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A Review on Smart Agriculture using IoT

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Abstract: *The Internet of Things (IoT) is a mechanism that enables everything to be managed over a computer network. By 2020, there could be over 30 billion connected gadgets, according to estimates. The calls for IoT in agriculture are directed at conventional agricultural businesses to meet rising demand and reduce waste production. IoT in agriculture uses equipment, drones, and sensors. Using IoT technology, a computerized agricultural system is developed to track and manage key farming factors like climate, moisture, soil humidity content, and sunshine. To feel the concepts, the sensors must be placed in the proper locations and orientations. Using clever approaches, it is possible to alter the automated structure's water availability, humidity, and temperature. Numerous approaches should be discussed.*

Keywords: Internet of Things

I. INTRODUCTION

While serving as Procter & Gamble's brand manager in 1999, Kevin Ashton, co-founder and executive director of the MIT Auto-ID Center coined the phrase "internet of things." In a different sense, the term "smart farming" refers to the use of IoT outcomes in agriculture.

1.1 IoT Application in Smart Farming

Farmers may make more informed decisions and enhance nearly every aspect of their job by using IoT sensors to conserve resources and gadget originality.

Growers can determine just how many pesticides and fertilizers they should apply to achieve maximum efficiency, for instance, by testing smart cultivation sensors to monitor the United States of America crops. A similar is true for the rationale for smart production. Environmental monitoring is necessary for agriculture to regulate particular plant conditions. A WSN can be used to do this work by gathering rough estimations of the data that is currently available and producing more precise estimates. WSNs are also used by several agricultural researchers to track environmental criteria. Data like the capability to adjust the water level or temperature level are the subject of research in an agricultural environment in addition to standard environmental factors like temperature, humidity, and precipitation.

Numerous scholars are studying and developing the themes of effective water management and optimal water delivery in the context of smart agriculture.

Table 1. A comparison of our model with existing literature.

Model	Advantages	Disadvantages
Development of wireless sensor networks [8]	- Reduce costs. - Increase agricultural productivity.	- Generates huge amounts of data.
Smartphone connectivity [11]	- Reduced capacity for real-time data processing - Significant negative impact on battery life.	- Generates incalculable data. - Requires challenging storage of large amounts of data.
A life cycle framework of green IoT-based agriculture [12]	- Recognizes the quality of agriculture ingredients. - Improves yields as well as quality. - Produces saleable agri-products for the market.	- Requires corresponding theory and methodology to address emerging finance, operations, and management issues in the digitization of agriculture using IoT techniques.
Our model	- Reduces costs. - Increases agricultural productivity. - Saves energy, increases efficiency, and enables excellent communication between farm and gateway. - Improves yields as well as quality.	- Requires challenging storage of large amounts of data.

Numerous survey articles introducing the research methodology have been written throughout the years by well-known scholars in the field of smart agriculture.for various communication [1] methods based on IoT technology that effectively manage resources. Table 1 provides a summary and comparison of our model to the body of prior research. Vietnam's socioeconomic situation has changed as a result of agricultural production, which has decreased poverty, eased food insecurity, promoted agrarian exports, and given employment to over half of the country's working force. These are only a few instances as LoRaWan technology is actively used in WSN for a variety of tasks including smart cities, trash[2] management, and waste collection.

II. PROBLEM IDENTITY

The weather is to blame for the rising water level. There are many distractions for farmers, which is bad for agriculture. Farmers use that smartphone application to regulate water levels in both Automatic and Manual modes. Farmers will find it more comfortable.

III. RELATED WORKS

3.1 Smart Water Management using IoT

This project helps manage water levels and where we are easy to use in society. The water level is maintained data is captured by sensors presented inside the tank and saved to the cloud with a mobile app. The user views the Water level by mobile phone; then the motor works automatically and manually. at water level, When it gets low, the engine will automatically turn on. The engine is then turned off [1]. in our proposed system

You can monitor the water level with your mobile phone, Control anytime can also be used for different industries for maintaining different types of liquids View and manage tank update information via mobile application. Users can also choose notifications notification according to defined criteria. It can also flood propane implementation like this install-in-install such as dams and riverbanks.

