IoT-BASED CONTROL AND PEST MANAGEMENT IN THE COTTON FIELD

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Abstract - Monitoring pest insect population is a big issue in crop protection. At farm level it is continuously checked by a human operator for disseminated through the field, where insects remain stuck when attracted. This is a labor and time-consuming activity yet it would be of great advantage to farmers, to have an atomized system for doing necessary tasks of pest control and after yield conflicts. In the present times, farmers face a major crisis due to the entry of more middle men into the sales cycle and hence as a result they were unable to get their right pay. One such costlier crop is cotton, which at budding stage is attacked by Bollworm, results in 30-40% of loss in crop cultivation. We can predict such mishaps with the aid of certain environmental factors, which leads to the growth of such worm. Hence on the confirmation pesticides can be sprayed automatically. As the demand rises in the market, as per the customer requirement, the goods are supplied directly from the farmer to the retailer with the aid of IoT and hence as a result the need for middle men is cut down so as to ensure that the farmer gets his right pay.

Key Words – Arduino Mega 2560, Cotton field, Farm automation, IoT

A. MOTIVATION FOR THE PROJECT

The common method for detection of pest or disease damage in crops is by visual inspection of the foliage in the field. Such methods are labor intensive and costly, and only a limited number of field samples can be examined at any one time. Also with fields counting methods small areas of pest/disease onset in healthy paddocks may often go undetected. Furthermore the effects of many pest/disease infestations are often not noticeable to the human eye, until it reaches an advanced stage when it becomes too late to control the outbreak.

B. EXISTING TECHNOLOGY

The Existing method failed to perfectly control the pests [1]. There is no pest monitoring system for sugarcane. The human eye is not so perfect to detect the bugs and larvae and it became one of the major issue in this existing method. After that another method came that has been developed with acoustic sensor and PIR sensor. This proposed design system used Arduino for monitoring the noise and temperature. Another existing system utilized the use of Digital Image Processing for monitoring pest activities in the field [2], [4], however it is of high cost and needs bulky equipment to be placed in the field. Another technology describes the monitoring of pest insect population by using wireless sensor network in field.

This illustrates a system based on a distributed imaging device operated through a wireless sensor network [3] that is able to automatically acquire and transmit images of the trapping area to a remote host station. The station evaluates the insect density evolution at different farm sites and produces an alarm when insect density goes over threshold. It uses zig-bee module for trans-receiving purposes.

C. DEMERITS OF PREVAILING TECHNOLOGY

These prevailing technologies were either bulky in size or inappropriate for practical use. Most of them were of high cost and showed less efficiency. Manual system was one of the most dis-advantageous system and hence these low level automation came into picture, yet showed some demerits. First system used an acoustic sensor, to detect sound by which insect and pest movement can be detected. But it gave only a lesser frequency of success. Many hindrances due to environment made the system to malfunction.

Another system made use of digital image processing camera to focus the crops and thereby to monitor the insects, but this system requires cameras to be focussed on the crops and thereby resulted in implementation of more cameras and it increased the cost.

D. PROPOSED SYSTEM

The main aim of our project is to control pest in cotton field using IoT. In this the IoT acts as a transceiver from which data is transmitted from the Arduino to the cloud and vice versa. The information like humidity, soil conditions, climatic conditions are taken from the local sensor placed in the field. The information from the cloud is accessed using IOT and thus it further actuates the sprayer. Depending upon the weather conditions of the cotton field, the presence of the pest BOLLWORM in the field is analyzed and it actuates the solenoid valve and the corresponding pesticide is sprayed automatically, with the aid of pump and sprinkler. This project reduces the man power by automatic spraying system. This is beneficial to the farmers, because of the reduction in labor cost and time consumption.

II. COMPONENTS AND ITS PROPERTIES

A. ARDUINO MEGA 2560

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. Arduino ATMEGA is a microcontroller board based on the ATmega2560 which is shown in Figure 2.1.

Fig 2.1

An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits.

An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus—so many shields can be stacked and used in parallel. Official Arduino's have used the mega AVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega328-P, ATmega1280, and ATmega2560. A handful of other processors have been used by Arduino compatibles. Most boards include a 5 volt linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the on-board voltage regulator due to specific form-factor restrictions.

This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently, optiboot boot loader is the default boot loader installed on Arduino ATMEGA. [5]

2.2.1 SPECIFICATIONS

The technical specifications of the Arduino ATmega and other related specifications are described on the Table 2.1.

