Advanced Smart Inventory Management System Using IoT

S.Prabakaran [1],V.Shangamithra [2],G.Sowmiya [3],R.Suruthi [4].
1.Assistant Professor 2,3,4 UG Student
Computer Science and Engineering
V.S.B. Engineering College, Karur, Tamilnadu, India

Abstract

The IoT-based Smart Inventory Management System is an automated system designed to manage inventory efficiently using the Arduino Uno, Nodemcu, three IR sensors, Load cell sensor, Status LED, and Ultrasonic sensor. This system utilizes the concept of the Internet ofThings (IoT) to provide real-time data oninventory levels, making it easier to manage andmaintain inventory. The IR sensors detect the quantity of goods in the inventory, while the ultrasonic sensors are used to detect the presence and level of inventory items. The system incorporates load cell sensors to accurately measure the weight of items in inventory and convert it into quantity count by dividing the total weight by the weight of asingle item. The collected data is transmitted to the cloud using the Nodemcu, and the Status LED indicates the status of the inventory, making it easy to monitor the system. The system is user-friendly and can be operated through a web or mobile interface, providing a convenient and efficient way to manage inventory. Overall, the IoT-based Smart Inventory Management System helps businesses reduce their inventory management costs andimprove their operational efficiency.

INTRODUCTION:

IoT based smart inventory management system is a modern approach to managing inventorythat leverages the power of the internet of things(IoT) technology. The system uses a network of interconnected devices, sensors, and software to track inventory levels, monitor product movement, and optimize inventory levels in real-time. The IoT based smart inventory management system works by collecting and analysing data from various sources, including point-of-sale systems, and other connected devices. This data is then processed and analyzed to provide real-time insights intoinventory levels management.

In This paper consists of multiple sensors, which are used to monitor different parameters such as the weight of the inventory, the proximity of the goods, and the movement ofthe products. The sensors communicate with the NodeMCU and Arduino Uno microcontrollers, which process the sensor data and transmit it to a cloud-based platform.

The NodeMCU, on the other hand, is a smaller and more powerful development board designed specifically for IoT applications. It is built around the ESP8266 Wi-Fi module, which allows the device to connect to the internet and communicate wirelessly with other devices. The IR sensor is used to detect the presence of an object in a given inventory area. The load cell is used to measure the weight of the inventory, while the ultrasonic sensor can be used to measure the distance between two objects or thelevel of the inventory in a container. With this IoT based smart inventory management system, businesses can easily monitor their inventory levels in real-time, identify trends, and makedata-driven decisions to optimize inventory levels, reduce waste, and ensure that the right products are available at the right time.

LITERATURE SURVEY:

[1] Inventory management is a crucial aspect of supply chain management, and with the advent of the Internet of Things (IoT), it has become possible to improve inventory management systems. IoT is a network of interconnected devices that communicate and exchange data to enhance efficiency and productivity. TheSystem on inventory management systems using IoT highlights the benefits of integrating IoTdevices with inventory management systems. IoT devices such as sensors and GPS trackers can be used to track inventory levels, monitor stock movement, and provide real-time data on inventory status.

[2] Inventory management is an essential aspectof supply chain management, and the use of Radio Frequency (RF) technology can significantly improve inventory management systems. RF technology allows for real-time data collection and analysis of inventory levels, which can help optimize inventory managementprocesses. The literature on inventory management systems using RF technology highlights the advantages of using RF devices such as handheld scanners and RFID tags to track inventory levels and movements. RFIDtags can be attached to products, and their movements can be monitored as they move through the supply chain, providing real-timedata on inventory levels and location.

[3] Ultrasonic sensors use sound waves to measure distances and detect the presence ofobjects, making them suitable for monitoring inventory levels. The inventory management systems using ultrasonic sensors highlight the benefits of using this technology to automate inventory management processes. Ultrasonicsensors can be used to monitor inventory levels in real-time, allowing companies to optimize their inventory levels and reduce waste. Several studies have proposed inventory management systems that use ultrasonic sensors to monitor inventory levels and alert companies when inventory levels are running low. For example, researchers have developed an ultrasonicsensor-based system that automatically reorders products when inventory levels fall below a specified threshold.

[4] An inventory management system using Arduino Nano and RFID, along with a status light, is an advanced system that enables automatic tracking and management of inventory items using RFID tags, while also providing a visual indication of inventory status.This technology is gaining popularity due to its ability to provide real-time data on inventorylevels, reduce human error, and enhance operational efficiency.

