COLD STORAGE MONITORING SYSTEM

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Abstract - *In recent years, wireless sensor network (WSN) is increasingly applied in the field of environmental monitoring due to its promising capability. Focused on the monitoring of cold storage, this paper constructed a wireless sensor network based on Cloud Storage protocol. The design scheme of sensor node and sink node were described in detail. Cloud Storage technology was considered as the core of information processing and wireless nodes detection. Through sink node as well as integrating wireless mobile network (CDMA), acquired data was sent to database server on control center. Experiment results show that the working performance of the system is quite stable and can reach the design requirements in real-time data acquisition and remote control. Furthermore, the system has the characteristics of good expansibility, networking flexibility and low cost. The design gives a new way to collect the data of environment instead of the traditional way using wires or manually. This work describes a monitoring system for cold storages that includes: temperature, relative humidity, electric power and the state of the access door. It is compliant with ISO 12830 Class 1: capable of measuring temperature from –20 to 60°C and humidity up to 100%RH. This system is a complete monitoring, logging and alarm generation solution whose capability was tested in real life applications.*

Keywords: *Cold storage, Internet of Things,*

I. INTRODUCTION

We are familiar with the word Cold storage; it is used to preserve something for a longer period of time, just like Refrigerators. Cold Storage is usually use to keep things like food products, agricultural products, Pharmacies, etc. It has been the most effective and the best way to transport products from one place to another until lately when the news has been spreading of products getting spoiled on the way because when it is on its way to somewhere no one knows of the temperature inside the cold storage or even in some cases, no one knows if the product inside it requires a lesser temperature or anything like that.

Basically, when the product is on its way to somewhere we cannot handle it, and it has been a major concern now. We had the opportunity to talk to Shree Vinayaka foods Karanja MIDC for the problem facing to monitor the cold storage online and to give the alert message on mobile for some errors like high temp and power failure

So we decided to work on it. A cold storage system based on IOT, where one can accesses the temperature of the Cold storage from anywhere, anytime. Also, our product will give an alert message if anything goes wrong The modern-day scenario of the global cold chain pharmaceutical industry has called upon the cold chain logistics as the need of the hour. The cold storage requiring industry is being crippled with challenges like increased product volume and sensitivity, ever growing regulations and controlled environment monitoring.

We aim to reduce the extent of human presence all along the cold storage by means of a powerful tool in the form of the Internet of Things (IOT).

II. LITERATURE REVIEW

An IOT-based cargo monitoring system for enhancing operational effectiveness under a cold chain environment

Differing from managing a general supply chain, handling environmentally sensitive products (ESPs) requires the use of specific refrigeration systems to control the designated range of storage conditions, such as temperature, humidity, and lighting level in a cold chain environment. In general, third party logistics (3PL) companies are authorized to handle ESPs, who therefore need to have a good cargo monitoring system in the cold chain environment, without which the functional quality is difficult to control and manage. This may result in product deterioration and even inventory obsolescence of the ESPs due to the lack of such systems, so there is a need to develop an effective cargo monitoring system to prevent such situations.

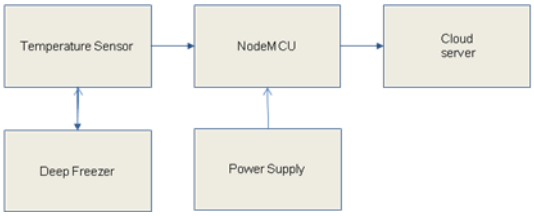
This article proposes an Internet of Things-based cargo monitoring system (IOT-CMS) to monitor any environmental changes of ESPs in order to ensure their functional quality throughout the entire cold chain operational environment. Operational efficiency, maintenance strategy, environmental change, and electricity consumption are considered in real-life cold chain operations. Through applying (i) a wireless sensor network to collect real-time product information, together with (ii) fuzzy logic and case-based reasoning techniques to suggest appropriate storage conditions for various ESPs, effective storage guidance can be established. Through

conducting the case study in a 3PL company in Hong Kong, the performance in customer satisfaction, obsolescence rate, and inventory visibility after adoption of IOTCMS is evaluated. It is found that the functional quality of ESPs can be effectively assured, and the overall customer satisfaction is increased.

