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Optimizing Logistics Operations Efficiency through Integration of Virtual Reality and Machine Vision Technologies with Radio Frequency Identification

Xiaobo Sun[1a], Guohua Yang[2b], Xinliang Liu[3b] and Kaixian Gao[4b*]

[a]College of Business, Jiaxing University, Jiaxing 314001, China
[b] Naval Architecture And Shipping College, Guangdong Ocean University, Zhanjiang 524088, China

[1]qtbk202@163.com,[2]yangguohua1209@qq.com,[3]506002891@qq.com,[4]kaixian45@163.com

corresponding author:Kaixian Gao,kaixian45@163.com

Abstract: The rapid development of the economy led to the improvement of living standards, while the logistics is also supported by the relevant policies of the country continue to develop. Traditional manual management of the product cost a lot of time, instability of the eye detection goods in the operation and miscellaneous repeated operation heavily influence the efficiency of logistics operation. The key to improve the efficiency of logistics operation is find a way to efficiently automate the sorting and identification of goods. This paper discusses the existing problems of logistics operation efficiency, using machine vision and RFID to analyze and solve the problem, discusses the work flow of technology itself in logistics operation, through the analysis of their advantages and disadvantages, using machine vision combined with RFID two way interaction in the operation process to improve operational efficiency, and ultimately reduce the labor cost of logistics operation, reduce logistics operation error rate, get the operating efficiency of logistics enterprises be improved, Improve the value creation ability of the enterprise and the market position of the logistics enterprise.

Keywords: Machine Vision; Radio Frequency Identification Technology; Efficiency Improvement.virtual reality
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1 INTRODUCTION

With the rapid development of the times and the improvement of human's average living standards, logistics has become inseparable from people's lives. In recent years, the State has continuously implemented related logistics policies to support the development of logistics. In the traditional logistics operation, a series of loading and unloading, handling, sorting and packing of products from the warehousing to the library is carried out by the direct labor of the person or by

the manipulation of certain working tools or machinery. The artificial way expends a lot of time to manages the product, which pays excessive labor cost, meanwhile the artificial worked slowly, the error frequently, the efficiency slowly, finally causes the enterprise goods overall turnover speed to be excessively slow, thus affects the enterprise logistics operation comprehensive efficiency. Therefore, to enhance the automation of logistics operation, and strive to improve the efficiency of logistics operations so as to save costs for enterprises, and create value in today's fast-paced life is very important. With the continuous growth of domestic High-tech, obviously it is impossible to adapt to the modern production and operation atmosphere by means of manual operation alone. To solve this problem, various technologies are being upgraded and applied in the field of logistics. RFID is widely used in various working environments in the field of logistics which has high recognition speed and good spatial transmission performance. So that it can realizes contactless data exchange and bidirectional communication by using high frequency radio waves for spatial information transmission, including highway parking fees, car park management, freight vehicle identification and so on. In addition, RFID has the advantages of long-distance data recognition, strong reading convenience, large data storage, recyclable and loss-tolerant, which meet the needs of modern logistics extremely.The combination of RFID, machine vision, and virtual reality technologies can greatly enhance the automation and efficiency of logistics operations, thereby saving costs for enterprises and creating value in today's fast-paced life.

Since the 21st century, most manufacturing enterprises have made use of machines instead of manual production, and the technology of artificial intelligence has developed rapidly. Machine vision, as an important branch, widely used in industry, agriculture, medicine and other fields, which attracts people's attention. In the modern logistics activities, the traditional manual logistics operation means, and the human eye visual recognition detection can't meet the current products rapid identification and accurate sorting of the actual needs, for these products have already shown a large quantity, many batches, short cycle, many varieties and other distinctive characteristics. Advanced logistics equipment and technology can effectively promote the improvement of logistics operation efficiency. Improving logistics technology is an important measure to improve logistics operation. There is an urgent need for the technology of identification, classification and detection of products in logistics enterprises, which integrates RFID and machine vision. If the enterprise does not aim at improving the logistics operation efficiency to introduce the RFID, the traditional manual logistics operation will directly cause the cost, the time, the human resources, the equipment and so on all kinds of related resources waste. And when enterprises need to deal with more complex and diverse process models and different forms of products, the application of machine vision technology can timely response to the challenges of the Times, while human eye recognition of human operation can't be from the root of the immediate need to meet the requirements, which affects the overall strength of enterprises.

