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AI AND IOT BASED DETECTION OF PESTICIDE IN ORGANIC FRUITS AND VEGETABLES

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Abstract— Several contemporary methods have been devised to increase food production in order to meet the needs of a rising population. In contemporary times, fruits and vegetables have emerged as the primary reservoir of essential nutrients and energy. Several chemicals are used in the cultivation of fruits and vegetables, posing a risk to consumers. In order to detect the presence of pesticides in organic fruits and vegetables, it is essential to develop a cost-effective, portable, highly sensitive, and specific biosensing platform. Various types of sensors, including as nano-sensors, pH sensors, humidity and temperature sensors, and gas sensors, are used to detect the presence of pesticides on fruits and vegetables. The input data is acquired from sensors and sent to the microcontroller. The software implemented in the microcontroller is designed to compute the quantity of pesticides detected on fruits and show the result on the display. The primary objective of our work is to compute the NDVI (normalized difference vegetation index) using infrared sensors. The software for this project is developed using the embedded C programming language. The acceptable levels of pesticides on fruits or vegetables that are safe for consumption by humans and animals are provided in the embedded C program. If a fruit is found to fall outside the specified range, either above or below the threshold level, then the fruit sample is determined to contain pesticides. The mobile application allows for the visualization of pesticide content and sensor readings via the use of Internet of Things (IoT) technology.

Key words: Artificial Intelligence, IoT, detection of pesticide, organic fruits and vegetables, sensors

INTRODUCTION

The population is experiencing rapid growth, but the available acreage for cultivating food remains unchanged. Therefore, several technologies have been created to increase food production in response to the expanding population. Chemical fertilizers, insecticides, and pesticides are used to augment crop productivity. However, ingesting these pesticides and chemicals via food may result in several hazardous illnesses, including cancer and sometimes fatal outcomes. However, several individuals are embracing the practice of organic farming and using integrated forming systems, as well as incorporating contemporary technology, in order to enhance the quality of fruits and vegetables. Organically cultivated fruits and vegetables yield double the quantity of conventional produce. Producers are fraudulently selling fertilized fruits and vegetables by mislabeling them as organic. This poses a potential hazard to customers. Therefore, the identification of pesticides on organic fruits and vegetables is crucial in the agricultural industry.

The available conventional methods for pesticide identification include mass spectrometry, gas chromatography, liquid chromatography, high-performance liquid chromatography, and protein-affinity immunoassay. Although these processes are precise and reliable, they need significant maintenance and operational expenditures, a scientific laboratory, skilled workforce, large sample size, and are time-consuming. In the future, our goal is to develop a detection platform that needs a smaller number of samples, shorter response time, and is user-friendly, cost-effective, flexible, and diverse.

IR sensors may be used to differentiate pesticides. The IR sensor consists of two essential components: the transmitter module and the receiver module. The transmitter has the capability to emit light beams with frequencies reaching a maximum of 960 nm. The transmitter emits beams that are directed towards the products of the soil. The reflected beams from the fruits are then captured by a receiver. An infrared sensor collector is capable of detecting electromagnetic waves with frequencies ranging from 400 nm to 1000 nm. The output from the infrared receiver is sent to the regulator. This cycle has been repeated many times in order to thoroughly examine accuracy (for eliminating errors). Signal inspection occurs here. After completing this process several times, an exhibition showcasing the advantages of the regulator will be built, and the average values of all the characteristics will be shown on the screen. A chart outlining the advantages of each path is obtained by the repeated process several times.

1.3 PROBLEM STATEMENT OF THE PROJECT

As the demand for organic produce continues to rise due to its perceived health and environmental benefits, ensuring the absence of pesticide residues in these products becomes paramount. Organic farming practices strictly prohibit the use of synthetic pesticides, but the inadvertent contamination of organic fruits and vegetables with such chemicals can occur through various sources including neighboring conventional farms, shared equipment, and environmental factors.

