Provides an optimization system for controlling input and output of materials in large industrial depots using the combination of image processing and RFID

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Abstract

The purpose of this research is to provide an optimization system for controlling the input and output of material (goods) in large industrial depots using the combination of image processing and RFID. One of the practical applications of information technology in the industrial domain, and in particular intelligent systems, is intelligent detection systems that control the exit of objects from the warehouse, which has many uses in order to mechanize the processes required to identify objects. Image processing and the system for detecting goods leaving the warehouse and detecting radio waves or RFIDs due to their proper capabilities and the use of new technologies have a special place in intelligent material identification systems. Of course, along with the unique features of the above methods, each one has some irrefutable disadvantages. In this project, we tried to provide a combination of advantages of two methods of intelligent identification of objects in industrial warehouses such as RFID and image processing, which, with

the elimination of the disadvantages of the two methods, has a higher accuracy than each method.

Key words: Material input and output System, Large Industrial Storage, Image Processing and RFID.

1. Introduction

Warehousing is an economic service, which is the provision and maintenance of goods for delivery on time or extending its delivery period in such a way that the goods are available for longer periods of time. In the economies of each country, storage is a circle of production, transmission, distribution and consumption chain, and has the role of interconnection and intermediary in moving goods from production areas to consumer markets and then local distribution. A large percentage of the organization's capital consists of raw materials and components, equipment and goods. Therefore, careful maintenance of them and the establishment of an accurate information system for controlling inventory or timely delivery of orders and order quantity of goods are very necessary and, with the improvement of warehousing, it is possible to avoid losses caused by inaccuracy in the maintenance of goods and added to the organization's profit. In sanitary, medical and hospital departments, warehouses are divided into different types

depending on the type of goods, the equipment needed for the covered units, all of which go through the warehouse system.

Warehouse, as an organizational entity in the organizational chart of all organs, therefore requires, in addition to the special importance of this sector in the organization, to further oversee the maintenance and safety of the relevant standard. On the other hand, it is obvious that if materials and supplies are not available at the right time for the consumer unit, it will be interrupted in a workflow of particular importance. Although new administrative and management systems are in the process of being deployed, their goal is to remove the warehouse and create a virtual warehousing methodology that is required by carefully studying and taking into account all the factors leading to the above Started.

RFID technology is one of the radio-based technologies used to trace and identify objects and individuals. With the help of this technology, items can be found in the warehouse by label (sticker) attached to each item. The tags contain a variety of data warehouse products that communicate wirelessly or receivers and exchange information. The exchange of information between the goods tag and the reader (receiver) is carried out through radio waves. When an object containing a single RFID reaches the readable range by a reader, the reader gives the command to send the information by sending a pulse to the tag.

The first advantage of RFID is the unique identification of objects and entities without having to go directly to the reader, and the second advantage is to automate the identification process without user intervention. So it's very important that the exact physical condition of the objects is scanned. The use of RFID tags in data centers can help in preventing equipment theft, tracking resources.

The visual machine is a non-destructive status monitoring technology, which controls the input and output of goods in large warehouses.

Warehousing requires operational operations such as inventory, inlet and outlet, tracking of goods, controlling production dates and expiration, etc. With the use of RFID technology, this tough and costly operation is carried out with ease, accuracy and speed.

One of the uses of this system is for the industry and production lines. This technology allows the system to see, process, decide and provide its control systems with the necessary commands to reject and accept products, complete information, ratings, and so forth.

The image processing footprint is observed in many science and industry, and some of these applications are so dependent on image processing that without it, are basically usable. The application of image processing in each of the areas referred to below is very extensive.

Today, industrial image processing systems play an important role in monitoring, controlling and measuring manufactured products, following the logic of image processing. In other words, these systems have used countless applications in the quality control sectors of the industries and factories. Therefore, in this research, implementation of a new method is an optimal method for input and output of materials in large industrial depots using the combination of image processing and RFID. Then this laboratory system will be used for use in warehouses of industrial refineries and petrochemicals.

