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IoT Based Smart Farming Monitoring System for Bolting Reduction in Onion Farms

Khatal Om Pradip, Kadlag Ayush Rajendra, Yewale Ashish Dattatraya
Arote Akash Dnyaneshwar, Prof. Kulkarni B. L.
Department of Electronics & Tele-Communication Engineering
Amrutvahini Polytechnic, Sangamner, India

Abstract: *Commercial commodities like onion, tomatoes, potatoes are very essential for our day-to-day life and living. India ranks second in onion production in the world, which acquires 6% of the market share in the total production of vegetables in India. Onions are the important spice commodities consumed in India almost everyday in every house. Unlike other vegetables, their requirement is daily essential in the kitchen, and therefore, availability in the market at reasonable prices for both producers as well consumers is highly essential. However, they are harvested twice or thrice a year. Unless stored for some time, daily supply, irrespective of the season is not possible. Therefore, storage of onion becomes more important for regular supply to consumers. But the stored onions in onion sheds are exposed to the hot, cold, and humid air. Due to continuous change in climate onions can rot easily. Once the rotting process is initiated it grows drastically and rapidly resulting in unexpected losses of up to 15% of the total production or more. So to avoid this we propose a hygiene monitoring and reporting system using IoT. Internet of Things plays a vital role in smart agriculture monitoring system. Smart farming is an emerging concept, because IoT sensors are capable of providing information about their fields. This system includes electronic circuitry which has been designed and developed to monitor and report. Gas sensors are used to sense the emitted gases. The main purpose of paper is to propose a grid system onion storage methodology which will help to reduce onion degradation due to temperature and humidity. When the onion starts rotting developed system informs the owner and provides a three-way alert which includes alarm, display, and SMS. Inbuilt wireless IoT transmission system enables preserving the record for analysis in the cloud*

Keywords: IoT

I. INTRODUCTION

The Internet of Things (IoT) is a computing concept that describes the idea of everyday physical objects being connected to the internet and being able to identify themselves to other devices. Internet of Things focuses on connection of different sensors to physical object and transmits information to internet.

It has a significant role in the field of agriculture in terms of control and protection, providing real time information and communicating with the physical world. Onion storage methodology to reduce its degradation. Focuses on studying various monitoring systems that have been designed and implemented in the field of agriculture. Internet of Things plays an important role in smart agriculture monitoring system.

Smart farming is an emerging concept, because IoT sensors are capable of providing information about their fields. The main feature is monitoring temperature and humidity in agricultural field. This monitoring is done by using sensors and sending the message to the farmer. The main purpose is to propose a grid system onion storage methodology which will help to reduce onion degradation due to temperature and humidity. If in the storage of Onions, one of the onions starts degradation then this system will send the message to the farmer. This will help to improve yield better quality onion and save the farmers from the major economic loss.

India is the second most populated country of world after china Population of India is 1.37 billions. Onion is one of the biggest vegetable crops in India. India is the Second Largest Producer of Onion in the World. Onion is one of the most important commercial crops of India. In India, onion crop is grown in above 1.20 millions hector area with an animal production 19.14 million tons with productivity 16.12 tons per hectors. By considering survey, we observed 60 to 75

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percent onions are get wasted from total production. These are big loss to our farmer and our nations. To overcome from this problem and save the money of our farmers and nation, we are working on this project.

1.1 Problem Definition

Onion is one of the most important commercial crops of India. In India, onion crop is grown in above 1.20 millions hector area with an animal production 19.14 million tons with productivity 16.12 tons per hectors. By considering survey, we observed 60 to 75 percent onions are get wasted from total production. These are big loss to our farmer and our nations. Our project would to help monitor and determine the condition of onion. By using smell sensor we will try to find how much onion are rotted in storage. By placing the sensoron the shed by considering their range. System will send collected data through sensor to the farmer by using message and by checking they easily get notification about how many onion are rotten in storage

1.2 Objectives

- To designed an onion preservation system, which preserves an onion in a prescribed manner.
- To monitor temperature & humidity in this system the temperature & humidity sensors are use respectively.
- To make the system smarter and more efficient by making use of Internet of things (IoT).
- To eliminate the shortfalls in the existing onion inventory monitoring system and methods, one must design and improve a more efficient and effective system and device to monitor onion warehouses

II. LITERATURE SURVEY

Vinit Kumar Gunjan explained Wireless System for Onion Storage condition Detection and reporting using Temperature sensor and GPS. In this paper, Gas sensor is used to detect the ammonia. In case of its presence, the system sends automated message to the preprogrammed number such as family member and even display the container temperature.

