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Designing a Smart Onion Storage System to Reduce Degradation Using Arduino, Gas Sensors, and GSM Technology

Shedage D. N. [1], Kadam M. S. [2], Jadhav S. A.[3], Kumbhar N. N.[4]

[1, 2, 3, 4]Assistant Professors, Department of Electronics, Mudhoji College, Phaltan, Maharashtra, India

Abstract: ***In Proposed system we are analysing to design and implement the proposed post harvest onion storage methodology to reduce its degradation. In this project we are going to build a Onion Harvesting detection using Arduino, Gas sensor and GSM Module. onion storage methodology to reduce its degradation. Focuses on studying various monitoring systems that have been designed and implemented in the field of agriculture. GSM plays a important role in smart agriculture monitoring system. Smart farming is an emerging concept, because GSM sensors are capable of providing information about their fields. The main feature is monitoring damaged onion smell 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 by using the mobile phone for giving the sms.***

Keywords: GSM, methane gas sensor, Arduino UNO, mobile phone, embedded system

1. Introduction

Smart onions storage monitoring system is aimed to monitor and control onions storage and prevent it from damages occurring due to atmospheric or climatic changes. But in our project work, only monitoring operation is shown through GSM technology. The monitoring system capable of measuring methane gas and other parameters variability during transport and storage is of prime importance. This system makes use of storage units implanted with various electronic sensors which can read those parameters affecting onions storage. Design of Control circuits so as to tackle the problem of undesirable condition of onions storage is the important part of this idea.

First of all, There is a greater need than ever for creative ways to maximize crop productivity and quality in the quickly changing agricultural world of today. Keeping an eye on the environment and protecting crops from any hazards are two of the many problems that farmers must overcome. Acknowledging the importance of tackling these issues, our group presents a cutting - edge remedy: the Onion Monitoring System. Modern technology, such as the Arduino microcontroller, GSM (Global System for Mobile Communications) module, and MQ2 sensor, is integrated into the core of our system. These elements have been combined to create a thorough monitoring system that is especially suited to the particular requirements of onion farming. Giving farmers real - time insights into important environmental indicators is the main goal of the Onion Monitoring System.

The device is built on Arduino UNO which is a popular prototyping board. The Arduino board is interfaced with various sensors like MQ2 to detect methane gas content. The GSM Wi - Fi Modem is interfaced with the Arduino to connect it to the internet via Wi - Fi router. The sensor data is also displayed on amobile phone interfaced with the Arduino UNO.

It has always been a great issue solving the problems of segregating the good product from the contaminated ones. MQ2 sensor helps in intimating the user even about the percentage of freshness of the onions. The device detects these gases in ppm using MQ2 and compares it with the resistance of the air and makes a consolidated result of the percentage of freshness of the onions.

2. Literature Survey

Spurthi D et al. research describes The Early Detection of Onion Spoilage during Storage and Transportation demonstrates the use of AI and IOT technology for monitoring Onions [1].

Mokshi Vyas et al. Research describes the grid system onion storage methodology which will help to reduce onion degradation due to temperature and humidity [2].

S. Veenadhari et al. research describes The present study demonstrated the potential use of data mining techniques in predicting in crop yield based on the climatic input parameters [3].

The present study demonstrated the potential use of data mining techniques in predicting the crop yield based on the climatic input parameters.

Nishit Jain et al. research describes the great help in predicting crop sequences as well as maximizing yield rates and monetary benefits to the farmers [4].

Igor Oliveira et al. research describes a machine learning system that provides pre - seasons yield forcasting, meaning farmers can make farm management decisions before seeding occurs [5].

R. Nageswara Rao et al. research describe, A Raspberry Pi based automatic irrigation IOT system is proposed to modernization and improves productivity of the crop by

implementing of Precision Agriculture (PA) with cloud computing, that will optimize the usage of water fertilizers while maximizing the yield of the crops [6].

Syed Musthak Ahmed et al. research describes the benefits of implementing the IoT - based monitoring system in onion warehouses to control losses and improve efficiency in onion storage practices [8].

Zahid khan et al. research describes the IoT - based smart farming monitoring system (SFMS) to reduce bolting in onion crops. The SFMS uses sensors to monitor environmental factors in both open and greenhouse environments [9].

Vinay S et al. research describes, This system can control the temperature inside the cell required for the onion preservation by using Peltier tiles. According to the quantity of onion, this system can be easily modified and implemented [10].

