Polyhouse Automation using IoT & Image Processing

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Abstract

Polyhouse is the latest method in farming technology and also a growing organic business in developed countries. Polyhouse is creating a virtually real and comfort-table environment to the crop. This method yields more crop than the normal method and it is more organic. Automation in polyhouse avoids the mistakes by the farmer. This system monitors the temperature, humidity, soil moisture, intensity of light in the polyhouse using various sensors. System more focuses on detecting the suspicious object and notify to farmer. Template matching algorithm to process the images and detects the suspicious objects in poly house. The whole farm is controlled and monitored using IOT. Polyhouse field is monitored through the mobile app which is connected to internet, so it becomes easy for farmer to control it from anywhere around the globe.

Keywords: IoT, Ardiuno, Template Matching, Image Processing, Temperature, Humidity, Moisture

I. INTRODUCTION

Farming is a fastest growing business sector in India. More than 50% of Indians having their income source as farming. Also many of the business dependent on farming sector. So it is necessary to increase the production and profit rate and reduces the efforts. Mechanization and modernization of agriculture must infuse telecommunication and internet so as to make considerable impact. Agriculture and allied sectors contributes 24% of the total GDP and some two-thirds of Indian population depends on rural agro-related employment. Poorly maintained irrigation systems and universal lack of good extension services are among the factors responsible. Access of farmers to markets is hampered by poor roads, rudimentary market, infrastructure, and excessive regulation1. Indian farmers also face several other challenges such as small land holding, intermittent power supply, poor yields due to reliance on inefficient methods of farming, too much reliance on natural phenomena such as rainfall and lack of knowledge of modern methods of agriculture.[1]; Polyhouse is one of the best method to increase profit and production. It is creating a virtually real and comfortable environment to the crop. This method yields more crop than the normal method and it is more organic. In traditional agriculture, the crops are being grown in open field under natural conditions where the crops are more susceptible to sudden changes in climate i.e. temperature, humidity, light intensity, photo period and other conditions due to which the quality, yield of a particular crop can get affected and may be decreased. All above mentioned conditions can be controlled using poly house, this concept emerged to undertake adverse environmental conditions such as excess of raining, high temperature, extreme cold condition, air flow etc.[2];

II. POLYHOUSE AUTOMATION

Polyhouse automation is nothing but controlling the environmental parameters like temperature, humidity, light intensity, etc using wireless system. Automation is done using IOT devices like sensors and actuators and they are connected through wireless technologies such as Bluetooth, WiFi. A dedicated control system is used for automation. The farmer can set different control parameters. When the sensor network detects a value that is higher or lower than the predefined threshold, a regulator gets activated to start or stop a mechanical/electrical element. Sensors are installed inside the Poly house. Sensors collect the data and send it to the middleware so that it can be analyzed against the specific threshold. All the activities happening in the polyhouseare notified to the farmer and it is done by android Mobile Application. Mobile application shows the notifications and alerts regarding status of current environment. If farmers wish to control some parameters and devices it can be done using mobile application. System also does the surveillance of poly house. Any suspicious animal which can harm the crop is detected by the system. After detection it generate alert for the user and notified by the mobile application. Detection of animals is done by template matching algorithm.

III. SYSYEM ARCHITECTURE

Here, approach of embedded systems design a polyhouse to control various parameters automatically. The parameters temperature, Humidity, Soil moisture, are monitored and controlled using ARDUINO, transmitted through the WiFi module to the Think Speak middleware and then to the android mobile phone via a Wi-Fi or internet connection. Development process of hardware is a structure imposed on the development which including Printed Circuit Board (PCB) design using DIPTRACE. In this system, python interpreter software is used for programming. This program can receive data with microcontroller and stored in database. By using python interpreter software, Temperature sensor, humidity sensor are interfaced with the microcontroller. This program will start from the polyhouse where the sensors will collect the environmental data. Then, the data were transmitted through WiFi to ThinkSpeak. Overall, in the polyhouse the system monitoring temperature and humidity then transmitted through wireless WIFI and the changes made are monitored on the android application. Arduino Camera is used for surveillance purpose, it captures the video and send it to the MATLAB software using Wifi module. MATLAB analyses the video and generate alert if necessary.

