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Smart and Secure Warehouse Monitoring System of an Agricultural Industry using LabVIEW and IoT

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Abstract: In this paper, we have used different sensors to measure the parameters in the warehouse like temperature, humidity, pressure, flame and gas detection. These parameters are sensed by the respective sensors and sent to the arduino UNO microcontroller. The arduino is coded and the corresponding simulation is done through the proteus software. The arduino sends these data to the LabVIEW software built in the PC using an USB to TTL converter via the UART (Universal Asynchronous Receiver Transmitter) communication for the monitoring purpose. An IoT based camera module is used inside the warehouse for authorization and security purposes. A door is used for letting in the authorized person using a relay and motor operation.

Keywords: Temperature and DHT11, Humidity sensor, RFID reader and tags, Arduino, IoT based sensing camera, LabVIEW.

I. INTRODUCTION

A warehouse is a mercantile architecture for an entrepot of stuff. Warehouses are used by producers, dealers, traders, wholesalers, distributors, customs, etc. warehouses should be screened at regular intervals to reduce storage cost of food grains due to atmospheric conditions and are documented. With the enlargement of business and the continuous requirements of the food product multiplicity, old style granary management prototype will not meet that, due to its heavy capacity and low proficiency. To mitigate the manual labour work and to make the work easier, a smart warehouse is implemented which is enabled with several sensors and technologies. Based on the sensor's data the appropriate data is captured and manipulated based on the limit given in the software and sent timely information to the concerned department officials of Central warehouse corporation through SMS for moderation and corrective actions arising due to atmospheric conditions inside the warehouse.

In the data warehouse based implementation, the records about the particular organization or different organizations are stored to be fetched for future usage. Electronic health record (EHR) is an important system of information and communication technologies to the healthcare sector. EHR implementation is expected to produce benefits for patients, professionals, organizations, and the population as a whole [1]. Data visualization method in 3D space that includes actual positions, volumes and space relations of the chunks of data that are being visualized. Data that is being visualized is real-time information provided by the smart warehouse management system about packages distributed on pallet places within a warehouse [2]. A robot that moves products in the warehouse according to storage and shipping requests. Our solution is designed to allow the various actors to have real-time information on the different workflows within the warehouse and all the movement of stock. Hence the need for a system that controls all zones and locations and ensures communication between the various actors and software components while optimizing data exchange and load consumption for lOT equipment [3]. Sensors include vibration, humidity, temperature, fire sensors. It is done with the help of current technology (IoT). Raspberry pi controller adopts IoT technology to convey the messages. Based on the sensor's data the appropriate data is captured and manipulated based on the limit given in the software and sent timely information to the concerned department officials of Central warehouse corporation through SMS for moderation and corrective actions arising due to atmospheric conditions inside the warehouse [4]. In this paper a novel system to monitor warehouses with wireless sensor networks is proposed. The system consists of wireless nodes and monitors. Wireless sensor nodes collect temperature and humidity information and send them to the monitor. Monitor provides GUI for warehouse operators. The design of wireless nodes and monitors are introduced in detail [5]. This paper introduces a new warehousing environment monitor system based on wireless sensor network (WSN), which can acquire real-time warehousing environment parameters and reduce the unnecessary loss caused by emergencies such as fire. We adopt the CC2530 as a wireless data

