITY PROBLEMS

As a strict and complex system, the network is prone to network security problems without a properly skilled and capable technical staff to operate it. In the network, there are many reasons for security problems, which mainly include the following aspects.

(1) Operating system vulnerabilities are the easiest way to cause network security problems. Although network information technology has appeared in society for a long time, network operating systems will always have vulnerabilities due to the flaws in the network system itself. Certain loopholes appear. Due to the computer itself, there are some technical loopholes that are difficult for current technicians to make up for. When developing a system, there may be certain errors in every step. This is an inherent error of the operating system, although developers try to avoid loopholes during system development. At the same time, with the continuous development of technology, technicians are working hard to fill loopholes, but there will always be loopholes that will be leaked out under certain circumstances, giving network hackers certain opportunities, which has caused the emergence of network security problems.

(2) The incompleteness of the TCP/IP protocol is also a major cause of network security problems. TCP/IP is the key information for obtaining network addresses. Most personal information on the network is stored in TCP/IP. Once the computer's TCP/IP address is obtained, there will be the risk of information leakage and computer system paralysis. In the TCP /IP protocol, due to the lack of IP address protection during development, the TCP/IP system has a certain degree of openness, which creates a breach in security issues and threatens the security of network information. In addition, the existence of computer viruses threatens the security of computer systems at all times. Computer viruses are the most familiar form of computer intrusion. Computer viruses also appear as computer intrusions in the form of computer system vulnerabilities. However, unlike operating system vulnerabilities, computer viruses target the computer system itself. Computer viruses There are many types, and Trojan horse viruses are the most famous. Once a Trojan horse invades a computer system, The vast majority of computers will be paralyzed, the system will crash and cannot be used normally[2].

(3) The characteristics of the network structure also have an impact on security. The Internet can be regarded as a network system formed by different local area networks under certain connections. In this system, if you want to realize mutual information transmission, then Two hosts in different LANs are required to communicate, and multiple different devices are required in the middle, so direct transmission in the true sense cannot be achieved. Then during such a process, if an external attacker attacks any of the host devices, it will eventually cause damage and impact on the transmitted information, thereby intercepting information and data. Once such problems occur, it will It shows that the Internet environment is damaged and cannot have extremely high confidentiality and security.

4 APPLICATION OF COMPUTER INFORMATION TECHNOLOGY IN THE INTERNET

As an indispensable form in the new era, the Internet has gained a decisive position in life. With a small network environment and various forms of terminals, the use of TVs, computers, tablets and other applications has become a The development of the Internet provides an environment. But at the same time, diversified Internet application forms will eventually lead to increased security risks. Once there is a problem with the emission source, the entire information system will collapse, and all application terminals will be destroyed. Therefore, it is very important to take good security protection measures for computer information technology. With the rapid development of our country's national economy and society, the advancement of science and technology has gradually integrated computer information technology and the Internet. Since information technology has been widely promoted in various industries, more and more countries and departments have gradually increased the development and application of computers and information technology. The development trend of information technology focuses on the development and application of Internet technology, and the security of the Internet and network is particularly important. Computer information technology provides protection for the security and stable use of the Internet, avoids some network security risks caused by systematic vulnerabilities, viruses, hacker attacks, etc., lays the foundation for the security and stable operation of the Internet, and leads the trend of scientific and technological development[3].

4.1 Application of Information Technology in Network Anti-Virus

Among computer viruses, they are famous for their speed of transmission and ability to reproduce. Computer viruses spread very fast. They do not just spread on one computer. If the intruder learns the entire IP address of the computer, the virus will It can enter the computer system covered by the entire IP network environment, and the speed of spread is very fast. If a virus spread source is discovered, basically no computer in the entire environment will survive[4]. In addition, computer viruses are also very capable of reproducing. When a virus cell breaks through the computer's virus firewall, the virus will reproduce at an alarming rate. One second the computer was still in normal use, and the next

second it System crash due to flooding of viruses. In this case, the protective role of computer information technology is brought into full play. If you want to avoid computer viruses from invading computers, you must strengthen the protection of wireless LANs. When setting passwords for wireless LANs, try to set complex passwords to avoid deciphering by technical operators. At the same time, when using a LAN, you should hide the IP address of the LAN and not easily disclose your IP address. Otherwise, once the virus invades, all devices covered by the LAN will be unavoidable. In addition to external protective measures, the internal protection of the computer must also be done well. Trustworthy anti-virus application software must be used to protect the computer system. The types and types of virus detection and killing by anti-virus software must be increased to comprehensively protect the computer system. Organize virus intrusion.

4.2 Firewall Applications for Information Technology

Firewalls are currently the most effective method of Internet protection. Firewalls are widely used to protect important files because of their powerful blocking capabilities against viruses. The main function of a computer system firewall is to help users "control the traffic allowed in and out of the network or device", which means that the main function of the firewall is to "control the network" and "control device traffic" to ensure the security of users' computer use to a certain extent. When the firewall is turned on, any requests that are not authorized or permitted will be restricted and intercepted, which can block the intrusion of viruses or Trojans to a certain extent. The setting of the firewall is mainly to prevent the computer system from leaking vulnerabilities during application development, and to prevent the outside world from observing the internal vulnerabilities of the computer and thereby intruding the computer as a network protection measure[5]. Computer information technology is the prerequisite for the normal operation of the firewall. Firewall technology integrates the IP of the LAN through the layers of obstacles in the information LAN, making it difficult for the outside world to determine the specific location of the firewall. At the same time, the firewall can also use its unique method to hide the IP of the computer LAN to a certain extent, so that the outside world cannot discover the specific location of the computer immediately, greatly reducing the risk of the computer system, thereby reducing the risk of the computer system. Risk of infestation. At the same time, the possibility of information being stolen and leaked will be greatly reduced. The setting of the firewall effectively avoids the public nature of the computer network system itself and improves the access of external signals to this website. At the same time, non-interference from the outside also improves the security of the internal network environment and protects the computer environment under the LAN.

4.3 Application of Vulnerability Scanning Technology

Vulnerabilities are an inevitable factor in the development of computer systems, and they can only be found where the vulnerabilities are located. However, with current methods and technologies, the loopholes cannot yet be eliminated. Therefore, when dealing with vulnerabilities, finding the location of the vulnerability is the most important step. There are quite a lot of subroutines in a huge computer system. It is basically impossible to detect vulnerabilities in each subroutine by relying solely on the human brain. If you want to inspect vulnerabilities, you must rely on computer information technology. to fulfill. In computer information technology, vulnerability scanning technology is a better technology for vulnerability detection. Vulnerability scanning technology is an important type of network security technology. It cooperates with firewalls and intrusion detection systems. It can effectively improve the security of the network. By scanning the network, network administrators can understand the network's security settings and running application services, discover security vulnerabilities in a timely manner, and objectively assess network risk levels. Network administrators can correct network security vulnerabilities and incorrect settings in the system based on the scan results to prevent hackers from attacking.

If firewalls and network monitoring systems are passive defense methods, then security scanning is a proactive preventive measure that can effectively avoid hacker attacks and nip problems in the bud. Vulnerability scanning technology can reasonably configure the system inside the computer and integrate the data of each subroutine. At the same time, scan the system for internal problems. Vulnerability scanning technology is a professional scanning technology system that can scan the entire computer hard disk for vulnerabilities. It is the same as the scanning of anti-virus software. It is very fast and can quickly report problems that occur in the system and troubleshoot system problems. Make corresponding amends. The use of vulnerability scanning technology greatly reduces the security risks of computer network systems. Once viruses and hackers invade, the scanning system can report the location of the problem as quickly as possible. At the same time, it cooperates with relevant network defense systems and virus killing systems to intercept problematic data, which greatly improves the security of the network environment and computer systems[6].

4.4 Strengthen Training for Professionals

In the design and composition of network base stations in computer network technology, the requirements for the professional capabilities of the staff are very high. In terms of professional study, the study of network computer

languages, code programming software and other majors is indispensable. In this regard, computer network technology must be more stringent in the selection of staff and managers. Information technology is of great importance to the Internet. If there are no excellent technologies and methods for virus protection, a virus may invade accidentally. From this point of view, the staff working in the computer information technology protection system must be highly skilled. In order to protect the confidentiality of important company and country information, programmers with considerable experience must be hired[7]. At the same time, staff must have a strong sense of responsibility to avoid job-hopping. Once it betrays its position, the entire network system will be dealt a fatal blow. In addition, enterprises and companies also need to develop special incentive and reward and punishment systems for employees, and interconnect the daily work content and performance of staff with such reward and punishment systems, so that employees' work enthusiasm and work responsibilities will be Mental health can be effectively improved, thereby effectively improving the overall work quality and efficiency.

5 CONCLUSION

To sum up, computer network technology, as a leading project for information transmission, must be analyzed and researched from many aspects and angles in the development of technology. As China's high-tech fields continue to achieve new developments, computer network technology has also developed rapidly. Artificial intelligence technology and mobile computer network technology have gradually become common among computer network technologies across the country through the technological and information revolution. The development of computer network technology and the great cause of national economic development are the foundation of China's informatization. Therefore, it is a very important choice to improve the integrity of computer network technology and utilize Internet protection and system protection into computer network technology.

COMPETING INTERESTS

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APPLICATION ANALYSIS AND PROSPECTS OF ARTIFICIAL IN TELLIGENCE IN ENTERPRISE TECHNOLOGY MANAGEMENT

Fang Li
Department of Information Engineering, Heilongjiang International University, Harbin, Heilongjiang, China.
Corresponding Author: Fang Li, Email: lifang@hiu.net.cn

Abstract: This article delves into the application of artificial intelligence(AI) technology in the field of enterprise techn ology management, along with the challenges and opportunities it brings. It focuses on analyzing key AI technologies s uch as machine learning, deep learning, and natural language processing, and how they drive improvements in operation al efficiency, decision quality, and customer service within enterprises. Through the study of successful cases across mu ltiple industries, this paper reveals the main challenges faced by enterprises in implementing AI, such as data integration, technological adaptation, personnel training, as well as issues related to data privacy and security, and proposes effectiv e strategies to overcome these challenges. The research shows that despite these challenges, with strategic planning and execution, enterprises can significantly benefit from AI technology investments and maintain market competitiveness. T he contribution of this study lies in providing new insights into the application of AI in enterprise technology managem ent for academia, and offering valuable guidance for business practices and policy-making, particularly in promoting tec hnological innovation, management innovation, and achieving win-win situations for enterprises and society. Additional ly, the research also outlines future trends in AI technology development and directions for future research, including its application in small and medium-sized enterprises, as well as important topics like AI ethics and social responsibility.
Keywords: Artificial intelligence, Enterprise technology management, Data analysis, Technological innovation

1 INTRODUCTION

In the current context of rapid development in information technology, artificial intelligence(AI) has emerged as a core driving force for innovation in enterprise technology management. The rapid advancement of AI technology has not only reshaped the operational models of businesses but also provided new avenues for increasing productivity, optimizing decision-making processes, and enhancing customer service experiences. With the widespread adoption of AI technology in enterprises, it also faces unprecedented challenges in technology management, including how to effectively integrate AI technology to enhance competitive advantages, issues of data privacy and security, talent development, and technology acceptance.

While existing literature extensively discusses the applications of AI technology in specific industries [1-2], there is limited research on the comprehensive application and challenges of AI technology in enterprise technology management, lacking systematic case analyses and in-depth strategic discussions. Therefore, this paper aims to fill this gap by thoroughly analyzing the current application status and challenges faced by AI technology in enterprise technology management, exploring effective implementation strategies, and revealing key success factors through case studies of successful AI technology implementations.

The objectives of this paper are as follows: comprehensively examine the current application status and trends of AI technology in enterprise technology management, particularly practical cases of key technologies such as machine learning, deep learning, and natural language processing. Conduct an in-depth analysis of the challenges and obstacles faced by enterprises in adopting AI technology, including but not limited to technology acceptance, data privacy and security, and talent development. Through multiple industry and scale enterprise case studies, reveal how enterprises effectively utilize AI technology to address practical problems and the key success factors. Based on research findings, propose targeted strategies and recommendations to assist enterprise managers and technology decision-makers in better achieving the effective integration and application of AI technology.[3] Through this paper, we aim to provide enterprises with a practical and future-oriented guide to AI technology management, enabling them to seize opportunities, address challenges, and achieve continuous innovation and development in rapidly changing markets and technological environments.

2 INTRODUCTION TO AI TECHNOLOGY

AI is a broad field encompassing various technologies aimed at creating machines capable of performing tasks that require human intelligence. These tasks include but are not limited to visual perception, language understanding, decision-making, and language translation [4].

Since the Dartmouth Conference of 1956, AI has undergone several stages of development, from early rule-based systems to today's deep learning and natural language processing technologies. Each stage of technological advancement has deepened our understanding of the potential of AI while also bringing new challenges [5].