We discuss the existing problems of logistics operation efficiency, makes a deep research and analysis of its own work flow from two aspects of machine vision and RFID technology. By using the combination of machine vision and RFID technology, reduce the labor cost of logistics operation, reduce the error rate of logistics operation and improve the level of logistics Operation Automation. Through the research of this article, can make the enterprise logistics operation efficiency to obtain certain promotion, overall enhances the enterprise to create the value, and enhances this logistics enterprise's market position.

2 MACHINE VISION AND RADIO FREQUENCY IDENTIFICATION

2.1 Machine Vision

Machine Vision is a comprehensive technology, it integrates mechanical engineering technology, image processing technology, light source illumination imaging technology, computer technology,

sensing technology, using the machine's image intake function to replace the human eye work, through to the current product picture capture, through the series signal conversion, transforms the image to the computer to be able to recognize the digital image. The computer is based on a series of analysis methods, the current target to discriminate according to the results of the next step of the machine action. There are two ways to realize machine vision, one is through the real simulation of the structure of human eye vision, through the imitation of biological way to achieve similar functions and operations, but at present, due to the internal mechanism of human eye vision system is still in the process of research, the human eye specifically deal with the visual problems of the process is not clear [3]. Therefore, the development of machine vision technology in this way is more complex. The other is through the analysis of human visual function, this way does not need to be real imitation of human eye construction is only to consider how to ingest the external image information and input into the system, the system combined with the existing technology to realize the specific analysis, identification and judgment of the function.

Machine vision technology and image processing technology are widely used in foreign electronics industry, semiconductor, processing manufacturing and various inspection processes. A wine company in Dallas, USA, before the introduction of machine vision, the inspection of a specific stamp on a liquor bottle is performed entirely by the company's fixed employees, who are also required to be stored in the company's database for later verification, and the workload is enormous. The introduction of machine vision technology has a great influence on the work of recognizing the printing mark bottle. Failure to affix the label of the wine bottle according to machine vision recognition, the system will be processed and operation will be moving from the current pipeline to the fixed area, to a great extent to avoid the human eye work fatigue caused by the omission phenomenon [5].

In China, Baidu (a company) integrate artificial intelligence, image recognition, machine vision and other technology research and development of a small robot, whether in the speed or accuracy of the eye recognition. In addition, a group of new companies dedicated to the development of machine vision, such as Yun Cong technology, Sense time Business soup technology, Green Pupil, etc. are gradually exploring technological innovation continues to develop. Machine vision is also used in domestic agricultural products testing, industrial product testing, food packaging, such as damage detection and other fields.

2.2 Radio Frequency Identification

Radio Frequency Identification is a non-contact automatic recognition technology, it utilizes high-frequency wireless electromagnetic wave, it has good spatial transmission performance, so this technology can be in a certain range of space to automatically identify target objects and obtain relevant data information. RFID technology can identify multiple products at the same time, and can accurately read the data, its operation is fast and convenient, the work without manual intervention, compared to traditional barcode technology, electronic tags can be reused, the ability to store more capacity of data has become one of its many advantages. RFID in foreign countries was first advanced in the United States, including the well-known Wal-Mart RFID program results significantly, in the establishment of radio frequency identification technology and related standards and research aspects are far beyond other countries [7]. Followed by the European countries, many enterprises such as Philip, ST Microelectronics are constantly developing a new type of RFID chip, in order to reduce the cost of RFID tags. Germany uses RFID in the retail industry, the largest chain of retail METRO in Rheinberg will apply RFID in the retailer store all kinds of products from suppliers to stores throughout the process, using RFID to effectively improve the store goods turnover efficiency and inventory supervision. Swiss railway freight company using RFID, so that the entire freight convoy into and out of the site and warehouse to be monitored and managed, the technology allows the freight convoy each vehicle in and out of the site's time and the team's respective orders are displayed, can let the company and its

customers understand the information directly, instead of manual recording methods to avoid loss [8]. The introduction of RFID makes it easier to improve the loading and unloading process of freight. In addition, the United Kingdom, Japan and other countries have more sophisticated RFID products.