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transceiver, SHT11 temperature and humidity sensors to realize the gathering of warehousing environment parameters, and voice module to realize audio acquisition. The communication system runs the corresponding program for the coordinator nodes and terminal nodes under the IAR system, and realize data transmission between the nodes in a star network. The experimental results show that the system can realizes the acquisition and processing of environmental temperature and humidity in a wide area [6]. It presents a new method of the monitoring and controlling system for the great warehouse. The method uses CAN bus and Ethernet to design a distributed control structure with a multi-level subsystem. It can be accessed into the Internet to control several centralized warehouses remotely in real time. The host computer and the monitoring computer can be synchronously controlled through the CAN bus so that the parameters such as temperature and humidity can be modified and displayed not only from the host computer but also from the monitoring computer as well as the function of the fire alarm [7]. Environmental monitoring needs to realize the effective monitoring of the environment, but also to achieve the control of related equipment. In the era of rapid development of science and technology, environmental protection and management need to adopt new information and communication technology to replace the traditional and backward monitoring methods. Under the background of high reliability in industrial production, programmable logic controllers (PLC) emerged and gradually developed into a widely used industrial control device. In the industrial control system, PLC is often used as the main controller to complete the complex process control, as well as the real-time monitoring of the production status. This paper studies the stereo warehouse monitoring system based on PLC [8]. We design a comprehensive monitoring system of intelligent warehouses. The system architecture is mainly divided into four parts: software monitoring, wireless sensor acquisition, water leakage detection and alarm, data curve display and query export. Through wireless sensor network technology and Java Web, real-time monitoring of warehouse temperature and humidity data is realized, and data visualization is realized through a large screen [9]. In the warehouse, typical logistics software of the warehouse is Warehouse Management System(WMS) and Warehouse Control System(WCS). WCS is different from WMS, and WCS aims to manage a broad range of material handling equipment in the warehouse. We analyzed key functions and limitations of existing WSC and suggested a new architecture for WCS. To address such requirements and limitations, a new architecture and functions of Smart WCS/ECS are suggested. SMART WCS/ECS will enhance the efficiency of warehouse operation [10]. Nowadays storehouses need a low operating cost technology hence, required minimum managers for efficient operation of the storehouse management administration. Let's discuss those new modern technologies:

A.WMS: In the last decades, more advanced technologies used in the storehouse management systems. Labour-intensiveness is reduced due to efficient and time consuming processes.

B. Data entry and Paperwork: Data entry and paperwork has reduced the time working with the spread sheets and ledger maintenance of the management system.

C. Selection efficiency: With the help of a computer guided system the operatives can work faster with WMS, because the new modern technology helps us to arrange systematically for efficient and real time management of the WMS.

D. Task Interleaving: It becomes more powerful tools so that system guidance will be extended to all the activities. Especially, it is used for the operator of forklift [5].

Our proposed system allows only authorized people to enter into the warehouse. If the unauthorized person enters the warehouse then it will be intimated through the LCD module. DHT 11 sensor is used in this project to measure the humidity and the temperature of the warehouse. A DHT 11 sensor send the values to the arduino using a digital pin. Radio frequency identification technique is used to identify whether the person who enters the warehouse is authorized or not. Arduino is the main controller which receives the sensor and personal information using the RFID module. Once the arduino receives the corresponding value from these sensors then details are sent to the lcd module for the indication purpose. Lab view software is a graphical programming environment to show our virtual warehouse model.

II. BLOCK DIAGRAM

The block diagram of the warehouse monitoring system is shown below.

The block diagram of the system consists of power supply, arduino UNO microcontroller, DHT11 sensor, RFID reader, driver and relay, motor, USB to TTL converter, PC and LabVIEW. The power supply gives the required power for all the units. The sensors such as DHT11 sensor and RFID (Radio-Frequency IDentification) reader are connected to the arduino for sensing purpose. The driver and relay are also connected to the arduino for door operation using motor. The arduino send data to the USB to TTL (Transistor- Transistor Logic) converter and the from there the data is transferred to the Personal Computer (PC).