Malgorzata Labanska et al. research describes, The Electronic nose technology is constantly expanding, offering robust sensors with improved pattern recognition methods, and therefore it has great potential as a portable device for rapid, non - destructive monitoring of post - harvest crops' health status [12].

Hardware

The project under taken consists microcontroller to which whether monitoring system in interfaced. The entire hardware developed presented in the beginning in the form block diagram and further described under the handling circuit description. The system consist of Arduino Uno, Power supply, Gas sensor MQ - 2 and GSM module.

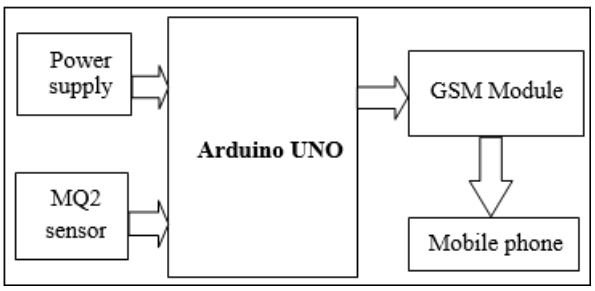


Figure 1: Block diagram of system

The following circuit diagram shows all the necessary connections required to implement this

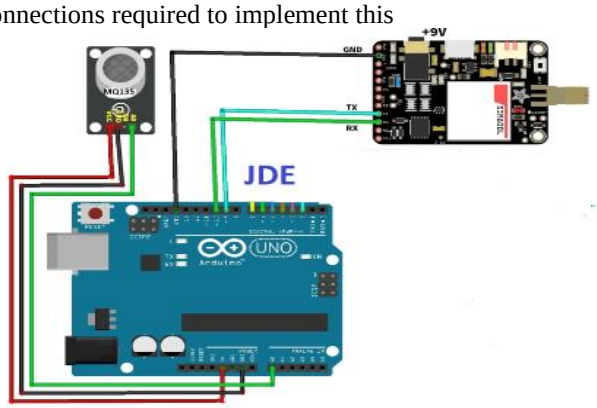


Figure 2: Prototype diagram

Arduino UNO:

Arduino Uno is a low - cost, flexible, and easy - to - use programmable open - source microcontroller board that can be integrated a variety of electronic projects.

The Arduino Uno is an open - source microcontroller board based on the microchip Atmega 328p microcontroller and developed by Arduino. cc. The board is equipped with sets of digital and analog input/ output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins, 6 analog I/O pins, and is programmable with the Arduino IDE, via a type B USB cable. It can be powered by the USB cable or by an external 9 - volt battery, through it accepts voltage between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a creative commons Attribution share - alike. The word "UNO" means "one " in Italian and was chosen to mark the initial release of Arduino software. The Uno board is the first in a series of USB - based Arduino boards The Atmega328 on the board comes programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

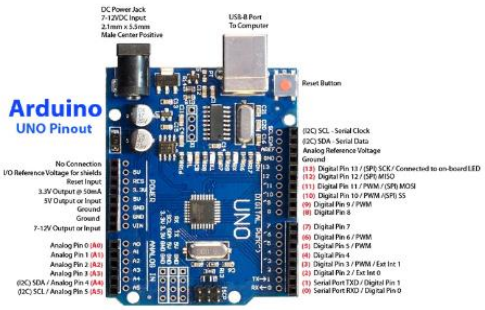


Figure 8: Arduino Uno pin diagram

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 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. MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide. MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

Figure 4: MQ2 gas sensor

GSM Module:
SIM900A RS232 for PC or TTL microcontroller interface with DTMF active feature. The GSM/GPRS Cellular Module for Microcontroller/ Embedded Systems/ Home automation is complete in all respect ready to plug - in interface for your microcontroller (Arduino, Raspberry pi, Atmega, PIC, Basic Stamp, 8051, AVR etc) with an SIM900A GSM/GPRS cellular module. This allows you to easily add SMS, GSM/GPRS, and TCP/IP functionalities to your microcontroller based project. Dual Mode functionality - connect with RS232 serial port for direct PC interface or through TTL I/O interface for microcontroller based autonomous projects.

All you need to add cellular functionality to your project is a SIM card (pre - paid or straight from your phone) and you can start sending Serial messages to make calls, send texts and serve web pages!

