Smart garden with intruder detection system

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Abstract. IoT contains of devices associated with the internet and communicate with each other. Considering the present scenario, people are more interested towards home gardening. Sometimes they forget to water the plants because of their monotonous work lifestyle, and also cannot guard them which eventually affects the growth of the plants. To overcome this situation a Smart gardening system using IoT is being developed. The system can detect the soil moisture level based on which it will inform the user whether to turn on the motor or not and also detects unauthorized entry into the garden. The IoT- based device is linked to the motor, which can be monitored and controlled by using a smartphone. It consists of a soil moisture sensor that can predict the soil's moisture level and a PIR sensor that detects any objects entering the range and a BMP280 sensor which detects the humidity, temperature and atmospheric pressure of the air and sends the result to the user through a smartphone application named Kodular app. It transfers the soil moisture data and motor status to the firebase which displays it in the app. It is an efficient way of sensing the necessity of the plant and watering it to maintain the soil moistness. Further it also helps in guarding the garden which keeps it away from birds and animals. Which thereby maintains the plant's health.

1 Introduction

Ashton, has developed Auto-ID Labs, and is continuing to advance the Internet of Things objective by extending its use. The Internet of Things is made possible by this center's research into RFID and various other sensors. With locations on four continents, it has grown into an international corporation. However, the idea of machines communicating with each other did not develop until the 1800s. The IP address, the Internet, and satellites were considered as the other important breakthroughs. The Internet of Things was pioneered by a Coca-Cola vending machine at Carnegie Mellon University in 1989. The programming students of the school were taught to connect to the vending machine and

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check to see if a cold option of their favorite beverage was available. The Coke machine did not fit well in the modern definition of an IoT device as it still required human interaction.

Cambridge introduced the first webcam in 1993 for the purpose of monitoring the amount of coffee present in a coffee pot. Shortly after, in 1994, creator Steve Mann was able to live-stream a feed to the Internet by mounting a camera to his glasses. The early IoT prototypes gave access for the development of social media, mobile devices, and even streaming. Walmart and the US Department of Defense, two sizable corporations, both supported Ashton's invention of RFID technology. By 2005, the Internet of Things had grown to be a major enough issue that the International Telecommunication Union of the United Nations published a formal report on it. Since then advancements in WiFi, microchips, and machine learning have contributed.

IoT refers to the idea of interconnecting various gadgets with the internet in order to gather and share data. These data are used to assess the environment and user behavior. There are a large number of items in entire shapes and sizes, including smart microwaves for automatic and precise food cooking, sensors enabled smart cars to identify entities in their path, and wearable fitness equipment to detect the heartbeat and the number of steps walked and use that information to suggest a certain exercise routine. An IoT environment is constructed with web-enabled smart devices that using embedded technologies, such as CPUs, sensors, and hardware for speech communication, to convene, transfer, and act on information from their surroundings. While connecting to an IoT gateway or other auxiliary device, IoT devices give-and-take the sensor data they have collected, enabling data to be forwarded to the cloud for analysis. These devices occasionally converse with other devices which are of similar nature and operate exclusively on updated information only. Although individuals can interact with the devices for setup, dictate instructions, or permit data access, the work of the devices are automatic. The IoT applications that have been adopted heavily influence the communication, networking, and connectivity protocols used by these web-enabled devices. The Internet of Things has the potential to make data collection methods simpler and more dynamic by utilizing artificial intelligence and devices that can learn about resources. IoT devices with built-in sensors is the primary step for the process while explaining how it operates. The gadgets are linked to IoT platforms, where data from all connected devices are gathered and stored. The required information is used further to complete tasks based on people's needs and requirements. Devices carefully choose only the specific data needed to complete a task. These data points allow for the early detection of trends, ideas, and issues. This describes how an IoT application interacts with a smart system that automates tasks to meet particular demands.Applications of IoT Applications of IoT are medicine and health care, smart agriculture, smart home, smart pollution, industrial automation.

2 Existing methods

The following section depicts the summary of existing methods.

