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SMART WAREHOUSE MONITORING SYSTEM USING IOT

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ABSTRACT: A warehouse is a heart of any enterprise. This is where the valuable goods and equipment of any business are stored. It has evolved from just being a storage and inventory facility. Its prime goal is to ensure safety and continuous flow of items. Businesses rely on warehouses for seasonal or surged demands, for security, transportation, and supply chain management. So, warehouse monitoring and management can't be ignored in the expansion story of an enterprise. The quality and safety of items kept in warehouses depend a lot on how well they are managed, especially with the world's population growing and the demand for food rising along with it. In this way, it is important to deal with the problems of post-harvest losses, wasted food, and keeping storage conditions at their best. This paper shows how an Internet of Things (IoT)-based smart warehouse tracking system can help with these problems. By using IoT technology, the suggested system allows for real-time tracking and control of warehouse conditions like temperature, humidity, and pest infestation. This minimizes food grain waste and enhances storage efficiency ultimately. The system collects data from various sensors and transmits it to the IoT cloud using ESP32, a set of low-cost and low-power system-on-chip microcontrollers with built-in Wi-Fi, and dual- mode Bluetooth, where warehouse owners or managers can access it through a mobile app. The paper talks about the importance of the Internet of Things (IoT) in warehouse management, describes the design of the system, and talks about the possible benefits of using such a system to reduce losses and improve food storage.

1. INTRODUCTION

Agriculture has been the world's longest running profession; one-third of the working population obtains their livelihood from agriculture. In India alone, as per Registrar General of India and Census report 2011 the total number of farmers in India is 118.7 million and 144.3 million people are agricultural workers/laborers which consists 31.55% of the total rural population. So, a lot of people depend on agriculture as a means to earn income. However, a lot of the food produced at farms usually does not make it to the consumers. This can happen due to many reasons including damage of the produce at the farm, during transport or during storage. India is the second largest producer of vegetables and fruit but unfortunately, 25 to 30 percent of it is wasted due to inadequate logistical support, lack of refrigerated storage, supply chain

Issues and bottlenecks, improper transport and underdeveloped marketing channels. Twenty-one million metric tons of wheat get ruined each year due to improper storage. This leads to food scarcity and insecurity.

Warehouses are used by producers, dealers, traders, wholesalers, customers etc. Every year, farmers face a huge loss due to the problem of storage requirements in warehouses. This is due to improper monitoring of the food stored and the inability to provide proper refrigeration systems. Various traditional storage methods were initiated which forced a huge manual approach which is time-consuming and inefficient.

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With the development of the Internet of things, there exist variety kinds of sensors. These sensors can not only monitor information about the various dimensions of the real world at anytime, anywhere, but also change the physical environment through some action. However, the information provided by a single sensor has limitations. The current status of the various sensors is often isolated from each other, lacking effective mechanisms to make various types of sensors to work together organically. The advantage of multi-sensor cooperative detection is that it can integrate the complementary information and redundant information of a scene, obtaining a more comprehensive and accurate scene representation than any single sensor can do. This establishes a good foundation for target recognition and tracking applications.

This project is to capture temperature, moisture and gas related information using sensors and send alerts using IoT technology. The problem faced by the Central Warehouse Corporation is storage loss of food grains due to environmental changes, Central Warehousing Corporation (CWC) is into handling and storage services for more than 400 merchandise include Industrial raw-materials Agricultural product, finished goods and variety of perishable and hygroscopic items. Storage loss of perishables goods and food grains are being monitored and controlled through quality check practices including regular and periodic chemical treatment, recording of humidity, moisture and other key parameters, regular inspection, proper documentation age analysis, sanitation, physical condition of storehouse. Further storage loss due to atmospheric condition beyond threshold results in infestation etc and hence damages the perishables/ food grains. By execute the new modern tools storehouse administration system involves different sets of motivations and expectations from the various shareholders. Logistics /Operations Managers by definition are looking for a smooth and speedy execution. The new technology with modern tool is used to be user friendly, by eliminating unproductive processes and horrific warehouse habits and practices. So that the errors will be get minimized. The main role of the administration is to provide a proper communication and expectation at all levels to assist the employees, so that to adjust the forthcoming changes in the storehouse operation. Various storehouse management systems during implementation are failed to meet their procedures. Then the project risk is issued after execution. Due to improper planning the execution failed. So we have to implement a flexible and real time plan to execute a storehouse management system

2. LITERATURE SURVEY

Green survivable collaborative edge computing in smart cities by W. Hou, Z. Ning, and L. Guo .

