IOT BASED WAREHOUSE STOCK MANAGEMENT AND MOVING ROBOT USING RFID TAGS

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ABSTRACT

In Germany, the "Industry 4.0" development opportunity is slowly changing the application of electronics and computer technology in traditional industries to achieve the overall layout of the "Internet industry". Conventional warehouse management mainly relies on manual operation, with paper documents as proof of warehouse material management, low efficiency, and causes a lot of human and material resources waste. And the current enterprise warehousing has slowly realized the semi-automatic management mode. Still, in the face of high demand and a competitive market environment, the semi-automatic management mode is gradually constraining enterprises' development. IoT-based inventory management system uses advanced Internet of Things technology (IoT) such as radio frequency identification technology (RFID), wireless sensor technology, and smartphone and communication network technology. This can be used through the wireless communication platform for specialized data processing and then applied to the storage of personnel management, material access, inventory, and other links. This realizes the Inform ionization, intelligence, and systematization of warehouse management, significantly reducing the cost of human and material resources. The introduction of IoT technology is a network technology that extends and expands based on Internet technology; its user side extends to any object and between objects for information exchange and communication

Therefore, the warehouse management system significantly facilitates the automatic collection and processing of data generated in the warehouse operation process, ensuring the accuracy and real-time of warehouse data. With the development of radio frequency identification technology, it's not accessible to damage, recognition speed, recognition distance, and other traditional bar code technology incomparable advantages. Radiofrequency identification technology in the warehouse management application has significantly improved the efficiency of warehouse operations, considerably simplifying the warehouse operations process.

Literature Introduction:

Authors have proposed a low-traffic, high-traffic workflow product portfolio warehouse management system. Because information exchange and updates are key issues in processing new orders, RFID technology and wireless technology sensors are used to track and trace raw materials: semi-finished and finished products. The Embedded system helps to collect all information on changes and updates of warehouse activities. And combined with the fuzzy logic engine in the final goods through the use of a warehouse management system based on the Internet of things, it can simplify the receiving process because the data can be automatically captured and input into the WMS, and the average receiving time can be reduced from 2.54 minutes to 0.96 minutes. Authors have proposed a selection algorithm to find the best solution. Develop a framework for optimization algorithms to find the best solution to select in-store products with a specified priority. An inventory management system that supports RFID can perform automatic availability checks and update the information data of order items in the warehouse database. At the same time, AS/RR's RFID embedding mechanism can automatically send these items out of the warehouse without any manual operation.

Authors have proposed an intelligent system that combines case-based reasoning (CBR) technology, route optimization programming model, and automatic data recognition RFID technology to assist logistics service providers in resource planning and execution to maximize effective utilization and the production allocation of warehouse material handling equipment with the lowest operating cost. Generally, it isn't easy to track. Real-time resource location and status. To track the location of real-time processing equipment, Ultra-Wideban (UWB) should be adapted. Authors have proposed an RFID-based digital warehouse management system (RFID-DWMS) to improve warehouse operations. The system benefits

from the advantages of RFID in data collection, such as wireless object recognition, multi- object recognition, and more storage space. In particular, RFID allows objects to communicate

information about it automatically without human intervention. A storage/retrieval allocation method based on ECA rules is proposed to improve the product turnover speed. The contribution of this paper is that, based on the intuitive understanding of the advantages of the automatic warehouse, combined with RFID, computer, and wireless communication technologies, an RFID-DWMS is designed to improve the operation of a flat warehouse. The system can make the plane warehouse realize the functions of automatic warehousing management, real-time inventory management, accurate shelf management, etc., mainly belonging to the automated warehouse. A resource management system using RFID technology is proposed. This system can obtain cargo loading information and collect cargo handling equipment information in real-time. Due to the accessibility of resource information, the system can provide the optimal storage/retrieval strategy and the optimal shuttle robot operation strategy in this warehouse management system, which uses two passive RFID tags to locate material handling equipment and identify functional target loading items. With additional marking information, location, and operational process material handling equipment information, the system develops two optimal strategies for storing/retrieving operational arrangements and material handling equipment for loading items. The shuttle robot reads each RFID tag on the way and immediately sends the read code and operation process information to the