[5] The inventory management system using Arduino Uno and Load cell sensor reveals that this system typically consists of a load cell sensor connected to the Arduino Uno microcontroller board. The load cell sensor measures the weight of the inventory, which is then processed by the Arduino Uno using a suitable program. Various studies have proposed different approaches for designing the system, such as using a wireless communication module for remote monitoring, implementing a web-based interface for user interaction, or incorporating additional sensors for enhancedfunctionality.

[6] Smart inventory management system using Bluetooth, Arduino Uno, and Ultrasonic sensor reveals that this system typically involves an Ultrasonic sensor connected to the Arduino Uno microcontroller board. The Ultrasonic sensor measures the distance between the inventory and the sensor, which is then processed by the Arduino Uno using a suitable program. Bluetooth is used to connect the system to a

mobile device or computer, allowing for remote monitoring and control of the inventory.

[7] Warehouse inventory management using NodeMCU and a webpage involves exploring various studies and articles on the topic. The NodeMCU is an open-source microcontroller that can connect to the internet and control devices. The webpage is used as an interface forusers to interact with the system. The technical details involve setting up the NodeMCU, designing the webpage, configuring the sensors and actuators for inventory monitoring, and creating a database for inventory management. Some studies have also explored the use of machine learning algorithms to optimize inventory management.

[8] The ESP32 is a powerful microcontrollerthat can connect to the internet and control devices. The camera module is used to capture images of inventory items for visualverification. The webpage is used as an interface for users to interact with the system. The ultrasonic sensor is used to detect the distance between the object and the sensor. The technical details involve setting up the ESP32, designing the webpage, configuring the camera module and ultrasonic sensor for inventory monitoring, and creating a database forinventory management. Some studies have also explored the use of machine learning algorithms to optimize inventory management.

[9] The Inventory management System using Arduino Uno and NodeMCU, along with the Cayenne IoT platform and Ultrasonic sensor involves exploring various studies and articles on the topic. The Arduino Uno is a popular microcontroller platform used in many projects. The NodeMCU is an open-source microcontroller that can connect to the internet and control devices. The Cayenne IoT platform is a cloud-based platform that enables remote monitoring and control of connected devices. The ultrasonic sensor is used to detect the distance between the object and the sensor. The technical details involve setting up the Arduino Uno and NodeMCU, configuring the Cayenne IoT platform, integrating the ultrasonic sensor for inventory monitoring.

[10] An IoT-based inventory management system using load cells, a mobile app, and email alerts has gained attention in recent literature. Various studies propose similar systems that aim to improve inventory tracking and management processes. The proposed systems use load cells to measure the weight of items, a mobile app to track inventory levels, and email alerts to notify managers when inventory levels fall below a certain threshold. Some studies also incorporate RFID tags to track items andprovide real-time data. These IoT-based systemshave been proposed for different industries, including healthcare, manufacturing, and retail, with the goal of improving accuracy, efficiency, and cost-effectiveness.

EXISTING SYSTEM:

One of the existing systems for IoT-based smart inventory management is the RFID (Radio Frequency Identification) system. In this system, RFID tags are attached to the inventory items, and RFID readers are used to detect the presence and level of these items. The data is then transmitted wirelessly to a central server, where it is analyzed and used to manage inventory levels. If you take that productwithout scanning, this system will not be able to update inventory. So our proposed systemdeveloped various sensors like IR and Load cell for detect Presence of Products.

BLOCK DIAGRAM:

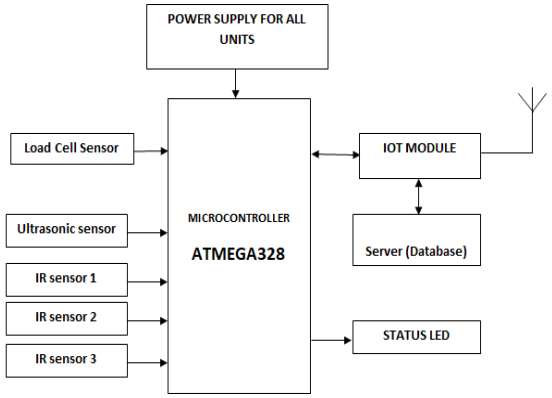


Fig.1.Proposed Block Diagram

PROPOSED SYSTEM:

The proposed system for IoT-based smart inventory management using Arduino Uno and NodeMCU, with IR sensors, Load cell sensors, Ultrasonic sensors, is an advanced solution for businesses looking to manage their inventory efficiently. The proposed system has been designed to tackle the challenges faced by businesses in managing their inventory efficiently. The system comprises of several components that work together to ensure accurate, real-time inventory management. The system uses IR sensors to detect the presence of inventory items in real-time. These sensors are placed at strategic locations throughout the storage facility, and they trigger when an item is added or removed from the inventory. The sensor data is collected by the Arduino Uno, which processes the data and sends it wirelessly to the NodeMCU for further processing.

