Automatic Hydro Culture (AHC)

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Abstract- *Agriculture is the backbone of our country. The available management is not sufficient to that of requirement. Today every person does not have an exact knowledge to manage the crop cultivation and its nutrient requirements. So the main objective of this paper is to develop an automatic system (AHC) that will measure the temperature, humidity and water flow levels to know about its condition and nutrient it requires. Based on the data analysis obtained from the field, necessary actions will be automatically taken by the controller immediately.*

Keywords- Microcontroller, Sensors, RTC, SD-card reader and LCD.

I. INTRODUCTION

Agriculture in India is gradually declining due to destruction of crops by various natural calamities and the crop rotation process being affected by irregular climate patterns. Also, the interest and efforts put by farmers lessen as they grow old which forces them to sell their agricultural lands, which automatically affects the production of agricultural crops. This paper mainly focuses on the ways by which we can protect the crops during an unavoidable natural climate changes and all the parameters related to the crop cultivation which are fully automated which can help the farmer to manage large fields with less effort. The common issues faced during agricultural practices are shearing furrows in case of excess rain or flood, manual watering of plants and security against animal grazing. This paper provides a solution for these problems by helping farmer to monitor and controls various activities [1, 2]. So that the data are transmitted from various sensors placed in the green house to the controller
and the status of the agricultural parameters are notified, monitored and shown to the farmer. Based on identified values, the controller can take decisions automatically.

OBJECTIVE OF AHC

Irrigation is one of the most promising hold for increasing food productivity.

- In this paper, we use Automatic Hydro Culture (AHC) system to improve the irrigation field in agriculture
- The AHC parameters such as temperature, humidity, water flow levels are measured and given as inputs to the controller.
- Based on the data obtained from the field, necessary actions will be automatically taken care of. These data are saved and can be viewed at any time and will be available for future analysis.

So the main objective of this paper is to develop the system that will help the farmer to increase the food production by using resources efficiently.

II. BLOCK DIAGRAM

The proposed AHC system is an embedded system which will closely monitor and control the agricultural parameters of a greenhouse on a regular basis for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. Fig .1 shows the basic model of the AHC that comprises of sensor modules, microcontroller, Real Time Clock (RTC) module, sd-card reader module, motor driver and display unit (LCD). When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports. The microcontroller then performs the needed actions by employing relays until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up, low-cost and effective.

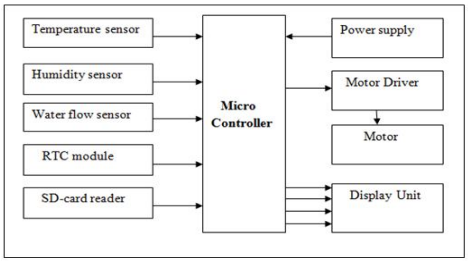

Fig.1 Basic Model of AHC

As the AHC also employs an LCD display for continuously alerting the user about the condition inside the greenhouse, the entire set-up becomes user friendly. Thus, this system eliminates the drawbacks of the existing set-ups mentioned in the previous section and is designed as an easy to maintain, flexible and low cost solution.

III. AHC COMPONENTS

3.1 Arduino-UNO Microcontroller
3.2 Sensors
  3.2.1 Humidity and Temperature sensor
  3.2.2 Water Flow Sensor
3.3 Real Time Clock (RTC) Module
3.4 SD-Card reader Module
3.5 Liquid Crystal Display (LCD)
3.6 Motor Driver and Power supply

3.1 Microcontroller

Arduino is a software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.

Fig.2 Arduino-UNO Microcontroller

This paper uses Arduino UNO board as shown in fig .2. It has 14 digital Input / output pins (of which 6 can be used as PWM outputs), a 16 MHz ceramic Resonator, a USB connection, a power jack, an ICSP header and a reset button. Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips [3].

3.2 Sensors

This part of the system consists of various sensors, namely humidity, temperature and water flow. These sensors automatically sense various parameters- temperature, humidity and water flow level and are then sent to the microcontroller.

3.2.1 Temperature and Humidity Sensor

In this paper, 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. 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.

