ICEAIST-24
International Conference on Exploring AI, IOT, Science & Technology-24
ESP Journal of Engineering Technology Advancements / ISSN:2583-2646

Original Article

IntelligentStorageSystembasedonRFID andZigBee

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Abstract: *A great deal of fragmented orders have occurred in recent years because to the rapid expansion of live broad caste-commerce. With the enormous demand for items entering and leaving the warehouse as well as for warehouse security, traditional warehouse management and operating methods find it challenging to keep up. As a result, IOT, visualization, and warehouse interconnection have emerged as the future trends and directions in warehouse growth. One Internet of things application scenario that has a lot of promise is the intelligent warehouse. The majority of items have various storage environmental needs. However, it is challenging to manually enter data into the conventional warehouse management system due to the rising need for warehousing. The aforementioned analysis indicates that this paper will leverage pertinent Internet of Things technologies to realize information-driven, intelligent, and integrated management of the traditional warehouse, enhance the warehouse's management effectiveness, and ultimately enhance the enterprise's efficiency.*

Keywords: *IntelligentWarehouse, Internet of Things, Sensor, ZigBee, RFID.*

INTRODUCTION

At the moment, big data, the Internet of things and the Internet's explosive growth are influencing every aspect of human development. The rapid growth of science and technology has created a societal backdrop for the creative design of storage [1]. In particular, the emergence of live-commerce has expedited the growth of e-commerce and resulted in a considerable number of fragmented orders. Conventional warehouse management and operation methods are difficult to meet given the high demand for commodities entering and departing the warehouse as well as warehouse security.

For goods management, the majority of small and medium-sized warehousing businesses still use manual recordkeeping as of right now. This type of record statistics approach typically has some unfavorable conditions when faced with high demand for warehousing and storage, such as difficulty updating inventory information in a timely manner, difficulty locating locations for goods storage, low level of warehousing information management, and difficulty ensuring the accuracy and timeliness of goods-related data in warehousing. These factors also greatly increase management costs, which in turn hinder the growth of enterprises. In order to truly benefit relevant enterprises, this paper seeks to address the issues of complex data processing and inadequate safety supervision in traditional warehouse management [2]. It also aims to identify a set of solutions for effective out-of-warehouse data processing and multi-directional safety information monitoring for Traditional warehouses.

BACKGROUNDKNOWLEDGE

Wireless Sensor Network Technology

A vast number of tiny sensor nodes grouped within a specific range make up a WSN. These nodes use wireless data transfer to create a multihop self-organizing network. The three primary components of a WSN system are management users, sensor networks, and sensor nodes. Sensor nodes cover the range in a particular manner, and depending on certain conditions, the entire range can satisfy the monitoring range. Micro embedded systems are typically used as sensor nodes. The power supply, processing unit, communication unit, and sensing unit are among the fundamental modules. Distributed self-organization, robustness, scalability, dynamic topology, application correlation, huge scale, high redundancy, spatial location addressing, and other attributes are features of wireless sensor networks.

ZigBeeTechnology

IEEE 802.15.4 is the basis for the ZigBee protocol. ZigBee alliance is formed and standardizes its network layer protocol and API because IEEE 802.15.4 standard only specifies physical layer protocol and MAC layer protocol. And the four layers make up the architecture of the ZigBee protocol. Layer Physical (PHY): In addition to providing physical layer data services and physical layer management services, the physical layer defines the interface between the physical wireless channel and the MAC sublayer.

Media access control layer (MAC): Adjacent devices' single hop data transfer is handled by the MAC layer. By using the CSMA/C A protocol, the MAC sublayer manages the radio channel. In addition, he can be in charge of synchronization, beacon frame transmission, and dependable transmission method provision.

Network layer (NWK): To guarantee the proper operation of the MAC sublayer and to offer suitable service interfaces for the application layer, the network layer performs associated functions.