3.2 Hybrid Intrusion Detection Architecture for the Internet of Things.

In this world, the Internet of Things (IoT) is the new paradigm, where you can connect and control everything from anywhere anytime. New architectural model for intruder deduction we propose IoT that knows anonymity [3] activities in specific areas. This model is based on a map reduction to find more intruders in the field. It walls alarm users with alarm notifications via a mobile phone application. The Internet of Things is a global network where you can connect and control all your devices. It is available anytime, anywhere, and with a variety of technologies. The main concept of this proposed system is a solution to the growing insecurity of the Internet more secure with a thorough IoT mobile app. result, Alert users at any time via alarm notifications anonymous approval is justified. you know multiple intrusion detection simultaneously. Use unmonitored OPFs are detected (internal attacks) and exploited intrusions are used for detection (external attacks). again, can detect cybercriminal attacks via IoT.

3.3 Real-time intrusion detection in the Internet of Things.

In IoT, resource-constrained things are connected. Unreliable Internet over IPv6 and 6LoWPAN network. even if protected by encryption. Also authentication, both these things are exposed to wireless attacks from within the 6LoWPAN network and the internet. Because these attacks can occur, Intrusion Detection System (IDS) is required. during implementation and rating based primarily [4] on routing attacks such as Falsified or Altered Information, Sinkholes, and Selective Transfers. Shows the evaluation in simulation. Scenario, SVELTE detects all malicious nodes that initiate this implemented sink holing and/or selective forwarding attacks. The true positive rate is not 100%, there is also a false positive rate alert during the detection of malicious nodes. Similarly SVELTE overhead is small enough to use a constrained node with limited power and storage capacity. Also, to protect against global attacks, design and implement a mini firewall.

3.4 Survey data on the cost and benefits of Climate-smart agricultural technologies in western Kenya

Data is collected to assess climate intelligence. Economics and Yields of Soil Protection and Soil Remediation size. Data were collected from many households.

These households were selected using a simple randomized procedure sampling procedure from 180 primary sampling frames farmers provided by the Ministry of Agriculture officer. controlled by disciplined research Assistants based on designed structured questionnaires at the Census and Survey Processing System (CSPro). Again, Data was exported to STATA version 14.1 for cleanup and administrative purposes. Data is an openly hosted source database so that other researchers can generate new [6] data insights from data.

3.5 Architectural Framework of Smart Water Meter Reading System in IoT Environment.

The Internet of Things (IoT) has created many opportunities for this. Create a domestic application. This also includes a smart metering main application. Water is the resource before everyone this intelligent measurement allows you to keep your water You can also manage and reduce water waste. We Proposal of building framework work for water meters that measures water flow and heat measurements (STUF280T). Introduce the concept with MediaTek a cloud sandbox to use as a cloud platform. All of the data and information are stored in the cloud, less expensive, making the process very economical. again, This IoT concept allows users to access their data at any time and everywhere. Smart meters allow users to maintain and process expensive data and analysis. Other technologies such as ZigBee, Bluetooth, and GSM are also analyzed. Same data, but with this smart meter, users can have Restful Underlying web service for communication to and from [5] IoT Cloud Water meters from an ecological sustainability point of view.