Control of machinery and industrial equipment is one of the most important tasks in manufacturing processes. The use of automated control and automation is becoming increasingly widespread, and new approaches, with the help of new technologies, allow competition in production. The need to increase the quality and quantity of a product is the use of advanced and automatic machines. Machine tools that is most automated and more reliant on human factors. Today, the use of visual machine technology and image processing techniques has become widely used in the industry, and its application is particularly widespread in terms of product quality control, robot guidance and self-guided mechanisms.

In this research, we are looking for a method for the input and output of material (goods) in large industrial depots using the combination of image processing and RFID. This research is due to limitations implemented only in laboratory by

MATLAB software and its outputs for the final applications are discussed and analyzed.

2. Theoretical Basics of Research

Jamshidi (2007) conducted a research on the use of information technology in new warehousing. The summary of this research is: Warehouses are the places for storage and maintenance of a large part of the company's capital, including raw materials, components, manufactured goods and goods under construction. In addition to the physical value of their warehouses, they are important as the storage space of the goods, their equipment and their facilities in terms of performance and the role they play in the supply chain. The optimal use of storage space and equipment will have major effects on reducing product costs. On the other hand, if less is stored, less capital will be accumulated in the warehouses. Therefore, if arrangements can be made to use warehouse space as well as to increase the accuracy and speed of warehouse administration, it will have an impact on reducing the cost of manufactured goods by reducing the cost of logistics and saving capital. On the other hand, the use of traditional methods with regard to customer-centric look at trade and economic exchanges and today's needs is not so consistent and appropriate. Therefore, we must move towards modern warehouse with the help of modern technologies. In line with the growth of information technology and related technologies such as RFID, significant achievements can be

made in mechanizing the warehouse system in accordance with modern warehousing and WMS methods, and rectifying traditional storage gaps and managing the physical storage space and inventories optimally.

Zarezadeh, Maryam et al. (2015) conducted a study to provide an improved algorithm for locating readers' antennas for storage management using RFID technology. In summary, RFID is a growth-enhancing technology that is increasingly used in various industries, and its industrial applications include detecting the monitoring of the status of moving and fixed objects and access control within specified ranges. Although RFID systems are recognized as one of the most comprehensive technologies, there are still many problems that can be solved before they are deployed on a massive scale. Problems with this issue include high costs of reader interactions and tags and security issues due to the increased cost of readers to tags. The following paper seeks to be able to manage RFID warehouses by reducing readers or switching readers to the target or storage and warehousing, with lower costs. The algorithm used for this purpose is the RCO algorithm based on the genetic algorithm. This algorithm takes into account the various forms of the warehouse in a regular or non-regular way. This algorithm takes into account the various forms of the warehouse, in a regular or non-regular manner, the angle and extent of the viewing of different linear and spherical antennas, the use of a combination of different types of antennas, antenna overlap,

the cost of antennas and readers, and a hundred per cent coverage of the tags will try to resolve the previous issues and will have the goals set forth.

Sepehri et al. (2008) conducted a research on optimal routing of transportation systems in automatic depots. The summary of this research: Material storage systems are among the systems that have made remarkable progress in recent years. These advances have also taken place in hardware such as shelving systems, storage and retrieval machines, and software applications such as travel time models and equipment utilization strategies. The development of Automatic Storage and Retrieval System (AS / RS) is one of the most important advancements in the modernization of the machinery industry. An automated warehouse system, sometimes referred to as high-rise warehouse, is a combination of equipment and controls that store or recycle materials faster and more secure and more efficient than traditional methods. In this paper, a new model has been developed in the field of Merchant Salesman (TSP), in which the issue of routing the transport of items and components from an AS / RS is based on an order, consisting of several different items of goods. This model represents the mathematical structure of a new problem based on the generalization of the GTSP problem. The new issue is called "Generalized Salesman's Issue in 2-Nested GTSP." In this paper, presenting the mathematical model of this new problem, it has been shown that using this model, one can order the ordering of order items

from an AS / RS, in which each item is stored in more than one location. How to solve the problem in an optimal way, as well as an anthem extraversion algorithm, called ACSrank, has been designed and comparative calculations are presented for twelve sample problems.