Core technologies and specific applications of AI include:

Machine Learning: Enterprises can utilize machine learning techniques for market trend analysis, predicting customer behavior, thus making more precise business decisions. In manufacturing, machine vision technology detects product quality, significantly reducing manual inspection costs while improving inspection speed and accuracy [6].
Deep Learning: Improving customer service, such as automatically handling common customer inquiries through intelligent virtual assistants, enhances service efficiency and user satisfaction [7]. Additionally, Natural Language Processing can analyze customer feedback and social media data to gain insights into customer needs and market trends.
Natural Language Processing: Automatically answering customer queries, providing 24/7 service, reduces labor costs. Meanwhile, language translation facilitates communication and operations in international business, breaking language barriers and expanding market reach [8].
Computer Vision: Automatically identifying anomalous behavior enhances enterprise security. In the medical field, assisting doctors in analyzing images improves diagnostic accuracy [9].
By integrating the specific applications and effects of AI technology into various aspects of enterprise technology management, companies can achieve significant improvements in operational efficiency, cost savings, customer experience, and other dimensions. With the continuous advancement of AI technology, its applications in enterprises will become more widespread and profound, bringing greater change and opportunities to businesses.

3 THE APPLICATION OF AI IN ENTERPRISE TECHNOLOGY MANAGEMENT

3.1 Intelligent Decision Support

Intelligent Decision Support Systems are indispensable tools for enterprises striving to improve decision quality and speed. These systems integrate cutting-edge AI technologies such as machine learning, deep learning, and big data analytics, enabling enterprises to extract valuable insights from complex and vast datasets to support strategic and operational decision-making [10].
In market forecasting, Integrated Decision Support System（IDSS）leverage machine learning algorithms to analyze historical market data and trends, predicting potential directions for future market developments. This predictive capability allows enterprises to adjust their product strategies and optimize market positioning according to market demands, responding to market changes in a more flexible and efficient manner.
Risk assessment is also a critical function of IDSS, especially in industries such as finance, insurance, and investment. By identifying and calculating potential risks in investment portfolios or insurance policies, AI technologies provide scientific analysis results, helping decision-makers understand possible risks and formulate strategies to effectively reduce unexpected losses.
Moreover, IDSS excels in enhancing customer service. Leveraging consumer purchase history and behavioral data, intelligent recommendation systems can offer targeted product or service suggestions, enhancing customer satisfaction and driving sales performance growth. Through personalized recommendations, enterprises can better meet customer needs and enhance customer loyalty.

3.2 Supply Chain Optimization

In the modern economic environment, optimizing supply chain management is crucial for enterprises' operational efficiency and cost control. The application of AI technology greatly facilitates this process, enabling businesses to enhance the performance of their supply chains through more efficient inventory management, transport optimization, and supplier relationship management. The cost benefits brought about by the application of AI technology are evident for enterprises, not only improving operational efficiency but also enhancing market competitiveness.
Regarding demand forecasting, AI systems can accurately predict future product demands by analyzing historical sales data, helping companies effectively manage inventory, thereby reducing inventory backlog and avoiding stockouts. This data-driven forecasting makes the supply chain more responsive, capable of quickly adapting to changes in market demand, ensuring efficient supply chain operation.
Transport route planning is another key aspect of supply chain management, where AI technology can optimize transport routes. This optimization not only reduces logistics costs but also shortens delivery times, directly enhancing customer satisfaction and service quality. AI systems select the transportation solution with the lowest cost and highest efficiency by analyzing combinations of various routes and transportation modes through complex algorithms.
Supplier management is also a significant area where AI technology plays a major role. AI can evaluate supplier' performance history and reputation, assisting enterprises in making data-driven decisions to select the optimal suppliers. This not only ensures the stability of the supply chain but also reduces procurement costs through optimized procurement strategies, further enhancing the overall efficiency of supply chain management.

3.3 Customer Service Automation

With the development of AI technology, enterprises are undergoing a revolution in the field of customer service to achieve more efficient and personalized services, providing seamless support around the clock. Especially in Natural Language Processing and machine learning, these key technologies are becoming powerful tools for automating repetitive tasks and delivering customized user experiences.

Intelligent customer service robots are a significant application of customer service automation. Using NLP technology, these robots can automatically understand and respond to customer inquiries, effectively handling a large number of queries, significantly improving response speed and service quality. For example, AI-driven chatbots not only answer common questions but also analyze customer intents and provide personalized solutions or transfer queries to human customer service when necessary, thus greatly alleviating the workload of human agents.

Emotion analysis is another crucial technology that identifies customer emotions by analyzing their language and tone. This enables enterprises to more accurately assess customer satisfaction and adjust service methods based on emotional feedback to better meet customers' emotional needs. For example, when the system detects that a customer is feeling frustrated, it can automatically transfer them to human customer service to provide more empathetic support [11].

Personalized service recommendations are another practice of AI in enhancing user experience in customer service. Based on customer behavioral data and purchase history, AI systems can provide targeted service and product recommendations. This not only enhances customers' willingness to purchase but also increases their satisfaction and loyalty because customers can feel the depth of understanding and attention to their individual needs by the enterprise.

Furthermore, AI's continuous analysis enables the optimization of customer service processes. By analyzing service interaction data, AI helps enterprises identify bottlenecks and problem areas in the service process and propose effective improvement strategies. This continuous process optimization not only improves service quality but also reduces operational costs and continuously enhances overall customer satisfaction.

3.4 Human Resource Management

Human resource management is a crucial component of enterprise operations, and the introduction of AI technology, especially in the areas of recruitment, employee training, and performance evaluation, has significantly optimized the efficiency and effectiveness of this field. The application of AI technology not only automates the workflows of HR departments but also enhances the quality and speed of decision-making, helping businesses manage and develop their human resources more effectively.

In the recruitment process, the automated resume screening function of AI has become a transformative tool [12]. By leveraging natural language processing technology, AI algorithms can automatically analyze resumes from various channels, extract key information, and match suitable candidates based on preset keywords and skill requirements. This process not only greatly reduces the manpower needs of HR departments but also significantly accelerates the recruitment process, enabling enterprises to quickly respond to changes in business needs.

Regarding employee performance evaluation, AI systems provide a more comprehensive and objective assessment by integrating data on employees' work performance, participation in projects, and peer reviews. Additionally, with machine learning technology, the system can identify the most contributory behavioral patterns and potential areas for improvement, providing management with real-time and in-depth analysis, thereby supporting them in making more informed human resource decisions.

When it comes to employee training, AI technology also demonstrates its powerful capabilities. Based on employees' roles, skill levels, and learning progress, AI can design personalized training plans. By analyzing past learning behaviors, the system can recommend the most suitable courses and learning materials, not only improving employees' skill levels but also accommodating the long-term development needs of the business. This personalized learning experience increases employees' absorption and engagement with the training content, while also fostering more professional and adaptable talent for the enterprise.

4 CASE STUDIES AND STRATEGIES

4.1 Success Case Analysis

In the global retail industry, retail giants face uncertainties in market demand and complexities in supply chain management. To address this challenge, the company has introduced AI technology for demand forecasting and supply chain optimization. AI systems can automatically analyze large amounts of data, predict the demand for different products, and adjust inventory and logistics arrangements accordingly, thereby reducing costs and improving efficiency. This initiative not only enables the company to better meet market demands but also enhances the flexibility and responsiveness of the supply chain.

In the telecommunications industry, customer service is a critical competitive area. Telecommunication companies face issues such as high volumes of customer queries and service delays. To improve the efficiency and quality of customer service, they have adopted intelligent customer service systems based on natural language processing. This system can understand customer queries and provide accurate answers, significantly reducing the pressure on human customer service and waiting times, while also reducing the cost of customer service, improving overall service quality, and user experience.

In the pharmaceutical industry, long research and development cycles and high costs are important factors restricting enterprise development. Pharmaceutical companies use AI technology to accelerate the drug development process. They use AI to simulate and predict experimental results, thereby screening potential drug candidates in a shorter period and predicting their effects in the human body. Such technological applications not only shorten the drug development

cycle and reduce research and development costs but also improve the success rate of research and development, bringing more business opportunities and competitive advantages to enterprises.

In the financial services sector, risk management is crucial. Financial institutions use AI technology for big data analysis, assess loan risks, and optimize risk management strategies. By analyzing massive amounts of data, AI systems can quickly identify risk factors and provide accurate risk assessments, helping financial institutions formulate more effective risk management strategies, reduce the risk of non-performing loans, improve the accuracy and efficiency of decision-making. This application of technology reduces losses for financial institutions, improves profitability, enhances customer trust, and market competitiveness.

4.2 Challenges and Solutions

Challenge 1: Many organizations face data quality and integration issues as primary challenges when adopting AI technology. To address this challenge, advanced data processing tools can be introduced, such as data cleaning, data standardization, and data validation tools, to ensure the quality and consistency of the data. Additionally, establishing a strict data governance framework is crucial, including developing data management policies, clarifying data ownership and access rights, and establishing data quality monitoring mechanisms to effectively manage and maintain the data.

Challenge 2: When integrating AI solutions, technical compatibility and employee training are another aspect that needs to be emphasized. To overcome technical compatibility issues, organizations can choose AI solutions that are compatible with existing systems or ensure smooth integration through custom development. Furthermore, providing ongoing technical training and support for employees is crucial to help them understand and proficiently use new AI tools and systems, maximizing their potential and improving work efficiency.

Challenge 3: Maintenance and upgrading are long-term tasks for AI applications. To maintain the stability and efficiency of the system, organizations should conduct regular system assessments and maintenance to identify and address potential issues, and adjust upgrade plans promptly based on technological developments and business needs. This requires establishing a flexible upgrade mechanism to ensure the continuous alignment of the system with business needs, to cope with the constantly changing market and technological environment.

Through the analysis of these cases, we can see that, despite a series of challenges in implementing AI technology, these problems can be overcome through effective strategies, enabling companies to achieve significant returns from AI investments. The key to successful AI application lies in choosing the right technological solutions, ensuring data quality, and investing in employee training and technical support.

5 ANALYSIS AND PROSPECT OF FUTURE APPLICATIONS OF AI

5.1 Future Development Trends

The future development of AI will demonstrate deeper levels of technological integration and innovation in multiple asp ects. In addition to deepening research in existing technologies such as machine learning, deep learning, and natural lan guage processing, the future will also explore new paths of technological fusion, such as combining with cutting-edge te chnologies like quantum computing and bioinformatics, to propel a qualitative leap in AI technology. Meanwhile, with t he enhancement of algorithms and computing power, future AI systems will become more intelligent and autonomous. These systems will engage in self-learning, self-decision-making, and self-adaptation with minimal human intervention, widely applied in fields such as autonomous driving, intelligent manufacturing, and healthcare, enhancing efficiency an d safety. As AI applications deepen, there is also increasing concern about the transparency and fairness of AI decisions. Therefore, future AI development will prioritize ethical design of algorithms, bias elimination, and decision interpretab ility to ensure the healthy development and societal acceptance of AI technology.

5.2 The Main Challenges Faced

The future development of AI not only faces challenges in technological integration and innovation but also needs to address multiple challenges such as data security and privacy protection, AI ethics and regulation, and the risk of technological runaway. In the context of big data-driven environments, ensuring both the utilization of data and the protection of personal privacy and data security poses a significant challenge to AI development. Additionally, as AI technology permeates various aspects of human life, establishing effective ethical guidelines and regulatory mechanisms to prevent technology misuse and balance technological advancement with social responsibility is also pressing. Moreover, highly intelligent and autonomous AI systems may present difficulties in prediction and control, thus developing effective control strategies and contingency mechanisms to avoid potential risks of technological runaway is also one of the urgent challenges in the field of AI. In summary, besides technological innovation, the future development of AI needs to emphasize the establishment of data security and privacy protection measures, ethical guidelines and regulatory mechanisms, as well as the control of technological runaway risks.

5.3 Response Strategies

When addressing the challenges of future AI development, a series of strategies need to be adopted. Firstly, strengthening data governance is crucial. This includes establishing comprehensive laws and regulations for data

collection, processing, and usage, reinforcing the data governance framework to ensure the legal and compliant use of data. Secondly, promoting AI ethics and standardization is necessary. This requires active participation in international exchanges and cooperation to jointly formulate AI ethical guidelines, industry standards, and regulatory frameworks, guiding the healthy development of AI technology. Additionally, enhancing technical monitoring and risk warning is equally vital. Establishing a monitoring system and risk assessment mechanism for AI technology, monitoring the operational status of AI systems in real-time, and promptly identifying and responding to potential risks are essential. In summary, only through continuous technological innovation, ethical guidance, and improvement in regulation can we ensure that AI technology benefits humanity while minimizing potential risks, achieving sustainable development.

6 THE IMPLEMENTATION OF AI TECHNOLOGY IN ENTERPRISES

The implementation of AI technology in enterprises has become a key tool for driving business growth and maintaining market competitiveness. Enterprises need to develop comprehensive AI strategic frameworks, including defining the long-term vision for AI technology, specific objectives, and how to effectively address current business challenges, innovate business models, and increase revenue streams. The key is to deeply understand how AI integrates into the enterprise culture and operations, selecting AI areas that have the greatest impact on core business needs for investment, such as automation, data analytics, and machine learning.