To determine the quantity of the inventory items, the system uses Load cell sensors. These sensors are placed beneath the storage racks and are used to measure the weight of the items. By measuring the weight of the items, the system can determine the quantity of items that have been added or removed from the inventory. The Load cell sensors data is also collected by the Arduino Uno and sent wirelessly to the NodeMCU. The Ultrasonic sensors are used to count the number of products. These sensors areplaced at the entrance and exit points of the storage facility and are used to count the number of items that enter or leave the storage facility. The sensor data is collected by the Arduino Uno and sent wirelessly to the NodeMCU for further processing.

To provide real-time feedback on the inventory status, the system uses Status LED. The Status LED is programmed to display different colors depending on the inventory levels. For instance, the LED can be programmed to display red when the inventory levels are low, yellow when the inventory levels are moderate and green when the inventory levels are optimal. The proposed system uses Wi-Fi connectivity to communicate between the NodeMCU and the central server, allowing for real-time monitoringof inventory levels. The system can also be programmed to automatically reorder inventory when levels reach a certain threshold, reducing the likelihood of stock

outs.

METHODOLOGY:

The methodology for a IoT based Smart Inventory Management System involves both hardware and software components.

HARDWARE EXPLANATION:

The system comprises of several componentsthat work together to ensure accurate, real-time inventory management**.** The proposed system for IoT-based smart inventory management using Arduino Uno and NodeMCU, with IR sensors,

Load cell sensors, Ultrasonic sensors, is an advanced solution for businesses looking to manage their inventory efficiently.

COMPONENTS LIST:

- Power supply system
- Arduino Uno
- Nodemcu
- Ultrasonic sensor
- Load cell sensor
- Status LED
- IR Sensor

SOFTWARE DESCRIPTION:

ARDUINO IDE:

Arduino IDE (Integrated Development Environment) is a software tool used for programming and development of Arduino boards. It is an open-source platform, available for free, and is compatible with multiple operating systems including Windows, Mac OS,and Linux.

The main features of the Arduino IDE include:

- **Code Editor:** The code editor is the main interface of the Arduino IDEwhere you can write, edit and upload code to the Arduino board. It includes features such as syntax highlighting, auto-completion, and code snippets to make programming easier.

- **Sketches:** Arduino programs are referred to as "sketches" and can be easily created and saved within the IDE. The sketch contains two main functions: the setup () function, which is called onceat the start of the program, and the loop()function, which is called repeatedly as long as the program is running.

- **Library Manager:** The Library Manager allows users to easily install and manage libraries for their Arduino projects. It includes a collection of pre- built libraries that can be used to add functionality to your projects. Users can also create their own libraries and add them to the IDE.

- **Serial Monitor:** The Serial Monitor allows users to communicate with theArduino board and monitor the data being sent and received through the serial port. This is particularly useful for debugging and troubleshooting.

- **Board Manager:** The Board Managerallows users to select the type of Arduino board they are using, configure settings, and install the necessary drivers. This is important because different Arduino boards may have different specifications and require different drivers.

- **Upload:** The Upload feature allowsusers to upload their sketches to the Arduino board and begin executing the

program. Users can select the correct board and serial port before uploading the sketch.

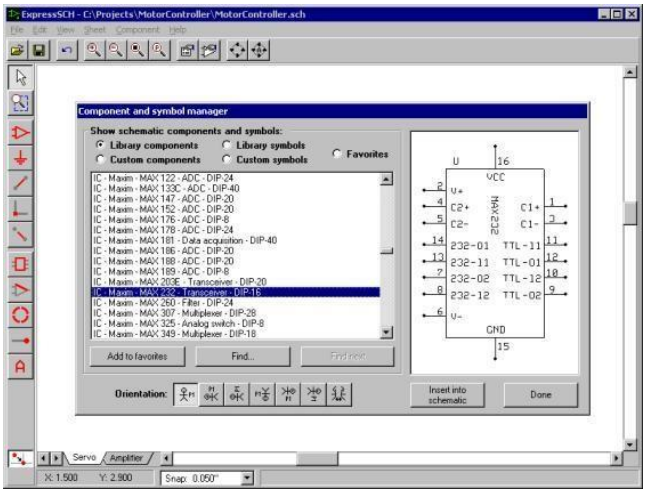
- **Tools:** The Tools menu includes a range of options for configuring and customizing the IDE. This includes options for setting the board type, serial port, programmer, and other settings.

