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ABSTRACT

IoT is essential to agricultural technology. As IoT sensors may provide data regarding the agricultural fields, smart agriculture is a novel phenomenon. The goal of the article is to employ IoT and intelligent agricultural production utilizing innovative technology. The main component to increase the production of productive crops is to identify environmental conditions. This article's characteristic involves employing CC3200 single chip-based sensors to observe the climate and humidity in farmlands. The camera is connected to the CC3200 so that pictures can be taken and sent via MMS to the farmers' mobile devices over Wi-Fi.
Keywords: IoT, Temperature, NWP, CC3200

1 Introduction

IoT is commonly employed it to link devices and gather data. IoT platforms are employed in conjunction with Internet of Things to manage and communicate with data and data-related information. Users of the system can record their sensors, produce data streams, and analyse data. IoT may be used in many different agricultural methods. Smart cities, intelligent surroundings, smart irrigation, smart metres, safety and emergency, factory automation, smart farming, security systems, and e-health are a few examples of IoT applications. The "Internet of Things" is built on a technology that can analyse the data sensed and then broadcast it to the user.

Why is IOT necessary for agricultural production?

The Food and Agriculture Organization of the UNs has conducted research that indicates that in 2050, the world's food production must increase by 70% to accommodate the growing population. Agriculture is the backbone of the human population because it provides the majority of the food and plays a significant role in the growth of a country's economy. Moreover, it provides people with lots of great opportunity alternatives. Conventional farming practises are still being used by the farmers, which leads to a low crop and fruit output. The crop output can therefore be increased by adopting automated machinery. In order to increase yield, it is required to use contemporary technology and research to farming. By observing the efficacy of the land, temperature and moisture, rain, fertiliser effectiveness, checking water tank storage space, and even fraud identification in agricultural regions, we may anticipate a production increase at a cheap cost. Agriculture can become more modernised by inter-combining conventional practises with cutting-edge techniques like WSNs and the IoT. The Wireless Sensor Network gathers information from many sensor kinds and transmits it wirelessly to the central server. There are numerous more elements that have a significant impact on productivity. Insect and pest attacks that can be prevented by applying the appropriate insecticides and pesticides, as well as attacks by birds and wildlife as the crop matures are among the reasons. Because to erratic monsoon rains, scarcity of water, and inefficient water utilisation, agriculture yields are dropping.

2 Recent Works

Research on IoT-based smart farming was proposed by Nikesh Gondchawar et al. [1]. The article's goal is to use robotics and Internet of Things technology to make farming smarter. Intelligent GPS-based wireless router robots will handle tasks like watering, humidity detection, and other tasks like cleaning. It incorporates smart decision, reliable real-time farm data-driven watering, control technologies, and smart logistics management. It keeps an eye upon that warehouse's leakage detection, moisture, and temperature management. Smart devices will be used to accomplish all of the processes, and they will do so by integrating sensors. ZigBee components, a camera, and controllers with a raspberry pi controller each and every detector. Three Modules are connected directly to microcontrollers utilising a raspberry pi and wireless technology. Employing wireless router robots for automatic watering systems and smart warehouse control systems, this research provides data on field operations, irrigation difficulties, and storage concerns.

Rajalakshmi P. et. al. [2] discussed utilizing soil moisture content, humidity and temperature sensors, light sensors, and an intelligent irrigation facilities to manage crop fields. In order to keep the server information, the sensor information is encoded in JSON format and wirelessly transmitted to the web application. When the humidity and temperature content of an agricultural field are at risk, the watering equipment will automatically turn on. Occasionally, alerts are delivered to farmers' mobile devices, allowing them to remotely check on the state of their fields. The components utilised here include the soil water sensor, the temperature and DHT11, the LDR, the web server (NRF24L01), and the humidity sensor. This methodology is 92% more effective than the traditional method and will be particularly beneficial in locations with a lack of water. Information from an automated system of irrigation was recorded in a MySQL database by use of a PHP script. According to an evaluation of the water requirements, an individual motor pump uses an average of 2 Ah of electricity every day.

According to Tanmay Baranwal et al [3].'s initiative, this work focuses on the safety and protection of farm products against rat or harmful insects in the farms or crop storage. After detecting the issue, security system utilizes real-time alert to deliver information. Python scripts are used to combine sensors and digital equipment. A program is created based on the collected information to provide precision in notification to the user and repelled deployment. The device is set up in the corner of a 10 sq. m. space for evaluation. When the PIR sensor detects temperature, the URD sensor and webcam turn on.84.8% of test scenarios that were attempted resulted in success. Extending the surveillance system would be beneficial to stop rats from entering crop storage facilities.

Nelson Sales et al. [4] presents WSNs. Information such as temperature and humidity are acquired, collected, and analysed by the network's three nodes. The use of agricultural irrigation reduces water usage and has a positive impact on the environment. The Wireless Sensor and Actuator Network's great processing and storage capacity for large amounts of information makes cloud computing an appealing alternative. Farming, greenhouses, golf resorts, and environments are the focus of this project. Three major components make up the structure: a WSAN component, a cloud platform element, and a software component. There are three main kinds of nodes in it, including sink nodes, sensor nodes, and actuator nodes. A straightforward protocol called SimplitiTI is used to execute WSAN in a cluster tree architecture. The moisture in the soil detectors determine whether plants require water for healthy growth and resource management.