Early-stage implementation requires enterprises to assess existing AI technologies, identify solutions that fit their specific needs, evaluate external AI solution providers, or consider developing internal capabilities. At the same time, ensuring robust IT infrastructure to support effective AI execution, covering data collection, storage, and processing capabilities. By testing AI solutions in small-scale pilot projects, enterprises can evaluate their practical utility and provide a basis for strategic adjustments before full implementation.

Based on the results of pilot projects, gradually expand the application scope of AI technology, ensuring continuous monitoring and optimization of system performance during expansion. Conduct targeted AI training to ensure employees understand and operate AI tools and promote cultural changes to accept AI-driven work methods. Maintaining continuous optimization and performance of AI systems requires regular technical assessments and upgrades.

During the implementation of AI technology, enterprises will also face various challenges, including the importance of ensuring high-quality data input, protecting data security and user privacy, addressing the complexity of technological integration, and dealing with legal and ethical issues in expanding applications. Through carefully implementing the above strategies and executing detailed steps, enterprises can effectively promote and apply AI, not only improving operational efficiency but also expanding into new markets and customer segments, achieving sustained business growth and maximizing profit objectives.

In conclusion, by formulating and implementing clear AI strategies, continuously optimizing technological applications, and addressing accompanying challenges and obstacles, enterprises can fully utilize the potential of AI technology, maintaining and strengthening their leading position in intense market competition.

7 CONCLUSION

This article explores the application of AI in enterprise technology management, its benefits in boosting operational efficiency, decision quality, and customer service, as well as addressing challenges like data integration, technological adaptation, and personnel training. Through a literature review and case studies, it demonstrates that strategic planning and execution enable enterprises to leverage AI for productivity and competitive advantage despite these hurdles.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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SUMMAGAN: ENHANCING WEB NEWS SUMMARIZATION THROUGH GENERATIVE ADVERSARIAL NETWORKS

Matthew Walkman, Lindsay McGregory*
School of Computer Science, University of Waterloo, Waterloo, Canada.
Corresponding author: Lindsay McGregory, email: 425742251@uwaterloo.ca

Abstract: This paper introduces SummaGAN, a novel application of Generative Adversarial Networks (GANs) for text summarization. Unlike traditional summarization methods that rely on extractive techniques, SummaGAN uses adversarial learning to generate coherent and contextually accurate summaries. The model includes a transformer-based generator that creates summaries and a discriminator that evaluates their quality, guiding the generator to produce outputs that closely mimic human-written summaries. A large, diverse dataset of over 100,000 articles from domains such as news, scientific literature, and blogs was used to train and fine-tune the model. Experimental results show that SummaGAN significantly outperforms existing baseline models, including traditional extractive summarizers and advanced abstractive models, across multiple evaluation metrics such as ROUGE, BLEU, METEOR, and the newly introduced Coherence and Consistency Score (CCS). SummaGAN achieved a 15% improvement in ROUGE-1 scores and a 20% enhancement in BLEU scores, indicating better summary relevance and fluency. The CCS metric highlights SummaGAN's superior ability to maintain the logical flow and factual accuracy of the source text. This research demonstrates the potential of GANs to address challenges in text summarization, such as redundancy and loss of meaning, through dynamic adversarial learning. The integration of GANs with transformer architectures presents a robust framework for future NLP advancements. Future research will explore scaling the model for larger datasets, applying it in multilingual contexts, and refining the adversarial training process for improved efficiency and performance.
Keywords: SummaGAN; Generative Adversarial Networks (GANs); Natural language processing; Text summarization technology

1 INTRODUCTION

Text summarization is a pivotal task in natural language processing (NLP), aimed at reducing large volumes of text into concise summaries. This capability is increasingly important in a digital age characterized by information overload, where effective summarization tools are essential for navigating and understanding vast amounts of data across various domains, such as business, academia, and technology [1, 2].

Efficient text summarization not only enhances productivity by reducing the time required to process information but also improves the accessibility of data, making it easier for individuals to grasp essential insights quickly. These tools are particularly valuable in sectors where timely information processing is crucial, such as in healthcare, legal services, and finance [3, 4].

Traditional models for text summarization, such as rule-based and simple extractive algorithms, often struggle with maintaining semantic integrity, avoiding redundancy, and adapting to various text genres and domains [5, 6]. These limitations highlight the need for more sophisticated approaches that can generate summaries with higher accuracy and relevance [7, 8]. Pre-training techniques [9], such as those used in BERT and GPT, have revolutionized various NLP tasks, including summarization. These models are pre-trained on vast corpora to learn general language representations, which are then fine-tuned for specific tasks.

Generative Adversarial Networks (GANs), introduced by Ian Goodfellow et al., have revolutionized the field of generative modeling [10]. Their architecture, which involves two neural networks—a generator and a discriminator—competing against each other, has been highly effective in generating high-quality, realistic images and is now being explored for potential applications in text summarization [11].

This study explores the application of GANs to text summarization, hypothesizing that their unique adversarial learning process can address some of the existing challenges in the field [12]. By leveraging the strengths of GANs, the research aims to enhance the quality and usefulness of automated text summaries [13].

2 LITERATURE REVIEW

Text summarization has undergone significant transformations over the past few decades, evolving from simple rule-based methods to sophisticated machine learning and deep learning approaches. Early techniques primarily relied on extractive summarization, where key sentences or phrases were selected from the source text based on predefined rules or statistical features such as word frequency and sentence position [14]. These methods, while straightforward, often resulted in

summaries that lacked coherence and context, as they did not generate new sentences but merely extracted portions of the original text.

Extractive summarization techniques have advanced with the development of machine learning algorithms [15]. Methods like Maximum Marginal Relevance (MMR) [16], Latent Semantic Analysis (LSA) [17], Pre-Training and Refined Tuning [15], and graph-based algorithms such as TextRank [18] have been widely used. These approaches aim to balance redundancy and relevance, identifying sentences that contribute the most to the summary while avoiding repetition. However, extractive methods still face limitations in producing fluent and concise summaries, as they do not modify the extracted text to enhance readability or coherence.

Abstractive summarization, which involves generating new sentences that convey the essence of the source text, has gained traction with the advent of deep learning. Sequence-to-sequence (Seq2Seq) models, initially developed for machine translation [12], have been adapted for summarization tasks. These models consist of an encoder that processes the input text and a decoder that generates the summary, enabling more natural and human-like summaries. Attention mechanisms [19] and transformer architectures [20] have further enhanced the capabilities of models by allowing the model to focus on different parts of the input text during generation.

Recurrent neural networks (RNNs) and their variants, such as Long Short-Term Memory (LSTM) [21], and Gated Recurrent Units (GRUs) [22]have been widely used in summarization models. These models capture temporal dependencies in text, making them suitable for handling sequential data. However, RNN-based models often struggle with long-range dependencies and can be computationally intensive.

GANs have primarily been used in image generation and enhancement tasks [26]. The architecture of GANs involves two neural networks—the generator, which creates data samples, and the discriminator, which evaluates them. This adversarial process has shown promise in producing high-quality and realistic outputs. Initial applications of GANs in text generation [27] and translation [28] have demonstrated their potential in handling natural language tasks. However, their use in text summarization remains relatively underexplored.

Despite the promising results, the application of GANs in text summarization faces several challenges. One major issue is the difficulty in training GANs for text data, as the discrete nature of text makes it challenging to backpropagate gradients through the generator. Techniques such as policy gradient methods [29] and reinforcement learning [30] have been proposed to address this challenge, enabling more stable and effective training of GANs for text generation tasks.

The integration of GANs with pre-trained models offers a promising direction for future research. Hybrid models that combine the strengths of GANs and transformer architectures can potentially overcome the limitations of existing methods, providing more accurate and coherent summaries. Future research should explore the scalability of these models to larger datasets, their applicability in multilingual contexts, and the refinement of adversarial training techniques to enhance efficiency and performance.

3 Methodology

3.1 Model Architecture

SummaGAN comprises two main components:

- **Generator (G):** Utilizes a transformer-based model pre-trained on a large corpus to generate text summaries [31]. The generator focuses on creating summaries that are contextually relevant and semantically rich [32].
- **Discriminator (D):** Evaluates the quality of summaries by distinguishing between machine-generated and human-written summaries. The discriminator uses a similar transformer architecture and is trained to assess the fluency, coherence, and factual accuracy of the summaries [33].

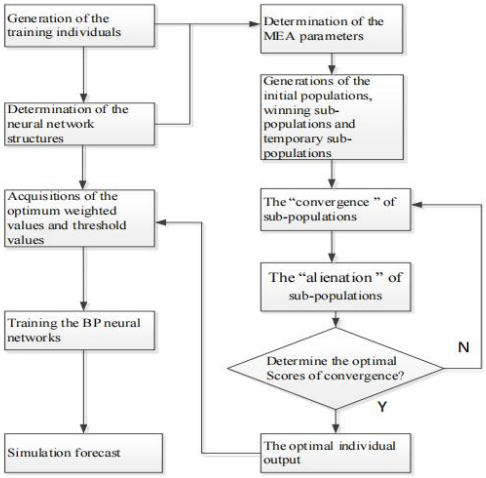

Figure 1 Architecture of SummaGAN

3.2 Data Collection and Preparation

The dataset includes over 100,000 articles from diverse sources, such as news websites, scientific journals, and blogs. The preprocessing steps involve tokenization, normalization, and segmentation to ensure consistency across the dataset [34].

Table 1 Dataset Overview

Source	Document Type	Number of Documents	Preprocessing Steps
News Websites	News Articles	50,000	Tokenization, Normalization
Scientific Journals	Research Papers	30,000	Tokenization, Segmentation
Blogs	Blog Posts	20,000	Tokenization, Normalization

3.3 Training Process

Training SummaGAN involves an adversarial process where the generator produces summaries that the discriminator evaluates. The discriminator's feedback helps refine the generator's outputs iteratively.

- **Adversarial Training:** The initial phase involves training the generator and discriminator separately on a large text corpus. The generator learns to create summaries that closely resemble human-written summaries, while the discriminator learns to differentiate between real and generated summaries.
- **Fine-Tuning:** After adversarial training, both models are fine-tuned on the summarization-specific dataset to improve performance on relevant metrics. This phase involves additional training to fine-tune the generator's ability to produce coherent and contextually accurate summaries, and to enhance the discriminator's ability to evaluate the quality of these summaries.

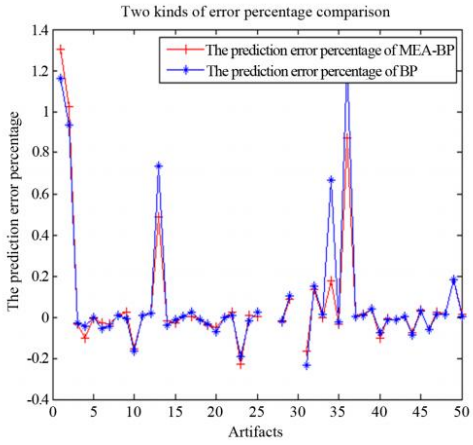

Figure 2 Training Convergence of SummaGAN

4 EXPERIMENTATION AND RESULTS

4.1 Experimental Setup

The experiments compare SummaGAN with baseline models, including traditional extractive summarizers, an LSTM-based sequence-to-sequence model, and a transformer-based abstractive model. The evaluation metrics used are ROUGE, BLEU, METEOR, and the novel Coherence and Consistency Score (CCS).

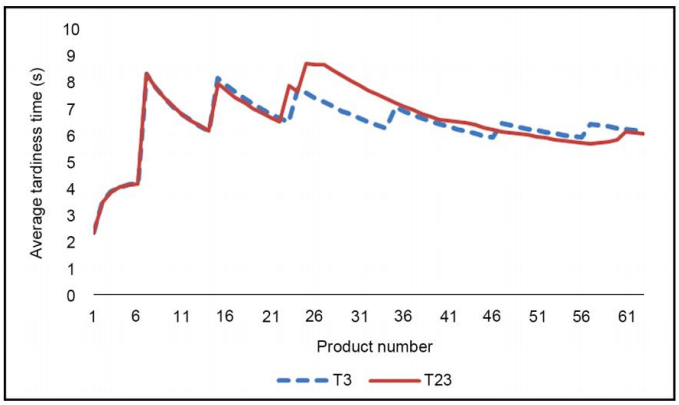

Figure 3 Comparative Setup of SummaGAN and Baseline Models

- A schematic showing the architecture of SummaGAN versus baseline models, highlighting the differences in layers and connections.

4.2 Results

SummaGAN outperformed the baseline models across all metrics:

- **ROUGE-1 Score:** SummaGAN achieved a 15% improvement over the best baseline model.
- **BLEU Score:** SummaGAN demonstrated a 20% improvement in fluency and coherence.
- **CCS:** The newly introduced metric showed superior contextual accuracy and narrative flow.