Rezapur et al. (2011) conducted a research on the use of information technology in modern warehouses. In summary, carrying out warehousing operations with the availability of portable computer equipment facilitates the process of expediting and expediting loading and unloading operations. In addition, if arrangements can be made to use warehouse space as well as to increase the precision and speed of warehouse administration, it will have an impact on reducing the cost of manufactured goods by reducing logistics costs and saving capital in the organization. On the other hand, the use of traditional methods has become obsolete, given the rising value of the time factor in modern commerce and the need to accelerate the process of unloading, loading and clearance at the corporate gateways. So, with the help of new technologies, we have to take a step towards new warehousing. In line with the growth of information technology and related technologies such as RFID and using the facilities provided by wireless equipment, significant achievements can be made in mechanizing the warehouse system in accordance with modern storage methods and Correcting the traditional stockpile

deficiencies that would result in the management of the warehouse space in a way that would be appropriate.

3. Method of doing work

The tools used in this research include several sections and several different tools. In the first section, an RFID system embedded in the organization is implemented experimentally and its outputs are presented with descriptions and defects of the system.

RFID tags are placed on all materials. These tags are managed and coded by the system and finally analyzed and stored in the warehouse system.

In the second part, using a few stereoscopes and calibrated, images of all materials are taken and stored in the central server database, and then checked in accordance with the principles and methods of diagnosis.

In the third section, which is a researcher's proposed method, the above two methods are implemented by the combination method and the defects of the above two systems are eliminated.

To implement the system, RFID equipment and image processing algorithms are used in combination with the software.

The data obtained from the RFID section enters the software system. The characteristics of the RFID section analysis component include the material name, material type. In the image processing section, after receiving the image from the material using the pattern matching algorithms, the RFID system properties are captured with the optimized image results (the same characteristics of the RFID segment that are extracted with image processing algorithms) and then analyzed comparison and ultimately confirms the accuracy of the material.

Work process:

1-Entry into warehouse:

At the beginning of the arrival of the goods in the warehouse, an RFID tag containing the full details of that product is taken by the warehouse and then, in the next step, by one or more cameras (depending on the type and size of the work), the images are assembled and these images are stored in a database.

2-stages of withdrawal from the warehouse:

In the first step, the commodity demanded is controlled by the warehouse. Then, in the second step, images are taken from the camera using the desired item, and these images are imported and processed as inputs and are used to determine the algorithms and patterns of matching with pre-determined images. The output, which is the title of the material, is stored in a variable, and then in the third step,

the information on the label on that material is read by the tag reader. In the fourth step, the comparison is performed between the output of the third and fourth stages, which, if both conform, are automatically exited from the system and, in the event of an inconsistency, are checked by the warehouse and Finding and fixing the problem (from the image or its label) and doing it again from the second stage.

The process of processing the image processing system in this project is as follows:

1. First, the automatic detection of goods (knees and flanges) and other products are separated.
2. The desired parameters (such as the type of goods) are extracted from the goods.

   Parameters extracted from image processing are compared with the parameters in the RFID tags as well as the database. Finally, all the data that is compared and processed in both systems is stored in our database and will be addressed to the subsequent operations of the system.
3. Goals and research hypotheses

There is a method and algorithm for managing inventory of central warehouses in large industrial depots using image processing and RFID.