Mohamed Rawidean Mohd Kassim et al. [5] discusses Precision Agriculture (PA). A WSN is the ideal solution for agricultural issues like field management, data integration, and resource management in agriculture. This method gives farmers recent data about the fields and harvests to them in making informed choices. The hardware architecture, network design, and systems development control of the smart irrigation system are explained by IOT-based accurate farming system. In a feedback mechanism, the software gathers information from the sensors and, based on a threshold level, initiates the controllers. By irrigation, WSN execution in PA maximises crop productivity while simultaneously maximising the use of water fertiliser.

The architecture and execution of greenhouse farming technology are described in LIU Dan et al [6].'s research, which uses the CC2530 chip and is based on Zig Bee technology. It primarily serves as a method for observing the environment. The CC2530F256 core is used in wireless sensor and control nodes for obtaining data, computation, transmission, and receiving. Here, a computer uses wireless technology to present the involved individual with all the real-time data, including fan and temperature conditions. This system employs sophisticated greenhouse management and monitoring. Farms can use it to sow crops in a regulated and systematic manner.

3 Proposed System Model

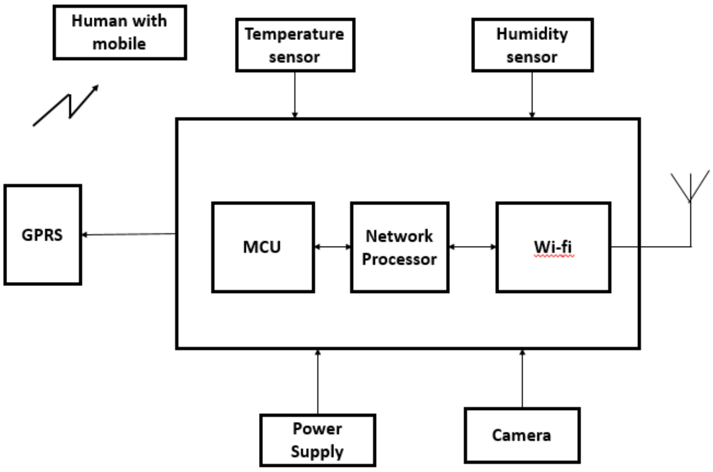

Figure 1: *Block diagram of proposed system*

The major component of the suggested system, the CC3200, combines a microcontroller, a network processor, and a Wi-Fi module on a single die. It is lightweight, battery-powered, quick and reliable connectivity, and accessible. Changes in the climate will impact the crop's overall output. In order for a plant to develop and stay healthy, there are certain criteria that must be met. Sensors are utilised because it is critical to track the state of crop fields. TMP007, a temperature infrared thermopile sensor with an integrated digital control and math engine, is employed. It measures temperature data in real time and tracks relative air moisture in an area of crops using a humidity sensor called HDC1010. Using the MT9D111 camera sensor, the camera is connected to the CC3200 camera booster pack via a PCB. This is utilized to take recent pictures of the specific field, and those pictures are communicated to the farmer via GPRS.

4 System Design

4.1 Description of CC3200 Launchpad

CC3200 Single chip with integrated network processor (NWP), Wi-Fi, and microcontroller. The communication sub-system and an integrated MCU program processor are both present in the CC3200. The CC3100 advantages are integrated, making it the first better than the existing Wi-Fi wireless microcontroller with user-specific functionality. 200kB of application code on the MCU is easily accessible and completely unrelated to Wi-Fi processing. Parallel camera, ADC, SPI, UART, I2C, PWM, I/O s, integrated power monitoring, and RTC are some of the peripherals. The CC3200 is a wireless networking device that uses 802.11bgn and a full network stack. Through the networking sub-system, user programming in the CC3200 microcontroller manages its power mode.

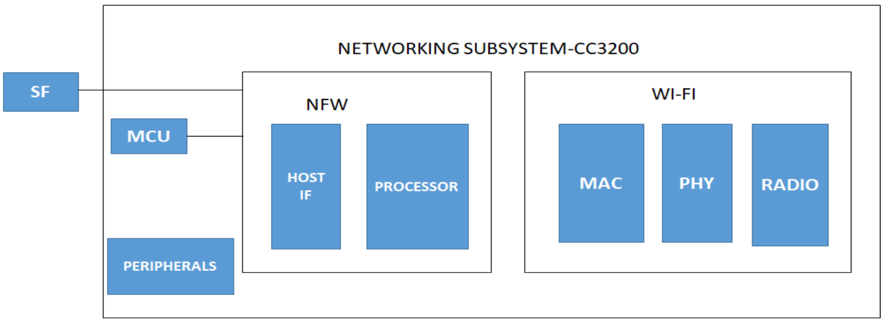

Figure 2: *Block Diagram of CC3200*

The CC3200 Launchpad is a quick and inexpensive platform for developing and evaluating microcontroller-based systems with a focus on low power. Configurable user buttons, RGB LED for unique applications, and integrated simulation for debugging are some of its characteristics. For connecting peripherals like graphical displays, antenna selection, environmental monitoring, etc., there are a tonne of Booster Pack add-on boards offered.

