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Development of IoT Based Smart Security and Monitoring Devices for Agriculture

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Abstract:

The goal of creating Internet of Things (IoT)-based smart security and monitoring devices for agriculture is to improve agricultural systems' security and monitoring capabilities. The goal of this project is to create and deploy a network of networked devices that may be used in agricultural situations for improved security, remote management, and real-time monitoring. This technology gives farmers early warning systems, effective control over their agricultural operations, and insightful information by utilizing IoT sensors, data analytics, and cloud-based platforms. Creating an all-encompassing IoT-based smart security and monitoring system for agriculture is the aim of this project.

Key Words: Arduino, power supply, GSM module, Wifi module, DC fan

I. Introduction:

Agriculture plays a crucial role in ensuring food security and sustaining the growing population. However, traditional agricultural practices face challenges such as limited monitoring capabilities, inadequate security measures, and inefficient resource utilization. To address these issues, the development of IoT-based smart security and monitoring devices for agriculture has gained significant attention. This project aims to design and implement a comprehensive system that leverages IoT technology to enhance security and monitoring capabilities in agricultural environments.

Smart farming technologies have empowered farmers which help them to complete with significant problems they face through much better remedies. The growth pattern and environmental parameters of crop growth provide scientific guidance and optimum counter measure for agriculture production.

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Existing System:

In traditional agricultural systems, farmers often rely on manual monitoring and face limitations in real-time data availability. This hampers their ability to make informed decisions and respond promptly to changing conditions. Moreover, the lack of robust security measures leaves agricultural assets vulnerable to theft, vandalism, and unauthorized access. The existing systems lack integration of advanced technologies and fail to provide efficient solutions for addressing these challenges.

Proposed System:

The proposed system focuses on the development of IoT-based smart security and monitoring devices for agriculture. The key components of the system include sensors, cloud-based platforms, data analytics techniques, and remote management interfaces. The system will enable real-time monitoring, efficient resource utilization, enhanced security measures, and remote control of agricultural operations. The system will integrate various sensors such as temperature, humidity, soil moisture, and light sensors into the agricultural environment. These sensors will continuously monitor the key parameters essential for crop growth and transmit the data to the cloud-based platform for analysis.

Fig.1.Smart Agriculture Monitoring System[2]

II. Literature review

2.1 Srisruthi, S.; Swarna, N.; Ros, G.M.S.; Elizabeth [1]

Land, water, and energy are only a few of the natural resources that must be dedicated to agriculture. Due to a number of economic issues, including rising input costs, declining farm incomes, dwindling labor and land availability, and ecological issues like soil erosion and water pollution, the quality and quantity of these natural resources have deteriorated over time, endangering the viability of agricultural operations in the future. The solution to this is to implement sustainable agriculture, which encourages the careful management and cultivation of crops with minimal use of pesticides and fertilizers as well as the measured use of finite natural resources like energy and water through controlled irrigation and fertigation techniques with the aid of electronic control systems and green sensor technology. All of the natural resources—land, water, and energy—must be devoted to agriculture.

2.2 Mr. Brodt, S.; Six, J.; Feenstra [2]

Large amounts of food, fuel, and fiber are produced on farms and ranches around the country, and they are all reasonably priced. Although this abundance is a sign of success, it frequently comes at the price of long-term agricultural productivity, public health, and the environment (Liebman and Schulte 2015; Steffen at al. 2015; Kremen and Miles 2012). Many fields are kept naked when not in production, are planted with the same crop year after year, and are frequently and intensely disturbed by machinery to control weeds and assimilate agricultural residues. The soil may be eroded, contaminated, and otherwise degraded by such activities. Numerous farms and ranches in the US generate enormous amounts of fuel, food, and fiber that are sold for reasonably low costs. A lot of fields are planted with the same crop every year, mechanically disturbed often and intensely to suppress weeds and absorb agricultural leftovers, and left naked when not in use. Such actions can contaminate, erode, and otherwise deteriorate the soil.

