The Innovation of the AI and Big Data Mail Processing System

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Abstract—*With the popularization of high-performance computers, the Internet, and big data, artificial intelligence (AI) has become an important technology and journey for science and technology development. There is a huge amount of mail – tens of millions every day – to process, and mail processing and statistics both adopt manual methods, which are time-consuming and costly on labor. This study first analyzes the advantages and disadvantages of the current postal code system. Given that tens of millions of mails circulate daily, if it is calculated on a global scale, it will be hundreds of millions, which consumes an enormous number of resources. The study then proposes automated operation as well as processing and storage of huge data through AI and big data database, combined with the Internet for daily mail data transmission, are necessary tools. Especially with today's high-volume global mail flow, consistent operations can finish processing daily mails.*
Keywords: *artificial intelligence, big data, sensor, automation, Internet*

I. INTRODUCTION

Traditionally, most mails are processed manually to avoid errors. The processing tends to be complicated and cumbersome. People also often cause defects due to physical and other factors, which lead to mail delivery errors and delays. Therefore, full digitization is a shortcut to improve efficiency. It is proposed to change the original 3-to-7-digit postal code to 12 digits and adopt RFID high-speed bar code recognition system and mail management software, in combination with the development of AI technology, as well as integration and application of big data. Nowadays, with frequent human interaction, rapidly increasing mail exchanges, as well as the increase of data and information, speed and efficiency have become important. With fast processors, input devices, networks and big data, combined with big data database decentralized operations where two or more software exchanges common information, computing tasks can be run on the same computer or on multiple computers connected via the networks. This realizes the whole process, including data acquisition, data storage, data storage, data query, and data analysis. The application of AI and machine learning has an increasing demand for processing speed and storage space. Cellular neural networks (CNN) containing multiple

layers and hundreds or thousands of units allow the processing unit to have a large enough and fast enough embedded memory to handle the frequent reading and writing of data related to machine learning, so as to realize a low-power, fast-access memory solution [1].

Figure.1 AI mode

Therefore, to process huge amounts of domestic and international mails involves complex and cumbersome procedures. It is required to receive, print mail barcode of various attribute, read data, summarize and integrate data, transmit data, and manage related events, all on the same day. While carrying out various tasks simultaneously via AI, big data and applications, the data tend to be so large that the devices are usually composed of multiple memory components. That is why memory is an important component in AI chips and requires low power loss and high performance characteristics. In terms of computing architecture and core technology, it solves the complexity in data transmission, thereby saving significant amount of power and energy consumption,

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reducing costs, and improving performance. The technology may be combined with the AI computing-in-memory technology by AI chip startup Gyrfalco Technology (GTI). GTI adopts a unique two-dimensional matrix processing engine (MPE) in its core architecture, combined with AI Processing in Memory (APiM) technology, which can significantly accelerate the cellular neural network processing at low power consumption and high performance. [2]

The two-dimensional matrix processing engine (MPE) is a two-dimensional digital multiply accumulate (MAC) unit array, used for multi-layer computing in neural network. It features an extensible matrix design which makes each processing engine directly interconnect with adjacent processing engines to optimize and accelerate the data flow. Based on GTI's two-dimensional matrix chip structure, a single unit can easily integrate tens to hundreds of thousands of computing units, and units can seamlessly interconnect for AI operations in different states. [3]

In the huge data storage of big data and the interconnection of instant messages, decentralized applications should be adopted. Generally, two modes of data storage are used: vertical partitioning and horizontal partitioning [4][5]. With vertical partitioning, only partial data with certain attributes are stored on the website, and the data stored on all sites are not repeated. With horizontal partitioning, data records are stored on multiple websites in a distributed manner, where the data stored on all sites are not repeated, and Internet data transmission is adopted. With today's big amount of global mail, improving mail processing speed, reducing manual operations, improving automated sorting operating systems, and improving efficiency are the tasks undertaken by the digital AI mail automatic processing systems. The systems clearly identify different countries, regions, and locations, and then distribute the mails to each designated location according to the sorting results to complete the work.