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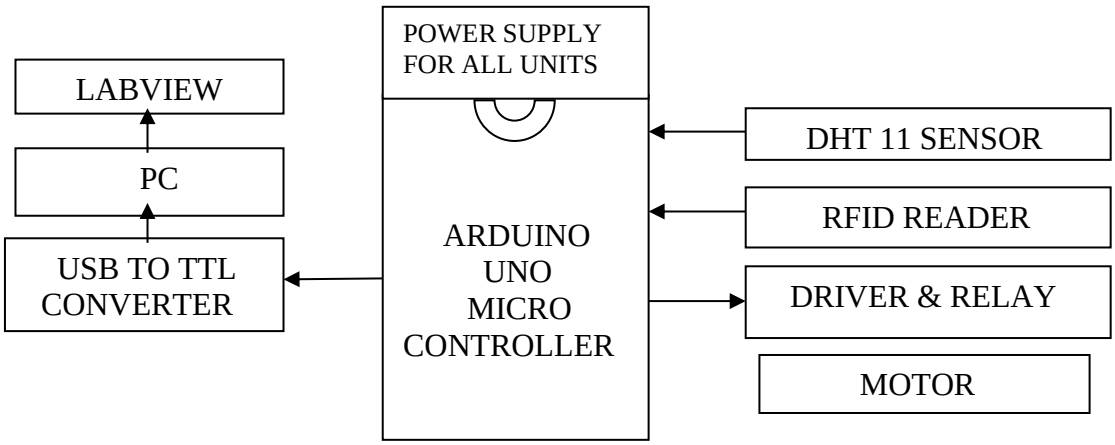

Fig.1 Block diagram of the Warehouse Monitoring System

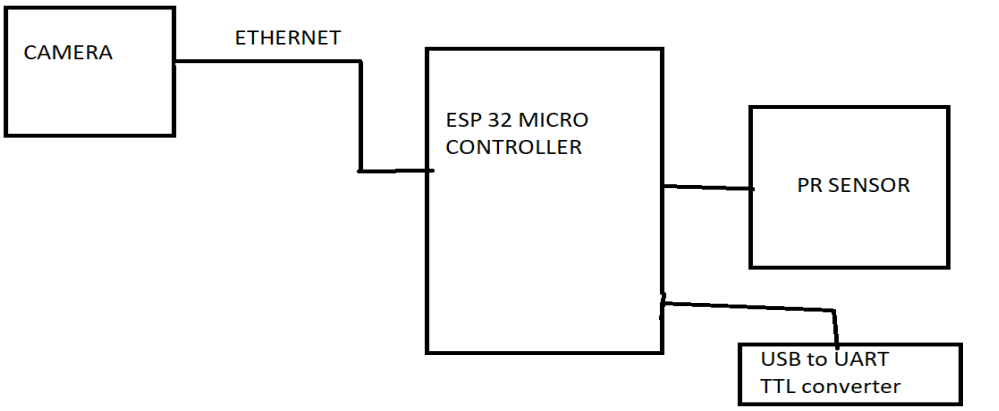

Fig.2 Block Diagram for the IoT based Camera Module

A camera which captures the warehouse in different angles is connected to the ESP 32 micro controller through an Ethernet cable and sends the captured data to it. The ESP32 micro-controller sends the received data to the PC through the USB to UART TTL converter. A PR sensor enables the capturing of images by the camera at 360 degrees inside the warehouse by rotating at an angle of 360 degrees inside the warehouse.

III. HARDWARE DESCRIPTION

1. Arduino UNO:

The operation of power supply circuits built using filters, rectifiers and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator unit, which remains the same if the input DC voltage varies or the output load connected to DC voltage changes. AC input step down transformer rectifier filter regulator. A diode rectifier that provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. A regulated circuit can use this DC inputs to provide a DC voltage that not only has much less ripple voltage but also remains the same DC value even if the input DC voltage varies somewhat or the load connected to the output DC voltage changes this voltage regulation is usually obtained using one of a number of popular voltage regulation IC unit. The Arduino board is the heart of our system. Entire functioning of the system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost.

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Fig.3 Arduino UNO

2. RFID Reader:

The Arduino board is the heart of our system. Entire functioning of the system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost.

Fig.4 RFID Reader

3. RFID Tag:

An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves , RFID tags contain a wire circuit and antenna for data transmission. The antenna receives the required amount of power from the RFID reader. It also responds to the interrogation signal provided by the reader. RFID tags can be as small as a pin or can be as large as an identity card.