GSM/GPRS module is a breakout board and system of SIM900 Quad - band GSM/GPRS module. It can communicate with controllers via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Command

In order to adjust the sensitivity of this sensor for the particular type of gas, you need to keep this sensor in the particular gas type you want to detect. Now we have to rotate the potentiometer on the sensor.

Rotate it till the Red LED on the sensor gets ON. If we have to increase the sensitivity, rotate it clockwise, and if we have to decrease the sensitivity we have to rotate it anticlockwise.

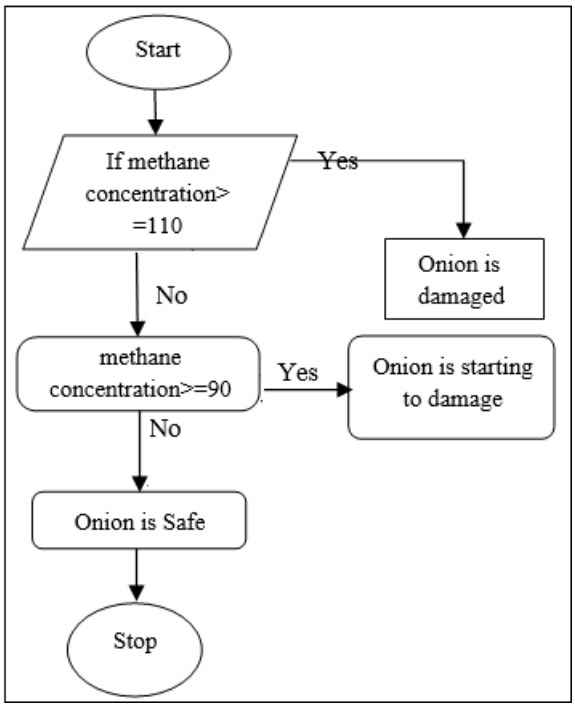
When we are rotating this potentiometer basically we are adjusting the threshold value of the sensor. The comparator on this board is constantly checking the threshold value.

Once this threshold gets crossed the digital pin goes high and the LED will turn on. In this way calibrate your sensor, it may take some time but once you calibrate it, it will give you accurate readings.

Figure 5: GSM Module

Software
The system utilizes a communication module, such as the GSM Wi - Fi module, to establish connectivity and transmit data between the sensors, image processing unit, and alert generation system. A user interface is designed to provide farmers with real - time information about the health status of onion stocks. This interface may display sensor readings, image analysis results, and alert notifications in a user - friendly format. The system uses GSM module, to monitoring and analyze data collected from the sensors.

Flow chart:



3. Working

The Early Detection of Onion Spoilage Utilizing GSM during storage and transportation is a step taken to control the spoilage of onions, seamlessly integrating hardware components and powerful machine learning algorithms. The sensors of this system, which include MQ - 2, continually collect real - time data necessary for monitoring the health of onions. The GSM uses this data to power a decision - making mechanism that carefully examines sensor inputs. Its main objective is to reduce the loss in spoilage and early detection of sprouting and rotting of onions. With the use of sensor inputs and image visualization GSM processes its data and sends it to the server which compares the data with given threshold values and alerts farmers to segregate the onions from spoilage, sprouting, or rotting of onions.

The project involves creating a system that continuously monitors the environment for gas leaks using an MQ2 gas sensor interfaced with an Arduino. When the sensor detects hazardous gas levels exceeding a predefined threshold, the Arduino triggers a GSM module to send an alert via SMS to predefined contacts.

