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Real Time Animal Detection In Agricultural Field Using IOT

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Abstract: Farming is a major input sector for economic development of any country. Livelihood of majority of population of the country like India depends on agriculture. In this project, it is proposed to develop a Smart Farming System that uses advantages of cutting an edge technology such as IoT, Wireless Sensor Network and Cloud computing to help farmers enhance the way farming is done. Four IR sensors is placed in Four direction such as north, south, west and east in order to prevent animal entry. If any animal is detected then it alerts by buzzer and alert through IoT app. Using sensors like temperature, humidity, IR sensors are used to get information about the field and help farmers to take precise decisions on insights and recommendations based on the collected data. The device is IoT enabled by connecting to Wi-Fi using NodeMCU.

Keywords – Real Time Monitoring, Animal Detection, Agricultural Field, IoT Devices, NodeMMCU.

I. INTRODUCTION:

This technology is designed to assist farmers in achieving two critical goals: satisfying the growing demand for food while minimizing the environmental footprint of agriculture. To assess the effectiveness of these pilot applications, researchers employed a three-pronged approach: user testing, benchmarking against similar projects, and in-depth examination of the pilot applications themselves.

The project team recognizes the importance of a wide range of stakeholders. The target audience for this document includes those directly involved in the project, decision-makers who can influence its implementation, farmers who will be the end users, and developers of agricultural software who can integrate this technology into their products. Smart Farming, which leverages information and communication technologies (ICT), is proposed as a solution to the complex challenges facing modern agriculture. This document dedicates a full chapter to exploring user feedback on the pilot applications, providing valuable insights into the practical considerations and potential benefits of this technology. Another chapter delves into the economic, environmental, and social impacts of Smart Farming.

One specific section focuses on how Smart Spraying can contribute to more efficient resource utilization, potentially reducing costs and environmental impact. The technical specifications of the pilot software are also explained in detail. The software architecture adheres to a Service-Oriented Architecture (SOA) and utilizes RESTful Web APIs to facilitate seamless integration with existing farm management systems.

II. EXISTING SYSTEM:

Protecting crops from destructive animal pests is a constant battle for farmers, impacting both yield and profit. Traditionally, farmers have relied on various methods to achieve this. One such method is slash-and-burn agriculture, where land is cleared by burning existing vegetation. While effective, this technique can have detrimental effects on the environment. Another approach involves superficial tillage by hand, where the soil is prepared for planting without deep plowing. Additionally, traditional farmers often practice mixed cropping, planting a variety of crops together in a single field. This strategy can confuse pests and make it harder for them to target a specific crop variety. Finally, traditional methods typically avoid the use of external inputs like fertilizers and pesticides, relying more on natural methods of pest control.

However, modern advancements offer alternative solutions. Today, farmers have access to sophisticated animal detection and repellent systems. These systems may utilize electronic sensors to detect animal presence, triggering repellent devices like sound emitters, flashing lights, or even water sprinklers to deter pests. Additionally, modern farming practices often involve targeted treatments using specific pesticides or deterrents for particular animal species. This approach can be more efficient and minimize the environmental impact compared to broad-spectrum solutions.

In conclusion, both traditional and modern methods offer ways to manage animal pests in agriculture. Traditional approaches rely on manual labor, mixed cropping strategies, and minimal external intervention. Modern methods, on the other hand, leverage technology for detection and targeted deterrents, potentially increasing efficiency and reducing environmental harm. The choice between these approaches depends on various factors, including the scale of the farming operation and economic considerations.

III. PROPOSED SYSTEM:

Traditionally, farmers have relied on manual scouting and intuition to protect their crops from animal pests. However, this approach can be time-consuming and inefficient. New technologies offer a smarter solution: Internet of Things (IoT) enabled animal detection systems. One such system utilizes strategically placed infrared (IR) sensors to create an electronic fence around a crop field. Four sensors, positioned facing north, south, east, and west, can effectively monitor animal movement from all directions. Whenever an animal crosses this invisible barrier by breaking the IR beam, the system springs into action.

