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Smart Farming System Using Iot Technology

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Abstract

Smart farming system is an emerging sector using IoT sensors provide information about farming areas and then respond based on the user input. We proposed in this paper to create an advanced agriculture system, which takes the advantages of state-of-the-art technology like Adafruit broker, IoT, and the Wireless Sensor Network. The paper focuses on making use of extensive technological i.e., IoT and smart farming system. Monitoring environmental conditions are the major factor to improve the production of efficient crops. IoT devices and communication methods related to wireless sensors encountered in farming applications are studied in detail. The system proposed in this paper uses ESP8266 NodeMCU, DHT11 Temperature, and Humidity Sensor, Soil Moisture Sensor, PIR sensors, mq135 air quality sensor, Jumper wires, LEDs bulb, exhaust fan, cooling fan, and live data feed can be monitored on serial monitor and Adafruit MQTT protocol platforms. This will allow the farmer to manage their crop easily and efficiently..

Keywords: Internet of Things, ESP8266, Soil Moisture Sensor, PIR sensors, MQ135 air quality sensor, MQTT Broker

1. Introduction

Ethiopia's economy and livelihoods mainly depend on the agricultural sector. However, strong dependency on rain-fed systems has made the sector particularly vulnerable to rainfall and temperature fluctuations. Climate change would slash national gross domestic product (GDP) by 8-10% by 2050 according to International Centre for Tropical Agriculture, but climate-shock-related damage adaptation steps may be halved. As the cropping rate has decreased, food prices are rising slowly. There are many reasons responsible for this, such as water pollution, poor soil fertility, misuse of pesticides, climate change or diseases, etc. So, smart agriculture using IoT is recommended for the Ethiopian Agricultural system. Without using this technology, thinking to change the economy of Ethiopia is difficult. Successful interference in agriculture is very critical and the approach uses IOT [1]. The Internet-of-Things or IoT is a way of linking something to the Internet, connecting objects or things that are not previously connected, and the primary purpose of the IoT is to ensure that specific information is accessible to the right users. The internet is creating a contemporary future, a quantifiable and tangible environment in which citizens and institutions can understand their farm and make more timely and higher-knowledgeable judgments about what they need or have been offered to do. Most of the time, Intermittent drought, land loss exacerbated by overgrazing, erosion, high tax rates, and poor connectivity are impacting agriculture [2]. There is an opportunity for food self-sufficiency and for the production of exports of cattle, seeds, and other agricultural products when the farming system is smart. Smart farming system is one of the best choices all over the world [3]. Many other economic activities, including the marketing, manufacturing, and export of agricultural products, depend on agriculture. The output is largely subsistence in nature, and the limited agricultural cash-crop market offers a substantial share of commodity exports. Coffee is the main foreign exchange earner and Ethiopia is also exporting many bags of coffee per year [4]. IoT will produce many real-life style modifications in the world with the aid of sensing our surrounding ecosystem, growing our fitness, comfort, and protection, even as on an identical time improving power efficiency and comfort. A brand-new source of present-day wealth forecasting would be the IoT. Combining conventional approaches with new technology, such as the Internet of Things will contribute to the modernization of agriculture. This project utilizes agricultural IOT technologies, capturing environmental parameters of crop growth to help farmers find any problems of farming. The important thing is that IoT is no longer the sensor but the software - whether or not wearables or smart farm systems. progress is not performed by way of sensors by myself, the era wishes a substantially unique manner today's thought, and it's going to make the effort to certainly adopt the brand-new machine. Our main objective is to change the traditional farming system of Ethiopia using smart agriculture by using IoT.

2.Literature Survey

Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk [5]. This paper examines current IoT, core supporting technology, and major industrial IoT implementations, and outlines the patterns and challenges of study. This study paper contributes mostly by thoroughly illustrating the emerging state-of-the-art IoT industry. Recently, Internet-of-Things, which is aimed at reducing inefficiencies and improving efficiency in all sectors, has been starting to influence a large array of industries and manufacturing companies from engineering to health, networking, and energy in agriculture Sill, IoT notably in the near future, considering this progress [5]. When you look closer, you feel that the new applications barely touch the surface and that the actual effect of IoT and its use is not yet shown. The smart farming system is an evolving concept of technology where data is collected using smart electronic sensors from many agricultural fields ranging from small to large scale and their surroundings. To draw short-term and long-term conclusions on weather patterns, soil fertility, current crop quality, the amount of water required for the next week to a month, etc, experts and local farmers analyze the data collected. Now in this, our idea is to control the farm switch especially the piano switch which is connected to different loads like temperature sensor, fan, water pump, moisture sensor, etc [6]. A more up-to-date state of water level management, evaporation of rivers and tanks is that the proper use of water is desperately needed [7]. The purpose of this paper is to propose a Novel Smart farming system using IoT to provide immediate data (temperature, soil humidity) for efficient monitoring, allowing smart agriculture to improve overall standards and product quality.