The current methods for detecting pesticide residues in organic produce are often time-consuming, expensive, and require specialized equipment and trained personnel. Additionally, these methods may not be sensitive enough to detect trace amounts of pesticides, posing potential health risks to consumers and undermining the integrity of organic certification.

Therefore, there is an urgent need to develop a rapid, cost-effective, and sensitive detection method specifically tailored for organic fruits and vegetables. This method should be capable of identifying a wide range of pesticides, including those commonly used in conventional agriculture, at levels well below regulatory limits. Moreover, it should be user-friendly, allowing growers, distributors, and regulatory agencies to conduct on-site testing with minimal training and equipment.

Addressing this challenge will not only safeguard consumer health and confidence in organic products but also support the sustainability and credibility of the organic farming industry. By developing innovative detection techniques, researchers can contribute to enhancing the quality assurance processes within the organic supply chain, thereby promoting transparency and accountability in food production.

HARDWARE COMPONENT

In this project the major hardware components which are used are Arduino UNO, IR sensor, Gas sensor, DHT11 sensor, LDR sensor and WIFI module. Arduino UNO plays the major role in this project as it is used to dump the program and run all the sensors. All the sensors are attached to the pins of Arduino UNO through jumper wires. There are four sensors that are IR sensor, Gas sensor, DHT11 sensor, LDR sensor that help to detect the presence of pesticide in the organic fruits and vegetables. LDR sensor is an electronic sensor which detects the light intensity from the fruit and vegetable. IR sensor can detect the range of motion and presence of object. GAS sensor is a device which is used to detect the amount of gas which is releasing from the fruit and vegetable. DHT11 sensor which is used to calculate the surrounding temperature and humidity which is present inside the box. WIFI module provides a mains for data communication between the device and the network.