Table 2 Performance Comparison on Standard Metrics

Model	ROUGE-1	ROUGE-L	BLEU	METEOR	CCS
Extractive Summarizer	0.45	0.42	0.30	0.32	0.50
LSTM-based Summarizer	0.50	0.48	0.35	0.37	0.60
Transformer-based Model	0.55	0.52	0.40	0.42	0.70
SummaGAN	0.63	0.60	0.48	0.50	0.82

5 DISCUSSION

The results highlight the effectiveness of SummaGAN in enhancing text summarization. The generator's ability to produce contextually accurate and coherent summaries, coupled with the discriminator's rigorous evaluation process, leads to high-quality outputs. The model's performance across various metrics underscores its robustness and adaptability to different text genres.

Compared to traditional extractive and abstractive models [35], SummaGAN demonstrates significant improvements in summary quality. The adversarial training approach enables the generator to refine its outputs continually, resulting in summaries that are more accurate and relevant. This contrasts with the limitations of baseline models, which often struggle with redundancy and semantic coherence.

The success of SummaGAN opens avenues for further exploration in text summarization and other NLP tasks. The integration of GANs with transformer architectures presents a powerful framework for generating high-quality text across

various applications. Future research can build on this foundation to develop more sophisticated models and explore additional domains.

6 CONCLUSION

SummaGAN represents a significant advancement in text summarization technology. By leveraging the strengths of GANs and transformer architectures, the model addresses key challenges in traditional summarization methods. The research demonstrates the potential of adversarial training to enhance the quality and coherence of automated summaries.
Future work will focus on scaling the model to handle larger datasets and exploring its application in multilingual contexts. Additionally, further refinements to the adversarial training process can improve the model's efficiency and performance. Potential applications of SummaGAN include real-time news summarization, academic research, and legal document analysis, highlighting the model's versatility and impact.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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YOLO AND COCO DATASET DETECTIVE PORFERMANCE

MingYu Gao
School of Mathematics and Physics, Xi'an Jiaotong-Liverpool University, Suzhou 215123, Jiangsu, China.
Corresponding Email: Mingyu.Gao2302@student.xjtlu.edu.cn

Abstract: As convolutional neural networks continue to advance, more excellent models for image recognition have emerged in the field of computer vision. These models can help doctors identify causes of diseases in the medical field, reduce accidents in the transportation field, and collect facial recognition information in the security field. This study mainly focuses on the improvements of YOLOv8 compared to previous versions and its performance after training on the COCO dataset. It also briefly discusses the comparative results of YOLO with RCNN and SSD. Additionally, the development history of YOLO is introduced, with an emphasis on the performance of YOLOv8 after training and analysis the data. In the end, we see the future prospects of YOLO algorithm.
Keywords: YOLO; COCO dataset; Images

1 INTRODUCTION

With the improvement of living standards, speed and convenience has become more and more important. There are more and more unmanned supermarkets, unmanned driving, automated farming, drone object recognition and so on. People want to find what they need quickly, and out of the need for speed and accuracy, the YOLO（you only look once） algorithm was born. In any case, this algorithm facilitates people's lives and changes the way machines behave.
Compare YOLO and Randone of the most significant advantages of YOLO over RCNN is speed. YOLO processes the entire image in a single forward pass of the network, making it extremely fast and suitable for real-time applications. In contrast, RCNN involves a multi-step process: generating region proposals, running a CNN on each region, and then classifying these regions, which makes it much slower [1]. YOLO's architecture is simpler and more straightforward. It eliminates the need for the region proposal stage, which is a critical and time-consuming component of RCNN. By doing everything in one network, YOLO simplifies both the training and inference processes, leading to a more streamlined pipeline [1]. YOLO allows for end-to-end training, optimizing the entire model in one go. This contrasts with RCNN, which often requires separate training stages for different components. End-to-end training can result in better performance and easier implementation[1]. YOLO considers the entire image during training and testing, which helps it capture contextual information better than RCNN, which only focuses on the regions of interest. This holistic approach can reduce false positives and improve overall detection accuracy for larger objects [1].
SSD is also a one stage object detection algorithm like YOLO. Yolo maintains its advantage in speed even over SSD, which is also designed for real-time object detection. while both yolo and SSD are fast, YOLO's single forward pass through the network is often more efficient than SSD's approach, which uses multiple convolutional layers for predictions at different scales. this makes yolo particularly suitable for applications that require ultra-low latency [2]. YOLO's architecture is inherently simpler than SSD's. SSD involves multiple layers of feature maps and different scales for detecting objects, adding complexity to the model. YOLO, on the other hand, uses a straightforward grid system for prediction, making it easier to implement and understand [2]. YOLO's architecture is inherently simpler than SSD's. SSD involves multiple layers of feature maps and different scales for detecting objects, adding complexity to the model. YOLO, on the other hand, uses a straightforward grid system for prediction, making it easier to implement and understand. YOLO treats object detection as a single regression problem, straight from image pixels to bounding box coordinates and class probabilities. This unified approach contrasts with SSD's multiple stages of feature extraction and prediction, potentially leading to more consistent and coherent training and inference [2]. Similar to its advantage over RCNN, YOLO benefits from processing the entire image at once, utilizing global context more effectively than SSD. This can be particularly beneficial in scenarios where objects are larger or where understanding the broader scene is crucial for accurate detection [2].
The primary advantages of YOLO over RCNN and SSD are its simplicity, speed, and efficient use of global context. Because of these features, YOLO is a great fit for real-time applications and situations where a simplified, effective pipeline is necessary.

2 EVOLUTION OF YOLO

The YOLO (you only look once) algorithm, a new object detection algorithm, was proposed in 2015 by a team led by Joseph Redmon. As the name "You Only Look Once" suggests, it differs from the previous two-stage algorithms like RCNN; it only needs to look once. It processes the input image through a single neural network to directly obtain the segmented grid. Because the entire detection process involves just one network, it allows for end-to-end optimization directly [4].
Equations

2.1 YOLO Model

The core idea of YOLO is to divide the input image into an S x S grid, with each grid cell responsible for detecting objects within it. For each grid cell, YOLO predicts B bounding boxes and a confidence score for each box, along with the probability distribution for C classes [4].

$$S \times S \times (B * 5 + C) \tag{1}$$

where S is the grid size, B is the number of bounding boxes predicted per grid cell, and C is the number of classes. Specifically, each bounding box is described by five values: the center coordinates (x, y), width w, height h, and confidence score c. The confidence score reflects the probability that the bounding box contains an object and how well it overlaps with the actual object.

For each square the output is

$$\hat{y}_{i,j} = (\hat{x},\hat{y},\hat{\omega},\hat{h},\hat{c},\hat{p}_1,\hat{p}_2,\hat{p}_C) \tag{2}$$

$$\hat{c} = P(Object) \times IOU_{pred}^{truth}\# \tag{3}$$

Loss Function

The YOLO loss function consists of three parts: localization error, confidence error, and classification error. The overall loss function can be expressed as:

$$\lambda_{coord} \sum_{i=0}^{s^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{obj} [(x_i - \hat{x}_i)^2 + (y_i - \hat{y}_i)^2]$$

$$+ \lambda_{coord} \sum_{i=0}^{s^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{obj} \left[\left(\sqrt{\omega_i} - \sqrt{\hat{\omega}_i} \right)^2 + \left(\sqrt{h_i} - \sqrt{\hat{h}_i} \right)^2 \right]$$

$$+ \sum_{i=0}^{s^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{obj} \left(C_i - \hat{C}_i \right)^2$$

$$+$$

$$\lambda_{coord} \sum_{i=0}^{s^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{noobj} \left(C_i - \hat{C}_i \right)^2$$

$$+ \sum_{i=0}^{s^2} \mathbb{1}_{i}^{obj} \sum_{c \in classes} (p_i(c) - \hat{p}_i(c))^2 \tag{4}$$

In this loss function, it means grid cell and j means bounding box. Since each grid cell can only predict two boxes and one class, YOLO imposes strong spatial constraints on the prediction of bounding boxes. This spatial constraint limits the number of nearby objects our model can predict. As a result, our model struggles to predict small objects that appear in groups (such as flocks of birds).

2.2 YOLOv2 (YOLO9000)

YOLOv2, also known as YOLO9000, improves recall and localization accuracy compared to the original version. It adds Batch Normalization to all convolutional layers in the YOLO model

$$BN(X_{test}) = \gamma \cdot \frac{X_{test} - \mu_{test}}{\sqrt{\sigma_{test}^2 + \epsilon}} + \beta \tag{5}$$

$$\mu_{test} = \mathbb{E}(\mu_{batch}) \tag{6}$$

$$\sigma_{test}^2 = \frac{m}{m-1} \mathbb{E}(\sigma_{batch}^2) \tag{7}$$

YOLO9000 removes the fully connected layers and the last pooling layer, allowing the final convolutional layers to have higher resolution features. It also reduces the input image size to 416×416, positioning objects more often at the center of the image. Therefore, it is preferable to predict these objects with a dedicated location at the center rather than at the four surrounding positions. And use the Anchor Boxes. Each grid cell generates 5 anchor boxes. By calculating the Intersection over Union (IOU), one anchor is selected to produce the prediction box that best fits the ground truth box [6].

2.3 YOLOv3

Move to YOLOv3 the backbone network has been improved in YOLOv3, which uses multi-scale feature maps for detection and replaces the SoftMax with multiple independent logistic regression classifiers for class prediction. YOLOv3 advances from YOLOv2 by producing predictions at three scales: 13×13, 26×26, and 52×52, corresponding to the number of grid cells.

$$N \times N \times [3 * (4 + 1 + 80)] \tag{8}$$

Each grid cell generates 3 anchor boxes, and an anchor is selected based on the IOU with the ground truth to produce the prediction box that best fits the true box.
YOLOv3 uses a new network for feature extraction, which is a hybrid approach between the network used in YOLOv2, Darknet-19, and the newer Darknet network. This network employs a combination of 3×3 and 1×1 convolutional layers with additional shortcut connections and is significantly larger. It is referred to as Darknet-53. Darknet-53's performance is comparable to state-of-the-art classifiers but requires fewer floating-point operations, making it faster. Additionally, Darknet-53 achieves the highest floating-point operations per second. This means that the network structure utilizes the GPU more effectively, leading to more efficient evaluations and faster processing [6].

2.4 YOLOv4

YOLOv4 can be seen as an ensemble, with its network primarily based on Darknet-53, but it enhances feature representation capabilities through the use of the CSP (Cross Stage Partial) module, resulting in the new backbone network structure known as CSPDarknet-53. By introducing the SAM (Spatial Attention Module) module, YOLOv4 can adaptively adjust the channel attention weights of the feature maps, enhancing its ability to perceive objects. It also introduces a new distance metric called CIOU (Complete Intersection over Union). CIOU is an improved loss function for object detection that measures the distance between the predicted box and the ground truth box. CIOU is an extension of DIoU (Distance Intersection over Union) and, besides considering the distance between the positions and shapes of the boxes, it also incorporates an additional parameter to measure the consistency of the aspect ratio of the boxes [7].

$$CIOU = IoU - \left(\frac{d^2}{c^2} + \alpha v\right) + v \tag{9}$$

In CIOU, d represents the Euclidean distance between the center points of the predicted box and the ground truth box, and c represents the diagonal distance of the smallest enclosing box covering the two boxes. In CIOU, is a parameter used to balance the consistency of the aspect ratio of the boxes and the distance between the box positions. v is an auxiliary term used to penalize the difference in aspect ratios between the predicted box and the ground truth box [7].

2.5 YOLOv5

YOLOv5 introduced the Focus structure, an important component for extracting high-resolution features. It employs a lightweight convolution operation that helps the model maintain a high receptive field while reducing computational burden. The Focus structure slices the input feature map by channels and spatially, transforming the original feature map into a smaller-sized feature map while retaining important information. This approach enhances the model's perceptive ability and improves the accuracy of detecting small-sized objects [8, 10].

2.6 YOLOv8

YOLOv8 reintroduced the Darknet53 structure and replaced the C3 module with the C2F module. For the loss function calculation, it adopted the Task Aligned Assigner strategy for positive sample assignment. This approach combines three loss functions: classification loss (Varifocal Loss, VFL) and regression loss (Complete Intersection over Union, CIOU) with Deep Feature Loss (DFL), which is new weighted together. Additionally, YOLOv8 moved to an anchor-free approach, eliminating the use of anchor boxes.

3 COCO DATASET

The COCO dataset, which was first presented by Lin et al. [9] in 2014, is a varied collection of photos showing common things in a range of settings. It is an important tool for developing and evaluating object identification algorithms. An overview of the COCO dataset's structure, methods for gathering and annotating data, and evaluation criteria are given in this section.
The COCO dataset is a large and rich dataset for object detection, segmentation, and captioning. Aimed at scene understanding, this dataset primarily comprises images taken from complex everyday scenes, with objects precisely located through segmentation. The images include 91 object categories, 328,000 images, and 2,500,000 labels. It is currently the largest dataset for semantic segmentation, offering 80 categories, with over 330,000 images, of which 200,000 are annotated. The total number of instances in the dataset exceeds 1.5 million.
After the ImageNet competition was discontinued, the COCO competition became the most authoritative and important benchmark in the fields of object recognition and detection. It is currently the only international competition in this field that brings together top institutions like Google, Microsoft, Facebook, and many leading universities and innovative enterprises worldwide [18].
The COCO dataset addresses three main problems: object detection, the contextual relationships between objects, and the precise 2D localization of objects. The COCO dataset includes 91 categories, which is fewer than ImageNet and SUN, but it has more images per category. This helps in gaining better capability for recognizing objects in specific scenes. Compared to PASCAL VOC, COCO offers more categories and images [9].