warehouse server via the wireless LAN. After receiving the code, the warehouse server searches its coordinate database according to the tag code, finds out the detailed location description of each tag, and obtains the location information of the relevant material handling equipment. A series of RFID reading performance tests are proposed by. Labels are placed in different locations and attached to other materials used to evaluate the reading performance of active and passive RFID devices. Based on the test results, check the adequate RF coverage of the reader and determine the most suitable location for installing the RFID device. In addition, based on the RFID case of logistics resources proposed management system (R-LRMS) through the development of reliable RFID technology to improve the efficiency and effectiveness of order-picking operations in the warehouse implementation plan. This will enable warehouse resources to be located in real-time and suggest instant material handling solutions to automate the processing of customer orders. The proposed system is supported by RFID technology, which also helps construct an effective triangulation scheme to determine the location of warehouse resources. The collected data is stored in an embedded case based engine to determine the appropriate material handling equipment for the order-picking operation. In addition, mathematical algorithms are used to build a formula model of the material handling solution to generate the shortest pick-up sequence for the appropriate

material handling equipment. In doing so, the objectives of maximizing warehouse productivity and minimizing warehouse operating costs are achieved. The author has proposed using a 902 MHz RFID tag and UHF antenna system, combined with Microsoft Visual Studio 2008, 2010, and My SQL Server 2008 environment, using C# in ASP. NET developmentplatform. Through one dimensional, two-dimensional code and RFID technology, it realizes the intelligent management and monitoring of the inbound and outgoing transfer and inventory of aviation supplies, reduces the work intensity of inventory management personnel, and improves the inventory management level. Authors have designed an intelligent substation

asset management system (ISMS) based on RFID technology. ISMS includes Asset Inventory Query Management System (AIMS) and Asset Tracking Management System (ATMS). A new collision algorithm is proposed to effectively solve the problems of dense equipment identification and a series of asset detection models. The operation results show that the scheme can effectively perceive the environmental objectives and monitor the substation assets. The system can automatically and accurately identify the substation asset information without being affected by the harsh environment. It no longer needs to manually record the processing relationship between personnel and equipment but automatically identifies and clears the substation asset information on the path. Make the system more intelligent and reliable. Authors have proposed the use of RFID technology. They are achieving first-in, first-out, electronic location management, and job flow process monitoring management to solve the shortage's bar code and maximize the benefits of warehouse management information systems based on digitization and information. The system makes use of the advantages of RFID electronic tag machine reuse, large data capacity, no manual intermediary, and so on, to improve the automation level of the warehouse and achieve pallet based lump-sum storage and

retrieval; The goods are pasted with one-dimensional barcode, and the cost of using one dimensional barcode has lowered the

advantages of RFID electronic tags to reduce costs, to achieve interests tracking. One-dimensional bar code and RFID. Not only can you get the opposite position, but accurate control of the database information can also reduce the cost of system implementation.

PROPOSED SYSTEM

The proposed solution is a smart warehouse system integrated with the RFID-based IoT framework. Therefore, the proposed smart warehouse solution can be designed in three phases Smart Warehouse system development, RFID based IoT framework integration, and system implementation. Each of the phases is discussed below:

➢ Phase 1: Smart Warehouse System Design and Development: PHP is a server scripting language and a powerful tool for making dynamic and interactive Web pages.

➢ Phase 2: RFID-based IoT Framework Design and Integration: The RFID system is a non-contact automatic identification system that recognizes the target image through radio frequency wireless signals and obtains relevant data.

HARDWARE DESCRIPTION:

POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

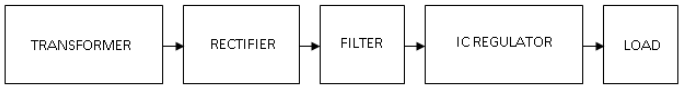


Fig 1: Block Diagram of Power Supply

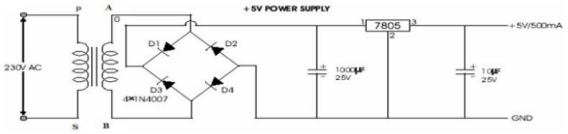
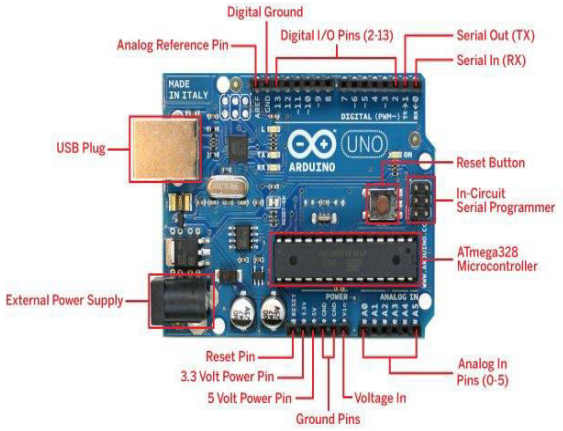