Table 2.1 Technical specifications of Arduino Mega 2560

Microcontroller	ATmega2560
Operating Voltage	5 V
Input Voltage (recommended)	7 – 12 V
Input Voltage (limits)	6 – 20 V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	16 mA
DC Current for 3.3 V Pin	50 mA
Flash Memory	256 KB (ATmega2560) of which 8 KB used by boot loader
SRAM	8 KB (ATmega2560)
EEPROM	4 KB (ATmega2560)
Clock Speed	16 MHz
Length	101.52mm
Width	53.3mm
Weight	37g

B. THERMISTOR

This is a pre-wired, Stainless steel encapsulated and waterproofed version, as shown in Figure 2.2. Handy for when you need to measure something far away or in wet conditions. While the sensor is good up to 125°C the cable is jacketed in PVC so we suggest keeping it under 100Â°C. Because they are digital, you don't get any signal degradation even over long distances! These 1-wire digital temperature sensors are fairly precise (Â±0.5Â°C over much of the range) and can give up to 12 bits of precision from the on-board digital-to-analog converter. They work great with any microcontroller using a single digital pin and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them. Usable with 3.0-5.0V systems. They are generally used for agricultural purposes, audio equipment, automotive, climate control, GPS devices, hard disk drive, medical equipment, set-top boxes, telecommunications etc.

Fig 2.2

C. HUMIDITY SENSOR

This module is based on HR202 resistive humidity sensor as shown in Figure 2.3, which exposes excellent linearity, has a wide measurement range and a low power consumption. The module features both a power output indicator LED and a digital output indicator. HR202 is a new kind of humidity-sensitive resistor made from organic macromolecule materials.

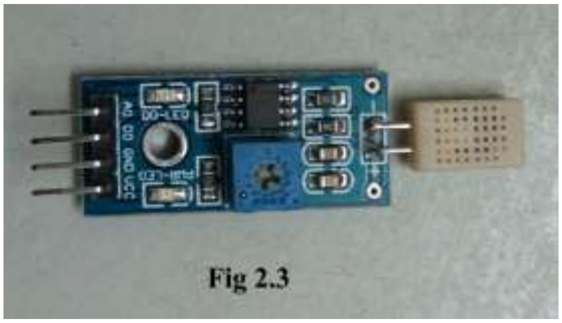

Fig 2.3

This module is ideal for custom humidity sensing applications, and can be used in fields like meteorology, storage facility humidity control, textile industry and other applications which need ambient humidity monitoring. The output is available both as an analog output and as a digital output obtained using a comparator based on LM393 integrated circuit.

D. SOIL MOISTURE SENSOR

Soil Moisture Sensor, as shown in Figure 2.4 is a simple breakout for measuring the moisture in soil and similar materials.

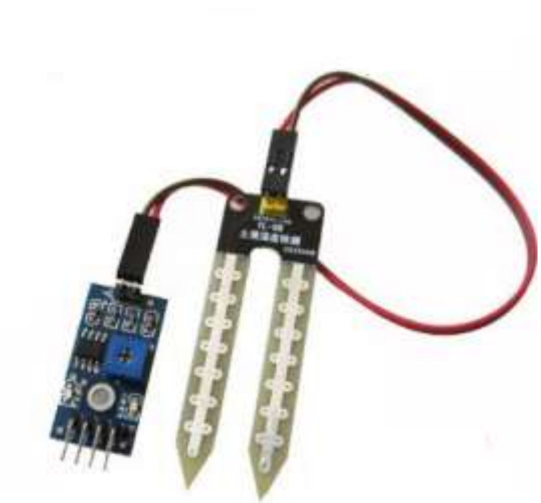

Fig 2.4

The soil moisture sensor is pretty straight forward to use. The two large exposed pads function as probes for the sensor, together acting as a variable resistor. The more water that is in the soil means the better the conductivity between the pads will be and will result in a lower resistance, and a higher SIG out.

To get the Soil Moisture Sensor functioning all you will need is to connect the VCC and GND pins to your Arduino-based device (or compatible development board) and you will receive an analog and digital out which will depend on the amount of water in the soil.

E. WIFI TRANSCEIVER

The ESP8266 WiFi Module, as shown in Figure 2.5 is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area.

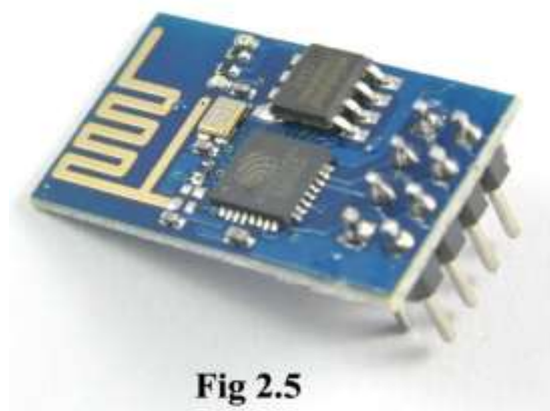

Fig 2.5

F. SOLENOID VALVE

A solenoid valve, as shown in Figure 2.6 is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off.