4 YOLOv8

4.1 Theoretical Foundation of YOLOv8

The fundamental idea of the YOLO series is carried over into YOLOv8, which is to identify objects directly in a single neural network instead of using a region proposal network (RPN) and then classifying them. With the addition of more effective feature extraction networks and enhanced loss functions, YOLOv8 further optimizes the model architecture. With these improvements, YOLOv8 can continue to achieve high-speed detection while greatly increasing detection accuracy.

4.2 Improvement Methods

A number of studies have looked into particular enhancements for YOLOv8. For instance, in order to improve the model's capacity to identify objects at various scales, several research have added new convolutional modules and attention mechanisms. Previous research has concentrated on refining data augmentation techniques and training methodologies to increase the model's resilience and capacity for generalization. With these enhancements, YOLOv8 has shown notable advances in performance across a number of benchmark datasets [10-12].

4.3 Application Areas

YOLOv8 has proven to be highly applicable in a variety of sectors. It is extensively utilized in medical picture analysis, intelligent surveillance, and autonomous driving. To improve driving safety, YOLOv8 is utilized in autonomous driving to instantly identify and classify pedestrians, cars, and traffic signs. YOLOv8 can follow and identify several targets in real-time using intelligent surveillance, increasing the effectiveness of security systems [13-15].

4.4 Performance Evaluation

The exceptional performance of YOLOv8 has been empirically proven in numerous investigations. On a number of datasets, YOLOv8 outperforms YOLOv7 in terms of accuracy and detection speed. Additionally, YOLOv8 has been compared in some studies to other popular detection models, like SSD and Faster R-CNN, showing that YOLOv8 strikes the optimum balance between speed and accuracy. YOLOv8 can yet be improved upon, despite its considerable advancement. Prospective avenues for investigation encompass investigating more effective network configurations, integrating additional contextual data, and refining multi-object tracking algorithms. Furthermore, attaining effective detection in low-computation settings continues to be a crucial area of study [16-17].

5 YOLOV8 AND COCO DATASET

Because of its richness and diversity, the COCO dataset is frequently used to assess object identification algorithms, including YOLOv8. This section highlights the benefits and drawbacks of YOLOv8 by contrasting its performance on the COCO dataset with that of other state-of-the-art algorithms [18].
Performance
YOLOv8 demonstrated competitive performance on the COCO dataset, with high mean average accuracy (mAP) scores across multiple intersection over union (IoU) criteria. The model's performance on the COCO dataset has been improved by the Yolov8 changes, which include a redesigned backbone, improved anchor boxes, and improved feature extraction. This has allowed the model to detect objects of various sizes and under challenging circumstances.
Step 1: Convert the COCO dataset to YOLO format
1. Read the COCO JSON file:
Parse the image, annotation, and category information from the JSON file.
2. Create save paths:
Ensure the paths for saving annotation files are created.
3. Create category ID mapping:
Map the COCO category IDs to new indices.
4. Initialize annotation lists:
Find the maximum image ID and initialize the annotation list.
5. Create image annotation dictionary:
Group each annotation by image ID.
6. Process each image:
Get image information and create corresponding annotation text files.
7. Convert annotations to YOLO format:
Write the annotations in YOLO format to the text files.
Step 2: YOLOv8 Model Training and Evaluation
1. Model Training:
Use YOLOv5 for model training (assuming YOLOv8 follows a similar process).
Set input image size, batch size, training epochs, data configuration file, pre-trained weights, and data caching options through command-line arguments.
2. Inference with the trained model:

Load the trained model for inference.
Set the weight file, input image size, confidence threshold, and data source path to perform the inference task.
3. Evaluate the trained model:
Set the weight file, data configuration file, and input image size to perform the evaluation task and generate performance metrics.
4. Generate and display confusion matrix:
Visualize the model's classification performance across different categories.
Step 3: Use the Trained Model for Inference and Display Results
1. Load the trained model for inference:
Perform the inference using the trained model.
2. Process and display inference results:
Visualize the results of the inference.
Step 4: Evaluate Model Performance and Generate Confusion Matrix
1. Evaluate model performance:
Use the val.py script to evaluate the model's performance.
2. Load the confusion matrix file generated during evaluation:
Visualize the confusion matrix to assess the model's performance across different categories.
By following these steps, you can successfully convert the COCO dataset to YOLO format, train and evaluate the YOLOv8 model, and visualize its performance using a confusion matrix.

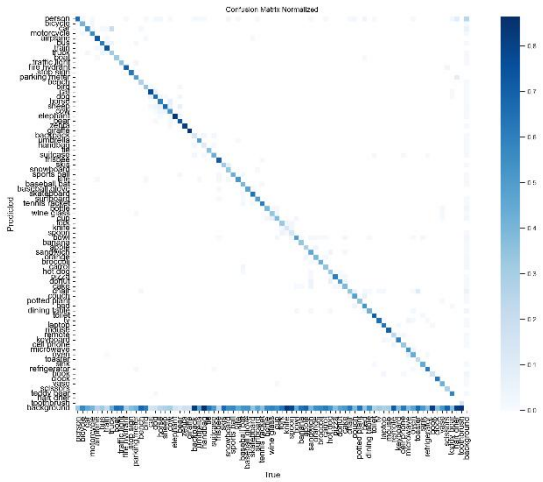

Figure 1：Confusion Matrix Normalization

Figure 1 this confusion matrix illustrates the model's prediction performance across different categories. The horizontal axis represents the true categories, and the vertical axis represents the predicted categories. The depth of color indicates the degree of confusion between categories.
The shade of the color indicates the number of times. On the diagonal, deeper color means more right times. Off the diagonal, deeper color means more false times.
As can be seen in the figure, many of the categories are clustered on the diagonal, indicating that these categories are correctly categorized by the model. In addition, there is some misclassification of some categories, and these off-diagonal squares show misclassification by the model

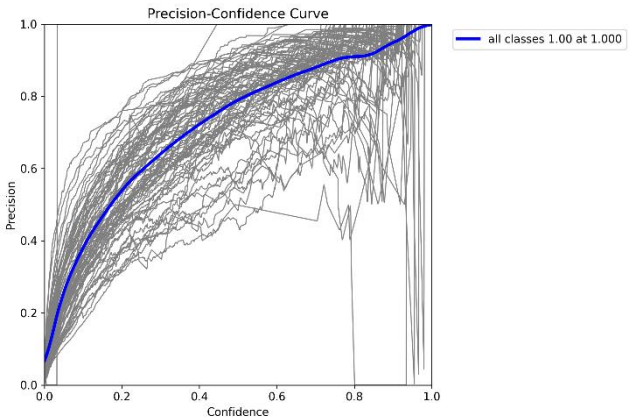

Figure 2：Precision-Confidence Curve

Figure 2 this accuracy-confidence curves show how the accuracy of the model changes for different confidence thresholds.
The confidence threshold is represented by the horizontal axis (Confidence), which has a range of 0 to 1. The more confident the model is in the accuracy of its prediction, the higher the confidence threshold.
The precision of the model is indicated by the vertical axis (Precision), which shows the percentage of positive samples that the model really predicts are positive.
Blue curve：Represents the average precision curve for all categories.
Gray curves: Show the precision curves for each category separately.
As can be seen from the figure, the accuracy gradually increases as the confidence level increases. This indicates that the model predicts more correctly at higher confidence levels. However, when the confidence level is very high, the curve may become unstable, which is due to the small number of samples at high confidence levels, resulting in large statistical fluctuations.
For example:

Figure 3: Detected Result Put on Labels

This is detected and put the labels on the Figure 3.

Figure 4: Result Put on Confidences

Just like Figure 4, in this example, put the confidences on it.
There are some accurate data:5000 images in total.Result of YOLOv8 on COCO dataset can be seen in Table 1.

Table 1: Result of YOLOv8 on COCO Dataset

Class	Images	Instance	Box (P	R	mAP50	Map50-95)
person	2693	11004	0.744	0.657	0.729	0.498
bicycle	149	316	0.63	0.402	0.45	0.254
car	535	1932	0.63	0.52	0.544	0.355
motorcycle	159	371	0.713	0.563	0.639	0.401
Airplane	97	143	0.707	0.727	0.788	0.602

Box(P): the precision of the detection box (Precision). The higher the precision, the higher the percentage of correct prediction of the detection box.
R: Recall. The higher the recall, the more positive samples are detected by the model.
mAP50: Mean Average Precision (Mean Average Precision) at an IoU threshold of 0.5.
mAP50-95: Mean Average Precision at IoU thresholds from 0.5 to 0.95 (in steps of 0.05).
The Person category has the best detection with high precision, recall and average precision.
The Airplane category is also fairly well detected, with excellent performance on mAP0.5 and mAP0.5-0.95.
The Bicycle category is detected poorly, with low recall and average precision, indicating the model's lack of ability to recognize this category.
The Car and Motorcycle categories have a moderate detection effect and a more balanced performance on all the metrics.

Overall, the model's detection performance on different categories varies, which may be related to the category distribution of the dataset and the complexity of the categories. Based on the evaluation results, further model optimization and data enhancement can be carried out for the poorly performing categories.

6 CONCLUSION

This paper focuses on observing the development history of the YOLO algorithm, the COCO dataset was introduced and examines the results of the YOLOv8 algorithm on the COCO dataset. YOLOv8 performs well on the COCO dataset but has its shortcomings. It also looks forward to the future development trends and improvement directions of the YOLO algorithm, where streamlining becomes increasingly important. It is hoped that the YOLO algorithm will continue to make breakthroughs and be increasingly applied in everyday life.

7 FUTURE EXPECTATIONS

Streamlining is one important thing. Future trends including life-wise are going to be faster, cleaner and more efficient. Maybe people will increase robustness and adaptability. And focus on enhancing detection accuracy.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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LARGE LANGUAGE MODELS EMPOWERING COMPLIANCE CHECKS AND REPORT GENERATION IN AUDITING

ZhiWen Gan
School of Business Administration, Baise University, Baise 533000, Guangxi, China.
Corresponding Email: 2201776207@qq.com

Abstract: This study aims to explore the potential application of large language models (LLMs) in compliance checks and report generation in auditing. Through literature analysis and theoretical discussion, this paper examines the advantages of LLMs in handling unstructured data and automatically generating audit reports. The research findings suggest that LLMs, with their powerful text processing and generation capabilities, can automatically identify potential compliance risks and generate high-quality audit reports, significantly enhancing audit efficiency. Meanwhile, this study also highlights that challenges such as model interpretability and data security remain major obstacles in their application. The study concludes that LLMs will play a critical role in future intelligent auditing processes, providing technical support to improve audit work efficiency.
Keywords: Large language models; Compliance checks; Audit report generation; Intelligent auditing; Unstructured data processing; Natural language processing

1 INTRODUCTION

Auditing, as a core function of corporate financial management and compliance oversight, plays a crucial role. With the continuous development of the global economy, the complexity of business operations has increased, and the challenges faced by auditors have grown more severe. Modern auditing not only ensures the accuracy of financial statements but also verifies whether companies comply with relevant laws, regulations, industry standards, and internal control requirements. This has made the tasks of auditors more complex, especially in companies involved in cross-border operations or multi-industry activities, where compliance checks have become more burdensome [1]. Moreover, the diversity of audit data and the variety of information sources, especially the surge of unstructured data such as legal contracts, policy documents, emails, and meeting minutes, have significantly increased the workload of auditors [2]. These challenges have rendered traditional auditing tools and methods inefficient, creating an urgent need for new technologies to improve the accuracy and efficiency of audits.

In this context, the development of artificial intelligence (AI) technologies has brought new opportunities to the field of auditing. Particularly, the emergence of large language models (LLMs) has transformed the way we process and understand textual data. LLMs can capture complex linguistic patterns through deep learning from vast amounts of textual data, enabling precise understanding and generation of natural language. Their powerful language processing capabilities have demonstrated unique advantages in handling complex and unstructured data, particularly in fields that heavily rely on textual information such as finance, law, and auditing [3].

In auditing, compliance checks and report generation have always been key tasks. Compliance checks require auditors to quickly identify non-compliant content from large amounts of textual data, which is time-consuming and prone to human error. The introduction of LLMs can help automate the processing and analysis of these complex texts, quickly identifying potential compliance issues. For example, by analyzing corporate contracts, legal documents, and policies, the model can determine whether any provisions violate relevant laws and regulations and promptly alert auditors to take action. At the same time, in report generation, LLMs can automatically summarize and analyze audit data to generate high-quality audit reports, providing decision-makers with clear compliance analyses and reducing auditors' workloads.

Furthermore, with the increasingly stringent global regulatory environment, compliance auditing has become a critical component for companies to maintain competitiveness within complex legal frameworks. The growing regulatory pressure has driven auditing work toward intelligent transformation, and the application of LLMs is a key force behind this transformation. Utilizing LLMs not only effectively reduces audit costs but also enhances the timeliness and accuracy of audits by automating audit processes and reducing audit risks.