As an integrated environment deployed with wired and wireless infrastructures, the smart city heavily relies on the wireless-optical broadband access network. The information flows captured by indoor devices are sent to optical network units through front-end wireless mesh sensor networks (WMNs) and, finally, reach the optical line terminal for industrial/commercial decision making via the passive optical network backhaul. To reduce the backhaul bandwidth saturated by this conventional approach, edge devices are deployed at the front-end WMN to pre-process information flows. Based on collaborative edge computing, home users or factory workers customize their computing services as virtual networks embedded onto the common WMN. In this paper, we propose the green survivable virtual network embedding for the collaborative edge

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computing in smart cities. We mathematically formulate the problem and derive the corresponding bound. Extensive simulations with real traces demonstrate the algorithm effectiveness.

Green Wi-Fi Implementation and Management in Dense Autonomous Environments for Smart Cities by Yaodong Zhang and Chunxiao Jiang.

Advanced informatics technologies facilitate the construction of green smart cities, especially the Wi-Fi implementation and management, for rapidly increasing personal Wi-Fi devices in autonomous environments residing in non-overlapped channels often result in low energy efficiency and severe co-channel interference. In this paper, a green Wi-Fi management framework is constructed in order to reduce the overall energy consumption through turning off a portion of access points (APs) and aggregating their users to the other active APs. A Tabu-search-assisted active AP selection algorithm is proposed to minimize the power consumption with seamless wireless converge. For the active APs, based on our defined metric airtime cost that is integrated by in-range interference and hidden terminal interference, a reinforcement learning aided AP self-management algorithm is proposed to dynamically adjust APs' channels in the partially overlapped channel (POC) space. Extensive simulations and field experiments demonstrate that the power consumption can be reduced by about 65% and the airtime cost of APs can be reduced by 50% compared with the typical least congestion channel search (LCCS) algorithm.

A design scheme of warehouse environment monitoring system, the solution uses the tiny4412 development board and as the main control platform, using DHT11 and DS18B20 sensors to monitor the temperature and humidity of the warehouse environment in real time, display the measured temperature through LCD1602 analyze and judge data, sound and light alarm and SMTP mail alarm are performed when the measured data exceeds the set threshold. Chunxiao Jiang used Wi-Fi wireless network to design the agricultural product storage monitoring system, which can realize the collection, display and alarm of temperature and humidity, designs a set of warehouse monitoring system for small and medium-sized enterprises. The system uses internet of thing technology, use tiny4412 development board based on CortexA9 and ST89C51 microcontroller, combine modern TCP/IP network communication protocol and HTTP network communication technology, combined with temperature and humidity sensor to collect data, able to monitor the warehouse environment with a smaller equipment volume.[1]

3. EXISTING SYSTEM

India, with more than 1.27 billion population, ensuring food security is very important. Grain production has been increasing steadily due to advanced production technology but improper infrastructure facilities and unfavorable environmental conditions result in storage losses of food grains. The environmental factors like temperature, moisture content, humidity, and light greatly influence the storage of food grains. Also, the factors like time and purpose of storage, type of storage, preventive insecticide treatments and storage practices account for the food storage losses. During storage, both qualitative and quantitative losses occur due to insect pests, mold growth, rodents, rats, fungi, micro-organisms and subsequent production of mycotoxins in storage. The occurrence and

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number of stored food insect pests are directly related to the climatic and geographical conditions. The safety of food storage is a significant issue concerning people's living quality and national economic development. In India, nearly 20% of food grains are going as waste due to storage losses. The food storage losses are accounted mainly due to the changing environmental conditions and improper infrastructure facilities. This paper proposes an integrated system to monitor and control the environmental factors like temperature, humidity and light illumination of food depots using wireless sensor networks. The food products chosen are Grains, Wheat, Rava and Maida flour. The ZigBee mesh networking technology is used to send the measured parameters from remote food depots and the LabVIEW software is used to monitor the environmental factors. The images of the food product are captured from remote end and checked for the right food product by image analysis. An automated aeration control strategy is employed to maintain the temperature and moisture content within the threshold limits for each of the food products, thus ensuring food security.

Clever cold storage and inventory tracking gadget ambitions to supply an IoT answer for cold Garage facilities which helps you to report monitor and maintain the situations in the Facility on a normal foundation. This facilitates us to reveal the essential parameters and adjust them while deviation occurs from their preset values. This especially enables from prevention of meals Decay. It right now sends an SMS textual content and an e-mail each time an anomaly is detected. Therefore retaining the item and maintaining regulatory compliance turns into clean. A cold garage Temperature tracking answer consists of thermostats and sensors that continuously measure the Temperature of a closed machine; it also captures records and sends them to a centralized platform via a community. This helps the logistics manager screen the cargo remotely and ensure the Renovation of the most desirable temperature

4. PROPOSED SYSTEM

The temperature & humidity sensor (DHT11) is used to sense the rise in temperature & is used to see the percentage of humidity present in the warehouse.