Parvathi suggested the effective irrigation system for water optimization to upkeep green environment [1]. In the system, sensors collect and examine data about climate, soil moisture, and humidity. The main aim is to preserve the nature of the plants by constantly monitoring the considerations leading to longevity of both plants and human beings. Automatic systems are preferred over manual systems. Drawbacks of IoT-based Smart Garden are inaccurate results, Expensive, and High maintenance.

Ananthi [2] presents India's economy and people’s survival which depend on agriculture. This paper's goal is to develop a mobile application that will take the position

of manual field inspection with an embedded system for irrigation and soil monitoring. The technique recommends suggestions to farmers for increased agricultural productivity. Several sensors are utilised for soil testing, pH level computation, temperature, humidity sensors and many more sensors through which farmers can identify the crop best suited for their soil based on the sensor findings. The mobile application suggests a crop while the field manager receives the sensor values received through the Wi-Fi router. When the soil temperature is high, automatic irrigation is performed. An email with a crop image and pesticide advice is sent to the field manager. Drawbacks includes, Expense and Lack of Security;

Rahul [3] represents the future of computers and communication can be seen in cutting-edge technology known as the "Internet of Things". Every industry, including smart traffic management, smart cities, and smart homes, uses the Internet of Things. The IoT can be used in various industries and has a wide range of possible applications. The Internet of Things (IoT) enables better crop management, resource management, cost-effective agriculture, enhanced quality and quantity, crop monitoring, field monitoring, and other duties. The suggested model makes use of sensors for air temperature, soil pH, soil moisture, humidity, and water volume. This essay discusses the issues farmers confront and the typical agricultural methods they employ. The suggested model is a simple IoT sensor architecture that gathers data and sends it to a server over a Wi-Fi network. Drawbacks include Expensive, Poor internet connectivity, and Inaccurate Results.

Musthak Ahmed [4] represented that, in rural areas where technology is not developed and it should be able to support farmers who produce large amount of grains and vegetables, the majority of paddy, wheat, and vegetable farming occurs. Farmers forego other duties to spend the majority of their time watering crops in the field. In order to save the time of the farmers from working wholesome in the field, we created a paper that automatically switches on the water pump into the field, based on the amount of soil moisture. The water syphon then naturally turns down at the point where the dirt reaches the proper level of moisture. Drawbacks include, poor internet connectivity and inaccurate results.

Manoj [5] suggested that a technologically improved agricultural support system is necessary to boost productivity and the main focus of this paper is an integrated IoT-based and smartphone-based agricultural monitoring system. With the help of this device, farmers can remotely monitor the soil moisture, the length of leaf wetness, the pH level of the soil, the ambient temperature and humidity. The technology [6] offers new information to guide decision-making by swiftly assessing the weather and soil conditions in a precise location. In the fields of Islampur and Maharashtra the technique is used and tested. The suggested tool is a cheap and effective farming approach. Drawbacks include, meagre internet connectivity, erroneous results and opportunity for wrong Analysis of Weather Conditions.

3 Proposed method

3.1 Problem Statement

The main objective of this paper is that a plant needs daily nutrition and regular attention in order to develop and thrive. This includes fertilization, watering, and the application of pesticides. The main concept is to construct a system that can feed and water plants by controlling the rate of specific activities while taking into account other factors such as temperature, humidity, and atmospheric pressure. The rate of watering should be able to increase if the soil moistness falls below a predetermined threshold, and after a certain

period of time, it should be able to additionally activate if any unlawful entrance is detected, providing protection for the garden. "Gardening can be a time-consuming, resource-intensive activity, and many gardeners struggle to maintain healthy plants and optimize growing conditions. In addition, traditional gardening practices can be unsustainable and environmentally damaging. The following are the paper's broad goals:

- To create a product that will make it easier for urban families to grow vegetables and flowers for everyday use in their backyard, roof, or even house.
- When the plant's soil moisture is measured, it can be determined whether the plant is adequately watered, overwatered, or submerged.
- Able to know the growing conditions of the plants like temperature, humidity, and atmospheric pressure using a BMP280 Sensor.
- The principal point is to give higher comfortability, water-utilizing effectiveness, and less human oversight exertion.