RFID extraction information

Advantages of the warehouse system with RFID:

The records of receipts (input) and remittance (output) of goods is automatically performed in the software system without the need for the operator and using the RFID system. Managing and controlling the actual inventory at any moment, and knowing the circulation of some goods in the warehouse, as well as the use of diverse and user-friendly reports, including the benefits of using intelligent warehousing management software. Warehousing with RFID is carried out by warehousing intelligent software.

Special goals and assumptions:

In this research, after presenting the method and process of the RFID system in the company, we examine the special hypotheses of various dimensions. At first, the input image of the material is dealt with in a predetermined pattern. The system then uses a neural network to train the material to identify materials based on the specified characteristics. Subsequently, the method for identifying objects is described. Ultimately, the result of this combination is presented.

The whole process of material detection can be done in 5 steps:

A. Preprocessing the image

B. Extraction of material properties

C. Making the appropriate neural network with extracted properties

D. Neural Network Training

E. Neural Network Test with New Examples

A-Preprocessing the image

In this phase, we prepare preliminary images that are completely broken and contain unrelated and non-toxic data for learning the neural network and extracting the feature. The shapes cannot be trained before being transmitted to the neural network; therefore, they must be sequenced from a series of processes under the preprocessing order in order to become an appropriate input. This preprocessing includes the following:

1- Noise elimination
2- Separating the image from the background
3- Convert image to binary image
4- Standardizing the dimensions of all images
5- And ….

B- Extraction of features

Various parameters can be used to extract the attribute. For example, to diagnose a flange from a knee with a simple, circular feature or shape, it can be done. The flange is circular, but the knees are at 45 ° and 90 °. And for example, to differentiate these two materials (knees 45 and knees 90 degrees) we should look for other features. So, we need to choose a sequence of attributes so that we can distinguish between all the shapes.

The features we chose in this project are as follows:

1- Number of angles

2- The output from the edge-finding algorithm

3- Image size relative to the whole shape

4- Output from the Hough transform algorithm

5- And ….

In the next step, using the "canny" function, the "edge" is performed, which is one of the material properties of the neural network. Once the edge shape is found, the edges of the material are likely to have no noise and thus not standard, so we use morphological algorithms to standardize it.

C- Making appropriate neural networks with extracted features

Neural networks with their ability to deduce results from complex data can be used to extract patterns and identify different trends that are difficult to identify for humans and computers. The benefits of neural networks include:

It has the ability to learn comparative learning, based on the information given to it or the initial experience of modifying the network.

An artificial neural network is self-organized.

Given that the calculations in the artificial neural network can be done in parallel they have a very high speed.

Failure on the network reduces some of its performance, but some features continue to exist despite major problems.

D- Neural Network Training

Neural networks are able to categorize inputs for proper output. On the other hand, a neural network is sufficiently stable and flexible and adaptive and can accommodate new ones without losing any previous information.

In this study, we used two types of coding, the first by observation learning method, and the second by providing extraction of the form factors, which follows the results with the test images (input):