Brief paper presentation: This paper provides insights into the development of a paradigm for rigorous farming work [8]. To conform to this use of the temperature and humidity sensors for the observation of production, a measurement is carried out which can be changed into a microcontroller-based enactment for the monitoring of water volume with the edge estimates of temperature and soil moisture. One of the core fields of IOT-based science and the introduction of new products on a daily basis is "agriculture." Agriculture is a key component of the research process. Agriculture is considered to be the most important field for food security worldwide. Talk to Indian farmers who are currently in serious difficulty and at a disadvantage in terms of agricultural growth, technology, trade, government regulations, environmental conditions, and so on. An ongoing field detection, regulation of the explicit accuracy of the site direct moving water system network to extend productivity with neglected water use, by using the conveyed remote sensor system framework Y. Kim was developed. The platform offers promising remote controls as well as remote controls for water accuracy [7].

3.Architecture and Process

3.1. Hardware Design

While the integrated system looks intimidating, but instead it is a series of components mounted on the PCB. We used EasyEDA to design the PCB in the best way we can. The novel futures for this integrated PCB design are that it contains a buzzer, 16 channel multiplexing, four output appliances, and five sensors. The buzzer can be connected with any sensors by defining in the Arduino code. 74HCT4067 Multiplexer/demultiplexer systems are analog or digital 16:1 application. The Switch consists of four digitally chosen inputs (S0, S1, S2, and S3), 16 different I/Os (Yn), one common I/O (Z), and a digital input activated (E). The switches will be switched off when E is Big. Clamp diodes are part of the inputs. This requires the use of current interface resistors in excess of VCC to voltages.

The Printed Circuit Board is very important for all electronic devices which are used for either conventional or industrial use. It also provides mechanical support in addition to electrically connecting the electrical sections. It includes 16 analog-digital multiplexing channels that allow multiple analog sensors to be connected since NodeMCU has only one analog pin (A0) [8]. In this PCB, we installed five analog pins and four appliances for output devices. The project works on a DC source given by a 12v adaptor. The brain of the project is the ESP8266 Wi-Fi module. The PCB can handle up to 5 sensors and 4 output devices at a time, obtain input sources from another source and react accordingly to the output.

3.1.1 Sensors and Appliance Connectivity

In the connection of hardware assembly, we use the Esp8266 Wi-Fi module as the brain of the project. First, we placed the Esp8266 Wi-Fi module with the 16- channel analog-digital multiplexer since Esp8266 has only one analog pin which is A0. 16 analog-digital multiplexers receive A0, GND, and VCC, and send as an output 16 pins which act as analog pins for this system. In the relay section we used four pins, they are D1, D2, D5, and D6 through a resistor to smooth and ensure the data transfer to each of the appliances. Then BC547 transistor is connected between the ESP8266 and relay to act as a switch. 1n 4007 diode is used at the pick to rectify the current. At the end relay is attached to the end section to get command from ESP8266 and act accordingly.

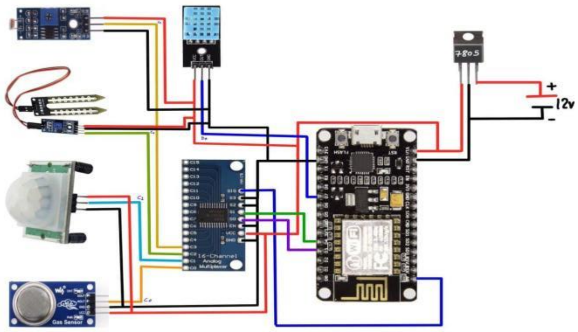


Fig 1. Sensor’s connectio

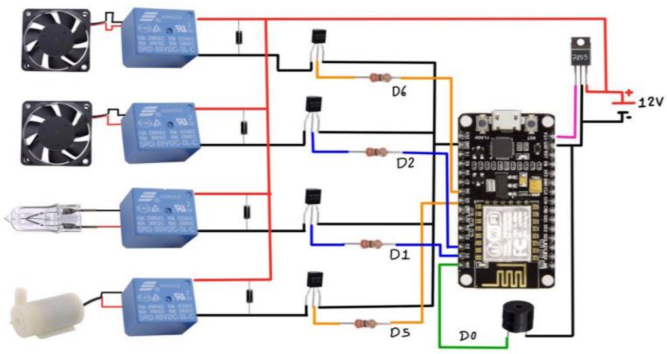


Fig 2. Appliance connection

Combining appliances and sensors connection, we can get below PCB which is a multifunctional printed circuit board that simultaneously monitors different sensors function such as soil moisture sensor, humidity and temperature sensor, gas sensors, and PIR sensor. On the side of the appliance, we have artificial lighting for indoor plants, exhaust and cooling fan, and a DC water pump which can be monitored manually or automatically through Adafruit IO platforms. All these works can be done by the system we proposed in this paper.