IV. SYSTEM ARCHITECTURE:

The purpose of this document is to provide a real-time water management monitoring solution that optimizes power consumption. Another goal is cost reduction in intelligent agriculture. A key factor affecting the energy dissipation of the sensor node is the transmitter module. The design work focuses on the structure of sensor nodes and the importance of network sensor architecture. Finally, the determination of effective data transmission techniques is directed toward the implementation of energy-efficient sensor nodes. However, most of the data in the field [7] of smart agriculture are important in nodes where users can be easily selected by manipulating more convenient components. Microcontrollers must therefore be chosen to ensure a good compromise between power efficiency and complexity. Finally, the best match between the accuracy of the measured data, the energy expected to perform that task, and the price should be considered to select the factors, thereby prioritizing the use of the sensor. This makes sensor performance a critical factor for energy consumption [8] and lifetime. The IoT nodes proposed in our system are built according to these requirements. First and foremost, choose a single-chip microcontroller such as the ATmega328/P or ATmega2560. A smart choice is to provide simple open-source software that allows users to observe programming and increase their programming confidence. Second, it uses fewer clock cycles than [9] others to execute the instruction. Developed a single-board microcontroller with all sensors and all devices integrated. Third, after considering the latest technology, the best option is his LoRa technology. LoRa technology offers his IoT connectivity in a wide range by allowing data transmission over a longer range. It consumes very little power, is robust in rural areas, and uses a holistic network architecture designed for smart farming situations. Finally, a low-cost, low-power sensor was chosen to provide an excellent balance between measurement accuracy and energy efficiency. Our paper presents a reliable, robust, cost-effective, and scalable solution for smart agriculture based on IoT technology. The architecture system is shown in Figure 1. The figure shows three node prototypes. Gateway, node 1, and sensor nodes 1 and 2. The flowchart shown in Figure 2 shows how data transmission is managed between the gateway, node 1, and node 2 of the system.

The gateway performs the core functions of collecting data from nodes via LoRa and transmitting data to the cloud and mobile applications via the WIFI ESP82666 module. In addition, the mobile app also allows users to control nodes across gateways. Node 1 and sensor node 1 are designed for this case as we assumed the water pump machine is far away from the sensor location. Node 2 is designed for orchard conditioners, with suitable terrain conditions for [10] pumping directly into the farm without removing the sensor block.

Various key features of such a three-node construction are described below, following the next subsections.

The gateway, node 1 and 2 power systems output 220V AC power. Still, this power needs to be converted to the expected form in the normal voltage range to conserve power for various types of devices at the proposed IoT node. Based on the power IoT system requires that the power system with the receiving node requires 5V and 3.3V for the microcontroller [11] and communication module respectively. The node must contain a voltage regulator. For this

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reason, two voltage regulators are used, a 5V regulator powering the sensors in Figures 3, 4, and 5, and a 3.3V regulator powering the power system of the receiver node.

Figure 1. Block diagram of the proposed IoT framework.

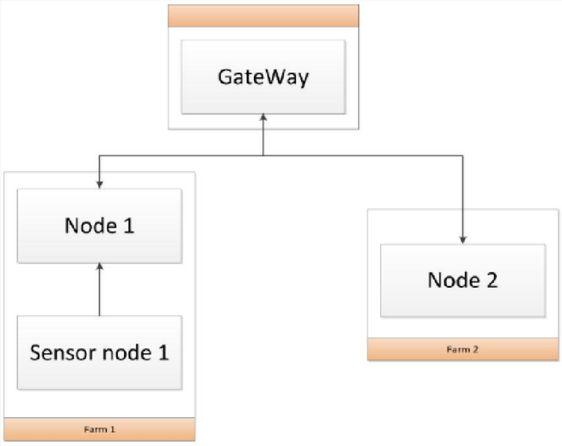


Figure 2. Flow diagram of the exchange data between two nodes with Gateway.

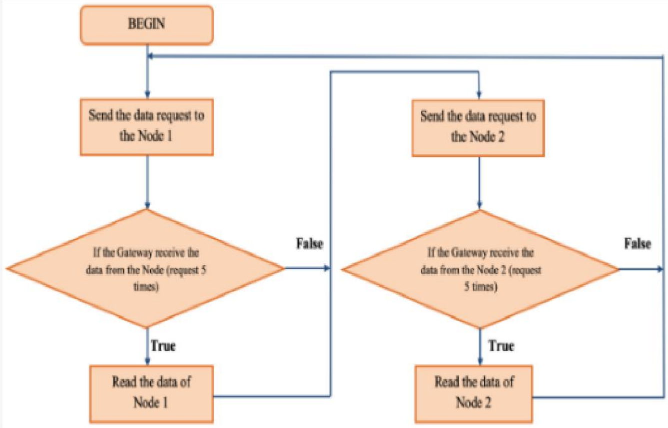


Figure 3. Block diagram of the proposed gateway.

