Application of Artificial Intelligence and Machine Learning Technology in Smart Cities

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Paper Information	A B S T R A C T
	Since the reform and opening up, China has been developing rapidly in politics, economy, culture and technology, creating a good political environment, economic environment, cultural environment and technological environment for the progress and development of major fields, and promoting the urbanization and social progress of China. Under the influence of this situation, China has ushered in the information network era and the intelligent era, and many advanced information network technologies and intelligent technologies have been derived, among which the influence of artificial intelligence technology and machine learning technology is greater, and they have achieved good application effects in various fields, accelerating the development of intelligence and informationization in various fields. Therefore, many regions have actively introduced and applied artificial intelligence and machine learning technology to promote the development of smart cities, which shows the importance of artificial intelligence and machine learning technology. In this regard, this paper discusses in depth the application of artificial intelligence and machine learning technology in smart cities based on relevant literature.

Introduction:

With the continuous development of social economy and science and technology, people's requirements for urbanization development are also rising, and they gradually realize the importance of smart city construction and development, and many regions have increased the importance of smart city construction in accelerating the urbanization process. The application of artificial intelligence and machine learning technology is the key to promote the development of smart cities, which can not only effectively solve the many problems faced by the development of smart cities, but also optimize the living environment of urban residents and accelerate the pace of urbanization and social and economic development. This confirms that the application of artificial intelligence and machine learning technology in smart cities is very necessary and important, and should attract the attention and concern of relevant staff. Based on this, the following briefly outlines AI and machine learning technologies, then analyzes the application of AI and machine learning technologies in smart cities, and finally briefly introduces face recognition and gait recognition fusion-related technologies and the advantages of fusion applications.

1 Overview of Artificial Intelligence and Machine Learning

1.1 Artificial Intelligence

Artificial intelligence technology is the collective name of a series of technologies with intelligent functions that can simulate, extend and expand human intelligence. Artificial intelligence technology was first born in the middle of the 20th century and has played an irreplaceable role in the development of human society and economy, not only in computer science and information science, but also in mathematical science and engineering technology science [1]. Under the support and guidance of artificial intelligence technology, many mechanical devices have gradually become intelligent, and because of the integration of cyberspace, Internet of Things space, communication technology and big data technology, it can accelerate the evolution of human society to artificial intelligence and enter the stage of artificial intelligence 2.0.

Artificial intelligence technology has been applied to smart speakers, smart printers and smart vending machines, which have contributed to the construction and development of smart cities [1-2]. In addition, with the continuous development of artificial intelligence, more advanced artificial intelligence technologies such as computer vision technology, machine learning technology, natural language processing technology and biometric technology have been derived one after another and fully applied to the construction of smart cities, among which biometric technology is the most widely used, which integrates computer, optics, biological sensors, biometrics and other sciences. Biometric technology is the most widely used, which integrates computer, optical, bio-sensor, bio-statistics and other sciences, and can be used for personal identification and judicial identification. The functions of different AI technologies are shown in Table 1.

Table 1 Types of artificial intelligence technologies and their functions [2]

技术类型	功能
计算机视觉技术	图像处理功能、数据计算及管理功能。
机器学习技术	数据分析功能、数据预测及处理功能。
自然语言处理技术	文本处理功能、文档信息自动识别功能。
机器人技术	智能操作功能、自动计算功能、信息分析功能。
生物识别技术	人脸识别功能、指纹识别功能、虹膜识别功能、声音识别功能。

1.2 机器学习

Machine learning refers to the process of acquiring new skills and knowledge by improving mechanical learning capabilities through system identification or knowledge recognition science. Machine learning is actually a kind of learning system that simulates human learning style and learning thinking. The system incorporates many learning methods and is able to analyze many problems and propose effective problem solutions, so machine learning is applied in many fields. Some literature shows that continuous innovation and upgrading of machine learning can not only accelerate the development of artificial intelligence, but also promote the construction and development of smart cities. Nowadays, machine learning has become the most indispensable and important technology of artificial intelligence, and its highly developed perception ability and parallel information processing ability can improve the perception function and information processing function of artificial intelligence, so in many cases machine learning needs to be applied with artificial intelligence fusion, for example, image recognition, speech recognition and other fields can be fused with machine learning technology and artificial intelligence technology [1-2]。

Here we also need to emphasize "deep learning", which is the core of machine learning technology and belongs to the core function of mechanical learning system, not only has the characteristics of learning intuition, but also has the characteristics of diversified learning methods and thinking, and it has a lot of problem analysis methods, learning methods and thinking in its own reserve, so in many cases it does not need human In many cases, learning can be achieved without human involvement [2]. Based on deep learning, we can quickly build image recognition system, target detection system, and natural language processing system, so it can be effectively integrated with computer vision technology, natural language processing technology, and biometric technology, and applied to the construction and development of smart cities.