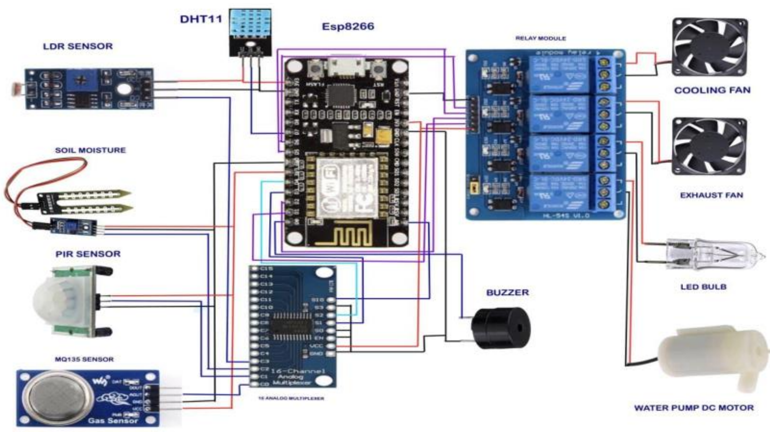


Fig 3. Over all Connectivity of the system

We are using the built-in Esp8266 12E wi-fi module as the center and brain of the project. Different sensors are connected to the Esp8266 micro-controller through PCB (Printed circuit board). Sensors will collect parameters of the farm like Temperature, Humidity, Soil moistness, and Sunlight. When the temperature sensor Sends the instant data of the temperature to the Adafruit cloud to store, it again can automatically send the command to the cooling fan if there is excess heat recorded by the Adafruit.

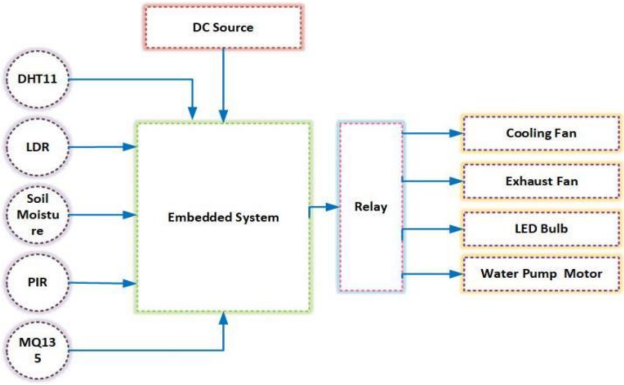


Fig 4. System Architecture

When the soil moisture sensor sends the condition of soil whether it's is wet or dry the micro-controller will send the command to the DC Water Pump Motor if the soil is dry enough. The notification is sent to the Adafruit MQTT broker as a message and the values are created on the page and the rancher is represented points by item. Equipment including a Dc water pump, air cooling fan, exhaust ventilation, and fireworks can be manually turned on/off by the Adafruit IO platform or automatically using sensor data in manual mode. Except for the Soil moisture sensor pad, all other sensors should be water proved or avoid from water contact. Water contact will create malfunction to the project as a general.

Fig 5. System testing

3.2 Protocol and Technics

Adafruit is a website for viewing, reacting, and communicating with data from the project components. It retains privacy and security for your results. The company manufactures and sells many electronic devices, parts, equipment, and accessories for electronics. It also produces several learning materials, including electronics, technology, and programming-related life and recorded videos [9]. We retain both MQTT and REST APIs, like many of the services we have added, which is how you can interact over the Internet with Adafruit IO. But there's no need for you to be an expert programmer! With lots of examples, we've developed robust client libraries.