Overall, the Arduino IDE is a user-friendly software tool that simplifies the programming process for beginners and experienced users alike. It is compatible with a wide range of Arduino boards and shields, making it a versatile tool for a variety of applications. With its many features and community support, the Arduino IDE is an essential tool for anyone interested in electronics and programming.

In addition to the basic features listed above, the Arduino IDE also supports advanced featuressuch as debugging and profiling tools, version control integration, and multiple file editing. The IDE can also be extended through plugins and add-ons, allowing users to customize thetool to their specific needs. Additionally, the Arduino community provides a wealth of resources and tutorials to help users get started and troubleshoot any issues they may encounter.

EXPRESS PCB:

Express PCB is a free-to-use software program for designing printed circuit boards (PCBs). It isa simple and user-friendly tool that is ideal for beginners and hobbyists who want to design and create their own PCBs.



Some of the key features of Express PCB include:

- **Schematic Capture:** Express PCBallows users to create schematic diagrams of their circuits using a library of pre-built symbols. The software also provides a range of editing tools to help users create and modify their schematic diagrams.
- **Board Layout:** Express PCB includes a powerful board layout editor that allows users to place components on the board, route traces between components, and add text and graphics. The software also includes a range of design rules to ensure that the PCB meets the required specifications.
- **Gerber Export:** Once the board design is complete, Express PCB allows usersto export the design as Gerber files, which can be used to manufacture the PCB.
- **Parts Library:** Express PCB comes with a large library of pre-built parts andcomponents that users can use to create

their designs. Users can also create their own custom parts library.

- **Auto-Router:** The software includes an auto-router feature that can automatically route traces between components on the board. This can save users a lot of time and effort, especially for complex designs.
- **3D Viewer:** Express PCB includes a 3D viewer that allows users to view their board designs in 3D, providing a realistic view of how the final product will look.

Overall, Express PCB is a powerful and user-friendly software tool that can help users design and create their own PCBs quickly and easily. The software is free to download and use, making it accessible to hobbyists and beginners who may not have a large budget for PCB design software. Additionally, Express PCB provides a range of tutorials and resources to help users get started and troubleshoot any issues they may encounter during the design process.

WEB SERVER:

The ESP8266 is a low-cost Wi-Fi microchipwith full TCP/IP stack and microcontroller capabilities. It can be used as a standalone microcontroller or as a Wi-Fi enabled communication module with other microcontrollers. One of its popular applications is to create a webserver page to control andmonitor devices over the internet.

Here are the details on how to create a webserver page with ESP8266:

- Set up the ESP8266 with Arduino IDE and connect it to Wi-Fi.
- Import the required libraries such as ESP8266WiFi.h and ESP8266WebServer.h.
- Create a web server object using the ESP8266WebServer class.
- Define a callback function that will handle requests made to the webserver. The callback function can take inputs from HTML forms and execute specific actions on the ESP8266.
- Write HTML code for the web page that the user will see.
- Create a server. Begin() statement in the setup() function to start the web server.
- In the loop () function, run the server.handleClient() method to handleincoming client requests.
- Upload the sketch to the ESP8266 and test the web page in a browser by entering the IP address of the ESP8266in the browser address bar.

By following these steps, the ESP8266 can serve up a web page to control and monitordevices over the internet. This can be useful for remote control of home automation devices or other internet of things (IoT) applications.

CONCLUSIONS:

In conclusion, the proposed work on the system for IoT-based smart inventory management involves designing and programming the hardware and software components, testing the system, and ensuring that it provides accurate and reliable data on inventory levels in real-time. The proposed work involves designing and programming the hardware and software components, testing the system, and ensuringthat it provides accurate and reliable data on inventory levels in real-time. By implementing this system, businesses can manage their inventory more efficiently, reduce stock outs,and improve customer satisfaction.

DISCUSSION:

The IoT-based smart inventory management system offers several benefits over traditional inventory management systems. Firstly, the system provides real-time data on inventory levels, eliminating the need for manual inventory checks, which can be time-consumingand prone to errors. This means that businesses can monitor their inventory levels more accurately and respond quickly to changes in demand or supply. The system has several advantages and

limitations.

Advantages:

- Real-time inventory monitoring.
- Remote access.
- Accurate inventory tracking.
- User-friendly interface.
- Visual representation of inventory levels.