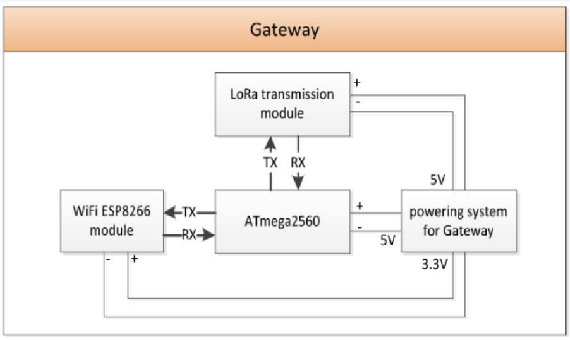


Figure 4. Block diagram of Node 1.

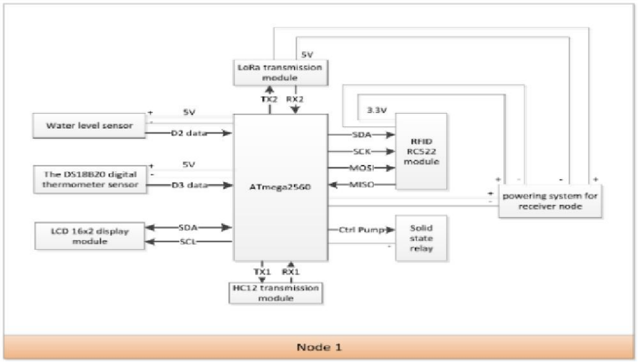
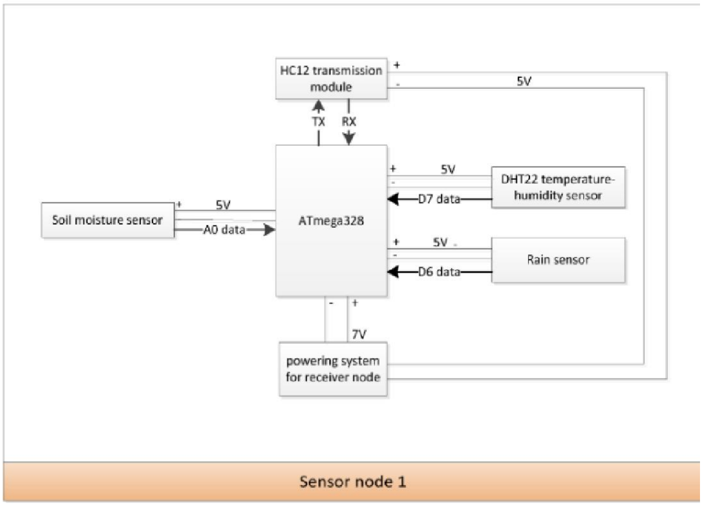


Figure 5. Block diagram of sensor Node 1.



Also, the power system is designed to provide enough capacitance to drive the entire board into the circuit, where unscientific component selection leads to some conditions such as the wrong voltage selection for the board. [14] It should also be noted that Fire and Damage - Defective components on the circuit board.

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V. OPERATIONAL TESTS

The proposed intelligent farming system is evaluated using two different scenarios in Vietnam. Demonstration of sensor effectiveness for laboratory [15] temperature and fixed humidity analysis. Verify data transmission over wide areas and long-distance using the LoRa channel.