2.3 Reddy, T.; Dutta [3]

The purpose of the research is to use a simple regression analysis to examine the relationship between agricultural inputs and agricultural GDP in the Indian economy from 1980–1981 to 2015–2016. The dependent variable is agricultural GDP, while the independent variables are pesticides, fertilizers, net irrigated area, electricity, rainfall, and HYV seed usage. Based on the analysis, it can be concluded that factors such as net irrigated area and fertilizers do not have a statistically significant effect on agricultural GDP from 1980–1981 to 2015–2016. The research also shows that variables such as electricity, rainfall, seeds, pesticides, and rainfall are statistically significant, and it is concluded that these variables had a significant effect on agricultural GDP over the specified data period.The use of HYV seeds, fertilizers, pesticides, electricity, rainfall, and net irrigated area are considered independent factors, whereas agricultural GDP is considered the dependent variable. According to the study, the factors that affect agricultural GDP between 1980–1981 and 2015–2016, such as fertilizers and net irrigated area, are not statistically significant. According to the study, there is a substantial correlation between the variables pesticides, electricity, rainfall, and In addition, the analysis shows that these factors are statistically significant.

2.4 Ferrandez-Pastor [4]

There are definite advantages to applying information technologies to precision agriculture techniques. Although precision agriculture maximizes output efficiency, raises quality, minimizes environmental impact, and uses less energy and water, its widespread adoption has been hampered by a number of issues. Several primary obstacles include costly hardware, challenges in operation and upkeep, and the ongoing development of sensor network standards. These days, new technological advancements in embedded devices (hardware and communication protocols), ubiquitous computing (ubiquitous sensor networks), and the development of Internet technologies (Internet of Things) make it possible to create systems that are less expensive, simpler to install, control, and maintain, and that use standard protocols that consume little power. Another issue is the widespread planting of crops resistant to herbicides combined with heavy herbicide use. Herbicide-resistant "superweeds" have evolved as a result, and herbicides have drifted onto nearby farms, posing new difficulties for certified organic systems and other farms growing crops that are not resistant to herbicides.

2.5 **N.**Srivastava [5]

Chemical pesticides are used more and more in agriculture to manage the pests that harm the crops. The effective pesticides that farmers have access to are severely limited due to growing pest resistance, secondary pest outbreaks, and increased concern over the environmental effects of pesticides. Farmers must choose when to irrigate pastures, apply fertilizer, or relocate cattle to another pasture as

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weather patterns shift, crops mature, and cattle graze pastures for food. A farmer uses his experience, intuition, and visual observation to make decisions. He also needs to spend a lot of time conducting periodic surveys across a large plantation. Technology for acoustic detection is a far superior replacement for these tedious tasks. Since sugarcane takes ten to eighteen months to mature, it is susceptible to various insect, pest, and disease attacks. Their attacks cause a 19–20% drop in production. Management of diseases and insect pests is crucial to raising crop productivity.

III. Working Principle

This IOT based Agriculture monitoring system makes use of wireless sensor networks that collects data from different sensors deployed at various nodes and sends it through the wireless protocol.

A. Block Diagram

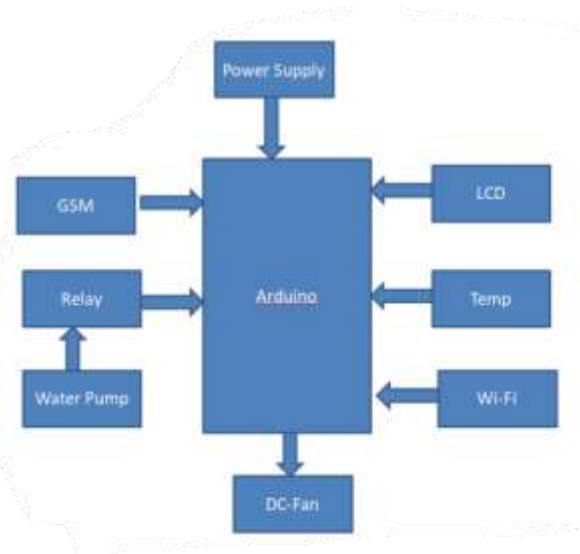

Fig.2.Block Diagram

B.Architecture

Device uses 3 interface for data collection, analysis and transmission. IoT architecture is categorized in 3 level architecture and five level architecture. Figure - 1 shows the working phenomena of device based upon 3 level architecture[13].