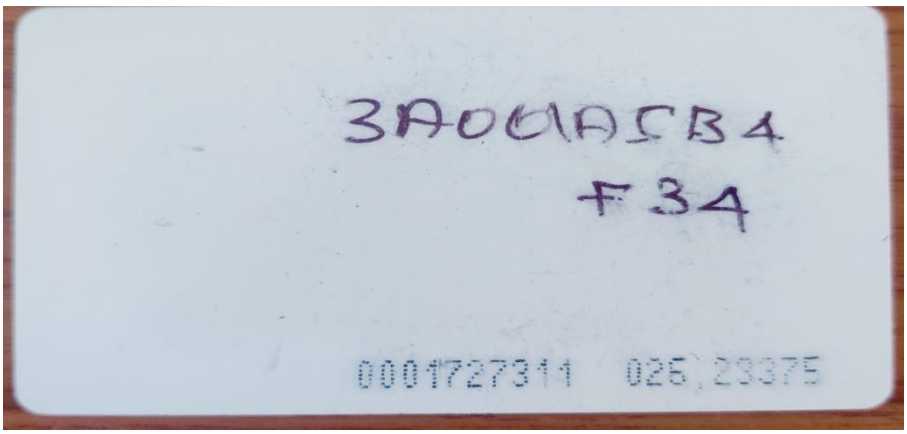

Fig.5 RFID Tag

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4. DHT11 Temperature and Humidity sensor:

The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

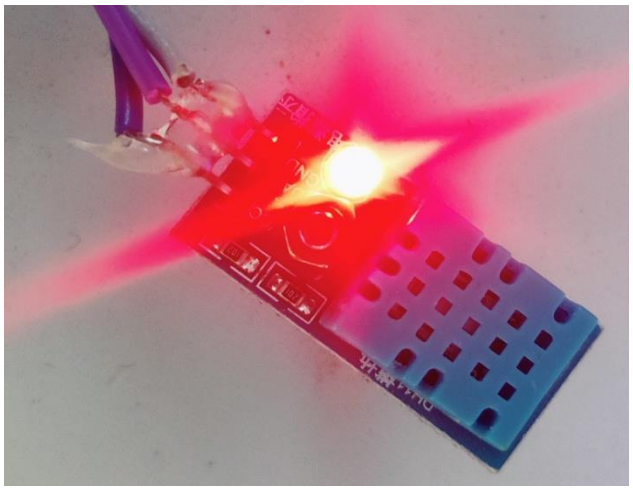

Fig.6 DHT11 Sensor

5. Liquid Crystal Display:

Liquid crystal displays (LCDs) are used in similar applications where LEDs are used. These applications are display of numeric and alphanumeric characters in dot matrix and segmental displays. The liquid crystal material may be one of the several components, which exhibit optical properties of a crystal though they remain in liquid form. Liquid crystal is layered between glass sheets with transparent electrodes deposited on the inside faces.

Fig.7 LCD

6. Relay:

A relay is an electro-magnetic switch which is useful if you want to use a low voltage circuit to switch on and off a light bulb (or anything else) connected to the 220v mains supply. The current needed to operate the relay coil is more than can be supplied by most chips (op-amps etc), so a transistor is usually needed.

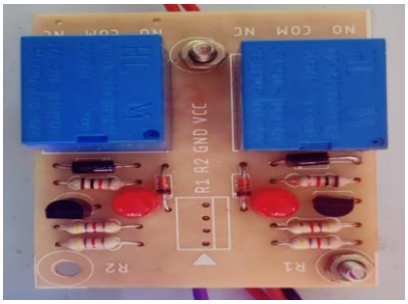

Fig.8 Relay

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7. IoT Based Camera:

A home security or baby monitor camera is an IoT camera. That means it's a computer connected to the internet, and should be treated as a potential security threat. Any person entering the warehouse (either authorised or unauthorised) is captured by the camera and their image is shown through mail.