Haier Group in China has become the first to try RFID technology manufacturing leader, through the introduction of RFID technology, to solve the at that time Haier stranded material too much, inventory accumulation of funds of the current situation. Clothing industry Hailan Home in the last year officially launched the "RFID Streamline Reading System", RFID tags are set in all kinds of clothing trademarks, will read the work of clothing information simplification, the use of RFID to complete the apparel information batch scanning, real-time upload, and comparison and classification disposal. After the technology has been put into logistics operation, it greatly reduces the labor cost and improves the efficiency of delivery and dispatch. The development of RFID technology in China is not preferable to foreign countries, but at present RFID technology has been widely used in the resident second-generation identity card, highway parking fees, goods in storage, industrial production lines, port container management and so on.

2.3 Existing Problems

To ensure that products after a series of loading and unloading, handling, sorting and other logistics activities can be properly sent to consumers, in addition to achieve a rapid and accurate identification of cargo information and the correct goods to the corresponding consumer, the actual state of the goods carrying the information also need to be detected and monitored. The actual quality of the final product is of great concern to consumers. Due to the logistics operation of product handling, handling, sorting slow and final goods, not to meet the quality of customer satisfaction caused by the poor logistics operation efficiency is a major impediment to the development of logistics one of the reasons.

In recently years, with the rapid development of economy and logistics, RFID technology can effectively and quickly identify the information in the label of goods, improve the slow problem of logistics speed, but it can only recognize the goods passed by now, read exactly what it is but can't read what it is in, still can't be separated from the manual highly repetitive and laborious human eye detection stage, but the human eye long-term recognition caused by the fatigue of the greatest degree of error affect the ultimate benefit, the manual operation of non-standard, not uniformity will also bring the rate of identification fluctuations [9]. On the other hand, although machine vision can take the product image through the machine real-time, according to the internal system and related program matching analysis of the current product status is met the requirements, but it can't be identified according to the appearance of the product details, can't be "goods number matching". In the current environment RFID and machine vision is not in the field of logistics related to the application, and according to their own present advantages can complement the relevant technical deficiencies.

3 ANALYSIS AND RESEARCH OF IMPROVING LOGISTICS OPERATION EFFICIENCY

3.1 Machine Vision

Machine Vision is an artificial intelligence technology that will be used by the machine to do the work of observing and testing the human eye. The machine vision system mainly includes the light source, the camera, the Image Acquisition unit, the image processing unit and the input and output system. The typical machine vision-based inspection table is shown in Figure 1, the related mechanical equipment and objects on the figure are 1 loading units, 2 sensors, 3 to be recognized products, 4 light sources, 5 cameras, 6 belts, 7 equipment scaffolding.

Machine vision system is mainly through the ingestion of images, according to the internal processing of the machine to analyze the image, and finally reached the relevant conclusions for this operation, the concrete manifestation is that when the tested product into the detection area, the sensor in the detection area fixed position of the current position of the goods have entered the designated camera range [1]. The computer receives the signal transmitted by the sensor and then instructs the camera to start working. The camera to the product after taking pictures, the photos conveyed to the host, the host based on the current system requirements for image format conversion, and then the image data transfer to the relevant processor for image depth processing, and the database in advance to store the standard product area of the product for subsequent processing work, the specific flowchart as shown in Figure 2. Machine Vision system can easily replace manual work in the process of logistics operation, it can quickly identify the actual state of the products in the inspection area and do the sorting work well, because the machine is more standard and stable than the human eye, which greatly improves the efficiency and quality of the testing product.