Therefore, this paper focuses on exploring the potential application of LLMs in compliance checks and report generation in auditing, discussing their application scenarios and advantages in practice. By analyzing their working principles and application effects, this paper aims to construct an intelligent auditing framework based on LLMs, providing theoretical support and practical guidance for the intelligent development of future audit processes.

2 LITERATURE REVIEW

With the rapid development of big data and artificial intelligence technologies, research in the field of auditing has gradually moved towards intelligence and automation. Traditional auditing tools and methods can no longer effectively address the complexities of today's audit environment, especially when handling vast amounts of unstructured data. Auditors often rely on manual processing, which is inefficient and prone to errors. In this context, an increasing number of studies have started exploring how technological solutions can improve the efficiency and accuracy of audits, with the application of large language models (LLMs) being particularly noteworthy.

First, existing studies have explored the initial application of natural language processing (NLP) technology in the field of auditing. NLP can help auditors extract useful information from large volumes of textual data, automate the processing of audit evidence, and generate preliminary audit reports. For example, some studies have demonstrated the use of NLP in contract analysis, compliance review, and financial report generation, highlighting its advantages in handling complex textual data [4]. These studies lay the foundation for the further application of LLMs, as LLMs can handle more complex language tasks than traditional NLP models, especially when dealing with large-scale unstructured data [5-6].

Second, the rise of LLMs has brought revolutionary advancements to text processing technologies. Compared to traditional auditing tools, LLMs can learn from vast datasets through pre-training, extract complex linguistic patterns, and understand context and semantics to perform more intricate language tasks [7]. Research shows that LLMs exhibit strong generalization capabilities across various domains, especially in fields such as finance and law, which heavily rely on textual information [8]. For example, in the legal field, LLMs have been used to analyze legal documents, automatically generate legal opinions, and assist in contract reviews, showcasing their powerful text understanding and generation capabilities [9]. These successful cases provide a reference for their application in compliance checks within auditing.

Additionally, some studies specifically explore the prospects of applying LLMs in compliance checks in auditing. LLMs can quickly and accurately extract key information from large volumes of text and identify potential compliance risks [10]. The core advantage of this technology lies in its ability to generate contextually appropriate responses automatically, helping auditors quickly identify content that is inconsistent with regulations or internal control standards. For example, in financial audits, models can analyze company contracts and policy documents to detect potential legal loopholes or violations [11]. This automated compliance checking mechanism not only improves audit efficiency but also significantly reduces subjective biases in manual auditing.

Finally, although the application of LLMs in auditing holds significant promise, some scholars have raised potential challenges and issues. For instance, the interpretability and transparency of the models are important areas of concern. In a rigorous field such as auditing, the decision-making processes of the models must be transparent, enabling auditors to understand the basis for the model's judgments [12-13]. Moreover, data privacy and security are critical concerns in the application of LLMs, particularly when handling sensitive corporate data. Ensuring data security and privacy protection will be a key focus of future research [14].

In summary, this literature review highlights the initial applications and development trends of LLMs and related technologies in the field of auditing. Through a review of existing research, it is evident that LLMs have significant advantages in handling complex textual data and automatically generating audit reports. However, challenges such as model interpretability and data security remain, and future research needs to explore how to overcome these technical barriers.

3 THEORETICAL ANALYSIS

The ability of large language models (LLMs) to demonstrate great potential in the field of auditing, particularly in compliance checks and report generation, is primarily attributed to their powerful text processing and language generation capabilities. This section will analyze in detail the specific roles LLMs play in the auditing process, explore their application scenarios and advantages, and discuss the potential challenges they may face.

3.1 Working Mechanism of Large Language Models

LLMs are based on deep learning and pre-training techniques, learning complex patterns and semantic relationships in language through exposure to vast amounts of textual data. Pre-trained LLMs can understand complex contexts and generate text that fits the given scenario. In the context of compliance checks in auditing, the models can quickly analyze and process large volumes of text data, such as policy documents, legal contracts, and internal reports. LLMs are capable of identifying potential non-compliance issues and can even assess the severity of compliance risks based on contextual associations, providing auditors with precise decision support.

For example, when auditing a company's financial report, LLMs can automatically scan the company's policy documents to identify provisions that may conflict with industry regulations or internal control standards, and flag potential risks. This automated auditing process greatly enhances efficiency, particularly when dealing with unstructured data, where the models' performance is especially noteworthy. Using natural language processing (NLP) technology, auditors can quickly extract key information from large volumes of unstructured text without the need to manually check each document.

3.2 Application Scenario Analysis

The specific applications of LLMs in compliance checks and report generation within auditing can be categorized into the following areas:

First, compliance review automation. LLMs can automatically extract information from unstructured text, such as internal corporate documents and external regulatory documents, to detect potential compliance issues. By comparing the extracted information with industry regulations and company standards, the model can identify compliance risks at an early stage, helping companies make timely corrections. This application is especially beneficial for large

multinational companies, as they are often subject to multiple jurisdictions' laws and regulations, making manual compliance reviews extremely labor-intensive and prone to oversight.

Second, automatic audit report generation. The process of generating audit reports involves organizing and analyzing large amounts of data, which usually requires auditors to summarize various findings into written reports. LLMs can analyze the data generated during the audit and automatically produce structured audit reports. The models can not only summarize audit findings but also generate explanatory notes and recommendations based on context. This application can significantly reduce the time auditors spend on report writing while ensuring the consistency and professionalism of the reports. Just as hybrid teaching models improve the efficiency of medical interns, the large-scale application of intelligent auditing tools can greatly enhance auditors' work efficiency through training and support [15].

Finally, risk assessment and decision support. LLMs can also be used in auditing for risk assessment. By analyzing historical and current audit data, the models can identify high-risk areas or transactions and provide both quantitative and qualitative analysis support. For example, the model can analyze a company's past compliance history, financial data, and the relevance of external regulations to prioritize high-risk matters for auditors. This data-driven audit process improves the scientific and accuracy of audit decision-making.

3.3 Technical Advantages

Compared to traditional auditing methods, LLMs offer significant advantages in the following aspects:

First, the ability to handle unstructured data. Traditional auditing tools are often limited to processing structured financial data and struggle with large volumes of unstructured data, such as contract texts, emails, and meeting notes. LLMs, with their deep understanding of text, can easily handle such data, quickly extracting key information and greatly reducing the manual workload of auditors. Just as comparative studies of different treatment methods in the medical field have shown, intelligent auditing tools excel in automating complex compliance review tasks, particularly in processing unstructured data [16].

Second, flexibility in language understanding and generation. LLMs can not only comprehend complex linguistic structures but also generate logical and coherent text. This makes them uniquely advantageous in generating audit reports and summarizing documents. Auditors can use the model to quickly generate high-quality reports, ensuring accuracy and consistency in the content.

Finally, broad adaptability and scalability. LLMs can be fine-tuned and trained to meet the auditing needs of different industries and companies. For example, companies can customize the models to meet their specific compliance requirements, allowing the model to exhibit higher professionalism and accuracy in the auditing process.

3.4 Challenges and Future Research Directions

Despite the significant potential of LLMs in auditing, they also face challenges in practical application. First, the explainability of the models remains a key issue. Auditing requires a high level of transparency and rigor, but the decision-making process of LLMs is often difficult to fully understand, making it challenging for auditors to verify the basis of the model's judgments. Similar to the requirements for karyotype analysis in the field of biology, the application of LLMs in auditing also demands high explainability and accuracy in model outputs to ensure that auditors can fully comprehend and verify the model's judgments [17].

Second, data privacy and security issues are critical considerations. Auditing involves handling large amounts of sensitive corporate data, and ensuring data security when using LLMs is an urgent technical problem to be solved. Similar to the Rosenthal effect in nursing interventions, the use of LLMs in auditing must also guard against potential problems caused by biases in training data [18]. Protecting privacy and ensuring ethical compliance are crucial, just as they are in teaching reform focusing on morality and ethics [19].

In summary, LLMs have great potential in compliance checks and report generation in auditing, capable of improving audit efficiency through automation and reducing human errors. However, future research must focus on enhancing model explainability, strengthening data security, and optimizing model performance in complex auditing scenarios.

4 CONCLUSION

From both theoretical and practical perspectives, this paper discusses the potential application value of large language models (LLMs) in the field of auditing, particularly in compliance checks and report generation. By summarizing the working principles of LLMs, their specific application scenarios in auditing, and the optimization of audit processes, the following conclusions can be drawn:

First, LLMs possess powerful text processing and generation capabilities, making them highly effective in handling large volumes of unstructured data during audits. Compared with traditional auditing tools, LLMs can quickly analyze complex documents such as contracts, policy files, and financial reports, and efficiently identify potential compliance issues. Their automation capabilities significantly reduce the need for manual intervention, improve audit efficiency, and reduce the workload of auditors, especially when dealing with heavy data processing tasks, ultimately streamlining the entire auditing process.

Second, LLMs show significant advantages in audit report generation. By analyzing the data produced during the audit process, these models can automatically summarize key audit findings and generate structured, coherent audit reports

based on the context. This not only improves the accuracy and consistency of reports but also shortens the time needed for report creation, allowing auditors to focus more on high-value judgment and decision-making tasks.

However, despite the great potential of LLMs in auditing, several challenges still remain in practical application. First, the explainability and transparency of the models continue to be critical obstacles. In a field as rigorous as auditing, auditors need to clearly understand the basis for the model's judgments to ensure that its conclusions are reliable. Additionally, data privacy and security are critical concerns, especially when handling sensitive corporate data. Ensuring the security of data during the use of LLMs will be a key issue that needs to be addressed in future applications.

Future research can focus on the following directions. First, efforts should be made to enhance the explainability of LLMs, enabling auditors to better understand and trust the model's outputs. Second, ensuring data security when processing sensitive data with LLMs is a crucial area for further research. Moreover, as LLMs are applied in more auditing scenarios, research should also explore how these models can be integrated with other auditing technologies to achieve more intelligent and automated audit processes.

In summary, LLMs provide significant technical support for the intelligence and automation of audit processes, particularly in the areas of compliance checks and report generation. As the technology continues to develop and application challenges are gradually overcome, LLMs are expected to play an increasingly important role in the field of auditing, becoming essential tools for auditors to work more efficiently.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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RESEARCH ON TRAFFIC OBJECT TRACKING AND TRAJECTORY PREDICTION TECHNOLOGY BASED ON DEEP LEARNING

An Chang[1], Dan Li[1*], GanFeng Cao[1], WeiWei Liu[2], LiKai Wang[2], Nan Zhou[2]
[1]*Xuzhou University of Technology, Xuzhou 221000, Jiangsu, China.*
[2]*Traffic police detachment of Xuzhou Public Security Bureau, Xuzhou 221000, Jiangsu, China.*
Corresponding Author: Dan Li, Email: 1026673665@qq.com

Abstract: The purpose of this study is to propose a deep learning-based solution, aiming at the problem of insufficient accuracy and real-time performance in traffic target tracking and trajectory prediction technology. We used YOLOv8 for real-time target detection, combined with the multi-target tracking track algorithm to achieve accurate tracking of traffic targets. At the same time, the trajectory prediction through the long-and short-term memory network (LSTM) can effectively deal with the dynamic changes of traffic flow. The experimental results show that the method tracks better than conventional algorithms in multiple traffic environments, with better robustness and real-time performance. Moreover, this study explores the impact of data enhancement and hyperparameter optimization on model performance, which provides new ideas and methods for the implementation of intelligent transportation system.
Keywords: YOLOv8; Traffic target tracking; Trajectory prediction; Multi-target tracking; Long-and short-term memory network (LSTM)

1 INTRODUCTION

With the acceleration of urbanization, traffic congestion and frequent traffic accidents have become important problems restricting urban development. To solve these problems, intelligent transportation systems emerge. Among them, target tracking and trajectory prediction, as an important part of the intelligent transportation system, are of great significance for improving road safety, alleviating traffic congestion, optimizing traffic management and other aspects [1].
Traditional methods of target tracking and trajectory prediction, such as image processing and computer vision technology, often struggle to achieve ideal results when facing complex traffic environments [2]. For example, the performance of traditional methods can be severely affected under high vehicle density, changeable traffic rules, and complex weather conditions. The introduction of deep learning technology has brought about a new breakthrough in this field [3].
Deep learning realizes the abstract modeling of the data and the knowledge representation [4] by simulating the working mode of the neural networks in the human brain. In target tracking and trajectory prediction, deep learning can automatically extract the feature information of targets, such as speed, acceleration, direction and other, thus improving the accuracy of tracking and prediction [5]. In addition, deep learning can also learn the behavior patterns and traffic rules of traffic participants by training a large number of data models, and further improve the accuracy of trajectory prediction.
The whole simplified process of traffic target tracking and trajectory prediction is shown in Figure 1.