The slot of onion gets detected and is informed the same to the owner. The authors used both humidity and temperature sensor for capturing such incidents. Based on the situation detected during the humidity sensor gathers the information and sends to the micro controller. The suggested method provides optimum solution and time required for completing the overall process is very less. But the onion must be removed immediately by the farmer to avoid any further loss to his onion yield.

Designed an onion rotting prevention system based on the microcontroller. The webpage address and configuration file of the paired devices is stored in the ROM embedded in the microcontroller. With the help of method, emergency alerts can be send at the correct time. Depending upon the microcontroller and GSM module used, the accuracy of message to reach the farmer is based on whether the farmers device is connected to the GSM network or not.

Used the integrated system to provide the alert information about the incident through the GSM module and Webpage. Based on the gas sensor, it will alert the onion is starting to rot. The alert message is send to the registered user via through the wifi and the rack in which the onion is located is given to the user.

III. SYSTEM DESIGN

3.1 Block Diagram

Onion harvesting detection is done using Arduino, LM35 temperature sensor, humidity sensor, gas sensor, and GSM module. The objectives of this quality of onion using Arduino is to sense the ammonia gas, temperature, and humidity with the help of the LM35 temperature sensor, gas sensor MQ 137, and send SMS alerts to mobile numbers stored inside the Arduino program, if onion quality is selected using global system for mobile communication (GSM). This paper introduces an advanced system that will help the user to control such parameters affecting positive feedback against different onion losses.

Shed net is used here because it improves the thermal behavior significantly decreasing the inside temperature. The system works on the principle of sensing emitted gases by onions and attempting to control them within the desired parameter range of temperature and so humidity and also gives an online record observation facility. In this novel methodology, a system is introduced, which is an IoT based food monitoring system.

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In this system, sensors related to food safety, like CO2, humidity, and nitrogen sensing elements are used, and IoT play an important role as it gives the alert to users at a remote location.

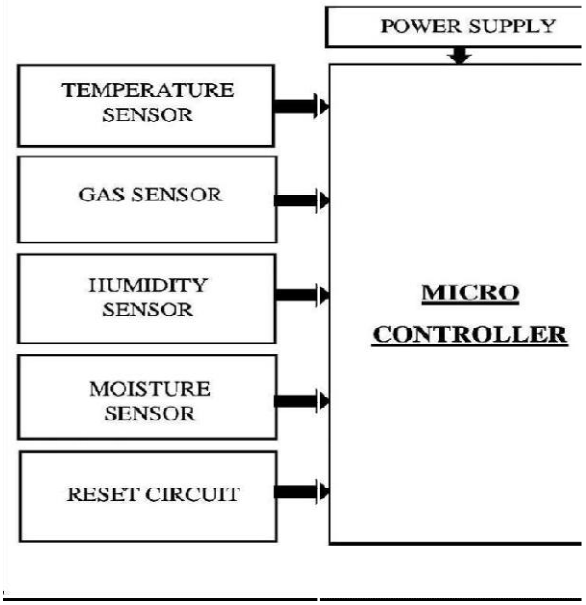

Fig.1 Block Diagram of System

3.2 Specification of Components

Microcontroller (PIC18F4520)

PIC18F4520 is a low-cost, low-power, high-speed 8-bit, fully-static Microcontroller unit that has 40 pins out of which 36 pins can be used as I/Opins. It has Power-on- Reset (POR) as well as the Extended Watchdog Timer (WDT) circuitry, which can be programmed for 4ms to 131s.

It is an 8-bit enhanced flash PIC microcontroller that comes with nano Watt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.

PIC18F4520 is a PIC microcontroller, introduced Microchip, and mainly used in automation and embedded systems. It comes in three packages known as PDIP, QFN, and TQFP where the first one is 40-pin (mostly used) while other two come with a 44-pin interfacePIC18F4520 also comes with 3 programmable external interrupts & 4 Interrupts-On-Change (IOC) pins, which are reliable features for interrupts related applications. Also, the system has a 13-channel 10-bit ADC converter module.