Fig 2.6

A solenoid is a coil of insulated or enameled copper wire wound on a rod-shaped form made of solid iron, solid steel, or powdered iron. Solenoid valves are found in many applications and are commonly used in refrigeration and air conditioning systems. Two-way solenoid valves have one inlet and one outlet, and are used to permit and shut off fluid flow. The type of valve used here is a Normally Closed (NC) solenoid valve, in which the Fluid is shut off when the coil is de-energized, flows through the valve when the coil is energized.

III WORKING

In this proposed system Figure 3.1, a cluster of inputs from various sensors like soil moisture sensor, humidity sensor and temperature sensor are taken as an input and is connected with the microcontroller.

It is further computed and compared with the pre-stored data, with respect to the information provided in the Tamil Nadu Agri University (TNAU) website to detect the presence of the insect BOLLWORM in the cotton field and if detected, pesticide is sprayed on with the aid of sprinklers fitted in the field.

It also detects the soil water level by manipulating the data from soil moisture sensor and temperature sensor and if the soil water level becomes too low, automatically water gets sprayed on to the field. Information from the sensors is displayed real-time in an LCD provided in the front panel. Safe level indicators for all the three parameters are provided in the front panel.

Fig 3.1

The data like status of water pump and pesticide sprinkler, sensor data, along with safe limit indication etc., is transferred to the farmer's mobile via IoT and he is given an option in the mobile app to control water pump and pesticide sprinklers remotely. There are certain criteria like spraying of pesticide into a cotton field must be done once in 24 days and this project paves a way by having a program lock, which turns on the solenoid of pesticide tank only once in 24 days.

The fully functional developed prototype module is as shown in the Figure 3.2.

Fig 3.2

IV DESIGNED MODEL

The proposed model was designed and simulated using the following software before building its prototype.

Solid Works (Mechanical Cad Software)

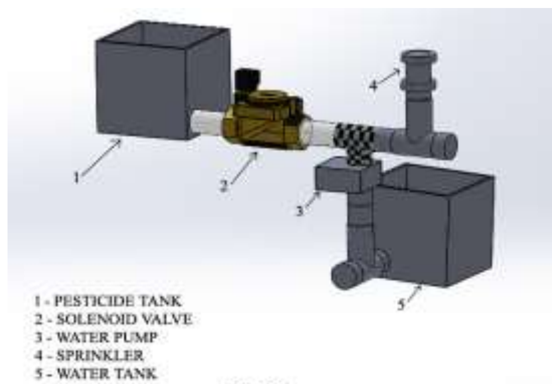

Fig 4.1

Solid works software offers flexible 3D mechanical design and product stimulation. Also offers a high–end real time rendering and animation. This contains In-built analysis. The Solid Works model of the proposed model is shown in the Figure 4.1.

V FEASIBILITY STUDY

The feasibility study is the study of factors influencing the success of the product, for the purpose of resource determination. Providing the solution for the project is more possible in an economic way. The components used in this project are easily and cheap which makes it economically feasible. As it involves only cheap components it costs around Rs.7, 000. Hence the proposed system proves it to be economically feasible. The system is also operationally feasible. The system uses simple components which are readily available in the market. And also it is easy to work with them. Hence the system also finds to be technically feasible.

VI FUTURE SCOPE

The future plan of the project is to implement the same in other fields of cultivation. By implementing this, we can analyze the pest and its effect. This is more beneficial as it can detect any pest attack with only the data like temperature, humidity, soil moisture, soil pH, soil EC etc. Through this farmers can easily monitor the crop and cultivate and market it. It plays a major role in any agricultural field which requires protection of crops from pest attack and also helps farmer get his right pay as he is given the option to ask for the amount to the crop that he cultivated. In addition, IoT (Internet of Things) can also be interfaced so that these data can be sent to the farmer's mobile phone directly and also provision for entering the production rate can help the farmer to gain more by eliminating the role of middle men.

VII MERITS AND DEMERITS IN IMPLEMENTING THIS TECHNOLOGY

A. MERITS

- Enhances the growth of crops
- Reduces crop wastage
- Increases profit to farmers by directing him with the retailer
- Cheaper and reliable farm automation.
- Reduces man power
- Eliminates wastage of money given to labours, who spray pesticides to the field

B. DEMERITS

- The sensor may occasionally fail and hence faulty signals could be sent to the microcontroller board
- Requires an WiFi connection for working of IoT.

VIII CONCLUSION

It is important to monitor the cultivation of crops, as nowadays many farmers are committing suicide due to very less yield and very less profit or no profit. Thus it is one of the essential methods for detecting and controlling the pest in cotton field. Since it is an automated technology, it will be of higher accuracy in detecting the pests and it will reduce the man power, thus saves money. In this present era, many farmers are getting cheated and their yields have been exploited by MNCs while they get very less pay for their yields. This is due to the presence of many middlemen between the farmers and stores. This project plays a vital role in cutting down those middle men and hence the farmer could easily get his right pay.

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