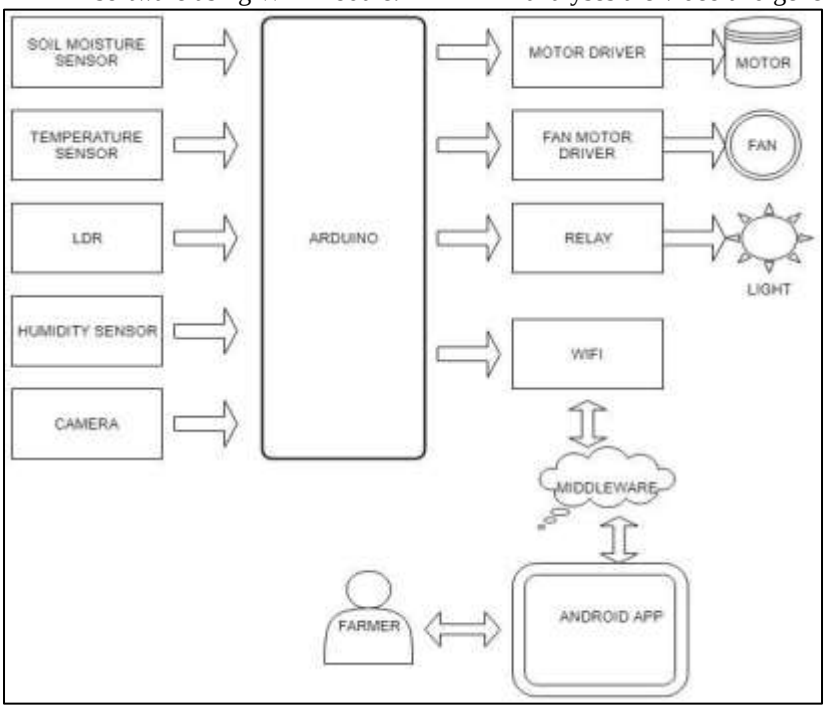

Fig. 1: System Architecture

IV. DEVICES

A. Arduino

The Arduino UNO is an Open-Source Microcontroller board based on the Microchip ATmega328P Microcontroller and Developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other Microcontrollers. [3].

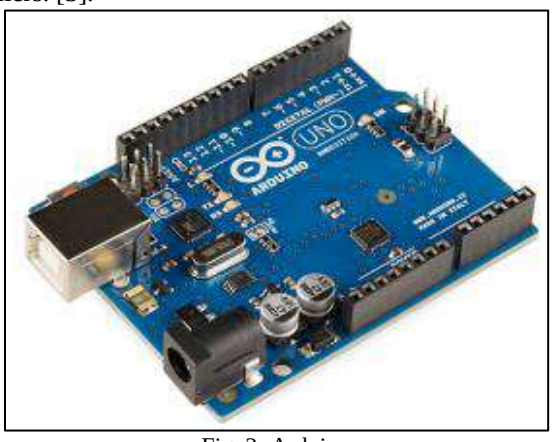

Fig. 2: Arduino

B. DTH11 Temperature & Humidity Sensor

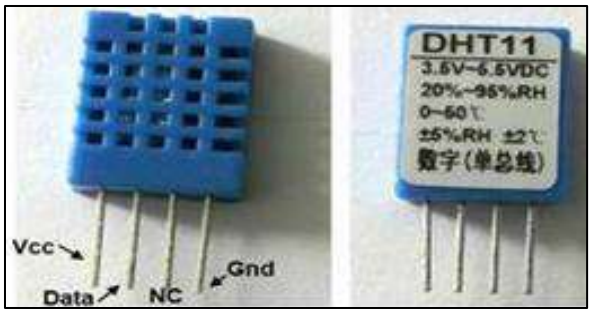

Fig 3: Temperature and Humidity Sensor

Among the variety of temperature and humidity sensors available in the Market, DHT11 is used for the implementation of the proposed System because of its advantages like accuracy, Also it does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.[5] Humidity sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. This sensor sends both temperature and humidity information in the form of digital signals.[4] This sensor uses digital acquisition technology for collecting temperature and humidity. Sensor consist of resistance element which are used for measuring the humidity. This sensor connected with arduino by 4 pins and sends data seraially 40 bits at a time while transmitting the data. [8]

C. Robocraze Soil Moisture Sensor

Soil Moisture sensor used to test the moisture of soil which is useful in smart irrigation. It gives high output when soil is dry and low when soil is wet. This sensor has two probes which are used to conduct electricity through them. As the water increases in the soil electricity can pass easily with less resistance and when soil is dry current passes with low frequency or with barriers as it is having more resistance. It requires 5V DC supply and it operates between 3.5 V to 5 V.[7].