II. AI AND BIG DATA IN MAIL PROCESSING

Due to the complexity of mail processing, which involves privacy, personal information and timeliness, processing international mails with the integration of AI and big data is necessary. Data security should also be taken into account, as well as data acquisition and privacy protection modules, centralized management of data, privacy conversion and sharing, data standardization, and globalized interactive message operations. It is the best to reduce defects to zero during interactive processing.

Then, data exploration module can be used to analyze big data information and extract the results of different applications, in collaboration with data security application audit module to resolve information security issues.

Every day, to handle an enormous number of domestic and international mails, an ideal system module is necessary. The operation is as follows:

Data analysis + data integration + data quality = a comprehensive big data integration platform, combined with the Internet, to achieve the highest target efficiency in the highly connected world nowadays.

Data application and exploration in an environment of massive mail processing need to be based on the collection and aggregation of massive data. The application of SSL VPN technology ensures the security of data transmission between nodes while using neural networks. It also has the characteristics of long life cycle, multiple access and frequent use, including privacy protection, data encryption, backup and recovery, etc. [6]

Current mail processing methods:

According to Wikipedia, countries all over the world use postal codes of 3 to 7 digits [7], and they have been used for a long time. More than 80% of the mail processing tasks are still done manually. The massive amount of mail requires much more manpower to process, and the frequent international interaction adds to the burden of workers. Mails come in many different categories, including regular mail, postcards, registered, prompt delivery, prompt registered, registered with AR, international mail, etc. The 3-to-7-digit postal codes cannot meet the complicated international mail exchange requirements. Also, an automatic sorter can only process a single type of bulk mail. Other types of mail still relies on manpower to complete sorting before entering the systems, and the computers have not been fully automated. (Table 4)

For example, the current processing of an automatic sorting machine of Chunghwa Post goes as follows:

A mail sorter OCR sorts 32,000 pieces per hour.

A culler facer canceller (CFC) processes 28,000 pieces per hour.

Examples of postal codes currently in use in different countries:

Taiwan uses 3-digit postal codes: Wanli 207, Jinshan 208, Banqiao 220, Zhonghe 235. Tucheng 236

The UK uses 7-digit postal codes: Ballymena, Northern Ireland AB10 1AG

The US uses 5-digit postal codes: Washington, District of Columbia 20001

Japan uses 7-digit postal codes: Tokyo To, Adachi Ku, Higashihokima 121-0063

The continent code, country code, and letter attributes are not included in the above codes, and the mail is processed manually.

III. SPECIFIC METHODS AND TRENDS OF AI AND BIG DATA USED IN DIGITAL AUTOMATED MAIL PROCESSING
A. The processing goes as follows:
Client: Establish a platform for customer's delivery and mailing, filling of mail related information, and processing standards for different pricing methods of various attributes.
Receiving party: Send the mail entrusted by the client through a digital automatic mail processing system, and then use RFID for encoding and storage, and categorize, store, print, manage and distribute using a quick mail processing system.

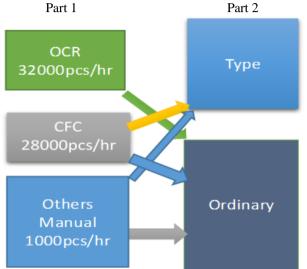1. Original Mode: Zip code 3-digest

Figure.2 Original single machine mail processor

The original processing method: The letter sorter OCR sorts 32,000 pcs per hour, and the CFC processes 28,000 pcs per hour. It adopts stand-alone machine operation, and the rest is operated manually.The manual sorting of 1000 pcs mails per hour is the upper limit. (Tables.1.2.3)

2. *The 12-digit postal codes work as follows:*
          C   1234   567890   ABC
Continent Code Nation Code   City   Type of Mail
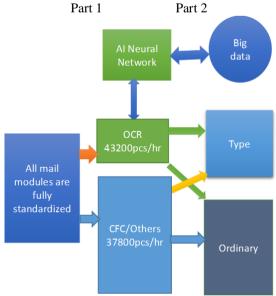
AI Neural Network and Big Data Mode: Zip code 12-digest

Figure.3 AI and Big data mail processor

B. AI massive mail processing center's requirements for mail flow:

1. The AI and big data one-stop automated processing increases the operation speed by 35%. The letter sorter OCR sorts 43,200 pcs per hour including postcards, and the CFC processes 37,800 pcs per hour, including standard, prompt delivery mails, prompt registered mails, registered mails, registered with AR, etc.