3.2 Architecture diagram

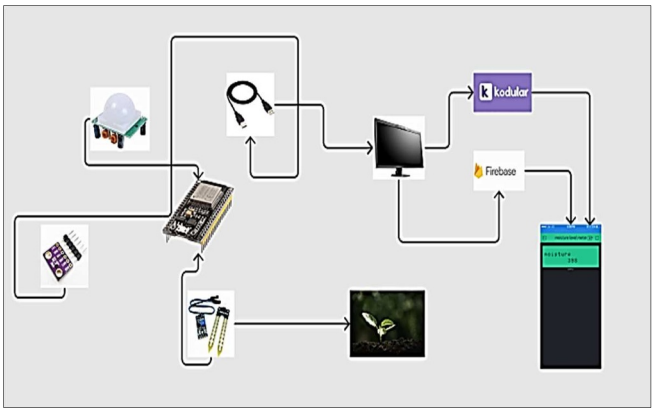

Fig. 1. Architecture Diagram.

The following section illustrates the working of the proposed method illustrated in the Figure 1.

- The system can detect the soil moisture level based on which it will inform the user whether to turn ON the motor or not and also detects unauthorized entry into the garden.
- It consists of a soil moisture sensor to predict the soil's moisture level when placed in the soil.
- It consists of a PIR sensor that detects any objects entering the range and sends the result to the user
- It consists of BMP280 Sensor which measures humidity and atmospheric pressure in the air. These sensors are connected to the ESP32 Board, which is connected to the computer through a USB wire.
- When we compile and upload code in Arduino it displays output in the Serial monitor. It transfers the soil moisture data, temperature, pressure, humidity, and motor status to the firebase using firebase credentials. After the successful uploading of code the data get transferred to firebase we can view output in a real-time database.

- Using Kodular, we can design the app in the way we want our results and have to build blocks to get desired output. After scanning through kodular companion we will able to see the output in our Mobile App.

The following section explains about the Modules-Connectivity which is further illustrated in Figure 2. Modules of the proposed method are Data Collection and User Interface, Detection of soil properties and unauthorized entry, Data Processing and Updating details Firebase and in Mobile.

3.3 Modules-Connectivity Diagram

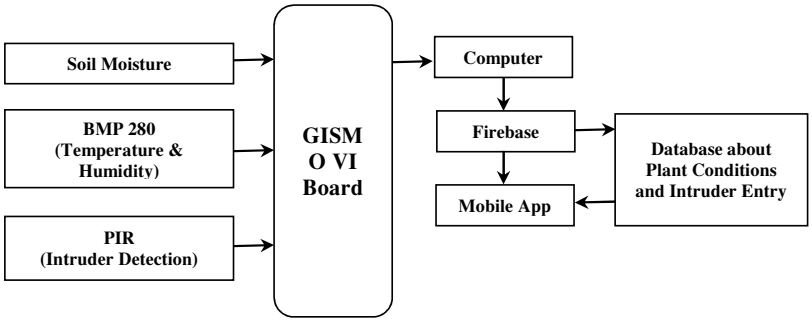

Fig. 2. Modules- Connectivity.

3.4 Modules and its Description

3.4.1 Module 1: Data collection and user Interface

Due to the wide variety of sensors used in this network, smart sensors wirelessly send their data. The laptop is connected to the soil moisture sensor, BMP280 sensor, and PIR sensor using USB wire. A red light that indicates the board is on and the sensors are ready for detection will reflect once the sensors are linked to the ESP32. A smartphone application has been created for the user's convenience, allowing them to quickly access the readings and determine whether or not their soil is suited for the proper growth of plants. This is the first module in our paper.