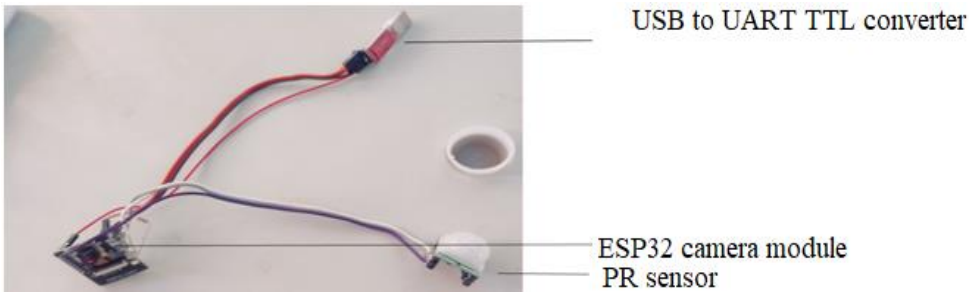

Fig.9 IoT based Camera Module

IV. SOFTWARE DESCRIPTION

1. ARDUINO IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. The Arduino IDE software is free to download, and installing it is really easy. Just follow the instructions below and you'll be writing code and getting your Arduino up and running in no time. Arduino 1.8.3 is the software used for the arduino coding and the respective images are attached below

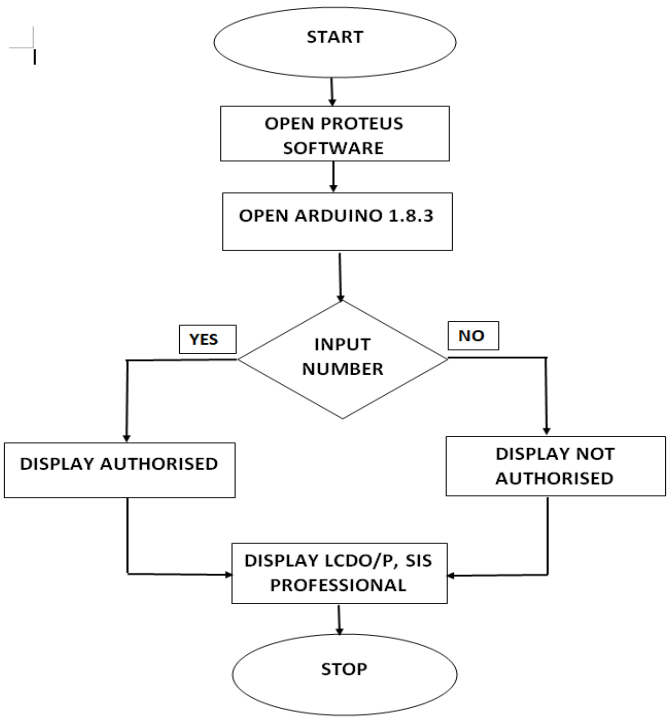

Fig.10 Flow Chart for Arduino Coding and Simulation

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2. PROTEUS:

The simulation for the arduino coding is done using the Proteus software. The image is attached below