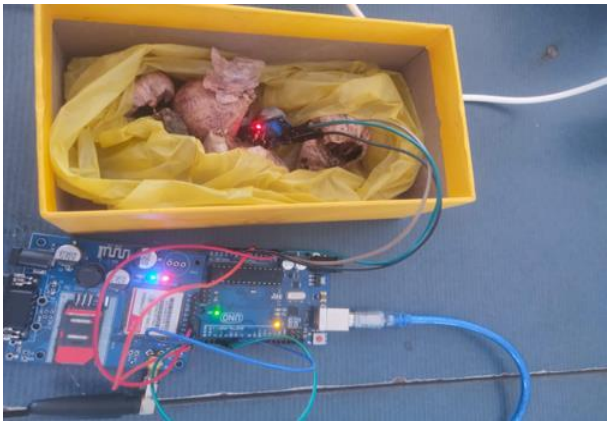


Figure 6: Proposed System

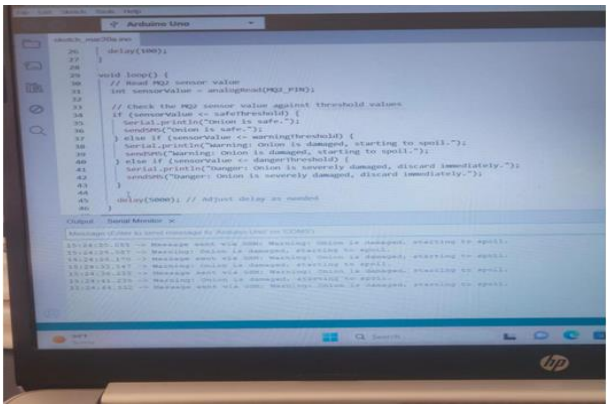


Figure 7: Serial Monitor in COM port

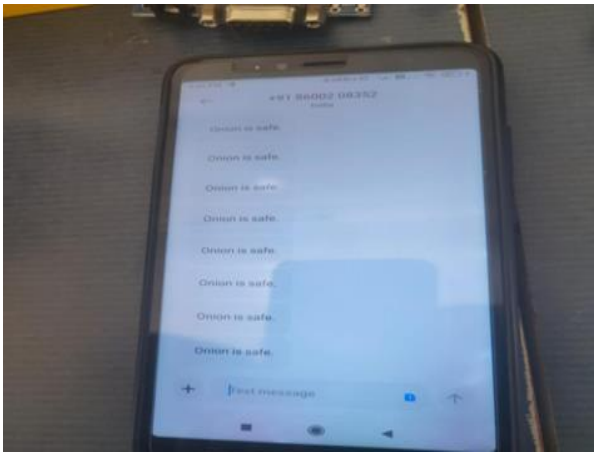


Figure 8: Messages on mobile phone

Steps of project working

1) Initialization:
- The Arduino initializes the GSM module and waits for it to establish a network connection.
- It also sets up the MQ2 sensor and defines the threshold gas level for triggering an alert.

2) Gas Sensing:
- The MQ2 sensor continuously measures the concentration of gases in the environment by detecting changes in resistance.
- It converts the analog signal corresponding to gas concentration into a digital value that the Arduino can read.

3) Threshold Comparison:
- The Arduino reads the digital value from the MQ2 sensor and compares it with the predefined threshold gas level.
- If the gas concentration exceeds the threshold, indicating a potential gas leak, the Arduino proceeds to send an alert.

4) Alert Generation:
- Upon detecting dangerous gas levels, the Arduino instructs the GSM module to send an alert SMS.
- It uses the `Software Serial` library to communicate with the GSM module via digital pins, sending appropriate AT commands to initiate the SMS transmission.

5) SMS Transmission:
- The GSM module sends an SMS alert to predefined phone numbers using the cellular network.
- The message typically contains information about the gas leak and may include additional details such as location or timestamp for context.

6) Alert Confirmation:
- The Arduino waits for acknowledgment or confirmation of SMS transmission from the GSM module.
- Confirmation can be in the form of an OK response to the AT command used for sending the SMS.

7) Continuous Monitoring:
- After sending the alert, the Arduino resumes monitoring the gas levels using the MQ2 sensor.
- It repeats the gas sensing and threshold comparison process continuously, ensuring real - time detection of gas leaks.

8) Power Management and Error Handling:
- The system includes mechanisms for power management, ensuring stable power supply to both the Arduino and the GSM module.
- Error handling routines are implemented to address communication failures or sensor malfunctions, ensuring the reliability of the gas detection system.

By integrating gas sensing, data processing, and communication capabilities, this project provides an effective solution for remote monitoring and alerting in environments susceptible to gas leaks. It enhances safety by enabling timely responses to potential hazards, thereby mitigating risks and minimizing damage.

4. Result

The result of the project that interfaces a GSM module and an MQ2 gas sensor with an Arduino is a functional system capable of detecting gas leaks and sending timely alerts via SMS. Here is a summary of the key outcomes.

5. Conclusion

In conclusion, the project that interfaces a GSM module and an MQ2 gas sensor with an Arduino presents a versatile and effective solution for gas detection and alerting applications. By combining the capabilities of the MQ2 sensor for gas sensing, the Arduino for data processing and decision -

making, and the GSM module for communication, the system offers several key benefits:

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