Deep learning differs from other learning systems in that deep learning specifically establishes three deep learning frameworks (also understood as learning structure layers, including deep convolutional neural network layer, deep confidence network layer and stacked self-encoder) to achieve high accuracy in predicting, classifying, computing and managing data information to build machine learning models or systems in conjunction with machine learning [3].

2 Application of Artificial Intelligence and Machine Learning Technology in Smart Cities

Face recognition is the core of artificial intelligence technology, and gait recognition is the core of machine learning technology, so this paper analyzes the application of artificial intelligence and machine learning technology in smart cities from two aspects of face recognition and gait recognition, as follows：

2.1 Gait recognition and its applications

"Gait recognition" is essentially a technology that identifies individuals by observing and analyzing their walking

posture and form, and carries out identity authentication. Some research shows that there are 24 different components of human gait, and each component can form a unique gait, so it can quickly identify personal identity information, which makes gait recognition more realistic and natural compared with traditional identification methods such as iris recognition and fingerprint recognition, and also requires camouflage and object cooperation, and can meet various identification needs, and has a very wide range of applications in many fields of smart cities. It has a very wide application prospect in many fields of smart cities, such as intelligent medical care and intelligent transportation [4]. The principle of gait recognition is to recognize individuals by detecting gait, extracting gait features, etc., then forming human motion image sequences, analyzing and processing them, and finally obtaining recognition results.

The application of gait recognition is mainly reflected in the security field, property security field and medical field, as follows.

(1) The application of gait recognition in the field of security. The principle is to use the emerging biometric recognition technology to improve the video surveillance system, to achieve real-time monitoring of streets, communities and other areas, so as to strengthen social security, and provide clues and basis for case investigation, anti-terrorism, etc.

(2) The application of gait recognition in the field of property security. The principle is to use gait recognition technology to optimize video surveillance systems and sensors to achieve real-time monitoring and storage of valuables, as well as to alert when an external threat is detected and to quickly locate suspects who can cause the threat [5].

(3) Application of gait recognition in medical field. For example, gait recognition technology can be used to distinguish the walking styles of healthy and unhealthy people, and then judge whether a person is healthy or not on that basis. For example, gait recognition technology can be used to improve medical rescue system and management mechanism, and then adhere to the "people-oriented" principle to build personal and property security system to ensure the personal safety of people and property security. It can also build an intelligent medical system based on gait recognition, and support corresponding database, medical data control center and hospital information management system, and enter medical personnel information, hospital medical information, medical equipment and medicine information, and patient information into the database or information management system, so as to provide data and information basis for the later rescue and treatment work [6]. It is also necessary to optimize the existing intelligent medical system of the hospital with the help of gait recognition technology to improve the accuracy rate of remote diagnosis and medical services, so as to improve the medical level of the hospital and promote the intelligent development of medical career.2.2人脸识别及其应用

"Face recognition" is essentially the process of using biotechnology to identify individuals, and is the most influential kind of biometric technology. The development of "face recognition" has so far formed 3 types of recognition modes: 1:1 face recognition, 1:N face recognition and M:N dynamic control, namely: ① 1:1 face recognition mode. Its principle is to compare the face that needs to be recognized with the portrait in the database, if the match is successful, it means that the personal information is accurate, if the match is not successful, the personal information is wrong, many stations, boarding gates, hospital entrances have chosen this face recognition mode, such as "brush face" boarding, ticket inspection, etc. need to face recognition. ② 1:N face recognition mode: Its principle is to match the current face data with the massive portrait database to find a target process from N faces, for example, case investigation, counter-terrorism, etc. need to find the deep hidden suspects through 1:N face recognition mode. ③ M:N dynamic deployment control. The principle lies in the face comparison of all individuals in the target area by computer, and then a number of faces that meet the requirements after the comparison are compared with the samples in the portrait database for dynamic face comparison, for example, blacklist monitoring, VIP customer management system, etc. are applied to the M:N dynamic arming mode [7].

Face recognition has been applied in the fields of security, finance, medical and transportation, etc., and also achieved good application results, as follows.

(1) The application of face recognition in the field of security. As we all know, many communities, roads and parks have installed a large number of monitoring and cameras, these monitoring and cameras have face recognition function, can

quickly identify personal information, so as to ensure personal security. For example, when staying in a hotel, face recognition is required for authentication, which effectively ensures personal security. For example, when arresting fugitives in cyber cafes and squares, face recognition technology can also be used to analyze and locate suspects.

(2) Application of face recognition in the financial field. With the advent of the era of artificial intelligence, the financial field has actively introduced a large number of advanced artificial intelligence technologies to meet the development requirements of the era of artificial intelligence, among which face recognition technology is the most widely used, for example, two-dimensional code payment collection, automatic teller machine, face payment, etc. are applied to face recognition technology [8].