Outputs of this section

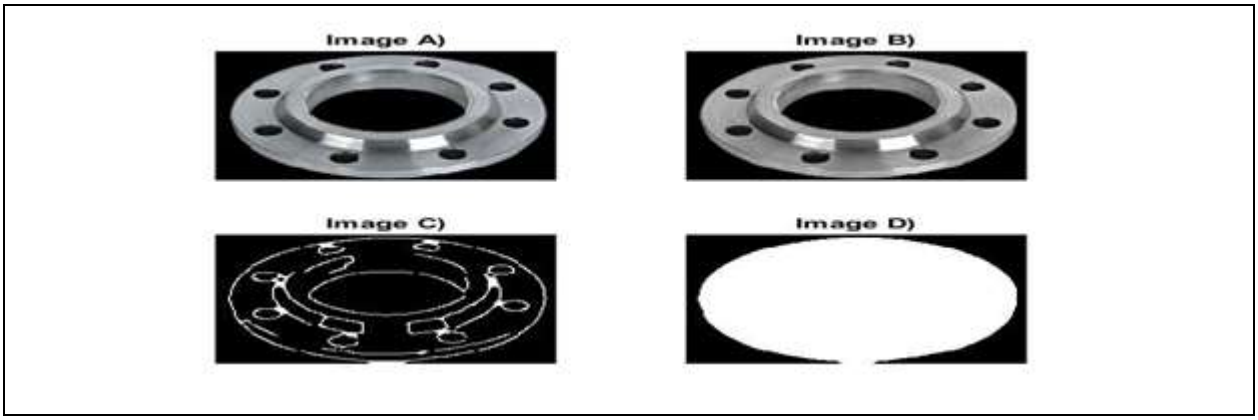

Figure 4-2- (a) Input image, (b) Binary image, (c) Edge image (d) Fill image cavities.

E-Test Neural Networks with New Sample

It's worth noting that the algorithm of the neural network used in this thesis has the ability to be generalized for any new pattern. In this algorithm, we have 4000 input neurons and 40 outputs and 10 hidden layers (helping to better learn to update the weights), which includes a matrix with a size of 40x40000. And features include: number of lines, number of angles, center of gravity, edges, environment, Huff transformation, used.

4. Comparison of the methods performed

We first selected 50 images of each one to teach the neural network. After testing for each of the 20 samples of the image, which are not the stages of the training, we have given the input for testing the neural network inputs, the results of which are as follows. For example, describe an item of it and see the table for the rest of the results. For example, in CTREE's decision tree for 45-degree knee materials, the test result of the 20 inputs of all these images is well recognized, even though it's not from our educational imagery. But for the flange of 20 cases, it has detected 19 cases.

In the RFID method, only identifiable materials are labeled (tag) and cannot be identified if the material does not have a tag or label. Also, the disadvantages of the RFID method are that if we attach a single link to a knee on a flat flange, it pulls

out of the warehouse as a knee. If a flange is removed from the warehouse, it is possible to use the tag. To solve this problem, a combination of image processing system and RFID system is proposed. It is worth noting, however, that the image processing system also has the weaknesses and problems described in Tables 4-2 and 4-3.

Table 4-1: Comparison of different classification methods by neural network

	A	B	C	D	E
1		Elbow45	Flange		
2	Elbow45	20	1	CTree	Image Proccessing
3	Flange	0	19		
4	Elbow45	20	0	SVM	
5	Flange	0	20		
6	Elbow45	20	0	Nbayes	
7	Flange	0	20		
8	Elbow45	20	0	KNN	
9	Flange	0	20		

Table 4.2: Advantages of RFID systems to solve image processing problems in material identification

Advantages of RFID	Image processing problems
Non-dependence on time conditions	Difference in the accuracy of time in darkness and brightness
The system is unique and has high security and the possibility of .confusing very little information	Failure to identify the material properly due to its failure

No difference in the labels used	Non-recognition of material and application of the system for all materials (system error if there are various （materials
The high speed of the system in identifying and announcing the result	Slow processing speed in some circumstances
Ability to identify multiple materials simultaneously	The ability to identify a material

Table 4-3: Advantages of image processing systems for solving RFID problems in material identification

Benefits of image processing	**RFID problems**
One of the most commonly used technologies for detecting objects	The system does not have the ability .to recognize visual material
As an auxiliary tool for dual matching and reliability improvement	This system alone does not have the ability to match the tag with the .material
No-noise in magnetic environments and radio waves	Problems due to interference with other frequencies and the possibility of receiving noise
No need for special tools installed	Need to install a tool inside the material

5-The architecture of the proposed method

As stated above, the two methods used to identify the material have disadvantages. In the proposed method, we try to cover the disadvantages of each system with the benefits of another system. The main flaw in the image processing system is the lack of precision in material identification (alloy) material, which due to the high security capabilities of RFID systems and the very low likelihood of tampering; this defect in the image processing system is covered. On the other hand, a RFID-

based processing system does not have the ability to detect material with the label, which means that a person can cross the label with the system and detect a material passage system. This defect can be addressed by the image processing system that is capable of detecting material (e.g., knee and flange) material. Another problem with the RFID system is the non-detection of a material with other material labels, which is also covered by the image diagnostic system based on image recognition and dual approval.

