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Research on the Neurology-based Internet Architecture

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Abstract

New achievements to the two fields, cross comparison of Internet and neurology begins to get more and more attention of neuroscientists and computer scientists. Important fruit has been obtained. According to fresh development of Internet, the article makes a neurological analysis, puts forward the concept of "Virtual brain of Internet", points out that Internet begins to gain features of central nervous system, sensory nervous system and Motor nervous system, probes into the structure of "Virtual brain of Internet" and its operation mode, draws out the structure map. On the basis, the article explores the relations of Networking, Cloud Computation, Big Data and Internet.

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Keywords: Internet neurology; Internet of things; Cloud computing; Big data

1. Introduction

Increasing researches have shown that there exist similarities in function and structure between the Internet and the brain. The comparative research in the fields of the Internet and neurology is bringing.

On one hand, the frontier research in the field of neurology has begun to be inspired by the structure of the Internet. On June 10\textsuperscript{th}, 2010, Larry Swanson and Richard Thompson, neuroscientists from the University of Southern California, published a paper titled as "Hypothesis-driven structural connectivity analysis supports network over hierarchical model of brain architecture" in the Proceedings of the National Academy of Sciences (PNAS), pointing out that the nervous system in a small section of mice brain was similar to the Internet structure [1]. Research of Larry Swanson shows that the presence of the Internet-type structure in the brain can give an explanation on the fact that brain can overcome partial injury. Like the Internet where any separate part

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can be removed, but other parts in the network still work as usual, some parts in the nervous system are also not absolutely necessary. This research evidences the relevance of the neurology with the Internet.

On the other hand, on November 16, 2012, Dmitri Krioukov from the University of California San Diego (UCSD) published a paper named as "Network Cosmology" in the Scientific Report, also proposing that there is a high similarity between the Internet and the cranial nerve network in development and structure. The research team used computer simulation and combined many other calculations methods to prove in the dynamic development and control of complex network, the curve graph describing the causal relationship network of large-scale space-time structure is a power function curve with significant clustering features, which has high similarities with many complex networks such as the Internet, the social network and the cranial network. [3]

The above research prompts that we may analyze the latest structure of the Internet from the aspect of neurology. The relation of the Internet of Things, cloud computing and big data with the Internet may be discussed on such a basis.

2. Proposing of the Internet virtual brain

If we observe the new applications and functions emerging in the Internet in the recent 20 years, we can also intuitively find that there are more and more similarities between the Internet and brain structure. These phenomena include:

The 1990s witnessed the application of WAN or MAN in controlling printers and copying machines in remote place. By the first 10 years of the 21st century, it has been quite common for doctors to conduct operation through remote network. There exist certain similarities between the functions of the remote-controlled equipment and the somatic motor nervous system in the brain.

At the beginning of the 21st century, the Internet of Things began to emerge. In 2007, the water conservancy departments of China deployed the sensors in soil, rivers and air to transmit such data as air temperature, humidity and wind speed to the information processing center via the Internet, generating a report for decision making in flood prevention and drought resistance. The environmental departments of China have installed networked sensors in the nature used for environmental monitoring system. These applications have certain similarities with the somatosensory nerve system in the brain.

In 2007, Google launched Street View service and installed multiple cameras in cities and the Internet users can watch the cityscape of Denver, Las Vegas, Miami, New York and San Francisco in real time. The project is very similar with the visual and auditory functions of the brain.

So we attempt to analyze the Internet structure from the aspect of neurology and abstract it to an organization structure that is highly similar with the human brain, i.e., the Internet virtual brain. Finding and positioning the virtual auditory, visual scenes, sensation and somatic motor nervous systems, we drew a brain-like structure diagram regarding the Internet (Figure 1) [3].
The proposing and drawing of the Internet virtual brain can help us forecast the future development trend and mature structure of the Internet and research the operation mechanism of the Internet from the prospective of neurology. On the other hand, we hope to integrate such applications as the Internet of Things, cloud computing, big data and mobile Internet organically and research the differences and links among them through the brain-like structure of the Internet.

3. Relationship among the Internet of Things, cloud computing, big data and the Internet

The proposing and drawing of the Internet virtual brain can help us forecast the future development trend and mature structure of the Internet and research the operation mechanism of the Internet from the prospective of neurology. We also hope to integrate such applications as the Internet of Things, cloud computing, big data and mobile Internet organically. Next, we'll explore their relation and mark them on the structural diagram of the Internet virtual brain.

The Internet Telecommunication Union (ITU) believes that "all things in the world can exchange information actively through the Internet to realize intercommunication at any time, anywhere, by anyone and anything, ubiquitous network and omnipresent calculation"; technologically, ITU thinks that "the Internet of Things involves in the radio frequency identification device (RFID) technology, the sensor technology, the nanotechnology and the intelligent technology etc."

On the whole, the Internet of Things highlights the concept of sensor perception. It also has the functions of network line transmission, information storage and processing and industrial application interface etc. Besides, it also shares servers, network line and application interface with the Internet. According to the differences and links between the Internet of Things and the Internet, we mark the structural diagram of the Internet virtual brain, as shown in Figure 2.
Cloud computing was first proposed by Google on August 9, 2006. Its birth has its historical root, with the development of the Internet, the data storage of emerging application of the Internet has been larger and larger, and the Internet service growth has also been rapider and rapider, so the software and hardware maintenance costs of the Internet enterprises increase continuously, imposing heavy burden on many enterprises. Meanwhile, the hardware and software resources of the Internet ultra-large enterprises such as Google, IBM and Amazon are redundant numerously and cannot be fully used. In this case, it has been inevitable for the Internet to transform the software and hardware construction of separate efforts of enterprises to central cloud computing. We mark cloud computing in the structural diagram of the Internet virtual brain, as shown in Figure 2.

It should be noted that big data is an inevitable outcome when the Internet evolves to a certain stage. The interaction of the Internet users, the information release of enterprises and governments and the real-time information from the sensors of the Internet of Things generate numerous structural and nonstructural data at all times. These data are scattered in the whole network system with extremely huge data dimensions. The data contain very valuable information in such fields as economy, science &technology and education, the research of big data is to sort out these data through data mining, knowledge discovery and deep learning to produce valuable data products, so as to provide them to the government, industrial enterprises and the Internet individual users for use and consumption. We mark big data in the structural diagram of the Internet virtual brain, as shown in Figure 2.

4. Summary

The paper proposes the concept of the Internet virtual brain from the aspect of neurology and draws its structural diagram. On this basis the relations of the Internet with the Internet of Things, cloud computing and big data are analyzed and thereby the positions of the Internet of Things, cloud computing, big data and the
traditional Internet are marked in the structural diagram of the Internet virtual brain. It is stated that the Internet virtual brain architecture established based on neurology can effectively integrate these new applications and new concepts.

Further, we can use more knowledge on neurology to analyze the operation model and development trend of the Internet, the Internet of Things, cloud computing and big data. Major research directions include: whether the principle of neural reflex arc can be used to analyze the interaction manner between the Internet of Things and cloud computing, whether the network of neuron can be used to analyze the combination trend of social network and the Internet of Things and whether the test design of "IQ of the Internet virtual brain" can be used to analyze the progress of big data research. These researches will be elaborated in our later papers.

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