5.1 Testing IoT Sensors

The first scenario was set up at the Department of Electronics and Communication Engineering, Thong Duc Thanh University, Vietnam, where the sensor infrastructure was evaluated. System performance was tested on a subset of nodes using [12] Arduino. These sensors were used because the presence of other components does not affect the accuracy of the measurements. In addition, the board has the equivalent microcontroller used in the node, so this board can take advantage of the ease of use, the need for rapid prototyping, and the equivalent microprogramming of IoT buttons, making it a specific was selected for testing. . An experiment was conducted in which LoRa with embedded sensors was integrated using gates, Button 1, and Sensors Button 1 and Button 2. An easy-to-read LCD screen has been added to the main board to display the temperature and humidity measured by the sensors, as shown in Figures 06 and 07. In addition, the accuracy of the sensor readings was displayed and confirmed on the LCD screen. Finally, the sensors were calibrated before testing to ensure data accuracy and allow users [13] to troubleshoot issues during the system setup process.

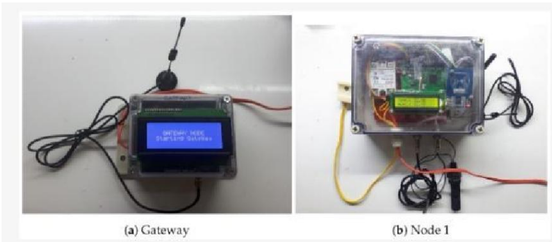

Figure 6: The prototype of the two boxes: gateway on the left and circuitry with all sensors of Node 1 on the right.

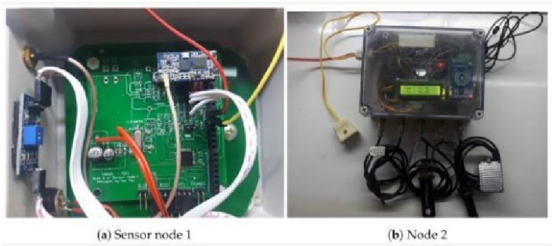

Figure 7: The prototype of the two boxes: sensor Node 1 on the left and circuitry of Node 2 with all sensors on the right.

5.2 Testing Data Transmission over the LoRa Channel

In a second scenario, we examined the effectiveness of his LoRa technology for farm surveillance infrastructure deployment by examining data transmission distances on two real farms, as shown in Figure 08. To this end, a model system infrastructure was built [17] in Cho Lac District, Ben Tre Province, Vietnam, to demonstrate the utility of individual star topology networks covering a completely rural area. The model infrastructure consisted of a gateway node and two sensor nodes generated by a LoRa E32-TTL-1W module connected to a mobile application. The transmitter module was built with his three key measures:

Information symbol rate, channel bandwidth, and information [19] rate are adjusted according to the datasheet provided by the manufacturer for the best sensitivity.

Based on the sensor network structure shown in the previous section, we placed the gateways in a farm to validate their transmission range. The nodes were in various places.

Node 1 covers 2000 m2 at a distance of 700 m from the gateway, and node 2 covers 1000 m2 500m from [16] Gateway. These positions were fixed to confirm that the actual data was being received correctly. Data was then collected from nodes 1 and 2 and sent to the gateway over the next 7 days of the same month, with 24 hours of measurements in

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between. In this way, the performance of the system was tested. Figures 09 and 10 show results for two nodes representing soil moisture, humidity, and temperature. Based on these value thresholds, the system can automatically activate the water.

Figure 8: Map of the area covered by the LoRa module.

Experimental results show that applying fast methods to the formation of effective resolution helps to reliably improve the results of sensor-based systems. Smart strategies can not only improve the performance of IoT- and sensor-based systems but [18] also improve the efficiency of these systems through smarter and more accurate decisions made by such smart systems. The results of this experiment clarified the method of intelligent irrigation system for water saving in tunnel farming, resulting in increased productivity and flexible farm management.