2. Then the mail processing center uses a fully automated sorting system to process 1,000,000 mails in a single day and 20,000,000 mails in a single month: 10% by OCR, 10% by CFC, and other mail processing is equivalent to CFC standards, such as 66 % standard, 5% prompt delivery, 1% prompt registered, 5% registered, 1% registered with AR, and 2% postcards. The operation results are as shown in Tables 1,2, 3, 4.

3. Fully automation and digitization with AI and big data not only speeds up mail processing, but also reduces human resource expenditures, improves business management and operating efficiency, saves time and effort, and maximizes the performance, as shown in Tables 3 and 4.

E. When the 12-digit postal code standardized

A digital and automated operation system can be fully adopted, and a consistent operation is established right at the front-line counter. After the end of business, the operation results can be reported to the management center. Part of the international mailing data can be sent to the management centers of different countries via the Internet, which can reduce the workload of employees. This can save over 30% of manpower, improve efficiency, and increase the speed by more than 30% in various mail processing. Also, after the 12-digit postal code is standardized, the management centers only have to take care of the results, eliminating the traditional, complicated processes. More importantly, in the general management center, the daily processed items of each branch can be looked up on a computer, making the statistics more accurate. The mail distribution information obtained in each branch also becomes more accurate, so that the entrusted matter can be properly done. (Table.3)

Figure 3: Diagram of AI and big data database mail processing

F. Results of applying AI and big data

Since the counter operations have been automated, large bulks of mail are processed in the mail processing center, and the rest is processed by each management center. The mails are then sent to the general management office for transfer, so as to reduce labor costs.

Based on the current stand-alone operation standard, the speed of operation is increased by 35% when it is fully automated. When the mails go through automated processing in bulk and then are processed separately by each management center, the processing is simplified.
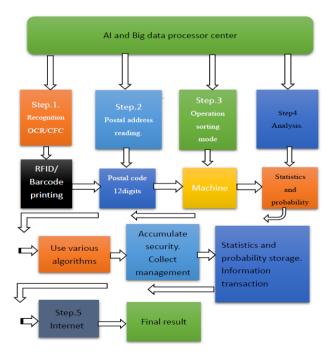

Fig.4 AI and Big data mails automatic processing system

1. Use RFID 12 digits Postal code Barcode printing processing and involving Recognition (OCR) (CFC) approach.
2. The emergence of AI and Big data has provided a solution for automatic postal address reading.
3. Mails fully automated sorting and processing.
4. The important contribution in this AI and Big data techniques in order to effectively recognize the written Postcodes. And algorithm and Big data, Statistics and probability analysis.
5. Transmit the results of the letter processing to the relevant mail centers through the internet

Table 1 Comparison of manual + single machine and AI + big data in single-day 10^6 pcs mail processing

Mail/action	%	pcs	Semi-auto (pcs/hr)	Processing time(hr)	AI& Big data Full auto (pcs/hr)	Processing time(hr)
OCR Auto	10	2000000	32000	62.50	43200	46.30
OFC Auto	10	2000000	28000	71.43	37800	52.91
Standard	66	13200000	1000	13200.00	37800	349.21
Prompt Delivery	5	1000000	1000	1000.00	37800	26.46
Prompt registered	1	200000	1000	200.00	37800	5.29
Registered	5	1000000	1000	1000.00	37800	26.46
Registered with AR	1	200000	1000	200.00	37800	5.29
Postcard	2	400000	1000	400.00	43200	9.26
Total ours				16133.93		521.16