Detection of smoke, the gas sensor (MQ2) helps in detecting LPG & methane gas inside the warehouse. If smoke is detected in the ware house then this sensor will sense it and it will automatically turn on water pump and also turn on the alarm.

Sensor is there to count the number of people entering in the room. If person in the room then IR sensor will sense it. Also another IR sensor is placed there to perform same action but this will take action against the first IR sensor. This sensor is placed to count people who are leaving in the warehouse.

Sensing the data from the sensors, the data will be displayed on the LCD display and for the controlling action the relay is used which will take actions against the sensors.

This paper provides knowledge on radio frequency identification (RFID) technology, where RFID reads the unique code of RFID tags and transmit it to the Arduino. Then after with the use of that code Arduino will send the command to DC motor. If the code is valid then the DC motor is turned 'ON' and at the same time it opens the door lock.

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and

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an adjustable sensitivity though a potentiometer.

5. BLOCK DIAGRAM

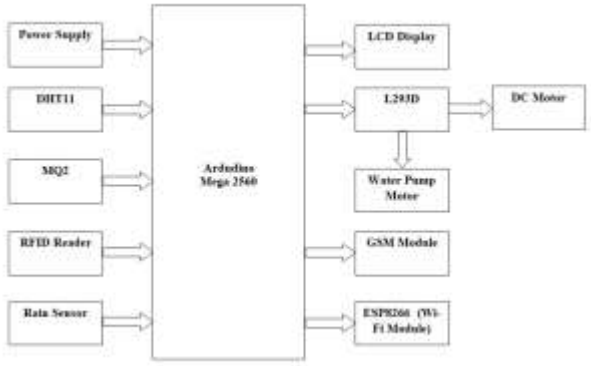

Fig.5.1 Block diagram

The main objective of the proposed system is to provide an IoT based warehouse monitoring system. An IoT-based system is proposed to enhance the features. The system also monitors the variation in the limit set for the sensors. The system is divided into three parts:

The sensor network comprises of three sensors: DHT 11 sensor, MQ 2 sensor. The DHT 11 measures both humidity and temperature. It has a humidity sensing component and a thermistor. It will continuously monitor the temperature and humidity conditions where the food is stored. A threshold is set for the same. The humidity sensing component has two electrodes with moisture holding substrate between them. The resistance between the electrodes changes as there is variation in the humidity. Similarly for the temperature, the thermistor is used which is a variable resistor whose value basically varies with the change in temperature. The MQ 2 sensor detects the gases which come from the food when it is rotten. The conductivity of the sensitive material present in the MQ 2 is lower in clean air. As the concentration of ethanol gases increases, its conductivity increases. When the target explosive gases exist, the sensor's conductivity increases more and more with the increase in the concentration of the gases.

Shows the experimental setup of our work, we aimed at reducing the cost of display controllers in a mobile device. It is commonly targeted at LCD and similar display technologies. It defines a serial bus and a communication protocol between the host and the device .

6. HARDWARE COMPONENTS

6.1 ARDUINO MEGA 2560:

The Arduino Mega 2560 is a broadly utilized open-source microcontroller board dependent on the Microchip ATmega328P microcontroller and created by Arduino.cc. The board is outfitted with sets of advanced and simple info/yield (I/O) sticks that might be interfaced to different extension sheets (shields) and different circuits. The board highlights 14 digital pins and 6 analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) by means of a kind Type-B USB cable. [4] It can be controlled by a USB link or by an outer 9 volt battery; however it acknowledges voltages somewhere in the range of 7 and 20 volts. It is additionally like the Arduino Nano and Leonardo. The equipment reference configuration is dispersed under a Creative Commons Attribution Share-Alike 2.5 permit and is accessible on the Arduino site. Format and generation records for certain variants of the equipment are additionally accessible. "Uno" signifies one in Italian and was picked to check the arrival of Arduino Software (IDE) 1.0 The Uno board and form 1.0 of Arduino Software (IDE) were the reference variants of Arduino, presently

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developed to more current discharges The Uno board is the first in a progression of USB Arduino sheets, and the reference model for the Arduino stage. The ATmega328 on the Arduino Uno comes prearranged with a bootloader that enables transferring new code to it without the utilization of an outside equipment software engineer. It conveys utilizing the first STK500 convention. The Uno additionally varies from every first board in that it doesn't utilize the FTDI USB-to-sequential driver chip. Rather, it includes the Atmega16U2 (Atmega8U2 up to adaptation R2) customized as a USB-to-sequential converter.