Limitations:

- Network dependence.
- Calibration.
- Cost.
- Limited to specific products.

REFERENCE:

1. In the 2014 IEEE International Conference on Consumer Electronics,
   S.M. Huynh, D. Parry, A. Fong, and J. Tang presented a home localization system designed to help locate misplaced objects. The system is described in their paper, which can be found in the conference proceedings on pages 462-463.
2. The International Journal of Computer Applications published a study in 2012 by A. Ramaa, K.N. Subramanya, and
   T.M. Rangaswamy that explores the effects of a warehouse inventory management system on supply chain

   operations. The article can be identified by its volume and issue number, 54 (6).
3. The International Journal of Physical Distribution and Logistics Management published a research article in 2014 by
   M. Bruccoleri, S. Cannella, and G. La Porta that investigates the impact of workers' behavior on inventory record inaccuracies within supply chains. The article can be found in volume 44, issue 10, and includes page numbers.
4. The International Journal of Engineering and Computer Science published a studyin 2015 by N. Wartha and V. Londhethat proposes a context-aware method for improving the security and privacy of RFID technology. The article is available in volume 4 and includes page numbers 178-88.
5. In 2011, Samer S. Saab and Zahi S. Nakad published an article in the IEEE Transactions on Industrial Electronics journal regarding a passive tag-based indoor positioning system for RFID that operates independently. The article can be identified by its volume and issue number, 58 (5).
6. The Future Generation ComputerSystems journal featured an article in September 2013 by J. Gubbi, R. Buyya, S.Marusic, and M. Palaniswami that outlines the architecture and future prospects of the Internet of Things (IoT).The article can be identified by its volume and issue number, 29 (7), and includes page numbers 1645-1660.
7. In the proceedings of the 6th International Conference on Cloud Computing and Services Science (CLOSER) in 2016, K. Stravoskoufos and colleagues presented a study that addresses the challenges in the designand implementation of IoT systems by using IoT-A and FIWARE technologies. The paper is available in the conference proceedings and can be found on pages 146-153.
8. The proceedings of the 6th Workshop on Positioning, Navigation and Communication in 2009 featured a paper by R. Mautz that highlights the difficulties associated with indoor environments for positioning systems

   and proposes alternative solutions. The paper can be found in the conference proceedings and is located on pages 29- 36.
9. The IEEE International Conference on RFID Technologies and Applications in 2012 included a paper by J. Ziegler, M. Graube, and L. Urbas that proposes the use of RFID as a universal entry point for linked data clouds. The paper can be located in the conference proceedings and is available on pages 281-286.
10. The International Journal of Engineering Research and Review published a study in 2015 by P. Karthika, J. Harriet Rathna Priya, and A. Rathinavel Pandian that presents an indoor location tracking system based on RFID technology. The article can be found in volume 3, issue 1,and includes page numbers 73-80.

11. The International Journal of Engineering Research and Applications (IJERA) featured a study in 2014 by M. Gireesh Kumar and K. Sripath Roy that proposes a Zigbee-based inventory tracking system for indoor campus environments using RFID modules. The article can be found in volume 4, issue 7(1), and has the ISSN number 2248-9622. The page number is 132.
12. In the International Conference on Electrical and Computing Technologies and Applications (ICECTA) held in the United Arab Emirates in 2019, U. Ahmad, K. Poon, A. M. Altayyari, and M. R. Almazrouei presented a low-cost

    localization system for warehouse inventory management. The conference paper can be found on pages 1-5.
13. At the 4th International Conference on Control, Robotics and Cybernetics (CRC) held in Tokyo, Japan in 2019, W.Chang, F. Lin, T. Liao, and W. Tsai presented a technique for remote crack measurement that uses an Android camera and laser positioning. The conference paper can be found on pages 196-200.
14. At the IEEE 7th International Colloquium on Signal Processing and its Applications held in Penang in 2011, Norhashim Mohd Arshad, MohamadFarid Misnan, and N. Abdul Razak presented a technique that utilizes a single infra-red sensor for line-tracking in autonomous mobile vehicles. The conference paper is available on pages 159-162.
15. In their paper titled "A Novel Smart CityUsing IoT and Open Source Technology," B.S.S. Tejesh, MD Shabeena Begum, N. Mayuri, S. Neeraja, and B. Purvaja Durga discuss a new approach to building smart cities based on the Internet of Things (IoT) and open source technology, presented at the conference proceedings (pp. 4633-4637) in 2019.