Table 2 2×10^8 pcs mails processing records in a single month comparisons

Mail/action	%	pcs	Semi-auto (pcs/hr)	Processing time(hr)	AI&,Big data Full auto (pcs/hr)	Processing time(hr)
OCR Auto	10	2000000	32000	62.50	43200	46.30
OFC Auto	10	2000000	28000	71.43	37800	52.91
Standard	66	13200000	1000	13200.00	37800	349.21
Prompt	5	1000000	1000	1000.00	37800	26.46
Prompt registered	1	200000	1000	200.00	37800	5.29
Registered	5	1000000	1000	1000.00	37800	26.46
Registered With AR	1	200000	1000	200.00	37800	5.29
Postcard	2	400000	1000	400.00	43200	9.26
Total Hours				16133.93		521.16

Table 3 The difference between the processing of 3-to-7-digit postal codes and 12-digit postal codes

Processing / Descriptions	Single machine and manual mail processing	AI and Big data auto mail processing
One day takes time 10^6 pcs	806.7 hours	26.6 hours
Time required for a single month 2×10^8 pcs	16133.93 hours	521.16 hours
Customer mailing information	Can't master	Can be fully mastered
Mail management method	Only count the number of pieces	Complete statistics of the number of pieces and customer information
Mail data delivery	Only total number can be delivered	Detailed number of packages and address information can be delivered
Inside and abroad delivery	Total number of addresses can only be delivered	The detailed number and address information can be transmitted through the network
Mail processing speed	Manual processing is complicated and takes a long time	The operation time of digitization is short
Safety	The manual operation is poor	All processes are controlled in the database
Confidentiality	Open processing and poor confidentiality	Digital AI database control and confidentiality
Contact each management center	Each management center makes statistics by itself	The entire AI database management and control can be queried at any time
Coordination at home and abroad	Notify each other by total number of messages	Global intercommunication information directly from the Internet
Efficiency	Manual processing is time-consuming and inefficient	AI and Big data mail automation processing high efficiency

Table 4. Total amount of mail processed per month and the number of hours required with semi-automated and AI digitized processing

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Number Of mails	2×10^8	3×10^8	2.5×10^8	3.5×10^8	5.85×10^8	6.55×10^8	4.75×10^8	7.75×10^8	6.75×10^8	8.75×10^8	8.35×10^8	9.35×10^8	69.1×10^8
Semi-auto(Hr.)	16133.93	24200.89	20167.41	28234.38	47191.74	52832.62	38318.08	62518.97	54452.01	70585.94	67356.12	75426.12	557421.24
AI auto (Hr.)	521.16	781.75	651.46	912.46	1524.4	1706.81	1237.76	2019.51	1758.93	2280.09	2175.86	2436.44	18006.63

The advantage of changing the postal code to 12 digits is that it is an innovative way to integrate artificial intelligence, big data, and automated mail processing into one action, reducing manual operations and other related processes. It also speeds up mail processing, maximizes efficiency, and more importantly, reduces operating costs. The AI big data automated mail processing also facilitates sending the information of mails processed on the day to each mail management center via the Internet, so that each management center can properly distribute the mail after receiving it. As the international economy becomes diversified, liberalized, and interactive, plus that the volume of mails is constantly increasing, automation is the best and most reliable way to improve efficiency in today's world of prospering AI and big data development. It can thoroughly, precisely, efficiently and quickly categorize a large number of mails based on the identification codes. Also, due to the improved efficiency of the operation process, the staff allocation is reduced year by year, and a fully automated operating system is achieved. (Table 4)

IV. Prospect brought by AI big data automated mail processing

In general, AI consists of the knowledge base, research methods, problem solving systems, reasoning systems, planning systems, learning systems (from previous examples/instances and from the knowledge base), genetic programming, and decision-making or conclusion-drawing systems[8][9]

Artificial intelligence will become an important factor in determining the bank communication with customers and discovering their financial needs. It will bring a new round of support for financial products, service channels, service modes, risk management, credit financing, investment decisions and so on in China and Taiwan, and decisions in all kinds of financial transactions and financial analysis will be used in the background for risk prevention, control and supervision. It will dramatically change the existing structure of finance, and financial services (banking, insurance, financial management, lending, investment and so on) will be more personalized and intelligent. Securities Research.