Features:

CPU Speed:	40MHz
Program Memory Size:	32KB
RAM Memory Size:	1.5KB
No. of Pins:	40Pins
MCU Case Style:	DIP
No. of I/O's:	36I/O's

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Fig 3.3.1(a): pic18f4520 microcontroller

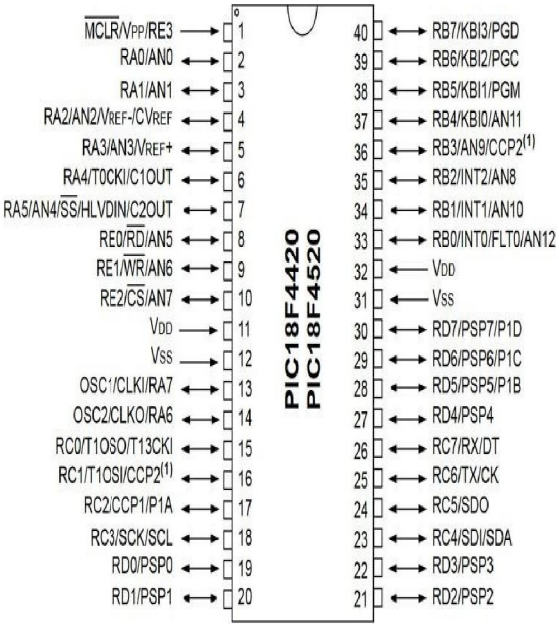

Fig 3.3.1(b): pin diagram of PIC18f4520

GSM Module :

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

IOT

"The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction."

Things are either sensors or actuators. A sensor is something that tells us about our environment. Think of a temperature sensor, or even the GPS receiver on your mobile phone. Actuators are something that you want to control, things like thermostats, lights, pumps, and outlets. The "Internet of Things" brings everything together and allows us to interact with our things. For example, you could have your thermostat control itself based on where you're located.

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Power Supply :

Design of Power supply :

All electronic circuits use DC power supply of adequate voltage for their operation. To obtain this DC voltage from 230V AC mains, we need to use a 'rectifier'. The rectified DC voltage is 'pulsating' in nature. We know that a combination of rectifier & filter can produce a dc voltage which is almost pure i.e. ripple free. However, the problem with such a power supply is that its output voltage will not remain constant in the event of fluctuations in ac input voltage or changes in load current. This type of power supply is called as unregulated power supply.

The power supply, which provides a constant output voltage irrespective of everything is called, regulated power supply. So we have to design a regulated power supply using series voltage regulator IC 7805.

Following figure shows general block diagram of regulated power supply.

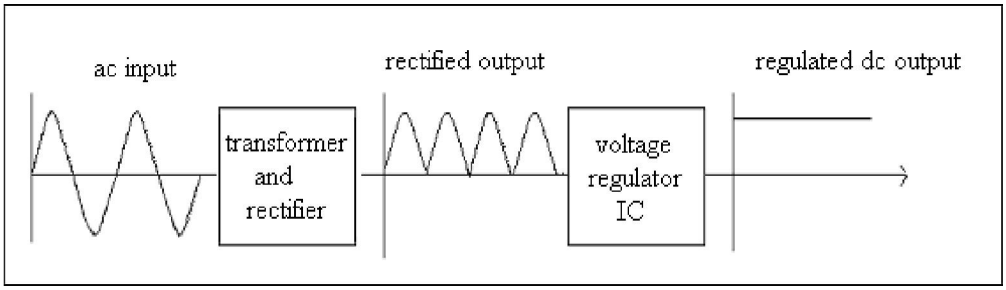
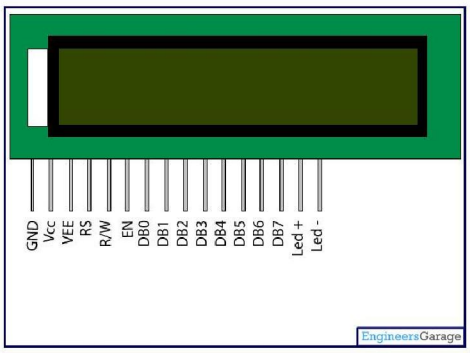


Fig 3.3.4: Power Supply

16*2 LCD Display



LCD (Liquid Crystal Display) screen is an electronic display module and find a widerange of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Relay Driver

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as shown in the diagram.