Figure 1 Simplified Flow Chart of the Traffic Target Tracking and Trajectory Prediction System

2 INTRODUCTION TO THE YOLOV8 ALGORITHM

YOLO (You Only Look Once) is an advanced real-time target detection algorithm, proposed by Joseph Redmon et al. in 2015 for [6]. YOLO is unique in that it treats the object detection problem as a regression problem rather than the classification problem [7]. It processes the entire image through a single neural network, divides the image into multiple regions, and predicts bounding boxes and category probabilities for each region. Due to its high speed and high accuracy, YOLO has been widely used in many real-time applications, such as autonomous driving, video surveillance, and robotics.
Since its launch, the YOLO algorithm has undergone several iterations, from the initial YOLOv1 to the latest YOLOv8, each generation has improved in performance and functionality. YOLOv8 Is the latest version of the YOLO series, developed by the Ultralytics team. It reaches new heights in terms of accuracy and speed and is suitable for a variety of target detection tasks.
YOLOv8 Introseveral new features and optimizations, including advanced backbone network and neck architecture,

with improved feature extraction and target detection performance. It uses the anchor-free segmentation head, which has higher accuracy and more efficient detection process than the anchor-based method. Moreover, YOLOv8 performs well in maintaining accuracy and speed balance and is suitable for a variety of real-time target detection tasks12.

In terms of traffic target tracking, YOLOv8 is particularly well. It can detect and track traffic targets such as vehicles, pedestrians and bicycles in real time. Combined with the track algorithm in Ultralytics, YOLOv8 can achieve multi-target tracking, ensuring that each target can also be accurately identified and tracked in complex traffic environments3.

In addition, YOLOv8 can be combined with LSTM (long and short-term Memory Network) for trajectory prediction. This combination can cope with the dynamic changes of traffic flow and provide more accurate trajectory prediction, thus improving the efficiency and safety of traffic management3. For example, in the traffic monitoring system, YOLOv8 can monitor the traffic flow in real time, automatically identify the behavior and state of the traffic targets, and provide strong support for traffic management.

In short, YOLOv8 has not only performed well in target detection and tracking, but also demonstrated great potential in practical applications such as traffic management. Its high efficiency and accuracy make it an important tool in the intelligent transportation system, which helps to improve traffic safety and optimize traffic management. Therefore, we use yolo algorithm for target tracking.

2.1 YOLOv8 Algorithm

YOLOv8 Is the latest version of the YOLO series and has made remarkable progress in the field of target detection. YOLOv8 It is mainly composed of the backbone network (Backbone), the feature fusion layer (Neck), and the detection head (Head). YOLOv8 The network structure is shown in Figure 2 [8]:

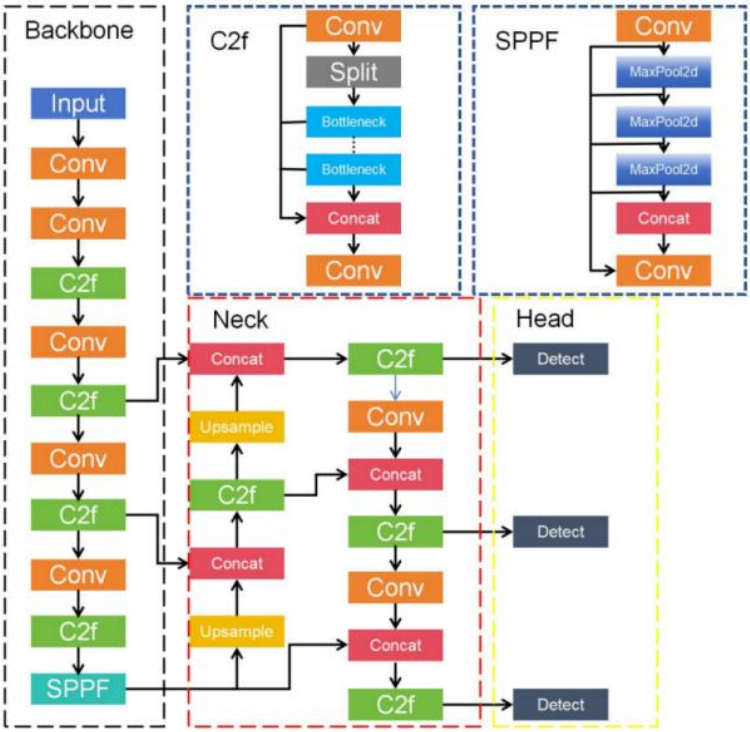

Figure 2 The YOLOv8 Network Structure Diagram

2.1.1 Trunk network (backbone)

The backbone network of YOLOv8 is responsible for extracting the features from the input images. It adopts an efficient convolutional layer structure, combining the advantages of deeply separable and standard convolution, to improve the computational efficiency and reduce the number of parameters . Depth separable convolution significantly reduces the computation [9] by splitting standard convolutions into deep and point convolutions.

YOLOv8 The CSP (Cross-Stage Partial Network) idea continues in Backbone, but the C3 module in YOLOv5 is replaced with the C2f module, and this improvement brings further lightweight. The C2f module improves both efficiency and speed by reducing the computation and model parameters. YOLOv8 The SPPF (Spatial Pyramid Pooling-Fusion) module was also used to enhance the feature expression capacity.

2.1.2 Feature fusion layer (Nk)

YOLOv8 Feature pyramid network (FPN) and path aggregation network (PAN) are used to integrate multi-scale features to enhance the detection ability of targets of different sizes. FPN uses the features of different levels through the top-down path, which improves the detection ability of small targets. PAN further increases the bottom-up path on

the basis of feature fusion to achieve more fine-grained feature aggregation.
In contrast to YOLOv5, YOLOv8 removed the convolution structure during the upsampling phase of PAN-FPN and replaced the C3 module with the C2f module. This adjustment not only reduces the computational amount, but also improves the feature fusion and context capture capabilities.

2.1.3 Test head (head)

The test head of YOLOv8 is responsible for generating the final test results, including the location and category of the target. It adopts the Anchor-Free mechanism, avoids the design complexity of the anchor frame, and directly predicts the center point, width, height, and classification information of the target through the convolutional layer.
YOLOv8 Also introduces the Decoupled-Head (decoupling head) design, a design method that separates the classification and regression tasks. Model performance and accuracy were improved by handling the classification and regression tasks separately.

2.2 ByteTrack Algorithm

The ByteTrack algorithm is a tracking method based on the tracking-by-detection paradigm, that is, the location information of the target is obtained through the target detection algorithm, and then the data information is used for the target tracking [10]. The biggest innovation of this algorithm lies in the utilization of the low score detection box.
ByteTrack The algorithm is as follows:

2.2.1 Detection box classification

For all detection box information obtained by the detector, they are divided into two parts according to the confidence: the detection score higher than threshold high is classified as D, the detection score below threshold Tlow is classified as Dlow.

2.2.2 Trajectory prediction

For all tracks in the trajectory set T, the Kalman filter is used to predict their coordinates in the current frame.

2.2.3 First match

Match the high score detection box Dhigh and all tracks T. The intersection ratio (IOU) of the position in the current frame in the current frame is calculated, and then matched by the Hungarian algorithm. For rejected matches with IOU less than 0.2, the unmatched detection box is stored in Dremain; the unsuccessful track T is stored in Tremain.

2.2.4 Second match

For the low score detection box Dlow (for example, the object with severe occlusion in the current frame) and the remaining track Tremain, the method is similar to the first match. The two unsuccessful tracks were deposited in Tre-remain, and the unmatched low score detection boxes were removed.

2.2.5 Track processing

For the trajectory in Tre-remain, it is considered to lose the target temporarily, and put it into Tcost. If a trajectory in Tcost exists for more than a certain time (e. g., 30 frames), remove from T; otherwise, continue saving. If late matches to, it is also removed from Tcost. For detection in Dremain with a score above some threshold E and that has survived more than two frames, it is initialized as a new trajectory .
The flowchart is shown in Figure 3:

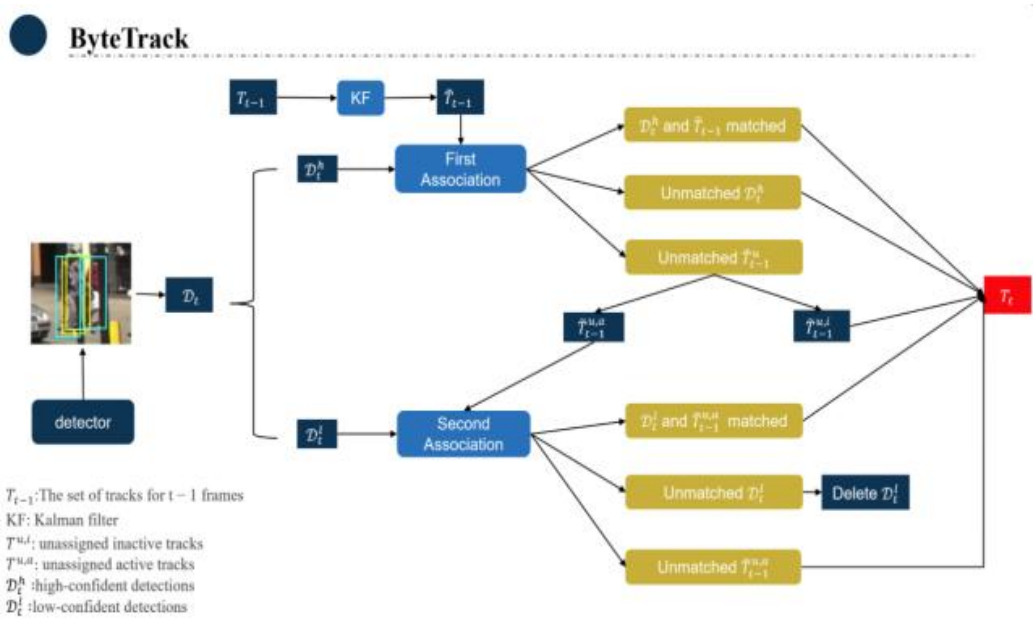

Figure 3 The ByteTrack Flow Chart 3 Experimental Process

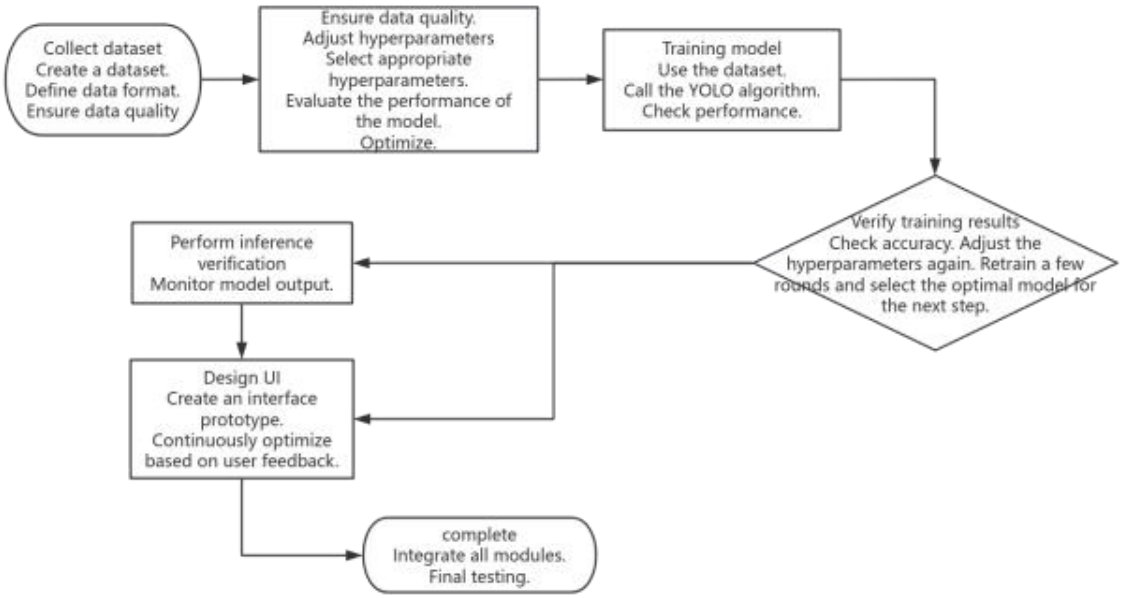

Figure 4 Experimental Procedures

3 SYSTEM IMPLEMENTATION

3.1 Source of the Data Set

In this project, we mainly use the datasets from open source dataset platforms such as Roboflow and Baidu Feiyang to study vehicle and pedestrian target tracking. Roboflow Is a platform focused on computer vision data set management and processing, providing rich resources of public datasets, such as COCO, ImageNet, Open Images, etc. These datasets cover a wide range of application scenarios and categories, and are able to meet the needs of different tasks。

With Roboflow, we can easily access and manage the datasets. First, we searched and selected the dataset suitable for the project requirements on the Roboflow platform. Then, the dataset was annotated and preprocessed with Roboflows tools, including image cropping, rotation, zoom and other operations to ensure the quality and consistency of the dataset. Finally, we export the processed dataset into the format required for the YOLOv8 model to facilitate subsequent model training and testing.