An IoT application connected to the sensors receives the alert and triggers an alarm. This can be a loud ringer or flashing lights, designed to startle and deter the animal from entering the field. The application can also send a notification directly to the farmer's smartphone, providing them with real-time information about the potential threat. Beyond just basic detection, these IoT systems can be equipped with additional sensors to gather valuable data about the field environment. Temperature and humidity sensors can provide crucial insights into factors that might attract pests. For example, high humidity can create ideal breeding grounds for certain insects. Armed with this information, farmers can take proactive measures, such as adjusting irrigation practices, to create a less hospitable environment for pests.

The collected data doesn't just provide a snapshot of the current conditions; it can be analyzed over time to identify patterns and trends. Advanced IoT systems can leverage this data to generate insights and recommendations for the farmer. Imagine receiving a notification suggesting adjusting the timing of pesticide application based on historical data and predicted weather patterns. The power of an IoT system lies in its ability to connect the farmer to their crops. By providing real-time data and actionable insights, these systems empower farmers to make informed decisions and take targeted actions to protect their crops. This not only reduces potential losses from animal damage but also allows for more efficient use of resources, contributing to a more sustainable agricultural approach.

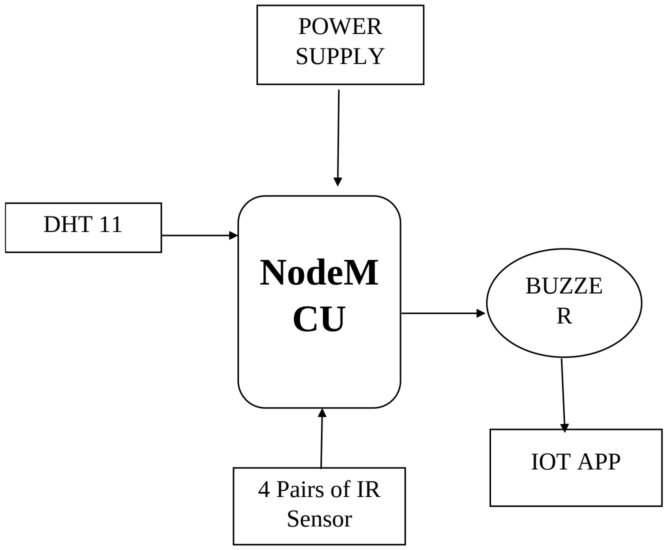

Fig 3.1 Block Diagram

3.1 COMPONENTS REQUIRED:

- NodeMCU
- DHT 11 (Temperature & Humidity)
- IR sensors
- ArduinoIDE

IV. THEORETICAL BACKGROUND:

Wireless Sensor Networks (WSNs): These networks consist of spatially distributed, low-power sensors that collect data and communicate wirelessly. IR sensors used in the system function as part of a WSN, detecting animal movement and relaying the information.

Internet of Things (IoT): This concept envisions a world where physical objects are embedded with sensors and actuators, allowing them to connect and exchange data over the internet. The animal detection system embodies this principle by connecting the IR sensors and alarm system to an IoT application via Wi-Fi using a NodeMCU microcontroller.

Machine Learning (ML): While not explicitly mentioned in the scenario, some advanced IoT systems incorporate machine learning algorithms. These algorithms can analyze sensor data over time to identify patterns in animal behavior or environmental conditions that correlate with pest activity. This information can then be used to generate predictive alerts or suggest preventive measures.

Precision Agriculture: This approach aims to optimize agricultural practices by using technology to collect and analyze data about specific areas of a field. The animal detection system contributes to precision agriculture by providing real-time data on potential threats, allowing farmers to target their pest control efforts more effectively.

Biomimicry: While not directly involved in the technical aspects, the use of IR sensors can be seen as inspired by nature. Many animals, including some insects, utilize infrared radiation for sensing their environment. The system replicates this ability to detect animal movement through the invisible IR spectrum.

V. HARDWARE DESCRIPTION:

DHT11 SENSOR:

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit micro controller, offering excel lent quality, fast response, anti-interference ability and cost-effectiveness.

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones.

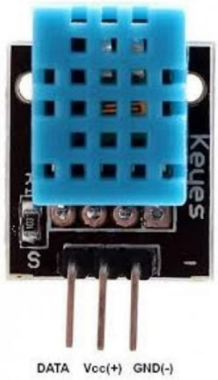

Fig. 5.1 DHT11

ESP8266 NodeMCU:

NodeMCU is an open-source firmware and development kit that helps you to prototype or build IoT products. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266.