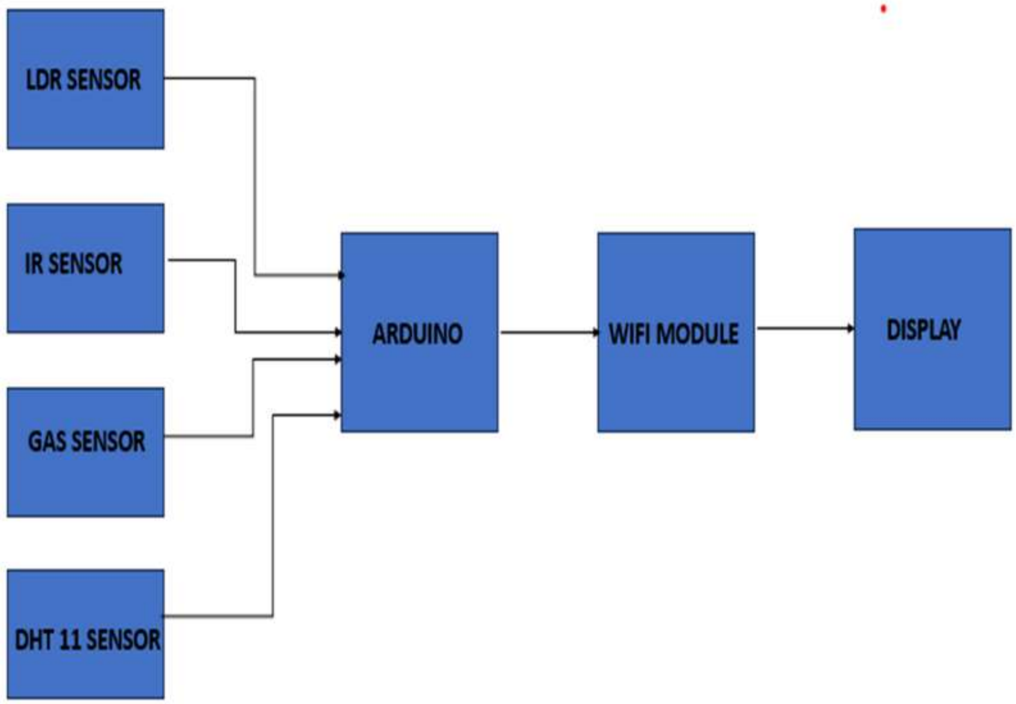


fig. Block Diagram

Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

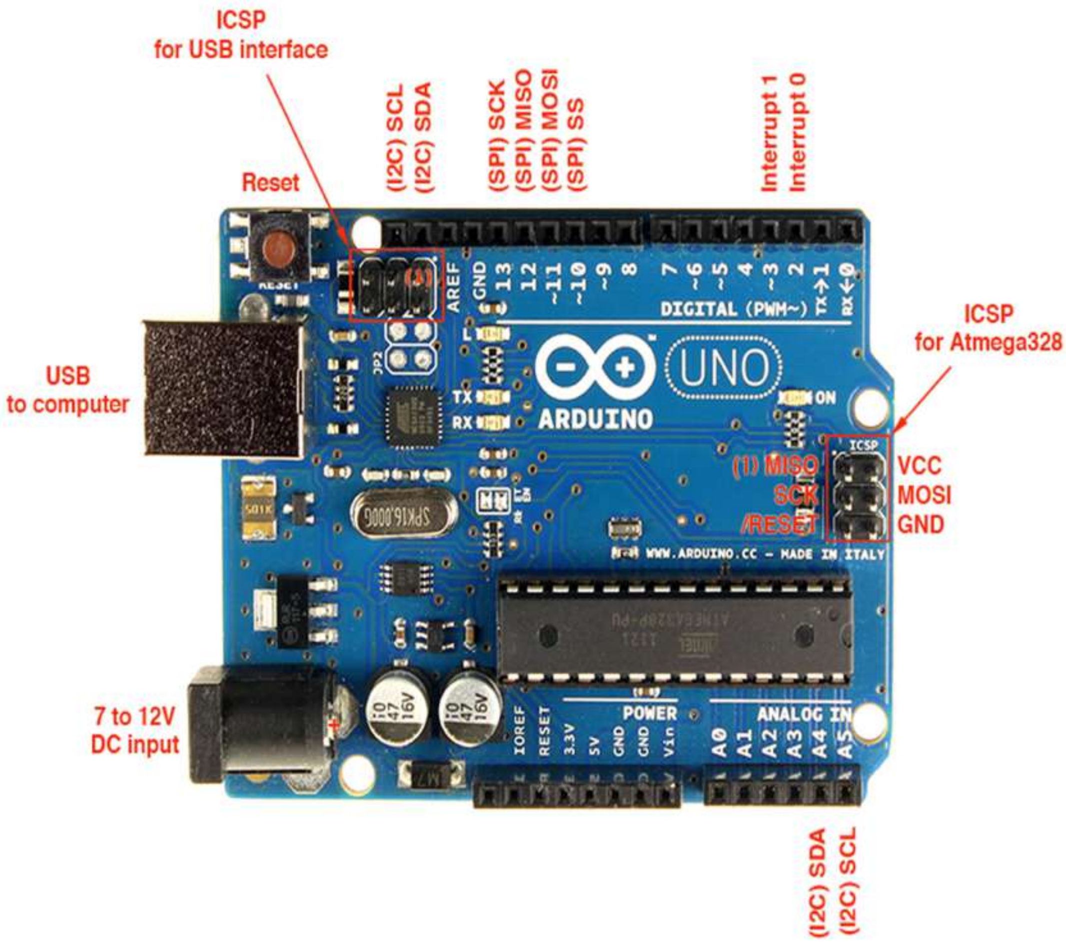


Fig 2.3 Arduino UNO

SOFTWARE DESCRIPTION

This project is implemented using the software's such as Proteus Arduino IDE and cloud server App. The compilation part is done by Arduino IDE , it helps to write and dump the program in Arduino UNO hardware. App is used for generating the values which helps in NodeMCU.