3.4.2 Module 2: Detection of soil properties and unauthorized entry

By running the code in the Arduino, the attributes of the soil, such as humidity, temperature, and moisture level, may be determined. It is possible to identify unauthorized entrances. Soil Moisture sensor measure the water content in soil and BMP280 sensor measure the atmospheric pressure, humidity, and temperature. PIR sensors will detect the entry of intruders into the garden. Once readings from the sensors are gathered and moved to the firebase, the readings are displayed in the firebase for the user accessibility via an application. If the PIR Sensor detects any intrusion, it activates and notifies the user of the entry into the garden. This allows the user to shield their plants from intruders like animals, robbers, and other potential threats to the plants. The output will be displayed on the serial monitor following compilation and upload of the code.

3.4.3 Module 3: Data processing

If the PIR Sensor detects any intrusion, it activates and notifies the user of the entry into the garden. This allows the user to shield their plants from intruders like animals, robbers, and other potential threats to the plants. The output will be displayed on the serial monitor following compilation and upload of the code. The data will be processed in Arduino while execution and after placing firebase credentials like database secrets and real-time database authentication it get transferred into firebase and shows results in the firebase. The Firebase Realtime Database is a database that resides in the cloud.

3.4.4 Module 4: Updating details in firebase and in mobile

If the sensor picks up any intrusion, it activates and notifies the user of the entry into the garden. This allows the user to shield their plants from intruders like animals, robbers, and other potential threats to the plants. The output will be displayed on the serial monitor following compilation and upload of the code. The user can also get output in the kodular companion app. Kodular is an online resource that offers free mobile app development tools. It essentially provides an online drag-and-drop tool for creating Android apps where any app creation is possible for anyone without writing a single line of code. Kodular will give results to user through companion app when the user scans the QR code, the display in the firebase will get transferred into the Kodular using firebase database.

4 Experimental Results and Discussions

Detection of Soil properties and unauthorized entry. Its goal is to make electronics more customized and accessible to hobbyists, designers, artists, or anybody else interested in creating interactive environments. This section gives a brief about the Experimental results and Discussions which is further explained with a diagrammatic representation in Figure 3.
Updating details in Firebase: The desired results we want after transferring code into the firebase database is shown in the Figure 3.

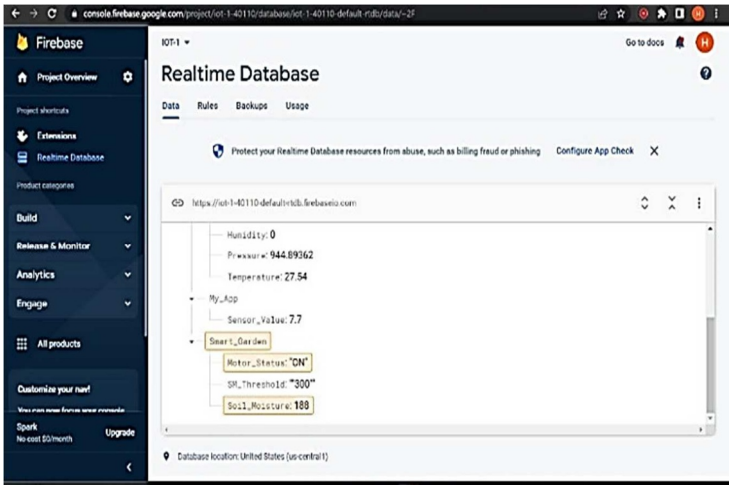

Fig. 3. Soil Moisture Sensor Output in Firebase.

This section explains about updating the details in Firebase and is illustrated in Figure 4.

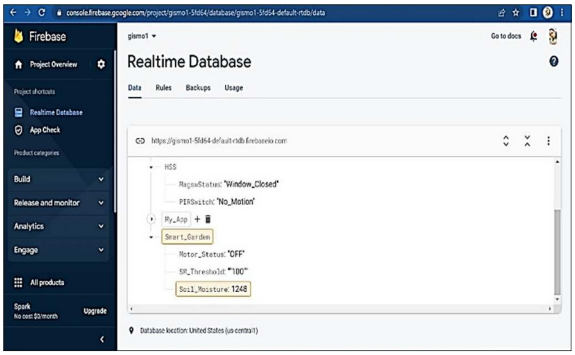

Fig. 4. PIR Sensor output in Firebase.