III. SYSTEM OVERVIEW

In this proposal we implement a framework for cold storage management system based on IOT (Internet of Things) technology by using heterogeneous IOT devices. This is used to preserve the various parameters of yield such as (degeneration time, temperature parameter, etc.) for longer period.

This information system also analyzes the data to report abnormal environmental status and jeopardizes during the storing process. So, the cold storage management systems can be innovative and operated with low cost and in short time interval, hence enhancing the monitoring obtain ability all through the year.



The PT100 Thermocouple is Industrial Temperature sensor we are using for this project the sensor is programmed in Node MCU to get the temperature of the deep freezer the data will store on cloud server to monitor w.r.t date and time as well as in the form of graph

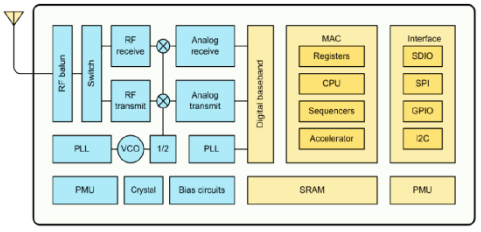
When the temperature goes above the set value then SMS will send to the respective contact person with GPS location of vehicle

IV. HARDWARE IMPLEMENTATION

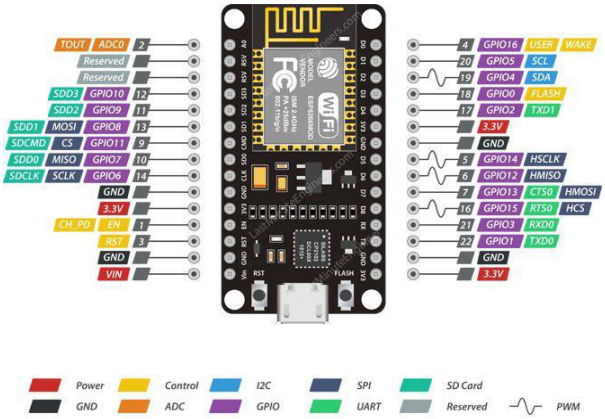
This section describes the hardware of the system. It includes Node MCU ESP8266, Temperature sensor DS1820 and Ni CAD Battery.

1. Node MCU

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. Figure 1 ESP8266EX Block Diagram ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to offload WiFi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a WiFi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area. ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the WiFi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK).



Pin Configuration



For the sake of simplicity, we will make groups of pins with similar functionalities.

Power Pins There are four power pins viz. one VIN pin & three 3.3V pins. The VIN pin can be used to

directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source. The 3.3V pins are the output of an on-board voltage regulator. These pins can be used to supply power to external components.

GND is a ground pin of ESP8266 NodeMCU development board.

I2C Pins are used to hook up all sorts of I2C sensors and peripherals in your project. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins ESP8266 NodeMCU has 17 GPIO pins which can be assigned to various functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

ADC Channel The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC viz. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

UART Pins ESP8266 NodeMCU has 2 UART interfaces, i.e. UART0 and UART1, which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. It supports fluid control. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

SPI Pins ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

- 4 timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

SDIO Pins ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

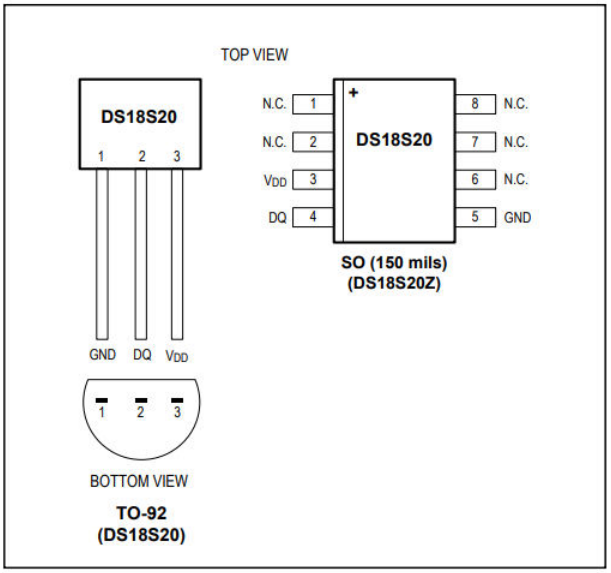
PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 µs to 10000 µs, i.e., between 100 Hz and 1 kHz.