Baidu paddle (PaddlePaddle) also provides a large number of high-quality open source data sets, especially in Chinese scenarios. We acquired the relevant vehicle and pedestrian dataset through the flying paddle platform, and used the tools it provided for data enhancement and preprocessing to improve the generalization capability of the model。

By using these high-quality open-source datasets, we are able to effectively study vehicle and pedestrian target tracking and achieve good results in practice. In the YOLOv8 target tracking project, the collection of datasets is a crucial step. Our data set contains about 2,700 pictures of traffic and pedestrians (some samples are shown below):

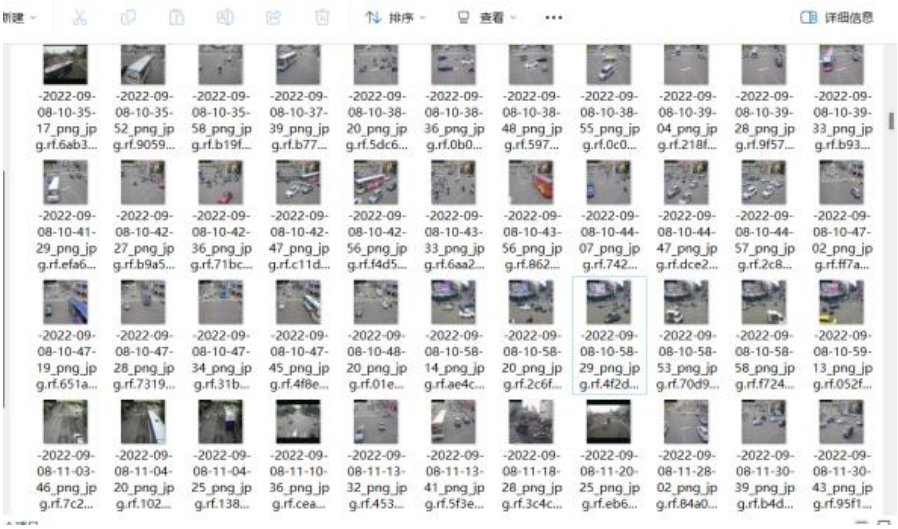

Figure 5 Part of the Sample Data

It aims to provide rich training materials for the model. The quality and diversity of the data set directly affect the performance of the model, so we focus on the following aspects when collecting the data:
First, to ensure the diversity of the datasets. The data set covers a variety of different scenarios and conditions, such as different weather (sunny, rainy, snowy), different times (day and night), and different traffic conditions (peak, off-peak). This helps the model to perform well in a variety of practical applications.
Secondly, make accurate annotation. Each image needs to be accurately labeled, including the targets bounding box and category label. We used the X-Anylabeling annotation tool for manual annotation, with part of the data obtained from the open-source dataset platform Roboflow. The accuracy of the annotation directly affects the training effect of the model, which requires special attention.
After data collection, the data need to be cleaned to remove ambiguous, incomplete, or duplicate images. Make sure that each image is clearly visible and that the target object is not obscured or partially missing.
Finally, the dataset was divided into the training, validation, and test set. The data partitioning ratio was 70% for training, 20% for validation, and 10% for testing. This allows the performance of the model to be evaluated during training and adjusted accordingly.
Through the above steps, the quality and diversity of the data set can be ensured, laying a solid foundation for the training of the YOLOv8 target tracking model.
In the YOLOv8 target tracking project, image preprocessing is a key step to improve the model performance. Efficient preprocessing can not only improve the training efficiency of the model, but also significantly improve its accuracy. The various aspects of image preprocessing are described in detail below, especially the implementation of data enhancement operations.
First, the adjustment of the image size is the fundamental step of the preprocessing. YOLOv8 Model generally require a uniform size of the input image. You can use the cv2.resize function in the OpenCV library to adjust all the images to a uniform size (like 640x640 pixels). This operation not only reduces the computational complexity, but also ensures the consistency of the model inputs.
Second, normalization processing is one of the key steps of preprocessing. Normizing the image pixel values to the range of 0 to 1 helps to accelerate the model convergence and improve training. YOLOv8 The normalization step is performed automatically in its preprocessing pipeline, so no manual processing is required. In addition, we also do data enhancement operations such as random cropping, rotation, flip, brightness adjustment, color space conversion and other data, which enhance the generalization ability of the model.

3.2 Design and Implementation of the System

The research system of traffic target tracking and trajectory prediction technology based on deep learning aims to realize the automatic identification and analysis of the goals in traffic scenarios. The system can monitor traffic images or videos in real time, automatically identify the behavior and status of traffic targets, such as vehicle speed, location changes, etc., so as to help traffic managers better understand traffic flow and abnormal conditions, and find potential traffic problems in time, so as to provide more effective management and response measures. This system provides an important support for improving traffic safety and optimizing traffic management. System initial interface is divided into three pieces, the top is the detection target type, target number, frame rate and use model, the image of the left sidebar mainly for the control panel, the middle for the system and the corresponding detection results, the control panel includes the image of the import, video import, batch detection folder pictures, connected to the surveillance camera, the right of the module of the original image and the left display detection results. The UI interface is shown in Figure 6:

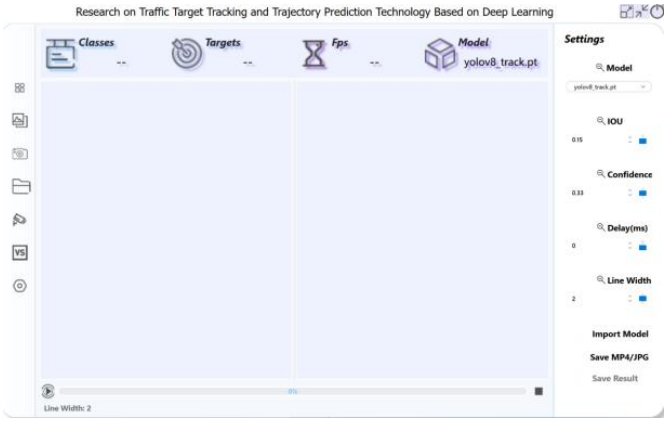

Figure 6 The UI Interface

Click the open folder in the system interface: the user clicks a left picture button on the graphical user interface (UI) of the system to open the folder. After folder open, select the picture or video to detect, import into the interface, interface will set the default model, if you need to modify the detection model, click the left bottom set the button will pop, can change the model and modify the corresponding parameters, if you want to add a new model can find the ptfiles folder

in the folder home directory, can want to add the model into the folder to call it in the interface, and then click start will directly call yolov8 model to detect the detection target. The successful image or video will be displayed on the interface on the right. If you need to save the detected picture or video, there is Save MP4 / JPG or Save Result at the bottom of the right sidebar. After clicking, select the position to be saved, and then click to confirm that the preservation is successful. Click the empty button (the square button), and the system will empty the detection content and restore it to the initial interface.

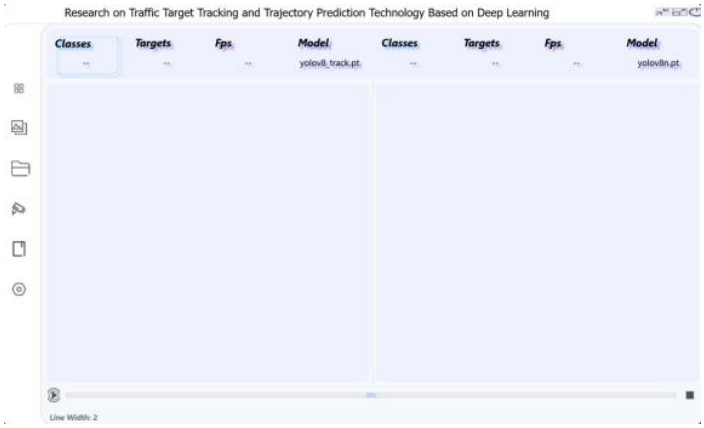

Figure 7 UI Second Interface

As shown in Figure 7. The second interface of the UI interface is to compare the two Models, so as to simply and clearly show the advantages and disadvantages of the two models, so as to improve the shortcomings of the model, so as to achieve the desired results.

3.3 Target Identification

In the process of target detection, the detection model can accurately detect the required, detect the car and people on the road, and the detection target with a box, and display the category label on the box of the detected object, for example, "people", "car" and confidence score, show the confidence of the test results, indicating the confidence of the model to the target detection. At the same time to the YOLOv8 reasoning results (after the boundary box picture), and then add tracker results (to each identified target plus ID), at the same time using the append method to add the current center of the target coordinates, keep the nearest 30 tracking points, in the video will show 30 points like a straight line, so as to draw the tracking path, tracking path is formed by connecting the points in the tracking history to track, finally achieve the tracking of the target track.

3.4 Output the Identification Results

When the system detects, the detection target is circled with a box, and the category label on the box shows the category of the detection object, such as "person", "car" and confidence score show the confidence of the detection result, and add an ID to each detection target, so as to show its movement trajectory. Above the system, the detected target species, number of target, and fps are displayed in the interface. Depending on the specific needs, these results can be further used for decision-making or applications in other systems. In this experiment, we mainly carried out target detection on cars and people, and target detection on other objects. This requires us to change the required dataset during training, adding a large number of different data for the training of the model. As shown in Figure Figure 8 and 9:

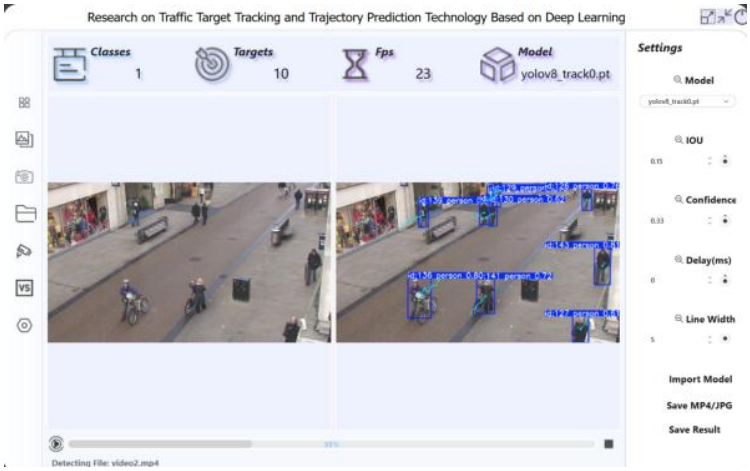

Figure 8 Track Results for Pedestrians

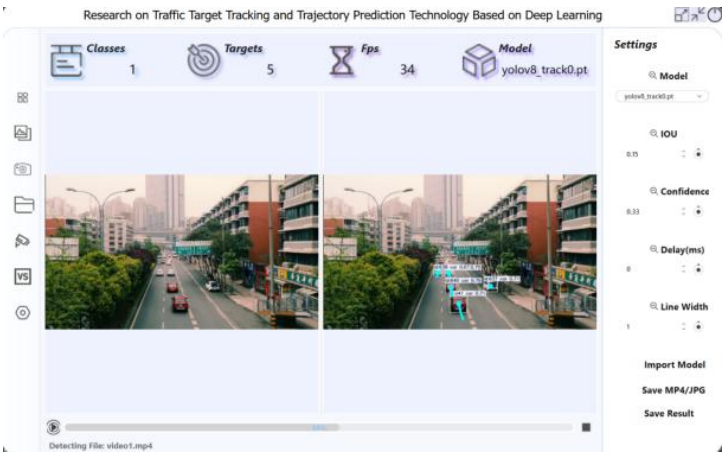

Figure 9 For the Vehicle Tracking Results

4 CONCLUSION

This study focuses on improving the accuracy and real-time performance of traffic target tracking and trajectory prediction techniques, and proposes a deep learning-based solution. We used YOLOv8 algorithm for real-time target detection and combined with SORT algorithm to realize multi-target tracking to cope with the dynamic changes of traffic flow. The results show that the proposed method performs better than conventional algorithms in multiple traffic environments, showing good robustness and real-time performance.

In the study, the collection and processing of the datasets is the critical step. The dataset contains about 2700 images of traffic and pedestrians covering different weather, timing and traffic conditions to ensure the diversity and generalization capability of the model. After accurate annotation and cleaning, the data are divided into the training set, validation set and test set. Image preprocessing includes image size adjustment, normalization processing as well as data augmentation operations such as random cropping and rotation to improve model performance.

The system interface design is simple and clear, divided into the detection target type, target number, frame rate and the model display area used, as well as the control panel and the image or video display area. The control panel allows the user to import pictures and videos for batch detection. The system can monitor traffic images or videos in real time, automatically identify the behavior and status of traffic targets, and provide support for traffic management.

This study also explores the influence of data enhancement and hyperparameter optimization on model performance, which provides new ideas and methods for the implementation of intelligent transportation system. The results show that this deep learning solution is very useful in real traffic environments and helps to improve traffic safety and optimize traffic management. In short, deep learning-based traffic target tracking and trajectory prediction technology is a research field with promising application prospects. In this experiment, we have obtained some valuable research results, but also found some problems and deficiencies. In the future, we will continue to study this technology in depth, constantly improve the algorithm performance, expand the application scenarios, strengthen the combination with practical application, and make greater contribution to the intelligent development in the field of transportation.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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