ARDUIONO 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. It connects to the Arduino hardware to upload programs and communicate with them.

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the **File > Sketchbook** menu or from the **Open** button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the **Preferences** dialog.

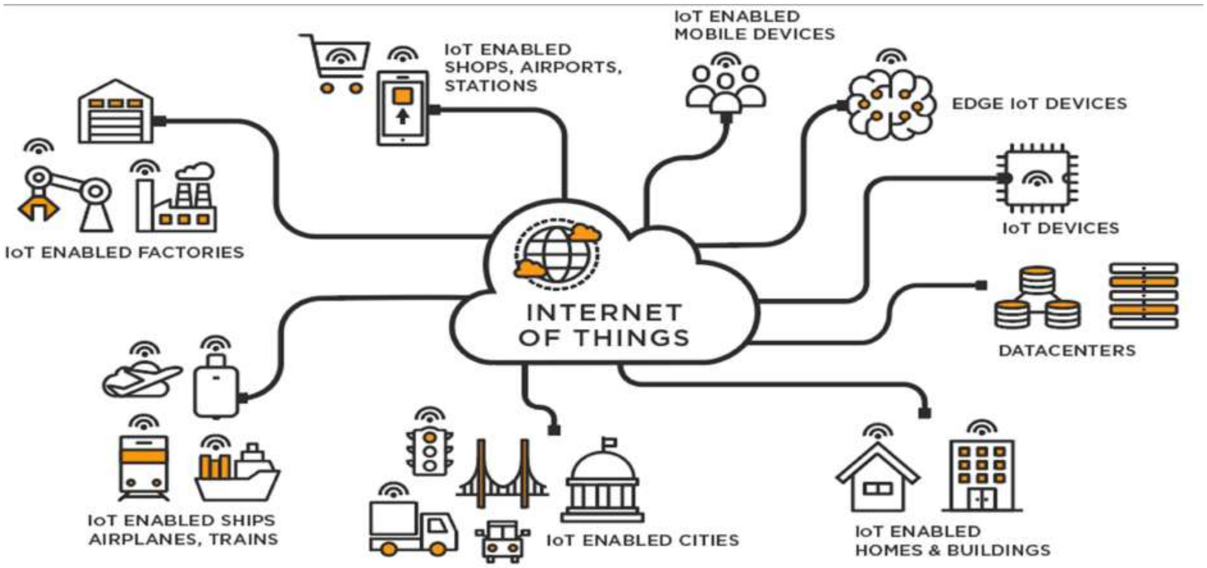


Fig.4.1 Internet of Things (IOT) Vision

In the concept of Internet of Things (IoT), the networked objects or things, called devices, are deployed worldwide and connected over the internet. Moreover, the IoT device is individually addressable, so that each device is interconnected and can be accessed through the standards of the web. In this chapter, we will introduce the basic elements in the IoT. Then, we will move onto web services for the IoT, where we will discuss the most relevant protocols for the web services.

ROLE OF WiFi IN IOT

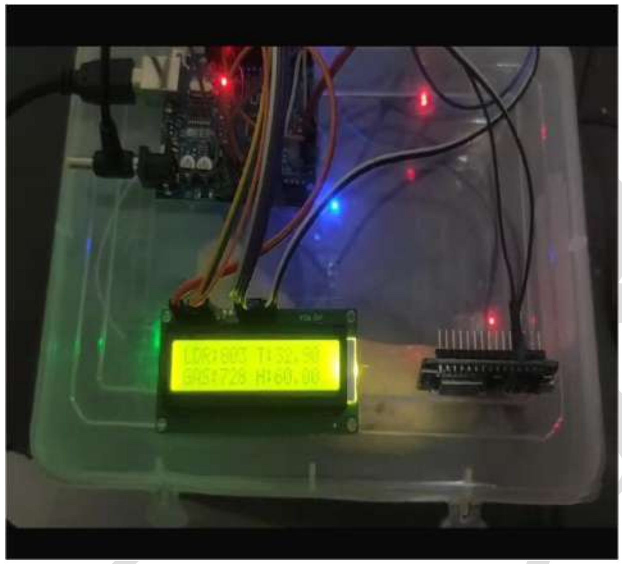
WiFi has the advantage of addressing a very wide variety of profiles because of the proliferation of its family of standards. This means it will play a role in most IoT environments, alone or interworking with more specialized protocols, or with cellular. Some IoT applications, such as vehicular services, or video-based apps like connected security cameras, will need the bandwidth of the wireless broadband network, implemented to enable other requirements like low latency (In critical environments this may take place in a private network or slice). WiFi is uniquely placed to support broadband and narrowband IoT applications from a common platform that can work at varying levels of power consumption and signal range.