5.1 Material Detection

The first step is to identify the material's existence. Because the material identification steps are carried out when there is material to identify. Detection of material presence is done by means of tools and sensors that detect material withdrawal by using industrial conveyors from the storage depot. The function of this stage is as follows. In this way, the system automatically captures the scene continuously and examines each frame taken with image processing algorithms. If the frame detects the material, it frames that frame for the other stages of the process of detecting the material and identifying it. For proper material identification, windows with appropriate dimensions in the direction of perpendicular to the material move are selected. If there is no material, the difference of two frames successively will be almost zero. If the difference value is relatively significant, it indicates the material flow. In the event of material

withdrawal from the warehouse, an activating signal is sent to the RFID and material detection system indicating the presence of the material.

5.2 Check the presence of tags

At this stage, by getting a signal based on the existence of the material, the tag reader is activated and the label is checked. In the absence of a label, an unauthorized withdrawal from the warehouse has occurred. A signal is sent to the alert system. The alarm system will be activated and announce the unauthorized status. Obtaining tag information if the tag exists, the tag information will be received by the tag reader. After receiving information from the tag, this information is sent to the central system by the reader.

5.3. Extract material information

The signal received from the first stage by the material detection system results in the start of the material extraction stage. In the first instance, an image of the conveyor is taken and after determining its range, the method of exploration of the character of the system attempts to extract the material type. The extracted information means the system's material specifications are sent to the center.

5-4-Matching with the database

The centralized system of information received from independent RFID and RFID systems examines the information contained in the database. By matching the separate information received from the system by the database, the exit status of the materials is declared. If the material specification is labeled the same one, the exit permit is issued. Otherwise, the material is unauthorized and the alert system is activated and the material is unauthorized. When the system finishes, the system returns to its original state to identify the next material. The operation of this hybrid system is illustrated by the proposed architecture of Figure 1. In other words, the material is removed from the warehouse, the information extracted from image processing and RFID matches the database, otherwise the system will alert.

6. Discussion and Review

The purpose of the present study is to provide an optimization system for controlling the input and output of material (goods) in large industrial depots using the combination of image processing and RFID. In this project, two RFID technologies and image processing in the application of Intelligent Material Identification in warehouses were examined and the disadvantages and advantages of each of them were analyzed. Then, a proposed method for identifying intelligent material with the combination of RFID technology and image processing is

presented. In this regard, the work has been done in this field and the accuracy and reliability of the proposed method have been discussed with other research results.

It needs to be explained that the two methods used to identify the intelligent materials are other than new technologies. The combination of RFID technology, which is a completely new subject, is an ideal system because of the method of detecting objects using an image processing method, which is an appropriate research topic, and many systems for detecting objects based on this method, because Firstly, these two methods are the best methods for object detection, and secondly, the combined method eliminates the disadvantages of each method with a high precision system with a minimum error. This hybrid method, the use of the two technologies, is a very novel solution, which by optimizing the process and its tools, one could hope for an ideal system with the least error. Of course, the combination of RFID and image processing can be implemented in different modes.

7-Research suggestions

✓ The implementation of a defective device identification system at the material withdrawal from the warehouse is recommended to researchers in this area.

✓ It is suggested that other mathematical models be used to implement the combination system, and the results will be compared with this study.

✓ It is suggested that a smart system will be implemented for the company's traffic on the company to install Verbatim Face Detection and RFID tags on their GITPS.

✓ It is suggested that smart methods be implemented with other algorithms for object recognition systems, and when implementing fetal development, we need to optimize resources and efficiency.

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