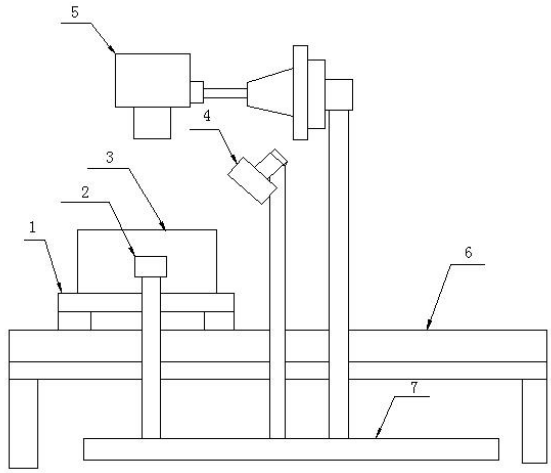

Figure 1: Mechanical equipment structure of the inspection table.

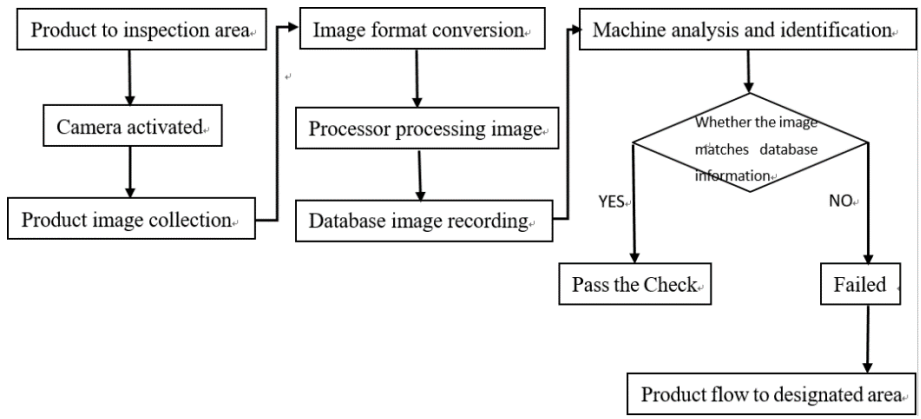

Figure 2: Working flow chart of machine vision system.

3.2 Radio Frequency Identification

RFID is a technology that can be automatically identified without contact, it can automatically identify fixed objects and obtain object data at the same time through a certain transmitting frequency, which is applied to perform tasks in various environments because its working process does not have to be automatically performed by manual operation.

The three main components of RFID are the electronic label, RFID tag Reader, and master control computer system which can deal with related data. The electronic label according to whether the energy is provided by the battery is divided into two kinds, one is the active electronic tag, namely the inside has the battery label, the other is the energy by the reader magnetic field excitation generated by the induction electromotive force to provide the passive electronic label, its internal does not have the battery. RFID tag Reader, also known as tag readers, is able to read the data stored in the electronic tag and transmit the data to the devices inside the computer system during subsequent work [4].

RFID tags in advance by the card reader to write to the product information to be recognized, when a product with such RFID tags into the RFID antenna and reader recognition range, the reader work through its antenna constantly emit a certain frequency of the RF signal received by electronic tags, the electronic tag immediately to the reader to send feedback signals. The reader and the electronic tag are exchanged, the related information inside the electronic tag is read by the reader, the data is decoded and processed in the reader, and then transmitted to the main control computer system, the computer system calls the server data to carry on the related data processing, finally realizes the object recognition. The specific workflow of RFID is shown in Figure 3. RFID in the process of logistics operation of products through the antenna coverage, the system can quickly identify the product information in the electronic label, timely product-related information system input and update, can accurately sorting out the demanded goods.