Control Pins are used to control ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

- EN pin – The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
- RST pin – RST pin is used to reset the ESP8266 chip.
- WAKE pin – Wake pin is used to wake the chip from deep-sleep.

2. DS1820

The DS18S20 digital thermometer provides 9-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18S20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18S20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18S20 has a unique 64-bit serial code, which allows multiple DS18S20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18S20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.



3. Ni CAD Battery

A battery is an electrochemical device that produces a voltage potential when placing metals of different affinities into an acid solution (electrolyte). The open circuit voltage)

that develops as part of an electrochemical reaction varies with the metals and electrolyte used.

Applying a charge or discharge places the battery into the closed circuit voltage (CCV) condition. Charging raises the voltage and discharging lowers it, simulating a rubber band effect. The voltage behavior under a load and charge is governed by the current flow and the internal battery resistance. A low resistance produces low fluctuation under load or charge; a high resistance causes the voltage to swing excessively. Charging and discharging agitates the battery; full voltage stabilization takes up to 24 hours. Temperature also plays a role; a cold temperature lowers the voltage and heat raises it.

V. SOFTWARE IMPLEMENTATION

Downloading Arduino IDE

First download the Arduino IDE to ensure that you have the latest software version (some older versions won't work), visit the following URL: https://www.arduino.cc/en/Main/Software.

The CH340G is a cheap serial to USB programming chip and does not come with native windows or mac drivers. However it has been made very easy to install.

Download and install the drivers through the wemos website: https://www.wemos.cc/product/d1-mini.html

Install driver and search in Device Manager that COM port is detected after connecting NodeMCU

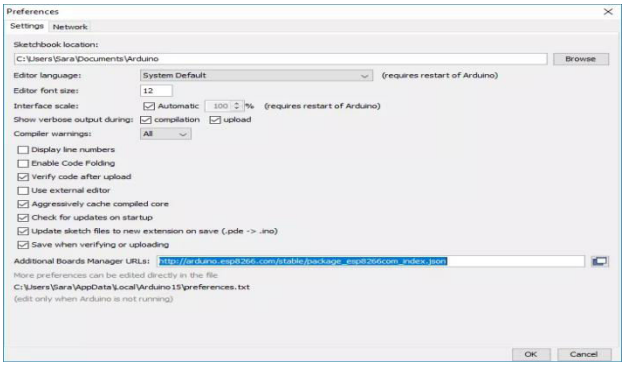
Installing the NodeMCU ESP8266 Board

To install the board in your Arduino IDE, follow these next instructions:

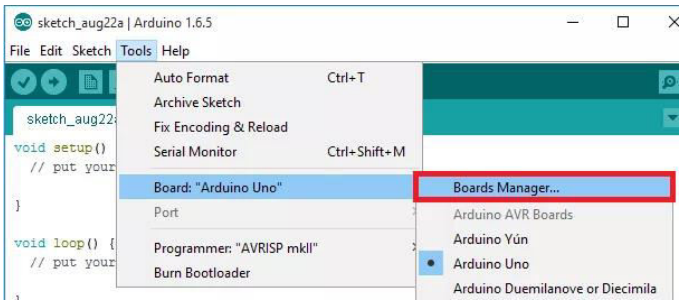
1) Open the preferences window from the Arduino IDE. Go to File > Preferences