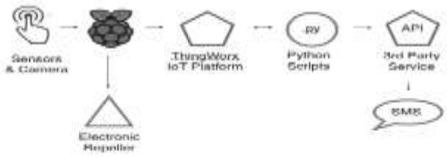

Fig. 3. Device's Architecture

These layers, categorised as

• Perception layer : Layer which is used to differentiate the different type of sensors used in device.

• Network layer : Layer used for process and transmit the information over network.

• Application layer : This layer is responsible for various practical application based on users' need.

IV. Circuit Design

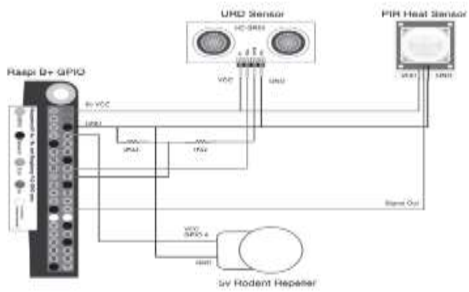

Fig. 4. Device's connectivity using RasPi's GPIO Header

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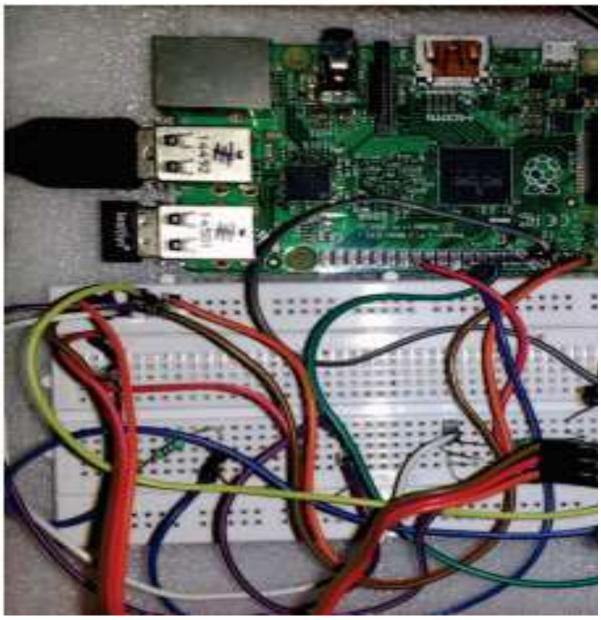

Fig. 5. circuit of Prototype

The sensors and camera is connected to GPIO header. PIR sensor has three pins as VCC, OUT and GND, while ultrasonic ranging device (HC-SR04) contains four pins as TRIG, ECHO, VCC and GND. Device also contains a ultrasonic sound based rodent repeller which will be activated by server based upon data analysis. Raspberry pi B+ GPIO header is consists of 40 pins which includes 5v, 3.3v, GND and 26 GPIO pins and 2 ID-EEPROM pins to provide connectivity to I/O devices.

A. Area and Device Installation

For circuit (Figure - 3) installation, a space was selected as working area. Since the device is consists of one heat sensor, one ultrasonic ranging device and repeller, space selected was a small area with the size of 10 sq. m.; The device was installed in the corner with sensors facing same side and camera fixed at some height.

B. Data Analysis

After installing and activating the device, scripts which was written in python language is used to identify motion of rodents using heat sensor which provides descrete values. Considering these descrete values as flag signal, URD sensor was activated to calculate the distance of rodent and simultaneously webcam daemon is activated to capture a snap of area. Ultrasonic ranging device and web camera is dependent upon the values generated by PIR sensor

C. Data Transmission.

The analyzed data and information is further stored in SQL based database provided by ThingWorx's IoT platform (Figure-4) using cURL command line tool and library through HTTP protocal. Further, a SMS application programming interfeace is used to deliver analyzed information to user including IP address of the server to access webcam daemon.

V. Conclusion

The development of IoT-based smart security and monitoring devices for agriculture offers significant potential to revolutionize traditional farming practices. By leveraging IoT technology, farmers can benefit from real-time monitoring, efficient resource utilization, enhanced security measures, and remote management capabilities. The proposed system aims to address the limitations of existing agricultural systems by integrating sensors, cloud-based platforms, and data analytics techniques. It has the potential to optimize agricultural operations, improve productivity, and contribute to sustainable and efficient farming practices.

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