Background

6.2 LCD (LIQUID CRISTAL DISPLAY)

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

6.3 DTH11

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc… Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

6.4 MQ2 GAS SENSOR

Sensors are the electronic devices used for interaction with the outer environment. There are various types of sensors available that can detect light, noise, smoke, proximity etc… With the advent in technology, these are available as both analog and digital forms. Besides forming a communication with the outer environment, sensors are also a crucial part of safety systems. Fire sensors are used to detect the fire and take appropriate precautions on time. For smooth functioning of control systems and sensitive

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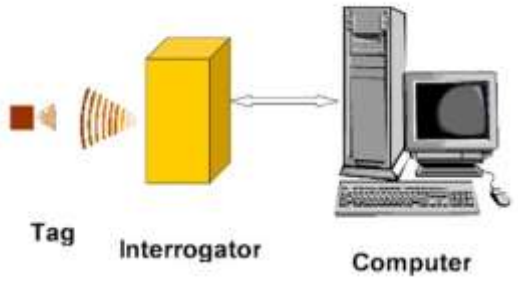
electronics, humidity sensors are used for maintaining humidity in the unit. One of such sensor used in safety systems to detect harmful gases is MQ2 Gas sensor.

6.5 RFID READER

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. Chip less RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at a lower cost than traditional tags.



6.6 (IR) INFRARED TECHNOLOGY

Technically known as "infrared radiation", infrared light is part of the electromagnetic spectrum located just below the red portion of normal visible light – the opposite end to ultraviolet. Although invisible, infrared follows the same principles as regular light and can be reflected or pass through transparent objects, such as glass. Infrared remote controls use this invisible light as a form of communications between themselves and home theater equipment, all of which have infrared receivers positioned on the front. Essentially, each time you press a button on a remote, a small infrared diode at the front of the remote beams out pulses of light at high speed to all of your equipment. When the equipment recognizes the signal as its own, it responds to the command.

6.7 Wi-Fi MODULE (ESP8266)

ESP8266 was designed by the Chinese company Espressif Systems for uses in Internet of Things (IoT) systems. ESP8266 is a complete Wi-Fi system on chip that incorporates a 32-bit processor, some RAM and depending on the vendor between 512KB and 4MB of flash memory. This allows the chip to either function as a wireless adapter that can extend other systems with Wi-Fi functionality, or as a standalone unit that can by itself execute simple applications. Depending on the specific module variant (ESP-1 to ESP-12 at the time of this thesis) between 0 and 7 General Purpose Input/Output (GPIO) pins are available, in addition to Rx and Tx pins of the UART, making the module very suitable for IoT applications. The Software Development Kit (SDK) provided by Espressif systems contains a lightweight implementation of a TCP/IP control stack (lwIP) for Wi-Fi communication. The modules houses libraries for optional services such as Dynamic Host Configuration Protocol (DHCP), Domain Name System (DNS), and JavaScript Object Notation (JSON) and Secure Socket Layer (SSL) libraries for Application Level programming. It incorporates 802.11 MAC extensions such as 802.11b/g/n/d/e/h/i/k/r that manage signal transmission, encapsulation, encryption, collision management and roaming functionality. The

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chip generally comes as part of a module, soldered to a Printed Circuit Board (PCB), however it is possible to purchase only the chip itself in order to create a truly custom module. The module variants currently available on the market may include an antenna (PCB or ceramic) or a U-FL connector, a hardware component for serial communication and a myriad of other auxiliary components such as resistors, capacitors and LEDs.

6.8 GSM MODULE

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

6.9 L293, L293D (QUADRUPLE HALF H-DRIVERS)

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

6.10 DC MOTOR

DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearin motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source -- so they are not purely DC machines in a strict sense.

7. CONCLUSION

In this paper, we have successfully interfaced with various sensors such as MQ2, DHT 11 sensor with arudino mega2560 to monitor and control the environmental conditions in warehouses to prevent decaying and rotting of food items mainly wheat, rice and maize. The system also supported by buzzer as an alarm system which will activate as soon as the threshold value of the sensor crosses a specific value. Data is sent to the ThingSpeak server. The user can get updates related to food grains through ThingSpeak. A login page is implemented for secure access to the database. The system is helpful to monitor the various parameters of the warehouse and also it will inform the Warehouse Corporation by uploading the data on the cloud computing server (ThingSpeak) using IoT.

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