2)Enter http://arduino.esp8266.com/stable/package_esp8266com_index.json

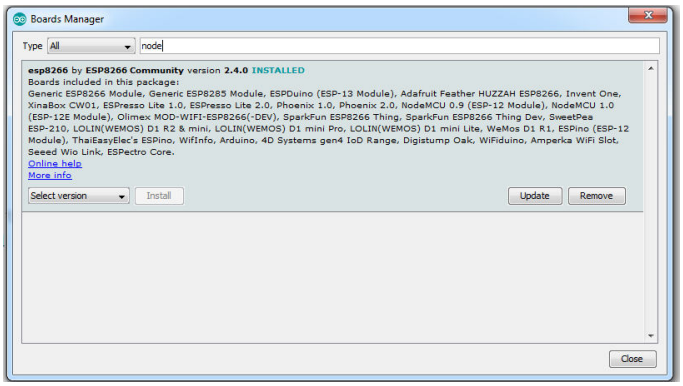
into the "Additional Board Manager URLs" field as shown in the figure below. Then, click the "OK" button.



Open board's manager. Go to Tools > Board > Boards Manager



Type Node MCU in box and select it and Install



Wait till Finish the installation then close the IDE and restart PC

Connecting of Node MCU to Cloud Server

Cloud server

Cloud storage is a model of computer data storage in which the digital data is stored in logical pools. The physical storage spans multiple servers (sometimes in multiple locations), and the physical environment is typically owned and managed by a hosting company. These cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running. People and organizations buy or lease storage

capacity from the providers to store user, organization, or application data.

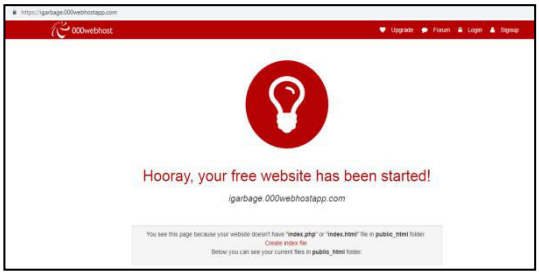
Cloud storage services may be accessed through a colocated cloud computing service, a web service application programming interface (API) or by applications that utilize the API, such as cloud desktop storage, a cloud storage gateway or Web-based content management systems.

Cloud storage is based on highly virtualized infrastructure and is like broader cloud computing in terms of accessible interfaces, near-instant elasticity and scalability, multi-tenancy, and metered resources. Cloud storage services can be utilized from an off-premises service (Amazon S3) or deployed on-premises (ViON Capacity Services).[5]

Cloud storage typically refers to a hosted object storage service, but the term has broadened to include other types of data storage that are now available as a service, like block storage.

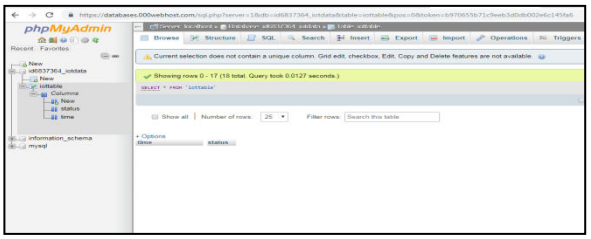
Object storage services like Amazon S3, Oracle Cloud Storage and Microsoft Azure Storage, object storage software like Open stack Swift, object storage systems like EMC Atmos, EMC ECS and Hitachi Content Platform, and distributed storage research projects like Ocean Store and VISION Cloud are all examples of storage that can be hosted and deployed with cloud storage characteristics

For our project we use 000webhost.com as free web cloud server

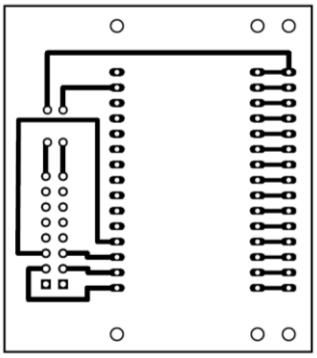


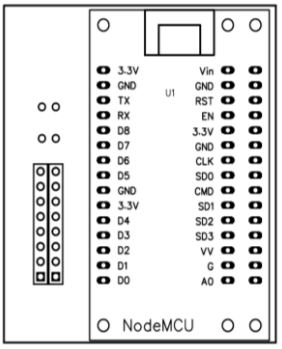
PhpMyadmin : to create the database and tables we are using phpMyadmin