Fig 2: Circuit Diagram of Power Supply

Arduino uno ATMEGA328 Microcontroller



Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

ATMEGA 328P FEATURES

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

RADIO FREQUENCY IDENTIFICATION

RFID, short for Radio Frequency Identification, is a technology that enables identification of a tag (that is normally attached with an entity) by using electromagnetic waves. RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many

different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

Features:

• Reading Distance: 6-10 cm

• Dimension: 40mmx20mmx8mm (LxHxW)

• Frequency:125kHz

• Compatible Card codes:Manchester64-bit,modules64

• Current Rating: 35mA (Max)

• Operating Voltage:4.6V - 5.4VDC

Specifications

It is an ADC (Automated Data Collection) technology that:

• uses radiofrequency waves to transfer data between a reader and a movable item to identify, categorize, track..

• Is fast and does not require physical sight or contact between reader/scanner and the tagged item.

• Performs the operation using low cost components.

• Attempts to provide unique identification and backend integration that allows for wide range of applications The reader, or scanner, functions similarly to a barcode scanner; however, while a barcode scanner uses a laser beam to scan the barcode, an RFID scanner uses electromagnetic waves. To transmit these waves, the scanner uses an antenna that transmits a signal, communicating with the tags antenna. The tags antenna receives data from the scanner and transmits its particular chip information to the scanner.

Fig 3: RFID READER

RFID TAG

RFID tag is a small device which stores and sends data to RFID reader. They are categorized in two types – active tag and passive tag. Active tags are those which contain an internal battery and do not require power from the reader. Typically active tags have a longer distance range than passive tags. Passive tags are smaller and lighter in size than the active tags. They do not contain an internal battery and thus depend on RFID reader for operating power and certainly have a low range limited up to few meters.

Fig 4:RFID TAG

BLUETOOTH

Bluetooth is a global wireless communication standard that connects devices together over a certain distance. Think headset and phone, speaker and PC, basketball to smartphone and more. It is built into billions of products on the market

today and connects the Internet of Things (IoT). If you haven't heard of the IoT.

Fig 5. Bluetooth Module HC05

L293D DRIVER CIRCUIT

L293D IC generally comes as a standard 16-pin DIP (dual-in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins (if you do not use enable pins).

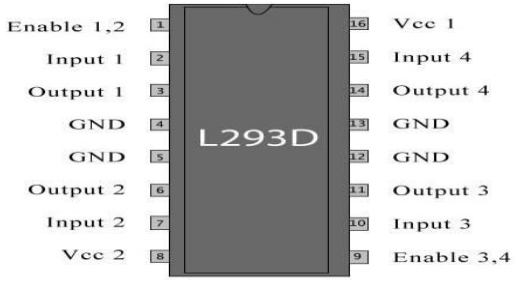


Fig 9 L293D pinout

DC MOTOR

A DC Motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. It's of vital importance for the industry today.

Gear DC Motor

Geared DC motors can be defined as an extension of DC motor. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

Fig 6. Motor

ULTRASONIC SENSOR

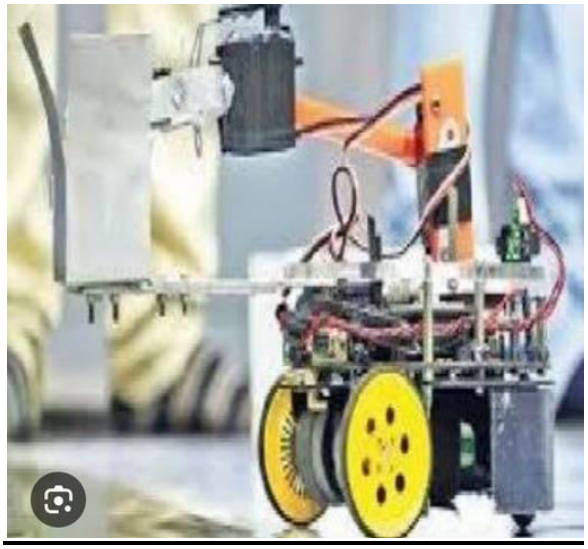
Ultrasonic sensors are industrial control devices that use sound waves above 20,000Hz, beyond the range of human hearing, to measure and calculate distance from the sensor to a specified target object.