This section explains about updating the details in Firebase and is illustrated in Figure 5. Updating details in Kodular: Kodular will give results to user through companion app when the user scans the QR code, the display in the firebase will get transferred into the kodular using firebase database. The final result that user see in his/her mobile using companion app are illustrated in Figure 5.

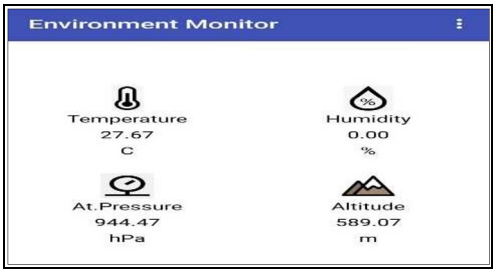

Fig. 5. Environment Monitor.

This section explains about updating the details in Kodular and the shows the environmental monitor and is illustrated in Figure 6. This section explains about updated and is illustrated in Figures 6 and 7.

Fig. 6. Representation of data in the Smartphone.

Fig. 7. Representation of data in the Smartphone.

This section explains the soil moisture levels which are shown in the Kodular and it is illustrated in Figure 8.

5 Conclusion

The primary objective of smart gardening is to use modern technology, including artificial intelligence, to streamline gardening operations. When compared to traditional agricultural practices, this sustainable farming method saves 80 percent of water. By directly connecting your smartphone to an irrigation system, you can control water from anywhere. All plants receive water from the device. To keep your plants from becoming dehydrated, make sure to regularly check the level of the water. This paper aims to measure the moistness of the soil. While the moistness of the plant falls below the Threshold value, it must receive water. The users of this paper gain greater control over their gardens. Based on the environment and the soil's moisture content, it can tell when the user needs to water the plants. This paper will optimize water levels as per soil moisture and weather predictions with the help of the BMP280 sensor and soil moisture sensor. This device gives security to the garden from birds, animals like dogs, and goats which will affect the plants and also humans. It provides accurate results. The gadget gives users access to a futuristic way of life in which they can control their electronic devices with a smartphone and makes efficient use of energy. The idea of using IoT for irrigation can be expanded to include additional gardening tasks like temperature control. The user will have access to a built application that uses the Internet of Things to monitor the garden's environment and display all necessary information and notifications.

References

1. R. M. S. Parvathi, K. Bala Bharathi, and D. Devimala,2019. “IoT Based Smart Garden”, in Proceedings of the International Journal of Innovative Research in Science, Engineering and Technology, 8 (3): 2257-2268.
2. N. Ananthi, J. Divya, M. Divya and V. Janani, IoT based smart soil monitoring systems for agricultural production. IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR), Chennai(2017), 209-214, DOI: 10.1109/TIAR.2017.8273717.

3. Rahul Dagar, Subhranil Som, Sunil Kumar Khatri,Smart Farming- IoT in Agriculture, International Conference on Inventive Research in Computing Applications (ICIRCA) Coimbatore, India, (2018) 1052-1056, DOI: 10.1109/ICIRCA.2018.8597264.
4. Syed Musthak Ahmed, Kovela, B., Gunjan, V.K.IoT Based Automatic Plant Watering System Through Soil Moisture Sensing-A Technique to Support Farmers Cultivation in Rural India.
5. Manoj A Patil, Adamuthe, A.C., Umbarkar, A.J.. Smartphone and IoT Based System for Integrated Farm Monitoring (2020)
6. Gunjan, V. Senatore, S., Kumar, A., Gao, Merugu, S.Advances in Cybernetics, Cognition, and Machine Learning for Communication Technologies. Lecture Notes in Electrical Engineering, 643. Springer, Singapore (2020). https://doi.org/10.1007/978-981-15-3125-5_28