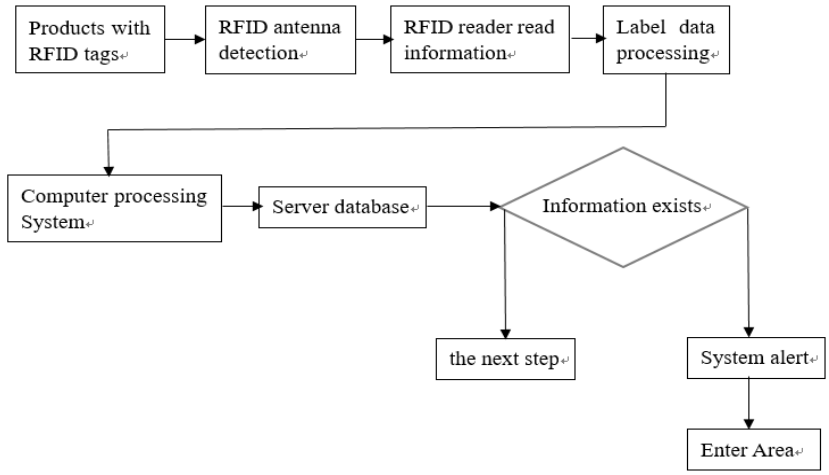

Figure 3: Working flow chart of RFID.

4 EFFICIENCY IMPROVEMENT OF LOGISTICS OPERATION

4.1 Workflow Design

In order to solve the complexity of the manual operation, RFID technology can be introduced instead of the traditional operation of identifying the goods information, many enterprises have

replaced the most of the artificial point goods by introducing RFID technology, however, although RFID can quickly read the product label built-in information, there is still a lack of product current status. To make up for this defect enterprises can introduce machine vision technology, introducing machine vision can capture the characteristics of the state of goods in real time to complement and perfect the entire logistics operation process [2]. To achieve two technology integration, two technical workflow integration work, the final overall flowchart as shown in Figure 4. After the product enters the inspection area, the first decision is made by the detector sensor, and the next step is based on whether the object exists in the machine vision equipment. The second decision for the machine vision and RFID technology joint interaction to determine whether the RFID read to the product data information for the next step to work. The third decision for the RFID system to read the data and database data, based on whether the data matching for work to continue or terminate and alert the operation. The fourth decision is the determination of the actual state of the goods and the matching of the database preset images based on the third judgment, through which the whole product information extraction and the actual state detection work flow are completed.

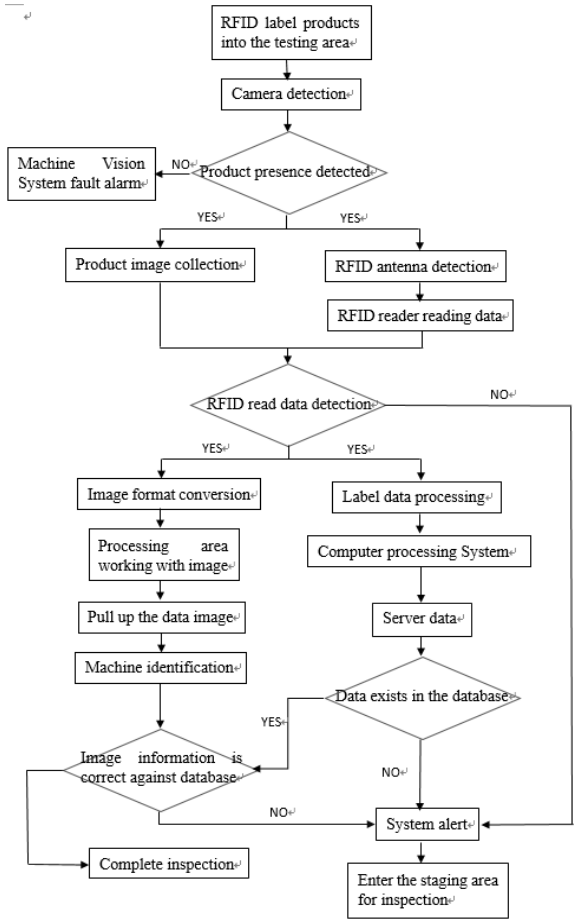

Figure 4: The whole work flow chart of machine vision and RFID technology.