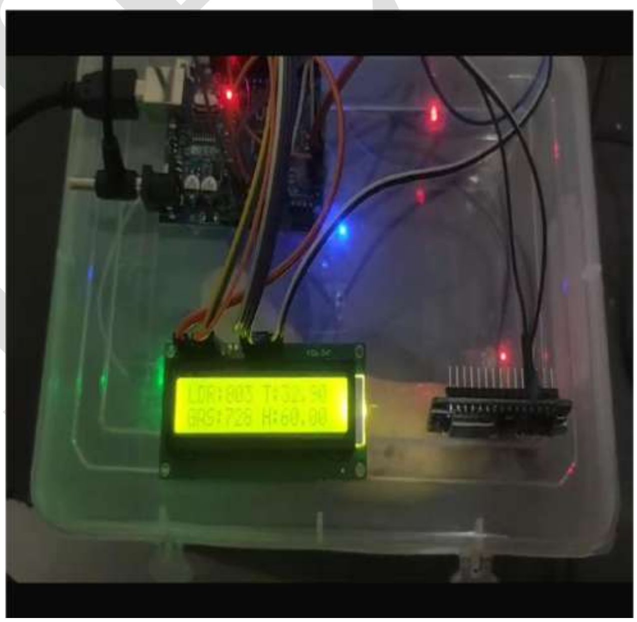
WiFi is an obvious choice for IoT connectivity because in-building WiFi coverage is now almost ubiquitous, however it is not always the appropriate choice. Standard WiFi (based on 802.11a/b/g/n/ac) is often not the best technology for IoT, but certain IoT applications can leverage installed standard WiFi, especially for in-building or campus environments. Obvious cases include building and home automation and in-house energy management, where installed WiFi can be leveraged as the communication channel and the devices can be connected to electric outlets.

WiFiHaLow, based on 802.11ah, is designed specifically for IoT, however it requires separate (as compared to standard WiFi) infrastructure and specialized clients. High Efficiency Wireless (802.11ax) standard holds a lot of promise, but we have to wait until Fall of 2017 to see how the adoption of 802.11ax takes off.

WiFi vendors continue to make improvements for IoT and some are beginning to provision enterprise Access Points with IoT technologies (ZigBee, Bluetooth and/or Thread) built into the box.