4.7.1 Features of ultrasonic sensors:

➢ Devices with TEACH-IN functionality for fast and simple installation

➢ ULTRA 3000 software for improved adaptation of sensors to applications

➢ Adjustable sensitivity to the sound beam width for optimized adjustment of the sensor characteristics according to the application.



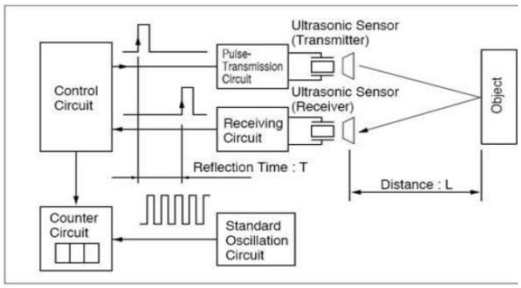


Fig 7.Block Diagram of Ultrasonic sensor

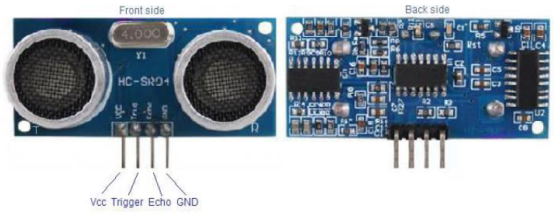


Fig 8:Ultrasonic sensor

RESULTS

ADVANTAGES

➢ Real-time Visibility: Enables real-time monitoring of inventory levels.Provides instant updates on stock movements.

➢ Error Reduction: Minimizes manual data entry errors.Improves accuracy in tracking and managing stock.

➢ Supply Chain Optimization: Streamlines the supply chain process. Enhances coordination between different stages of the supply chain.

➢ Accurate Item Tracking: RFID tags enable precise tracking and identification of

items. Reduces the risk of stockouts or overstock situations.

➢ Automation Benefits: Moving robots automate tasks like restocking and order fulfillment. Improves efficiency and reduces the need for manual labor.

➢ Cost Savings: Optimizes warehouse operations, leading to cost savings. Minimizes the impact of human errors on costs.

➢ Increased Productivity: Enhances overall productivity in warehouse management.

Speeds up processes through automation and accurate data.

APPLICATIONS

➢ Inventory Management: Enables real-time tracking and management of inventory levels. Automates inventory control processes.

➢ Order Fulfillment: Improves the efficiency of order picking and packing. Reduces order processing times.

➢ Supply Chain Visibility: Enhances visibility across the entire supply chain. Allows for better coordination with suppliers and distributors.

➢ Asset Tracking: RFID tags enable precise tracking of assets within the warehouse Reduces the risk of misplaced or lost items.

➢ Security and Loss Prevention: RFID technology enhances security by tracking the movement of goods. Helps in preventing theft or loss through real-time monitoring.

➢ Quality Control: Monitors and ensures the quality of goods in the warehouse. Alerts to any issues in real-time, reducing the risk of distributing faulty products.

➢ Task Automation: Moving robots automate routine tasks like restocking and material transport. Frees up human resources for more complex and value-added activities.

CONCLUSION:

Although this research is still in an early stage of development, it has already proven to succeed in several of its goals. The operating system of smart phone is android which can develop effective remote control program. At the same time, this program uses blue-tooth connection to communicate with robot. It has proven to allow for meaningful two-way communication between the Android phone and the robot which would allow a non-expert to interact

with and adjust the functionality of a system which uses ATmega328 controller, a single board micro-controller intended to make the application of interactive objects or environments more accessible.

algorithms will further improve predictive analytics, enabling the system to learn from historical data and make more accurate predictions for inventory management, demand forecasting, and route optimization.

FUTURE SCOPE:

➢ Advanced Robotics Integration: Future developments may include more sophisticated

robots capable of handling a broader range of tasks, such as complex sorting, picking, and even collaborative interactions with human workers.

➢ 5G and Edge Computing: The implementation of 5G technology and edge computing will enable faster data processing, reducing latency and enhancing the real-time capabilities of IoT applications in warehouse management.

➢ AI and Machine Learning: Integration of artificial intelligence and machine learning

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