With just a few lines of code you can establish a WiFi connection and define input/output pins according to your needs exactly like arduino, turning your ESP8266 into a web server and a lot more. It is the WiFi equivalent of ethernet module. Now you have internet of things (iot) real tool. With its USB-TTL, the nodeMCU Dev board supports directly flashing from USB port. It combines features of WIFI access point and station + microcontroller. These features make the NodeMCU extremly powerful tool for Wifi networking. It can be used as access point and/or station, host a webserver or connect to internet to fetch or upload data.

ESP8266 is highly integrated wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems or to function as a standalone application with low cost and minimal space requirement. The module supports standard IEEE 802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking or building a separate network controller.ESP8266EX offers a complete and self-contained Wi-Fi networking solution, it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated Wi-Fi chip in the industry. It integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules. It requires minimal external circuitry and the entire solution, including front-end module are designed to occupy minimal PCB area.ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the Wi-Fi functionalities.

ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs. Espressif System's Smart Connectivity Platform (ESCP) demonstrates sophisticated system-level features which include fast sleep/wake context switching for energy-efficient VoIP, adaptive radio biasing for low-power operation, advance signal processing, spur cancellation and radio co-existence features for common cellular, Bluetooth, DDR, LVDS,LCD interference mitigation.ESP8266EX is embedded with Tensilica L106 32-bit micro controller (MCU), which features extra low power consumption and 16-bit RSIC. The CPU clock speed is 80MHz. It can also reach a maximum value of 160MHz. ESP8266EX is often integrated with external sensors and other specificdevices through its GPIOs.

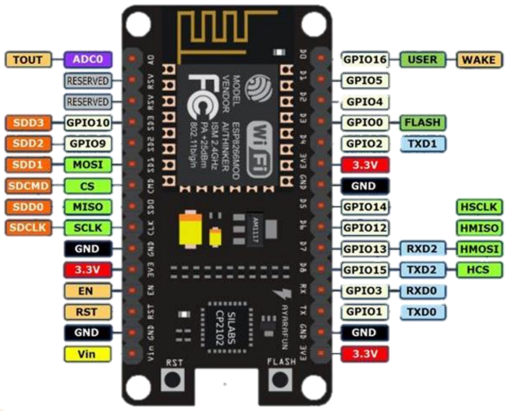

Fig. 5.2 ESP8266 NodeMCU

IR SENSOR:

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

The working principle of an infrared sensor is similar to the object detection sensor. This sensor includes an IR LED & an IR Photodiode, so by combining these two can be formed as a photo-coupler otherwise optocoupler. The physics laws used in this sensor are planks radiation, Stephan Boltzmann & weins displacement.

Fig. 5.3 IR Sensor

VI. SOFTWARE REQUIREMENTS:

Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a free, open-source software application that allows you to write code (called sketches) for Arduino microcontroller boards. It provides a user-friendly interface for beginners and a powerful environment for experienced programmers. Here's a breakdown of the key features of Arduino IDE according to the Wikipedia definition:

Integrated Development Environment (IDE):

Combines all the tools needed for writing, compiling (converting code into a format the Arduino board understands), and uploading code to the Arduino board in a single software package.

Free and Open-source:

Freely downloadable and allows users to modify and contribute to the source code, fostering a large and active developer community.

Writing Code (Sketches):

Provides a text editor with syntax highlighting for Arduino programming language (based on C/C++) to simplify writing and debugging code.

Compiling and Uploading Code:

Offers tools to translate your code into a format the Arduino board can understand and upload it to the board's memory for execution.

VII.SIMULATION OUTPUT:

Fig 7.1 Project Kit

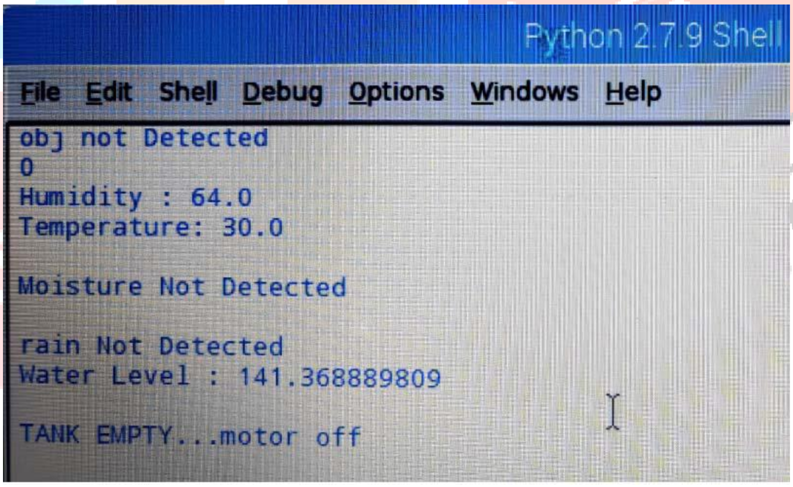

Fig 7.2 Output

VIII. CONCLUSION:

The agricultural sector is of vital importance for the region. It is undergoing a process of transition to a market economy, with substantial changes in the social, legal, structural, productive and supply set-ups, as is the case with all other sectors of the economy. These changes have been accompanied by a decline in agricultural production for most countries, and have affected also the national seed supply sectors of the region. The region has had to face problems of food insecurity and some countries have needed food aid for IDPs and refugees.

Due to the relatively low demographic pressure projected for the future, the presence of some favourable types of climates and other positive factors, including a very wide formal seed supply sector, it should be possible to overcome problems of food insecurity in the region as a whole, and even to use this region to provide food to other food-deficient regions. Opportunities must therefore be created to reach these results.

In order to address the main constraints affecting the development of the national and regional seed supplies that are mentioned here, the region requires integrated efforts by all national and international stakeholders and institutions involved in seed supply and plant genetic resource management. On practical issues, lessons learned by some countries could be shared with other countries; e.g. on how to progress with the transition or how to recognize the most immediate needs of farmers. Appropriate policies should also be established, at various levels, in order to facilitate seed investment and development in the region.

IX. RESULT AND DISCUSSION:

RESULT:

The adoption of IoT-based animal detection systems in agriculture holds significant promise for both farmers and the environment. These systems offer a multitude of benefits that can revolutionize how farmers protect their crops and manage their resources.

For farmers on the frontlines of food production, the most immediate impact lies in reduced crop loss. Early detection and deterrence of animal intrusion can significantly minimize damage to crops. Imagine a field protected by an invisible shield, where real-time alerts and automated deterrents prevent animals from reaching vulnerable crops. This translates to higher yields, increased profits, and a sense of security for farmers who have long battled animal pests.

Beyond immediate threats, these systems empower farmers to make informed decisions. Real-time data on animal activity and field conditions, collected by temperature and humidity sensors alongside IR sensors, paints a comprehensive picture of the agricultural ecosystem. Armed with this information, farmers can strategically plan their pest control strategies, allocating resources only where and when necessary. This targeted approach not only optimizes resource use but also minimizes the environmental footprint of farming practices.

The benefits extend beyond just efficiency. IoT systems can also contribute to labor savings. Automating animal detection through a network of sensors frees up valuable time for farmers to focus on other critical tasks, such as crop maintenance or strategic planning. The time saved can be reinvested in improving overall farm operations and exploring new opportunities for growth.

Perhaps the most exciting outcome lies in the potential for data-driven insights. By analyzing historical data on animal activity and environmental conditions, farmers can identify trends and patterns. Imagine being able to predict future animal incursions based on historical data and weather forecasts. This proactive approach allows farmers to take preventive measures, further safeguarding their crops and ensuring a bountiful harvest.

DISCUSSION:

While IoT animal detection systems hold promise for agriculture, a productive discussion needs to consider both advantages and challenges. Expanding the system's scope to target diverse pests and integrating it with existing farm management tools can maximize its impact. However, cost-effectiveness remains a concern, especially for smaller farms. Discussions should explore solutions like subsidies or leasing models. Security, technical expertise, scalability, and environmental impact also require attention. Ensuring data privacy, providing training for farmers, and using eco-friendly materials are crucial. Finally, discussions should explore how to make this technology accessible to small-scale farmers globally, promoting a more equitable and sustainable food system.

By fostering a comprehensive discussion that addresses these key points, we can move beyond simply recognizing the potential of IoT-based animal detection systems. We can unlock the true potential of this technology to empower farmers, optimize resource use, and ensure a more sustainable future for agriculture.

X. ACKNOWLEDGEMENT:

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