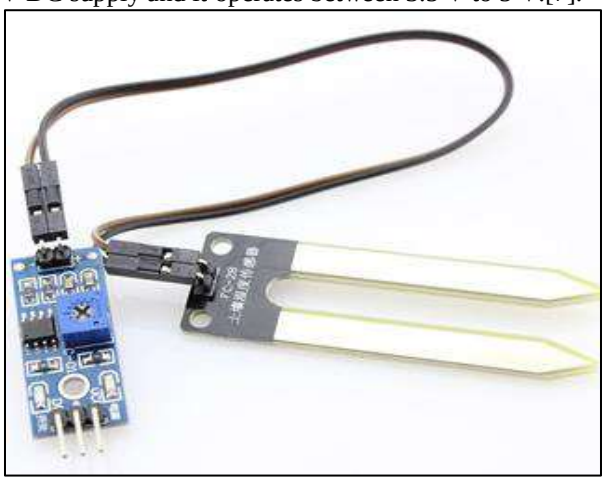

Fig. 4: Soil Moisture Sensor

D. LDR Sensor

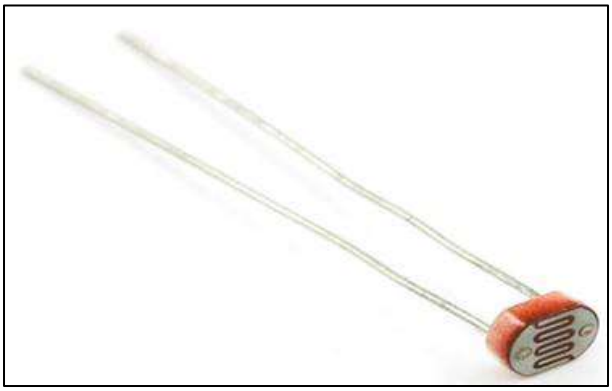

Fig. 4: LDR Sensor

A light-dependent resistor (LDR) connects to a voltage divider circuit, also known as a potential divider (PD), for proper circuit operation. LDR is light dependent resistors which consist of register which measure the intensity of light. As the dark has more resistance and light has less resistance. When light falls on resistor resistance drops up to 1 ohm. Dark resistance is 1Mohm. Sensor resistance vary from 1Mohm to 1 ohm.[9]

V. MATHEMATICAL MODEL

- Q1 = Sense the data.
- Q2 = Arduino send data to Middleware.
- Q3 = Middleware analyzes the data and check for threshold violation.
- Q4 = Send action to arduino if needed.
- Q5 = Arduino send command to actuators.
- Q6 = Send statistic to the user using android application.
- Q7 = Changes by Farmer using android application.
- Q8 = Actuating the action.
- S = Success State

Below figure shows the mathematical model of our system which includes the above mentioned states.

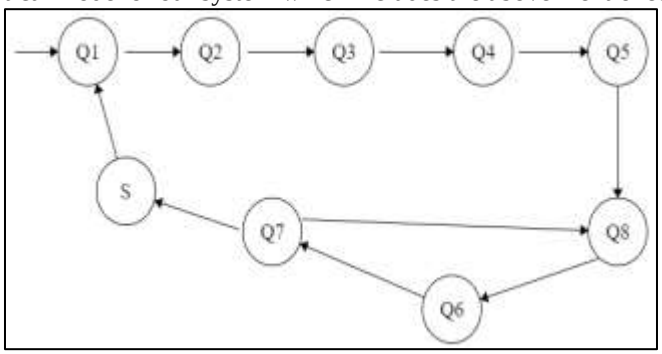

Fig. 5: Mathematical Model

VI. CONCLUSION

In this paper, we have presented the concept of automation in polyhouse using various sensors and actuators. The manual error held by farmer is avoided by this system and also provide the surveillance for suspicious activity in polyhouse. By applying this system farmer will get extra benefit with less effort.

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