Application Layer: The application layer, which comprises the application support sublayer (APS), ZigBee device object (ZDO), and application object specified by the manufacturer, is the uppermost layer of the architecture.

RFID Technology

Identification technology is a fundamental component of the Internet of things. Among the technologies used for identification are bar codes and QR codes. They have the ability to capture item data and communicate it to the system, enabling the connection of non-chip goods to the Internet of Things network. However, there are various security flaws in bar codes and QR codes because of their replicability; so, RFID technology is accessible.

The identifier for radio frequency identification (RFID) creates an electromagnetic field. The data is transmitted by the electronic tag attached to the article through an electromagnetic field that is tuned to the appropriate frequency. Within a few meters, the electronically encoded information on the tag can be recognized. In this study, we construct the system [3] using RFID and ZigBee technologies to achieve intelligent storage and increase the effectiveness of logistics.

ZIGBEENETWORKOFINTELLIGENCE WAREHOUSE

Overall design ofhardwarestructure

The ZigBee coordinator, camera, computer, and ZigBee terminal monitoring node make up the hardware portion of a smart warehouse. The coordinator receives a wireless transmission from the smart warehouse after it has gathered a variety of environmental data, items entering and leaving the warehouse, and storage environmental data. The coordinator uses the serial port to send the data to the top computer's intelligent warehouse management system after receiving it. Using the serial port, the monitoring module sends video to the host computer's intelligent ware house management system. The intelligent storage management system of the higher computer is the core component of intelligent storage and is in charge of processing, storing, and displaying storage data.

Hardware selection ofZigBeedataacquisitionterminal

Inthedesignofthesmartstoragesysteminthispaper, CC2530 is used as the chip developed by ZigBee Application. It hasthemainadvantagesofeasypackaging,programmability, highoutputpowerandperfectTIofficialIARdevelopmenttechnology[4].ThefunctionalblockdiagramisshowninFigure1.

ZigBee Networking Mechanism

A ZigBee wireless sensor network typically consists of a terminal node, router, and coordinator. The network's management, upkeep, and componentry are under the control of the ZigBee coordinator. It is capable of processing and transmitting large amounts of information. It has the ability to transmit data to every remote control terminal in addition to receiving data from the router or terminal for processing; Serving as a mediator between the coordinator and terminal nodes, the router node permits nodes to join the network, helps its offspring nodes with data communication, forwards packets, and relays data communication between the coordinator and terminal nodes;The router node, which handles terminal data acquisition and control, can establish a direct connection between the coordinator and the terminal node. Three connection modes are available for ZigBee networking connections: star, mesh, and string [5].

Following the identification of the network coordinator, the channel is scanned during network initialization. Once the suitable channel has been identified, configure the network ID. A single coordinator exists in a Zigbee network. Active scanning looks for network information within a node's communication range and uses this information to determine the best, quietest channel to record on. The node must submit an

association request command, wait for the coordinator to process it, send a data request command, and then respond in kind in order to join the network via the coordinator. In Figure 2, the flow chart is displayed.