4.2 Detailed Work Content of Technical Collaboration

When the products with RFID enter the testing area, the machine vision system first carries out the product detection, in order to detect the existence of the product as the basis for the next work. When the inspection area fixed position sensors feel the product into the camera area, the camera starts the image collection, the product also entered the RFID antenna and reader recognition range, the reader through its antenna constantly emit a certain frequency of RF signal work, the electronic tag received the signal to the reader immediately issued, the reader is exchanged with the electronic tag, and the relevant information in the electronic tag should be read by the reader [10].

When the product enters the time as the quasi, after a certain time, if the sensor does not feel the current product into no corresponding reaction, that is, there are items in the camera but the sensor does not report to the host in a timely manner, the machine vision system generates an alarm prompt.

After the second step of the image acquisition, the machine vision system and the RFID system linkage to the RFID system to read the product data as the basis for the next process, if the RFID system in the previous phase of the work did not read the product data, the system prompted the error, the product entered the area waiting for secondary detection. When the RFID system reads the product data, on the one hand the machine vision system carries on the corresponding image format transformation, the system internal processing area according to the current collection product image carries on the corresponding image depth processing, then brings up the database to store the image beforehand, prepares to carry on the next machine identification work [6]. On the other hand, after the data decoding is processed inside the reader, the data is transmitted to the main control computer system.

The RFID system uses the server data to carry on the related data processing, then it will judge whether there is data existed in the database, if reads the data does not exist in the database, at this time the system will produce the error, the product will be put in area waits two times inspection; If the data that is read does exist in the database, the data information is transmitted to 1 the Machine Vision System section.

Machine Vision system based on the previously collected images in the database call the RFID query to the information stored in the image to match the work, when the image is matched with the preset image, the product is inspected and entered the next circulation stage. If the acquisition image is passed into the machine recognition does not conform to the preset image setting, will produce an error system to detect failure through the warning, products into the area waiting to be processed again.

In this work flow, the product into the inspection area, the machine vision system can be based on the acquisition of image information database to identify the current state of the product is in line with the predetermined standards, the system can be in a timely manner unqualified products before the issue to remove, to avoid users receive unsatisfactory products. At the same time RFID technology can be the current product information read out, combined with machine vision, the product label in the same period of preset information and the actual state of the product one by one corresponding to the product data backup and update, greatly reducing the human workload.

5 CONCLUSION

The traditional manual repetitive work is gradually replaced by machines because of its high cost, low efficiency and high substitution. The innovation of technology and the change of the Times require enterprises to use technology to upgrade equipment, replace manual work with machines to meet the needs of the times and people, so effectively improve the efficiency of logistics operation can’t be separated from the key technology combination of choice and application. In

order to improve the current situation of slow object recognition, low product inspection efficiency, identification and inspection of operation time cost too high, in order to improve logistics operation efficiency, this paper combs and analyzes the related knowledge, working principle and process of machine vision technology and RFID technology. Through the analysis, it is found that the two technologies have their own advantages in the field of logistics operation, and there are also deficiencies. By using the complementary advantages of the two technologies, the integration of their work processes to achieve the work related to logistics operations, to solve the product in the logistics operation of a series of problems. This paper points out the possibility of machine vision and wireless RF technology in technology fusion, but because of my limited knowledge at present, in the system actual code construction, machine image processing algorithm and so on not to do further research, at the same time in the actual use of equipment selection still needs to be based on product attributes and the actual needs of enterprises to change and improve.

*Xiaobo Sun,*https://orcid.org/0009-0004-7877-4898
*Guohua Yang,*https://orcid.org/0009-0002-1243-9566
*Xinliang Liu,*https://orcid.org/0009-0003-5229-9403
*Kaixian Gao,*https://orcid.org/0000-0001-6240-6549

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