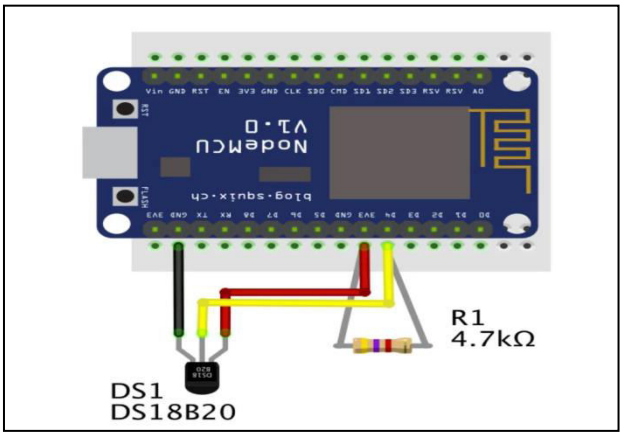
The Table and the column

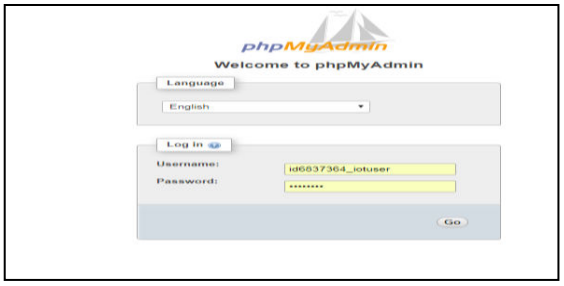


PCB Designing









Working of Project

Features

- Configurable SMS string
- Alert to multiple mobile numbers
- Continuous data store in memory
- Low power consumption

Specification

- Power supply: 9-30V DC or 230V AC power adapter
- GSM Modem frequency: 850/900/1800/1900MHz Quad band
- Indication : Three LED for Power, Network and Communication
- Maximum mobile number per alert: up to 10 nos.
- Temperature Sensor type : PT-100

Working

- The DS18B20 is Industrial Temperature sensor we are using for this project
- The sensor is programmed in Node MCU to get the temperature of the deep freezer
- The data will store on cloud server to monitor w.r.t date and time as well as in the form of graph
- When the temperature goes above the set value then SMS will send to the respective contact person
- Temperature is monitored and send to the cloud server MySQL database.
- Owner / user can monitor the temperature w.r.t time in the form of table as well as graph.
- If the temperature is not in the set limit then SMS will send to the owner as well as its entry will update on cloud server w.r.t. Time.

VI. CONCLUSION

It is significant to effectively manage the stored fruit in cold storage using electronic and information technology. In this paper, the design and implementation of a novel scheme for environment monitoring system is introduced based on wireless sensor network. Compared with the traditional method, the advantages of the system can be summarized as follows.

- The data can be acquired automatically, which promote the management efficiency greatly.
- The data can be stored.
- Communication function of the system provides the storage manager remote control ability.

The system mainly consists of monitoring nodes, router nodes, the control Centre node and the Management Centre (PC), web service. The warehouses or cold storages fresh food areas generally are divided into several small scale units, which are close to each other. Monitoring nodes consisting of sensors are the leaf nodes of the network, mainly responsible to collect data such as light, temperature, humidity and other environmental factors that help prevent foodstuffs and food grains from perishing or decaying.

All these nodes pass vital environmental information obtained from different sensors to a Central node via wireless communication. The Central node is responsible for passing the information to Management node. The Central node is replicated using Android application based cell phone and the Management node is replicated using Laptop, which makes it perfect client-server architecture.

FUTURE SCOPE

Going further, most of the units can be embedded within the controller such as android application, with change in technology thereby improving the detection system.

Can be implemented in Real time environmental conditions within cold storage, hence life of food products is extended for a longer period Can be made Easy accessibility for the cold storage using IOT and All the information are stored in database using MY SQL.

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