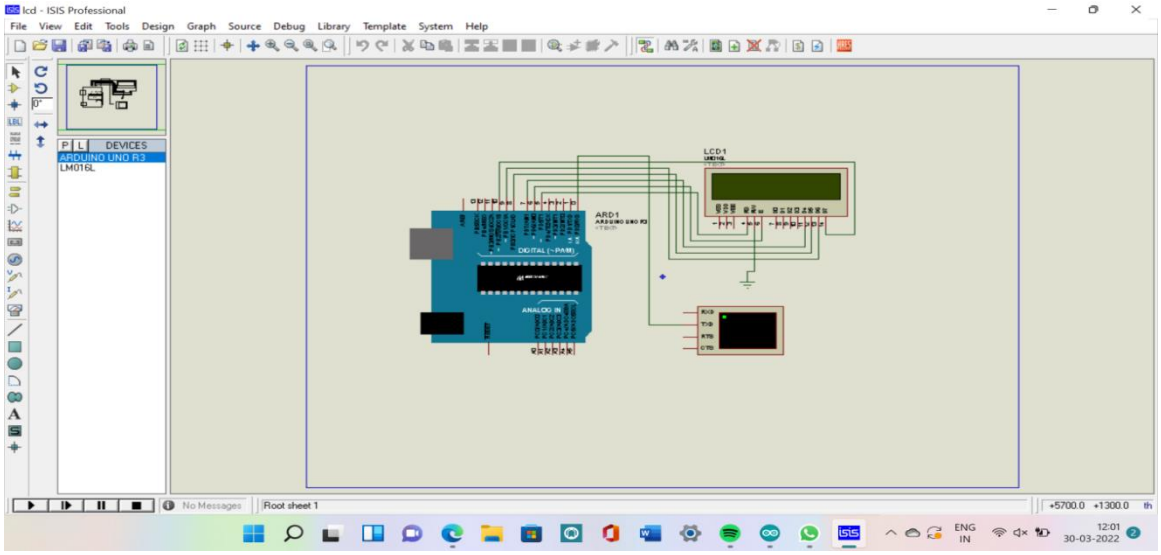

Fig.11 Simulation on Proteus

3. LabVIEW:

In the front panel of the LabVIEW window, a tank is used for indicating the temperature and a meter is used for indicating the humidity. Various numerical indicators are also used for numerically representing the parameters. Boolean LEDs are also used to represent the ON and OFF state of the LCD. A stop button is used to stop the process. Corresponding block diagrams are also constructed on the block diagram workspace by placing and connecting the appropriate parameters. The LabVIEW simulation for the warehouse monitoring system is shown in the image below

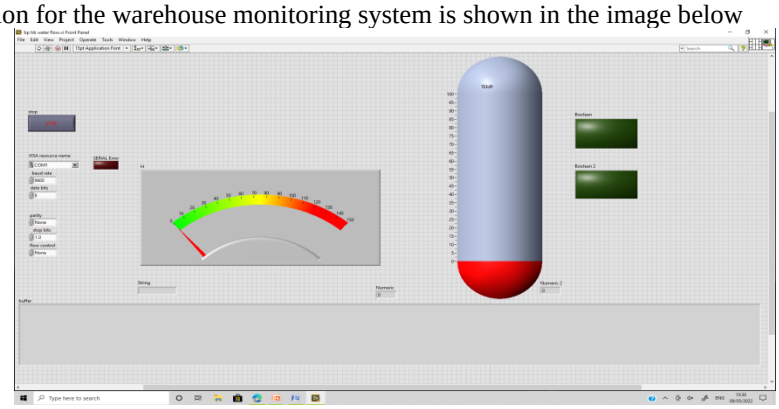

Fig.12 Front Panel of LabVIEW Simulation

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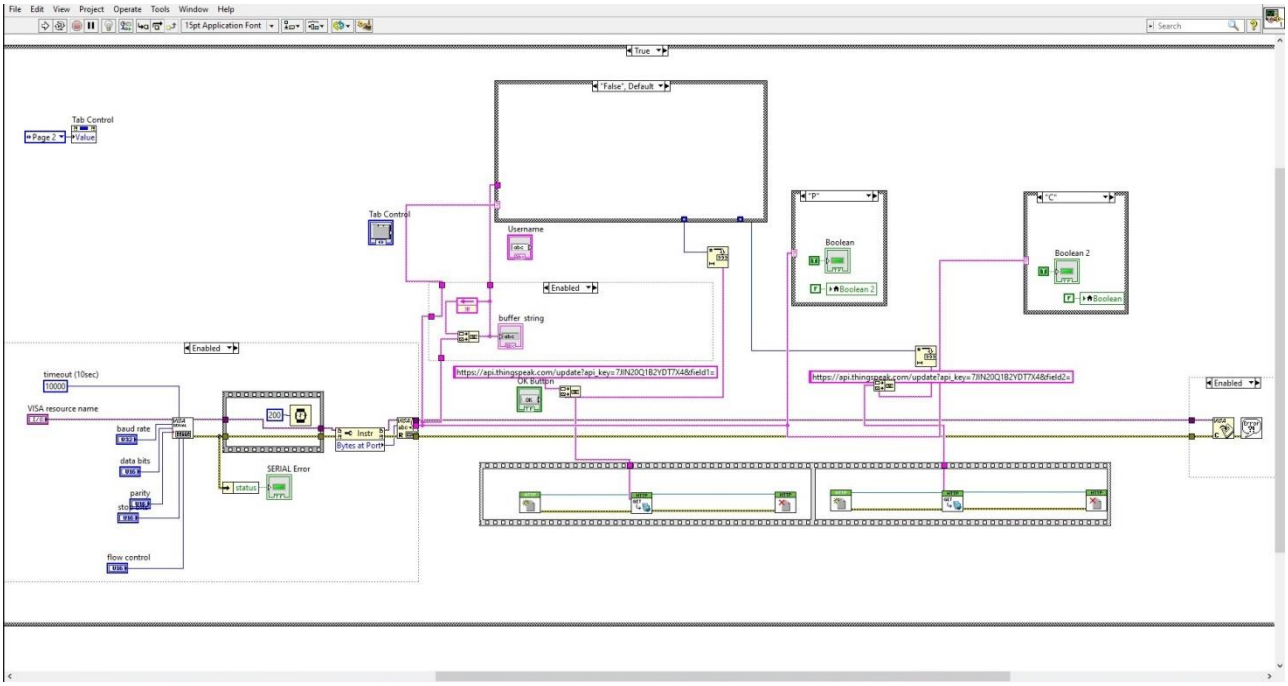