(3) Application of face recognition in medical field. Firstly, after applying face recognition technology, the hospital access control system can accurately identify the identity information of various case groups, and can also distinguish patients and medical personnel. Secondly, the information management system of each department of the hospital has improved its security after applying face recognition, and has also added the functions of identity verification, face recognition and permission setting, which has improved the information security of each department of the hospital. Thirdly, face recognition technology can be used to establish intelligent medical system, intelligent database and intelligent data control center, so as to realize real-time monitoring, analysis and processing of hospital staff, medical and nursing work and patient data information, which not only provides reliable basis for later rescue and treatment work, but also promotes the development of intelligent medical cause [9].

(4) Application of face recognition in the field of transportation. In addition to the installation of intelligent monitors and cameras on each major traffic road, intelligent traffic systems, real-time traffic information management systems, and dynamic road monitoring systems have been established based on face recognition technology, all of which can automatically identify and analyze road traffic conditions and provide data information such as dynamic road traffic flow to the traffic management department, and then have professionals reasonably adjust the signal indications on the road so as to effectively direct traffic and reduce the incidence of traffic jams and safety accidents [10].

3 Face recognition and gait recognition fusion related technology and fusion application embodiment

3.1 Convergence-related technologies

including DBN deep confidence nets and deep convolutional neural network-based image recognition, as follows.3.1.1 DBN deep confidence networkDBN

Deep belief networks are constructed based on Restricted Boltzmann Machines (RBMs), i.e., they are formed by stacking multiple Restricted Boltzmann Machines (RBMs).RBMs are an important component of deep belief networks and consist of 2 structural layers, an explicit layer and a hidden layer, which are able to interconnect the network units between layers [11]. As shown in Figure 2.
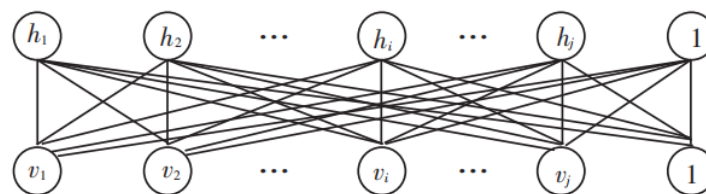

Figure 2 Schematic diagram of RBM structure

Both the explicit and implicit layers of the RBM model need to obey the Bernoulli distribution with the following expressions.

$$E(v,h;\theta) = -\sum_{ij} wi_j v_i h_j - \sum_i b_i v_i - \sum_j a_j h_j$$

in the formula：

θ——Parameters of the model（$\theta = \{W,a,b\}$）

The expression for the joint distribution of RBM is：

$$P\theta(v,h) = \frac{1}{Z(\theta)} \exp(-E(v,h;\theta)) =$$

$$\frac{1}{Z(\theta)} \prod_{ij} e^{W_{ij}v_i h_j} \prod_i e^{b_i v_i} \prod_j e^{a_j h_j}$$

$$Z(\theta) = \sum_{h,v} \exp(-E(v,h;\theta))$$

The expressions for the conditional probabilities of the explicit and implicit layers of the RBM are：

$$P(h_j = 1 \mid v) = \frac{1}{1 + \exp(-\sum_i w_{ij} v_i - a_j)}$$

$$P(v_i = 1 \mid h) = \frac{1}{1 + \exp(-\sum_j wi_j h_j - b_j)}$$

3.2 The integration of gait recognition and face recognition application embodies

The survey found that the fusion application of face recognition and gait recognition technology has been highly recognized in the smart city construction in many regions, for example, the database network system serving the smart city construction and development is based on the deep confidence network is based on the DBN deep confidence network established, also on the basis of that stacking multiple DBN deep confidence network effect system with certain restrictions, forming the function of the perfect intelligent city management system to accelerate the development of intelligent cities [12]. The effective fusion of gait recognition technology and face recognition technology can also construct the network space of multiple structural layers, and then build the smart city real-time monitoring system and intelligent supervision system based on networks such as convolutional neural network and fully connected layer to realize the supervision of the smart city, for example, the urban traffic monitoring system and security alarm system can be optimized based on convolutional neural network.

Conclusion

With the rapid development of social economy and science and technology, smart city has become an inevitable trend of urbanization construction and development, which is very beneficial to promote the progress and development of the whole human race. Smart city is essentially an intelligent and informative city form, in the construction of smart city not only applied to the Internet of Things technology and cloud computing technology, but also applied to artificial intelligence technology and machine learning technology, which is a subversive thinking compared with the traditional city construction method, but also a key strategy for China to become a strong network country, digital China and smart society.

The key of smart city construction also lies in the realization of smart transportation and intelligent medical care, which aims to develop smart city into a comprehensive carrier, while the application of artificial intelligence and machine learning technology can meet the above needs of smart city construction and development, and plays an irreplaceable role in promoting the construction and development of smart city, so artificial intelligence and machine learning technology must be efficiently applied in smart city. Therefore, based on the understanding of artificial intelligence and machine learning technology, the above analyzes the application of artificial intelligence and machine learning technology in smart city from the aspects of gait recognition and face recognition, and briefly analyzes the fusion of face recognition and gait recognition related technology and fusion application embodiment.

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