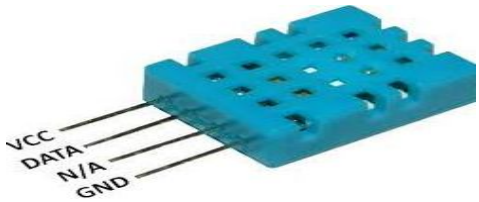

Fig.3a Temperature and Humidity Sensor

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. The component is 4-pin single row pin package. Fig.3a shows Temperature and Humidity Sensor [4].

3.2.2 Water Flow Sensor

Water flow sensor as shown in the below fig.3b which is used to measure liquid/water flow for solar, water conservation systems, storage tanks, water recycling home applications, irrigation systems and much more.

Fig.3b Water Flow Sensor

The sensors are solidly constructed and provide a digital pulse each time an amount of water passes through the pipe. The output can easily be connected to a microcontroller for monitoring water usage and calculating the amount of water remaining in a tank etc [5].

3.3 Real Time Clock (RTC) Module

The DS3231 is a low-cost, highly accurate Real Time Clock which can maintain hours, minutes and seconds, as well as, day, month and year information. Also, it has automatic compensation for leap-years and for months with fewer than 31 days. The module as shown in below fig .3c which can work on either 3.3 or 5 V which makes it suitable for many development platforms or microcontrollers.

Fig .3c RTC Module

The battery input is 3V and a typical CR2032 3V battery can power the module and maintain the information for more than a year. The module uses the I2C Communication Protocol which makes the connection to the Arduino Board very easy [6].

3.4 SD-Card reader Module

The Arduino SD (Security Disk)-Card Module is a simple solution for transferring data to and from a standard SD card. The pin out is directly compatible with Arduino, but can also be used with other microcontrollers.

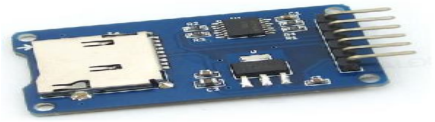

Fig.3d SD-Card Module

The module (Micro-SD Card Adapter) is a Micro SD card reader module as shown in the fig.3d and the SPI interface via the file system driver, microcontroller system to complete the Micro-SD card read and write files.

Table 3.1 Pin Definition of SD-Card

CS	Chip Select
SCK	Serial Clock
MISO	Serial data Out
MOSI	Serial data in
VCC	Voltage Supply (3.3 / 5 V)

Arduino users can directly use the Arduino IDE comes with an SD card to complete the library card initialization and read-write [7].

3.5 Liquid Crystal Display (LCD)

A liquid crystal display, or LCD, is a video display as shown in fig.3e that utilizes the light modulating properties of liquid crystals to display pictures or text on a screen. Since their invention in 1964, LCD screens have grown to be used in a very wide variety of applications, including computer monitors, televisions, and instrument panels. One way to utilize an LCD is with an Arduino microcontroller.

Fig.3e LCD (16 x 4)

By wiring an Arduino microcontroller to the pins of an LCD display it is possible to program the microcontroller to display a desired text string or image on the screen [8]. Interfacing an Arduino microcontroller with an LCD display consists of two parts, wiring and programming [9, 10].

IV. METHODOLOGY to support AHC

The power supply to the microcontroller is given under well biased circuit conditions. The system is connected to the power supply. When the power supply is in ON condition SD-card will be initialized. Temperature, humidity and water level sensors are deployed in the crop field area. These sensors sense the temperature, humidity and water level in a green house. When the threshold value from the sensor is detected, the sensed data from various places of crop field area is transmitted to the system and stored in SD-card. When these values are exceeded the threshold value the motor will be ON automatically and the water is fed to the crop field. If the crops have sufficient amount of humidity, temperature & water levels the motor will be in OFF condition. The above details are continuously monitored and stored in SD-card automatically. Flow diagram fig.4 of AHC is shown below.