RESULT





AI & IOT based detection of pesticide in organic fruits & vegetables

LDR: 600

GAS: 660

NDVI: 0.62 **ORGANIC**

TEMPERATURE: 31.10

HUMIDITY: 82.00

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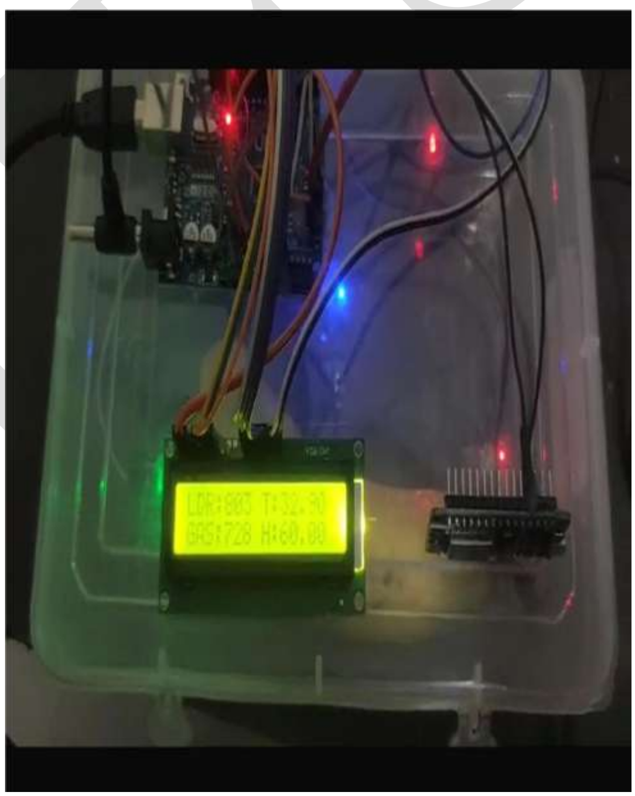

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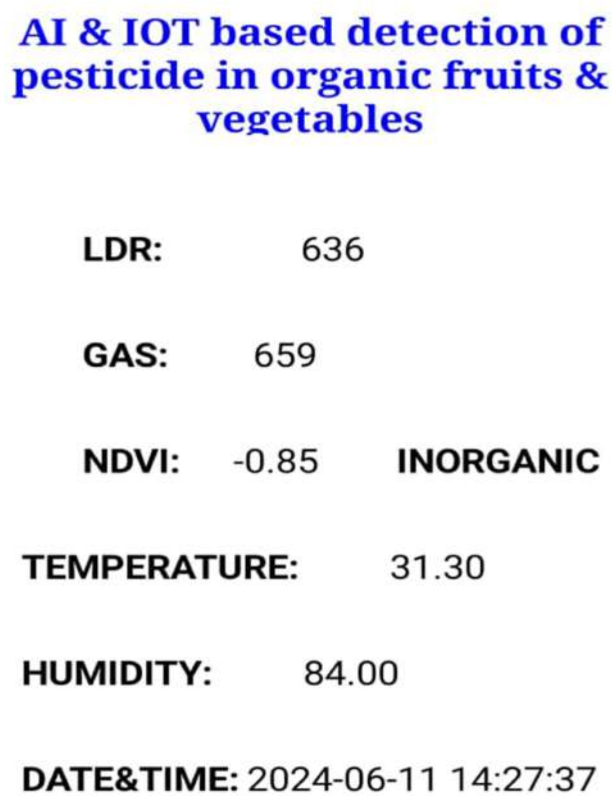

CONCLUSION

The process involves the assessment of fruit and vegetable quality and the detection of pesticides. The proposed work consists mostly of two parts. Module one is a wireless module that uses WIFI technology. These modules provide data transfer between the device and the network. Module 2 involves the identification of pesticides in fruits and vegetables using three methods: calculating the Normalized Difference Vegetation Index (NDVI), utilizing an infrared (IR) sensor, and employing a gas sensor. The results obtained from these methods are then compared. The detection information will be shown on the screen. The gas sensor approach provides higher accuracy in detecting pesticides on the surface of fruits and vegetables, as shown. Due to its portability, the gadget will improve the efficiency of food and safety authorities and guarantee quality.

The use of pesticides in fruits and vegetables poses a threat to human well-being, and there exist several techniques for identifying their presence.The detection of pesticides is facilitated by the use of IoT technology, which proves to be a suitable option due to its ability to assess the fruit's quality via the sensor. This system is designed to monitor the gas, pH, and temperature values of different fruit and vegetable samples in order to detect the presence of pesticide residue. The test results indicate that the parameters' values vary depending on the pesticide concentration in various samples. This method effectively identified the presence of pesticides in samples of vegetables and fruits. The recommended system is more reliable, operates in real-time, and produces superior outcomes when compared to other current systems. The performance is really accurate.

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