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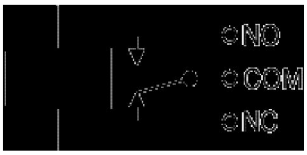

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.
The relay's switch connections are usually labelled COM, NC and NO:
COM = Common, always connect to this; it is the moving part of the switch.
NC = Normally Closed, COM is connected to this when the relay coil is off.
NO = Normally Open, COM is connected to this when the relay coil is on.

Piezoelectric Buzzer :

Features:
sealed: yes
operating power: 3-6V DC / 25mA
extremely compact, ultrathin construction
no electrical noise
low current consumption yet high sound pressure level

Specifications:
tone type: single
operating voltage: 3-6V DC
rated voltage: 5V DC
current consumption: 25mA
osc. frequency: 3.2kHz
sound level: 87dB
connector type: pcb
body color: gray
weight: 0.056oz

Moisture Sensor
This sensor measures the volumetric content of water inside the soil and gives us the moisture level as output. The sensor is equipped with both analog and digital output, so it can be used in both analog and digital mode. In this article, we are going to interface the sensor in both modes. So let's begin our tutorial on interfacing Arduino and Soil moisture sensor.

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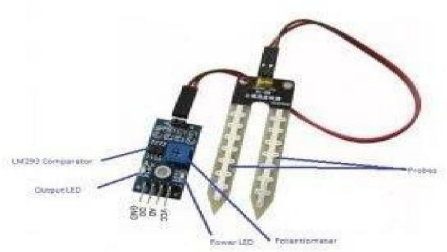
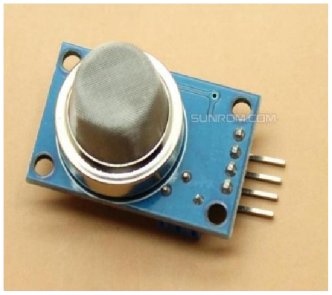


Specification:

The specifications of the soil moisture sensor FC-28 are as follows

Input Voltage	3.3 – 5V
Output Voltage	0 – 4.2V
Input Current	35mA
Output Signal	Both Analog and Digital

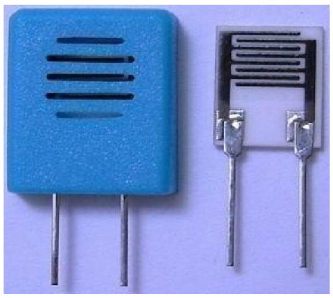
Gas Sensor



MQ-135 is an air quality or air pollution measuring sensor device. It can detect various chemical contents in air and give appropriate voltage variation at the output pin depending on the chemical concentration in air

It can detect the presence of ammonia(NH3),alcohol, Benzene, smoke, NH3, butane, propane etc. if anyone of the stated chemical concentration rises, the sensor convert the chemical concentration in air to appropriate voltage range, which can be processed by Arduino or any microcontroller. It cannot tell what kind of chemical concentration rose in the air.

Humidity Sensor



HR202 is a new kind of humidity-sensitive resistor made from organic macromolecule materials, it can be used in occasions like: hospitals, storage, workshop, textile industry, tobaccos, pharmaceutical field, meteorology, etc.

Features:

Excellent linearity, low power consumption, wide measurement range, quick response, anti-pollution, high stability, high performance-price ratio.

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Technical Specification:

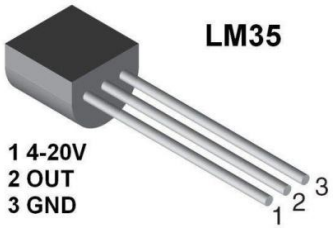
Operating range: humidity(20-95%RH) temperature(0-60Celsius)
Power supply: 1.5V AC(Max sine)
Operating frequency: 500Hz-2kHz
Rated power: 0.2mW(Max sine)
Central value: 31kΩ(at 25Celsius, 1kHz ,1V AC, 60%RH)
Impedance range: 19.8-50.2kΩ(at 25Celsius, 1kHz ,1V AC, 60%RH)
Accuracy: +-5%RH
Hysteresis: +-1%RH
Long-term stability: +-1%RH/year
Response time: <10s
Dimensions: with case 12*15*5mm, without case 8*10*0.7mm

Cautions:

Avoid polarization, driving voltage or current should be 100% alternative.
Please measure the sensor with LCR alternative-current bridge, don't use multimeter.
Avoid dew condensation.
Recommended storage conditions: temperature 0-60Celsius; humidity <80%RH

Temperature Sensor

LM35 is an analog, linear temperature sensor whose output voltage varies linearly with change in temperature. LM35 is three terminal linear temperature sensor from National semiconductors. It can measure temperature from-55 degree celsius to +150 degree celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 can be operated from a 5V supply and the stand by current is less than 60uA. The pin out of LM35 is shown in the figure below.