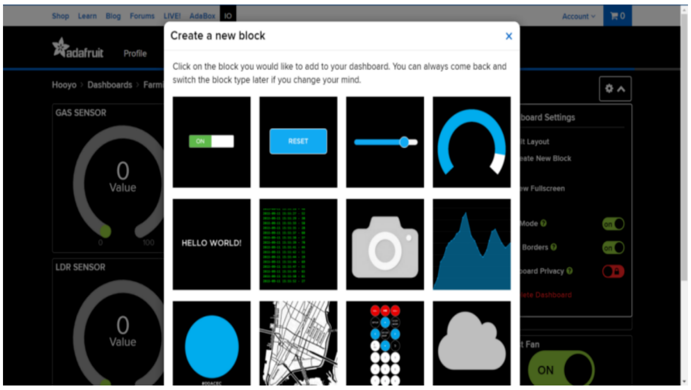


Fig. 6. Adafruit mqtt Protocol Create A block

A cross-platform application written with C and C++ functions is the Arduino Integrated Development Environment (IDE) (for Windows, macOS, Linux). It is used for writing and uploading programs to suitable Boards for Arduino, although other device prototype boards are also supported by third-party cores. Version 2 of the GNU General Public License opens the IDE source code. Arduino IDE supports C and C++ languages utilizing specific code structuring rules [10]. A program library from the innovative solution is supplied with the Arduino IDE, which contains many separate input and output procedures.

3.3 Workflow Diagram

the flowchart below shows the workflow of the system we proposed in this paper. starting from initiating the device and connecting with the internet to publish, subscribe to the Adafruit IO platforms. The flow chart shows all sensors related to the system such as the sensor of soil humidity, the sensor of humidity, and the gas MQ 135.

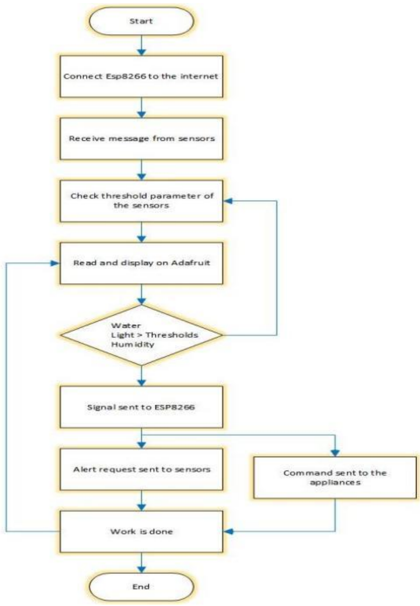


Fig. 7. Workflow Diagram

4.Result Anaysis

We also performed with an existing area on the Adafruit IO platform to test the approach suggested in this article. We have examined the proposed approach using other methods in analysis. Conventional farming and greenhouse techniques are by using a timer to monitor soil moisture. Every 1-minute information will be updated from the soil humidity, and an additional sensor will be connected to the farm in the evening and the morning since the greenhouse uses a timer to track the ground moisture. We also tracked and recorded any statistics of each part of the plants in order to know the rate of increase, production rate, and water-saving rate of each system in our experiment. By comparing both the farm and the system proposed, the solution presented is better than the conventional farm as the figure shows, 85% and better than a timer for soil humidity monitoring is 73%. Similarly, as seen in the figure, the suggested treatment is 71% more production effective than the standard farm. An online site has two halves – the Back End where the data is processed and the Front End where you connect with a Web browser. You wouldn't have to manage the back end at all for most Internet providers you use regularly. Adafruit Io also produces single diagrams to interpret data from all sensors to ensure a smooth and sustainable environment.

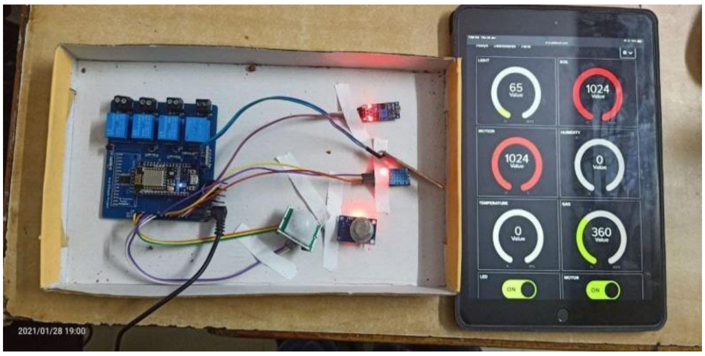
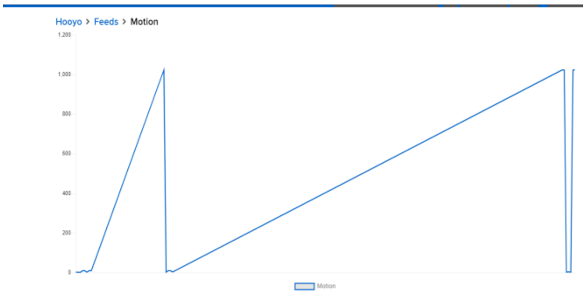