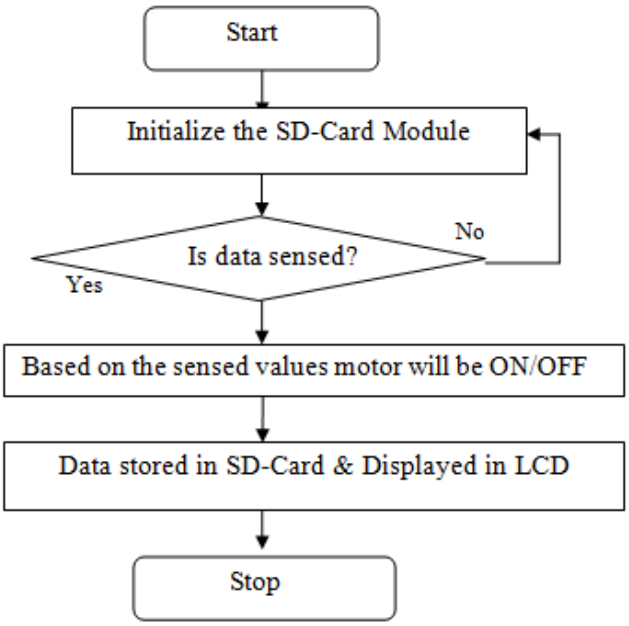

Fig.4 Flow Diagram of AHC

V. RESULTS & DISCUSSION

The hardware that is used for implementation is Arduino-UNO Microcontroller, Power supply, Sensors, RTC Module, SD-card reader Module, LCD. The Arduino-UNO microcontroller is initialized and RTC, SD-card reader, sensors and LCD are connected to the board. SD-card reader is used to store the data and based on the sensed values motor will be on or off. Through this the farmer gets a clear idea about the temperature, humidity, water level of the crop field at anytime.

Experimental Setup

All the AHC components are connected to the microcontroller as shown in fig.1. The AHC parameters such as temperature and humidity are measured from the crop field by using the sensors. We use Arduino IDE (Integrated Development Environment) software for the programming part of the AHC system. Based on identified values motor will be ON/OFF automatically and the above mentioned values are stored in SD-card.

Fig .5a shows experimental setup of AHC. Finally status of the AHC system will be displayed.

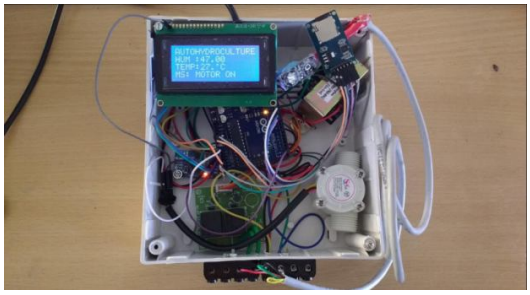

Fig.5a Experimental setup of AHC

. Fig .5b shows the outcome of the AHC system which shows serial monitor output of the measured values of AHC parameters which are stored in SD-card

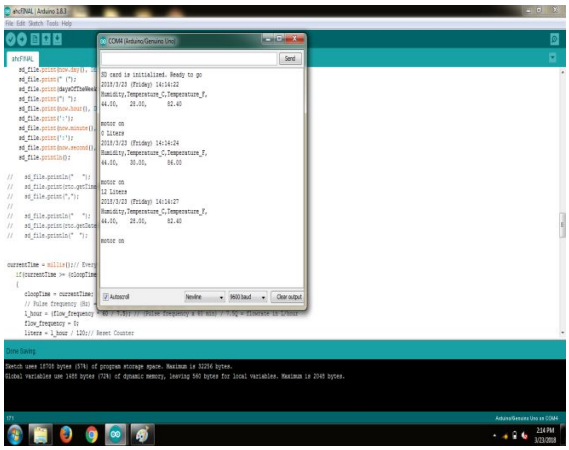

Fig.5b Outcome of the AHC system

VI. CONCLUSION

The new architecture for the **Automatic Hydro Culture (AHC)** system has been designed and different ways of utilizing the sensors in the crop field area are proposed and elaborated. Different readings from the **temperature, humidity and water level sensors** are deployed and analyzed in real time. The proposed work gives efficient monitoring of **green-house.**

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