4.2 Important Features of CC3200

- An embedded microprocessor Internet-on-a-chip system.
- The ecology of the 40-pin Launch Pad and Booster Pack.
- A sequential port-based JTAG emulator for Flash development.
- Three LEDs and two buttons for interactivity.
- USB-connected universal asynchronous receiver/transmitter for PC.
- A chip antenna on board.

Power modes: They are depending on the three factors listed below for the CC3200. MCU program controls the microcontroller subsystem's switch mode. The mixture of MCU and NWP mode controls chip level power mode while the power mode of the NWP is continuously sustained.

Table1: *CC3200 Power Modes*

MCU POWER MODES	Networking sub systems		
	Disabled	LPDS	Active
Hibernate	Hibernate	N/A	N/A
LPDS	LPDS	LPDS	Active
Sleep	Active	Active	Active
Active	Active	Active	Active

Temperature Sensor (TMP007): The TMP007 temperature infrared thermopile sensor, which includes an installed math engine, is employed in this study. Inside the specified field, this sensor collects power from an object with wavelengths between 4 um and 16 um. The interior block diagram of TMP007 is displayed in Figure 3.

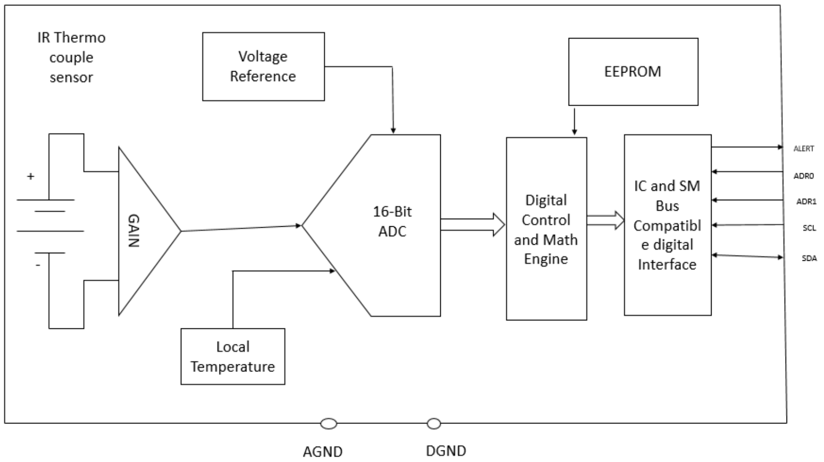

Figure 3: *Internal block diagram of TMP007*

In order to determine the necessary field temperature, it has a math engine that measures the corresponding voltage variation across the thermopile with an inbuilt cold-junction reference (1°C (max) from 0°C to +60°C and 1.5°C (max) from -40°C to +125°C). Accreditation coefficients can be stored in the TMP007's non-volatile memory. The TMP007 is made with flexibility and a minimal power supply in mind (2.5V to 5.5V). I2C and SM Bus are suitable with the TMP007 device. TMP007 measures 1.9 mm by 1.9 mm by 0.625 mm in dimension.

Humidity Sensor (HDC1010): Utilizing a digital humidity sensor, the HDC1010, which uses little electricity, accurately measures the amount of air that is moist. At high relative humidity, it maintains excellent durability. The wafer level chip scale package, or WLCSP, makes board construction simpler. The HDC1010 has greater resistance to sand, dirt, and other ecological contamination. Normalization data is stored in non-volatile storage on the HDC1010 coefficients. I2C is suitable with the HDC1010.

Power supply: In this case, a 600-W high-efficiency power supply with a phase-shifted full bridge converter has been used. It transforms a regulated 12-V output from a 370 V to 410 V DC input. The UCC28950 was employed to drive synchronous rectifiers on the secondary side of the complete bridge converter in order to achieve great performance. The explosion mode of the UCC28950 is in use. The DCM function (Discontinues Current Mode) is to fulfil Green-Mode specifications and improve no-load efficiency. Using a DCM comparator, meant to shut down the synchronous rectifiers when lighter loads (20%) reaches a critical conduction.

5 Conclusion and Future work

The "Internet of Things" is extensively employed to inter-connect gadgets and gather data. This system for observing farming is dependable and effectual, and it permits for the execution of remedial action. Wireless field tracking restricts the demand for human labour and authorizes users to precisely track developments in agricultural productivity. It costs fewer money and uses less energy. The technology for smart farming has indeed been created and assembled. The new method is much more effectual and advantageous for farmers. If the air humidity and temperature in a farming deviate from the ideal range, MMS is used to notify the farmer. The technology can be applied to greenhouses and plants that require specific temperatures. The use of such a technology on the farm can undoubtedly aid in accelerating agricultural harvesting and globalisation. Further upgrades to this technology could include the use of solar energy and various current irrigation approaches.

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