AI as a field aiming to build and understand intelligent systems, has a long history and applications, such as expert systems, natural language processing, robotics etc.[10] (Russell and Norvig, 2010). But recent advances in AI, especially in the form of machine learning and neural networks (deep learning), allowed for more innovation and elevated the use of AI in business as a primary concern of business leaders [11](McKinsey, 2018). For example Google has been using algorithms that learn from data in search since the company's inception. But most recently, Google has substantially improved the quality of search results using deep learning algorithms, such as BERT [12] (Nayak, 2019). Several researchers have written about the business effect of AI, exploring issues such as the future of work, bias and trust, and the economics of AI [13] (Raj and Seaman's, 2019). For example, [14] (Agrawal, Ganz and Goldfarb, 2018, 2019) argue that AI lowers the cost of prediction, and this has significant implications for managers. The unique perspective of our article is that it looks at the effect of AI at the level of the business model. We use the proposed framework to understand the effects of AI on business model innovation, focusing on the platform business model.

Automation can help achieving the mission of digital transformation. Enterprises nowadays are all faced with huge innovations and changes. Businesses must take on various challenges, such as providing support for global partners, delivering messages, attracting new customers, and launching innovative products and services more quickly.

Automation not only plays a vital role in the management, change and adjustment of IT infrastructure, but also in the way the process is operated. If one can make good use of automation to simplify changes, they can focus their time and energy on innovation. The goal of automation is to get work done faster, and automation helps the employees to solve larger problems without distraction and even pass on these problems to automation. Furthermore, various mail and information exchanges among different countries accelerate, and IT and business capabilities grow exponentially, which drives continuous innovation of corporate culture. When the scale is too large, let AI big data automated processing help achieve the targets.

V. The development and relevance of fully automated mail processing

Using artificial intelligence and big data to fully automate mail processing, postal services can be included in the field of business automation and marketing strategies. While collaborating with manufacturers and customers, more creative topics can form via innovations in marketing, such as new product development, price strategy, new strategic investment project, etc. As the world enters a high-tech era, it is better to plan ahead than to handle what is received and delay things. What's more, in the era of full AI big data processing, global synchronization is the best way.
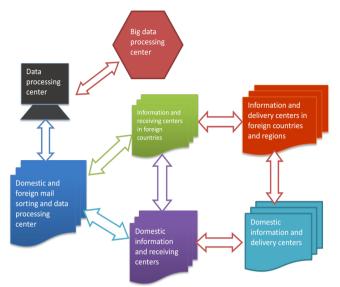
Figure 5: Diagram of global AI and big data database related mail processing

VI.Conclusion

The difference between human and AI is still a huge one. AI still bases mainly on the algorithms that rely on step by step reasoning, similar to the human brain solving a puzzle or making logical deductions [15], [16].

The ability to learn and acquire new knowledge is an essential component of AI. AI has to be able to decide whether and in what degree the obtained pieces of information are true (correct), but also to learn to cope with false information,

Without endangering the aspect of the whole of applied resources.

AI primarily utilizes several basic forms of logic: mathematical logic, the statements of which can be true or false [17]; first-order logic or predicate calculus of the first order, representing a formal deduction system allowing the use of quantifiers and predicates, able to express the facts about objects, their characteristics, and relations with one another[18],[19].

The postal codes can be changed to 12 digits, and only by adopting advanced artificial intelligence, big data, and fully automated processing, can business efficiency be improved. This can also help process enormous volume of mail synchronously and accurately, and enable the senders and recipients to effectively receive emails and deliveries in time, which will realize high working efficiency.

Artificial intelligence and big data automated mail processing combined with high-speed machinery and equipment can improve efficiency in handling very complicated mail processing. This is an important journey for the growth of corporate management. For large-scale companies specializing in mail processing, their automated mail processing centers require the installation of various high-speed mail sorting systems, as well as a full range of mail delivery systems to send various mails processed in the center, so that the processing can be sped up and mail delivery efficiency can be improved. Not only is the speed fast, but it can also reduce the physical burden of employees to carry heavy items. Therefore, by using IT artificial intelligence and big data combined with a fully digital system for transmission and reception via the Internet, postal services can indeed preserve manpower and improve efficiency.

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