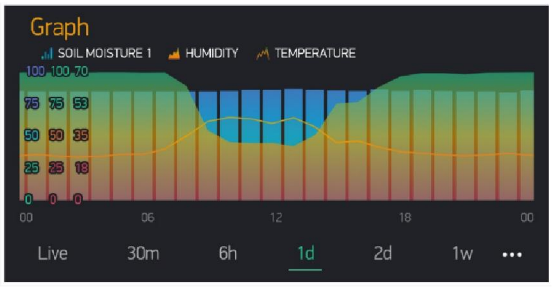

Figure 9: Collected soil moisture, humidity, and temperature during the data acquisition campaign carried out on Node 1 of Cho Lach district, Ben Tre province, Vietnam.

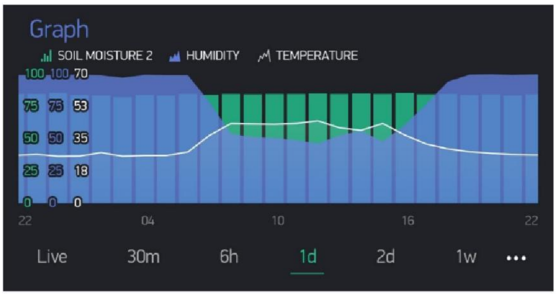

Figure 10: Collected soil moisture, humidity, and temperature during the data acquisition campaign carried out on Node 2 of Cho Lach district, Ben Tre province, Vietnam.

Data transmission is also important for intelligent IoT systems to check the effects of packet loss. Data transfer is tested using models created by internal sensors. Node 1, Node 2, and Gateway are connected via his LoRa module in the prototype as described in Section 4.1. Packets are dropped from all test nodes in transit. Packet loss was observed each time the model moved between test sites, but this is not an issue as the nodes of the growing farm are expected to remain in the study area. Therefore, LoRa technology has proven effective when deployed in rural areas without the need to turn on acceleration mode in the transfer module shown in Figure 08.

VI. DISCUSSIONS

Intelligent farming systems based on IoT applications have the following advantages over previous approaches:

- You can use this system to manage two or more independent farms with the same mobile application.
- These farms may have different growth plans. The purpose of this research was to utilize inexpensive and

readily available IoT system equipment.

- Applying LoRa technology to eliminate the need for WiFi on farms can save energy, reduce costs, increase efficiency, and provide better communication between farms and gateways.
- Control data is stored in system memory to prevent power failures that lead to data loss. In addition, various control modes make it easy for users to operate the farm. Real-time updates are available directly from the web to keep your system running more accurately.

It can detect her interrupted WLAN connection and report it to the user for timely action.

Various sensors [20] are integrated to collect tree management information to improve crop productivity. Our strategy looks at the following five parameters of his: Temperature, Temperature Humidity, Soil Moisture, Rainfall, and Water Level.

None of the above approaches discuss and investigate the impact of energy consumption in intelligent irrigation systems. In addition, other methods often rely on soil moisture to determine plant water needs.

Our intelligent irrigation system's test and measurement results are approaching standard irrigation methods as [12] a product for high-tech applications. This is at least 30% more economical than the technology used.

In addition to the above advantages, our study also has shortcomings that need to be overcome before it can be widely applied. For example, the ESP8266 module is a mid-range module with high stability, but the system can lose internet connectivity and relies on the Blynk application.

VII. CONCLUSION

This white paper presents a LoRa module transmission solution for cost-effective and effective intelligent farming systems for use in Vietnam, designed and implemented to control environmental factors in agriculture. Cheaper than other solutions with similar accuracy. The system can continuously observe measurements and communicate them to users via networks and mobile applications. Additionally, the system can send alerts to users and activate reduction devices. The IoT node was tested in two separate cases in Cho Lac District, Ben Tre Province, Vietnam, and used to measure different values such as humidity, humidity, and temperature. Finally, experiments were conducted to determine whether implanted electronics and wireless communication modules could influence the values collected. There were no signs of interference. In summary, the results confirm that the system is the best solution for intelligent agricultural control users for Vietnam farmers. With real-time data available, you can quickly use and manage anytime, anywhere. However, placing IoT nodes in different locations generates an enormous amount of data. In this case, the system needs time to store and analyze the data before finding the best solution.

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