Fig.13 Block Diagram of LabVIEW Simulation

V. EXPERIMENTAL SETUP / HARDWARE PROTOTYPE

The following image represents the photograph of the warehouse monitoring system.

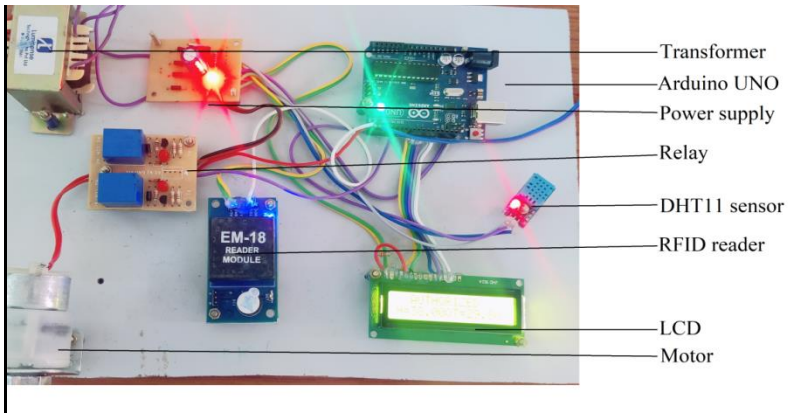

Fig.14 Hardware Setup

In this setup, a 5V supply is given to Arduino UNO. The digital sensor, DHT11 is connected to the arduino by using the jumper wires. A RFID reader is used for the purpose of authentication using allotted RFID tags. A relay switch is used for door open and close operations using a motor. An IoT based camera is interfaced to the ESP32 microcontroller using ethernet cable. A PR sensor enables 360 degree rotation of the camera and hence it captures the warehouse at 360 degree.

To start the process, a product database is created first. Five databases are required i.e., total product database with all information of the nine products, warehouse 1 database with the information of the four products belonging to it and warehouse database containing the information of five products. The last two databases contain the information of the supplier and warehouse.

First is to build up the database. This database should have the entire information of the products and warehouses. Second is to set up the relationship between the database and LabVIEW system. Without this, LabVIEW cannot find the needed database. The last step is to design the high level block of LabVIEW. This high level block establishes the system to identify the RFID USB hardware, identify the tags that are entering the warehouse and control the warning lights. This system uses the characteristic of RFID that can read many tags in one scan and automatically deliver the information in a short time. Traditional barcodes can only read one at a time, and thus cannot have this function. This feature can help a

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retailer to find out whether the product is at the right place or not. If the product does not belong to this warehouse the system can show where the product is at that moment, and the operator can deal with the problem immediately. Thus, the retailer or warehouses do not have to wait until the operators check the entire stocking inventory.
The biggest advantage to use this system is that mistakes can be detected right away. An RFID reader can read many tags concurrently and the information about the tag is sent to the system immediately. The system can easily identify whether the right products are in the right warehouse, and also the operator can deal with the problem once it appears. Because the interface can also show the information of other warehouses, the operator would be easy to figure out where the missing products are located.