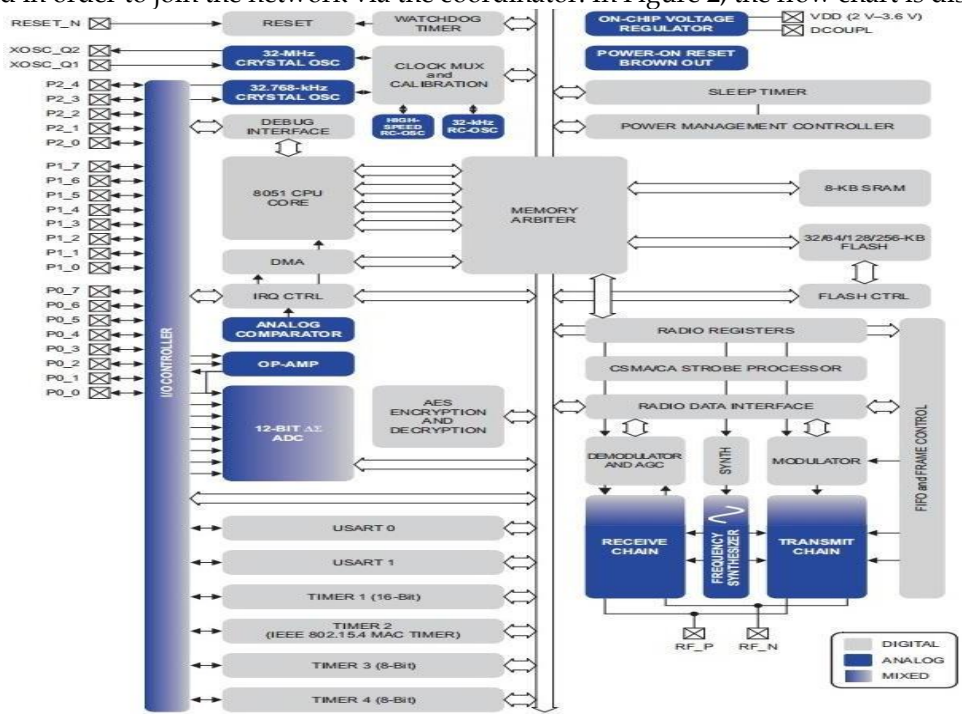

Figure 1: CC2530 Functional Block Diagram

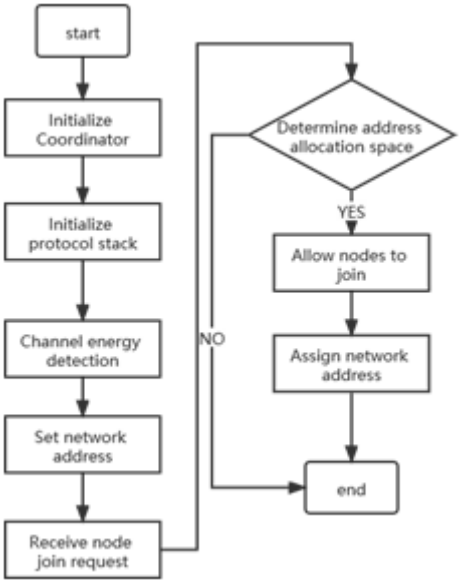

Figure 2: ZigBee Networking Flow Chart

ApplicationofsensorinZigBee

In order to construct an application ZigBee network, utilize two CC2530 nodes as terminal nodes to compile and burn the End Device Eb-Proprogram after designating one CC2530 node as the coordinator to compile and burn the Coordinate to Eb-Proprogram. Testing of data communication in a ZigBee network between the coordinator and terminal is possible after powering up [6].

Temperature and Humidity Sensor:

Figure 3 Cn. Pin 1 is grounded (GND), Pin 2 is data transmitted serially, Pin 3 is suspended (SCK), Pin 4 is powered (+VDD), and the voltage of the power supply is between 3.3 and 3.5 volts.When the sensor receives the start information from the MCU, it switches from low-power to high-speed mode. The sensor provides the MCU 40 bit temperature and humidity acquisition data when the start signal is finished, and then it returns to

low speed mode.

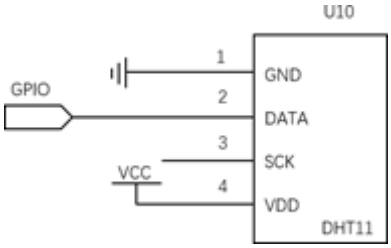

Figure 3: DHT11and CCInterface Circuit Diagram

Smoke Sensor:

The DHT11 sensor's development process is the same as that of the mq-2 sensor on the CC2530 singlechip microcontroller. The Mq-2 sensor requires a number of startup tasks before data conversion and processing can begin. In Figure 4, its task flow chart is displayed.