Features:

It has an output voltage that is proportional to the Celsius temperature.
The scale factor is .01V/**o**C or 1mV/C.
Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 oC temperature rise in still air.
The operating temperature range is from -55°C to 150°C
In this circuit, parameter values commonly used are:
Vc = 4 to 30v
5v or 12 v are typical values used.
R**a** = V**c** /10-**6**
Actually, it can range from 80 K**W** to 600 K**W** , but most just use 80 K**W**.

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IV. PROJECT PLAN

Week No	Date	Activity
1	24 JULY 2023 - 29 JULY 2023	Group Formation
2	31 JULY 2023 - 05 AUG 2022	Identification of Project Domain/Area
3	07 AUG 2023 – 12 AUG 2023	Project topic Search
4	14 AUG 2023 - 19 AUG 2023	Submission of Project Proposal
5	21 AUG 2023 - 26 AUG 2023	Discussion of project idea with project guide and HOD
6	28 AUG 2023 - 02 SEP 2023	Finalization of Project title from guide
7	04 SEP 2023 - 09 SEP 2023	Literature Survey of project
8	11 SEP 2023 - 16 SEP 2023	Problem Identification
9	18 SEP 2023 - 23 SEP 2023	Search the Specification
10	25 SEP2023 - 30 SEP 2023	Study and Design Block diagram of Project
11	02 OCT 2023 - 07 OCT 2023	Find out resource and consumable material required
12	09 OCT 2023 - 14 OCT 2023	Searching of Advantages and Disadvantages of Project
13	16 OCT 2023 - 21 OCT 2023	Prepare planning of project execution of next semester
14	23 OCT 2023- 28 OCT 2023	Starting and completion of report writing
15	30 OCT 2023 - 04 NOV 2023	Prepare Report as per Project Planning
16	30 OCT 2022- 11 NOV 2022	PPT Presentation to Guide and HOD

V. ADVANTAGES & APPLICATION

Advantages:

- Real-time Environmental Monitoring: Sensors can continuously monitor environmental factors such as temperature, humidity, light, and soil conditions. By collecting real-time data, farmers can make informed decisions about adjusting these conditions to prevent bolting. For instance, maintaining the optimal temperature can discourage bolting.
- Data Analytics and Predictive Modeling: The collected data can be analyzed to identify patterns and predict the likelihood of bolting.
- Alert message to mobile phone for remote information.
- Increased profit of famers.

Disadvantages:

- Costlier.
- Sending data not secure.
- This system is not applicable for poor network connection places.

Application:

- Automotive and transport vehicles.
- Security, remote monitoring and transportation and logistics.
- This system also can be interfaced with vehicle alerting system

VI. CONCLUSION & FUTURE SCOPE

Our product onion warehouse monitoring system is useful to store onions that long life which are under harvest and prevent the storage losses inside the warehouse. With the help of this system, onions can be preserved for up to 8 to 10 months preventing the onions get rottenstone onions which shows water contact, change in gas levels and temperature changes the system if found any set of onion about to rot it will alert the rotting problem to the onion to the owner. The owner after being intimated will check the segment number in which the onions are rotting and try to empty that set of onions first. So basically, this project helps to sell the near rotting batch of onions which helps the owner into loss by

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rotten onions. Compared to the traditional method of storing onions this onion warehouse monitoring will have less loss of onions. Hence by this method, the losses can be controlled to the maximum extent.

The other advantage of this product is it is used for analysis purposes the sensor values that is the gas levels and temperature, humidity values are being updated in the cloud (Thing speak) frequently. The owner can check the cloud for analysis purposes like in which year how much is the loss percentage. After analysis of losses, the owner can perform necessary advancements to the warehouse to prevent the losses which will be an added advantage to continuously update the method for more benefits to the owner and with minimized loss of onions.

Future Scope:

This system can be interfaced with automated machine that can separate the rotting onion from the container to prevent any further damage, immediately. This can also be developed by interconnecting a prosthetic arm to the controller module that can clasp the onion and remove it without any human intervention.

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