VI. OUTPUT

The output of the image is attached below

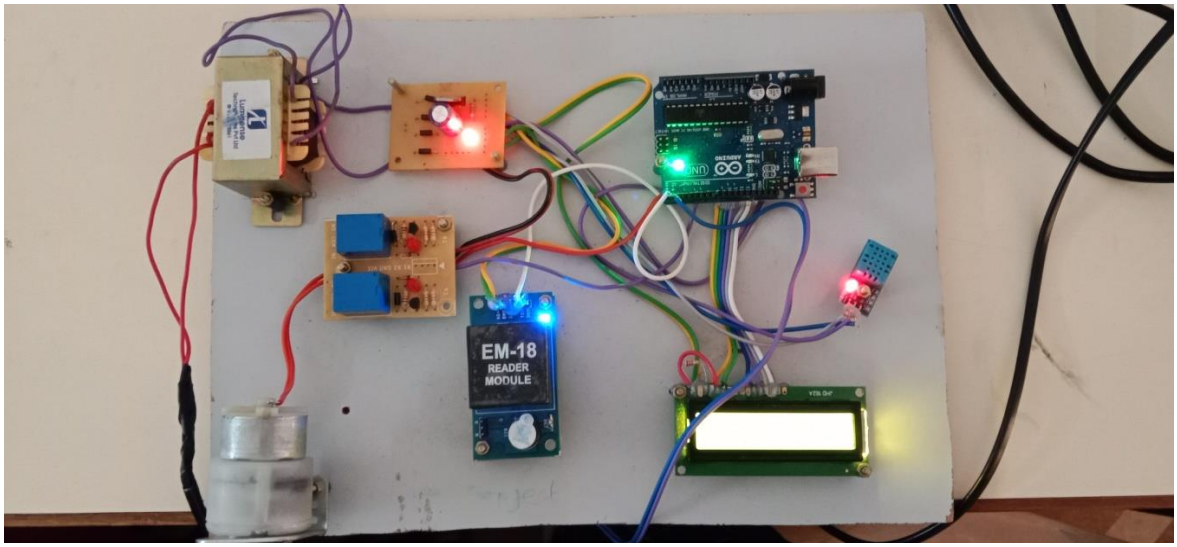

Fig.15 Output Image

VII. RESULT

By execution and implementation of the existing technology the inventory management for the next generation smart storehouse management is proposed with Iot enabled sensor technology. The feature of this method or model is that it has more advanced technology with enormous features. which is incorporated in the system itself. Hence this proposed system will reduce the gap between customer satisfaction and also with the commercial business. Hopefully this will help the main shareholders to formalize & formulate the standard principles of next level smart storehouse inventory management. This paper will rely on the current and advanced technology and propose a user friendly advanced and convenient solution for the customer. This system will provide end to end management in a smarter and and innovative manner. So we can say it is a future ready real time tracking system with cloud computing and support of the administration. The customized system with different topology with centralized and also in decentralized servers.

Fig.16 Output Photograph Caught by the Camera

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VIII. CONCLUSION

The applications of RFID for the supply chain management are important in the industry. Proper technology to integrate the database efficiently is the key to success. Much has been written in industry press regarding recent RFID mandates from Wal-Mart and the U.S. Department of Defence (DOD). Many inventory management applications demonstrate the versatility and impact of RFID solutions across a variety of industries and all areas of the supply chain. Thus, many retailers are searching for new technology and new process control systems to increase their efficiency of supply chain management. This work uses Lab VIEW to integrate the supply chain product database and RFID technology to increase the operational efficiency, prevent one from dispatching goods to the wrong place, and help an operator to relocate the misplaced products immediately. The developed integrated technique using LabVIEW can help a retailer to reduce the supply chain management problem as well. Our further work in this field is to apply the developed technique and system in the cases of complicated supply chain systems for large-scale industrial retailers.

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