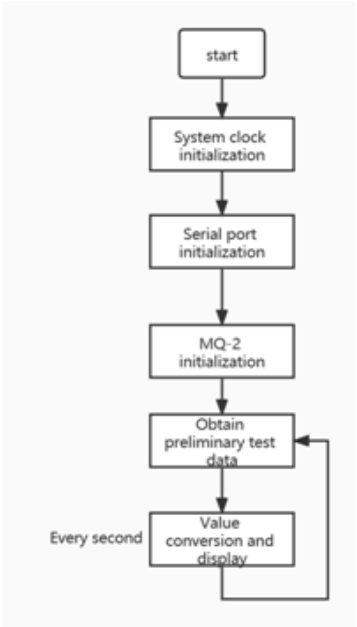

Figure 4: Mq-2 Task Flow Chart

Working principle of RFID Reade:

The high flat magnetic field and frequency emitting module make up the reader/writer. SPI (serial peripheral interface) serial port peripheral interface is used to communicate with the chip and 10 Mbps is the communication speed.Figure 5 displays the pindiagramof the RFID reader/writer, or RFC522.

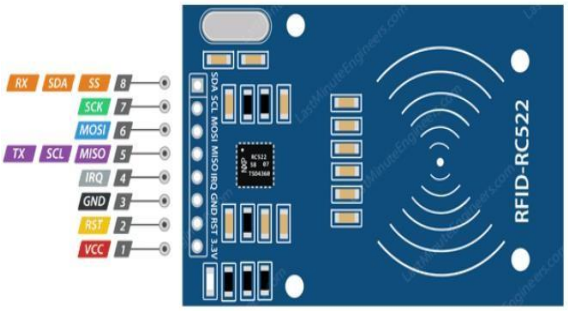

Figure 5: RFID Reader Pin Diagram

This chapter, which is based on the ZigBee protocol of CC2530, uses the DHT11 temperature and humidity sensor, the mq-2 smoke sensor, and the rfid-rc522 to build a wireless sensor network. It also explains the operation of each sensor and demonstrates how to achieve the multi-point environmental monitoring, cargo

information reading, and wireless data transmission functions of an intelligent warehouse, making it ready for the next phase of intelligent warehouse management system development.

CONCLUSION

The typical warehouse serves as the primary research foundation for the RFID and ZigBee-based intelligent warehouse management system [7]. The management of warehouse data is primarily done by pure software functions in traditional warehousing management systems. Environmental information monitoring is done separately, which results in low work efficiency. Thus, the state of traditional warehousing will be improved, and business efficiency will increase, thanks to the intelligent warehouse management system's highly integrated ware house environment data monitoring and automatic processing of warehouse in and warehouse out data information.

The level of development and efficiency of firms is influenced by the management efficiency of storage in this period of affluence and industry development. The Internet of Things, software, and other technologies are incorporated into the RFID and ZigBee-based intelligent storage system to enhance storage management, guarantee environmental safety of goods storage, and boost the effectiveness of managing items entering and exiting storage.

The CC2530 single chip microcontroller, a variety of sensor hardware and smart storage management system software make up the RFID and ZigBee smart storage system. Following an extensive battery of functional tests, the hardware component of the system is capable of collecting data from storage environments, warehousing environments, and wireless data transmission; the software component is capable of processing and storing storage data automatically, displaying data visually, generating warehousing data reports, and more. It has been possible to increase warehouse management's effectiveness.

Lack of research conditions prevents the speed at which items are detected entering and exiting warehouses from having the desired impact, and the functions associated with goods management are insufficiently sophisticated. As so, there's a lot of space for improvement in the next phase [8].As a result, the system's future development will focus on enhancing the system's functionality and user experience as well as increasing the system's speed and stability of detecting products entering and leaving warehouses.

Acknowledgment

MingboZhaoisthecorrespondingauthorofthispaper.

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