Fig. 8. Live data collection through Adafruit

Fig. 9. Live Data Collecting



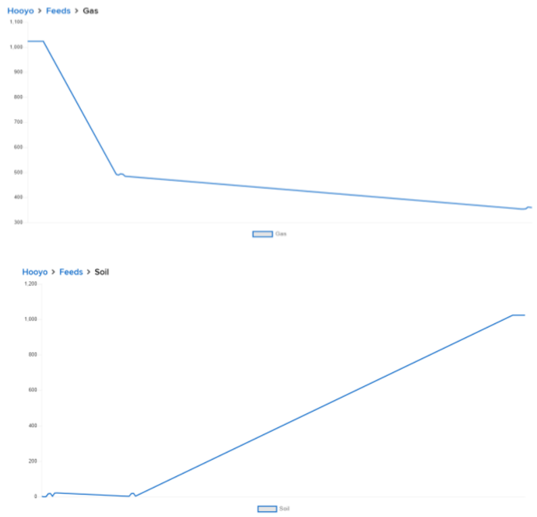


Fig. 10. adafruit Io different sensor graphs

A. Crop observation A crop display is another major component of exactness farming. The IoT also helps in the production of the irrigation tanks' and motors' clear working time following seed demands, for example, to propagate pesticide and insecticide sprays. This research has introduced a smart tracking system for soil conditions, where the IoT captors in the field supply, process and transfer the requested data to the PUBSUB, which is the virtual storage site for data loss and data difficulty in offline storage in Google Cloud Console [16].

B. Climate observation and greenhouse farming The Internet of staff for Climate Observation has been the most important standard of many farm owners. Because the technologies are integrated with good agricultural sensors and that they gather a great deal of knowledge from the settings and send this to the cloud to define the climatic conditions. How is the Internet of Things planning to refer to the agricultural sector? The Internet of Things, in summary, refers to the technology that shares information through the internet and may behave on each other. The Internet of Things in Agriculture could be a set of Internet of Things concentrates on providing information on crops and animals, evaluating their well-being, related issues with a great deal of efficiency than the desire for human intervention.

C. Tracking the farm Increased use of recent technologies in agricultural goods. Precision farming can guarantee high returns for a commercial enterprise if one doesn't have its full potential; it will make it easier for farmers to combat the negative effects of nature on crops by pooling remote sensing awareness. Compost, farm animals, and plant, and a variety of inter-and intra-field information. Accuracy agriculture additionally supplies inputs here inappropriate quantities of groundwater, liquid chemicals, vitamins and minerals, agrochemicals, thus reducing its waste of resources and therefore lowering the significance of farming.

5.Application

Any part of the conventional system of agriculture is radically altered by the implementation of the first recent sensing and Internet of technological elements in agriculture. Today, integrated implementation of wireless sensors and even Things online will make agriculture unimaginable [12]. The Internet of Things can continue to perpetuate solutions to many traditional agricultural challenges by adopting intelligent farming methods, for example, drought solutions, yield control, land appropriateness, irrigation, and pestilence prevention. Although the most relevant instances where modern technology tends to increase total performance at different levels. Also identified as precision farming is precision farming that makes farming more accurate and regulated when it comes to agricultural production and growing [9,10].

Management of irrigation: modern farming needs a better management method of irrigation in order to optimize water use in agriculture and related activities [12,14,15]. Four considerations have been used in an incredibly intelligent irrigation system, just as real-time prediction data are implemented, farmers' system can be regulated from anywhere in the world using a home, Wi-Fi and Ethernet networking are feasible, humidity sensors are connected to a farmyard configuration and monthly bills are minimized while minimal water is maintained. Regulation of pesticides and diseases: Controlled use of pesticides and fertilizers often helps to improve seed quality and to minimize agricultural costs. We would however like to monitor the frequency and occurrence of pesticides in crops and monitor the use of pesticides. We will need to gather bug information with sensor nodes, sorting, mining, etc. in order to foresee this [11].

6.Conclusions

We developed an integrated framework for a Smart farm system That reduces the time and resources needed while lowering Manually conducting it. This module contains smart farming system technologies for continuous monitoring of temperature and soil moisture using adafruit MQTT protocol. In collecting live temperature and soil humidity data the system has high levels of performance and accuracy. The Internet - of - things smart farming system we proposed would help farmers increase agricultural yields and carry effective care of agricultural production while the device would often continue providing farmers with more than 99 percent reliable results to provide a precise live feed of ambient temperature and precipitation. This scheme is cost-effective and practicable. Even, it reflects on Optimizing the use of water supplies to tackle challenges such as water shortages and to ensure Sustainability.

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