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# Smart Agriculture based on IOT Control

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## ABSTRACT

Agriculture is the backbone of our country. Growing agriculture products to the increasing population is mandatory at a huge level using smart methods. In this proposed work internet of things (IOT) is adopted for better monitoring and control of soil parameters, environment factors and crop dependent issues towards increasing the productivity. Different methods are employed on transferring the parameter between controller, devices and internet. In this work Wi-Fi communication method applied on signal transfer. Advanced microcontroller based prototype has been developed and thesignificance of the proposed work is studied. Results reveal the suitability of smart crop management system in agriculture.

**KEY WORD**: Internet of things, sensors, Wi-Fi, Microcontroller

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## 1. INTRODUCTION

In this era automatic control is emerging in all fields of engineering on account of increasing the productivity, reducing the losses and minimizing the man power. In the present scenario application of wireless sensors and internet of things (IOT) are involved in all fields which were already had monitored and controlled using nomadic technique and some artificial intelligent based method.Wireless sensors or internet of things are effectively used in the agriculture field for monitoring and controlling the different soil parameters of the land towards increasing the productivity and saving the electric power, water usage and man power.Different types of sensors are used to detect various signals of soil level, crops and environment conditions and also comparable communication techniques are used on communicating the data collected and transmitting the control signals. Control process using microcontroller with increased memory capacity, timer and I/O port are adopted in the agriculture monitoring and control using IOT [1]. Expert systems are evolving [2] in agriculture smart cropping by taking measures on proactive and preventive control actions on diseases and insects to reduce the losses. Agriculture products production to meet out requirement [3] is vital in the developing countries with high population, using IOT automation technology. Wireless sensor network (WSN) is the key role players in IOTbased agriculture production [4]. Developing sensitive high accuracy sensors are very important to use in the agriculture field to sense and collect different parameters of the soil and environment to improve the reliability of the agriculture soil. Traditionally formers made oral observation on the health condition of the crops, soli and environmenton[5] fertilization, pesticides supply and watering. Thismethod produced moderate yield which is uncertain. IOT based sensors application conforms the quantity of the output from the agriculture. Monitoring soil fertility and environmental factors [6] is viable on improving the agro products outcome. The use of sensors is consistent on soil parameters, environmental conditions towards improving the productivity. IOT gateway is responsible for the transceiver operations of signals between devices and controllers [7] on increasing the productivity from agriculture and minimizing the electric power handling on the operation of various electrical devices, sensors etc. Remote area (area where electric power or mechanical engines are not available) agriculture is difficult because of laying electrical wires and cables [8,9] and this problem can be eliminated by installing PV cell based renewable energy system generating the required power for pumping and control action of the IOT based automation system. Smart farming will reduce the burden on handling agriculture machineries', fertilizer, pesticides and water amount [10]. In this work a prototype experimental set has been developed to understand the IOT based agriculture and Section 1 discusses the literature survey on the IOT controlled agriculture forming and section 2 explains the architecture and operation of various types of sensors and microcontroller accomplished in this work and section 3 elaborate the operation of the experimental set and section 4 gives the conclusion of the work.

## 2. SENSORS

Sensor is the part of a control circuit which collects information from devices and environment either of electrical or nonelectrical nature. Sensor signals are simplifying the operation of control circuits and enhance the output of the overall system. Depending upon the nature of signals different types of sensors are used for collecting the signals from various devices or environment. In agriculture domain the sensors are used for the following

1. Collection of soil information
2. Collecting of environmental data
3. Multiple cropping on a single land
4. Fertilizer and pesticides sensing
5. Water level and moisture sensing

### *2.1 Soil moisturesensor*

Different types of soil moisture sensors are available in the market to use in the agriculture field to detect the moisture level of the soil. This data is very much useful on supplying the water to the crops. The signal collected from sensor is given to the microcontroller for monitoring and taking control action and also the signal is transmitted to internet(cloud) using Wi-Fi communication method. LM393 is a simple and easily accessible soil moisture sensor available in the market.

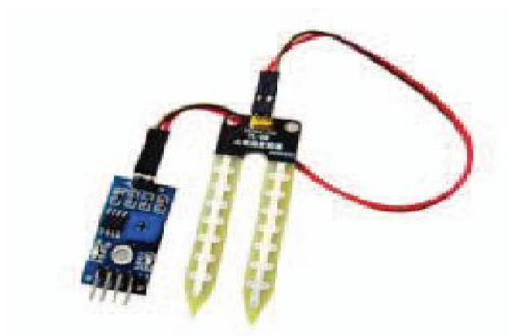

Fig 2.1 Moisture Sensor

## *2.2 Temperature Sensor*

Temperature sensor is used in the agriculture field to detect the temperature of the environment and light level from the sun. Based on the temperature water supplying to the land may be controlled through the controller. LM35 is a recently developedtemperature sensor whose temperature range is 22°Cto 55°C.


Fig 2.2 Temperature Sensor

## *2.3 PH sensor*

PH sensors are used in the agriculture land to detect the acidic level. The nature of the soil is based on the PH value which decides the crop that are cultivated and the productivity.

Fig 2.3 PH Sensor

## *2.4 Microcontroller*

Various types of microcontroller are available in the market based on the memory capacity, RAM, ROM, timer, no of I/O ports and other pulse generation techniques. ATMEGA328 is the simplest, handy in nature to use in the IOT based control circuits. It is having 1KB of RAM, 2 KB of ROM, 8 timer and 12 I/O ports. Its operating frequency is20 MHz.

## 2.5 PV Cell

Photovoltaic PV cells are used to harvest electrical energy from solar in the form of DC energy and converted to AC using DC to AC converters. Now, third generation PV cells are brought into application to generate large amount of power which is comparatively generating large power than the earlier generation PV cells. Controlling and monitoring the different parameters of PV cell, required power can be generated to drive the motor and to supply power to the control panel. Use of PV cell on agriculture is encouraged by the government to support on controlling power demand. In this project work a 12V, 5W PV cell is used to generate the power required to drive the motor and to control the operation of control panel.

# 3. PROPOSED SYSTEM

The proposed WSN based IOT agriculture monitoring and control block diagramis shown in fig 3.1 Microcontroller receives the signal from different sensors andit is processed based on the signal received with respect to reference.

## 3.1 Block Diagram

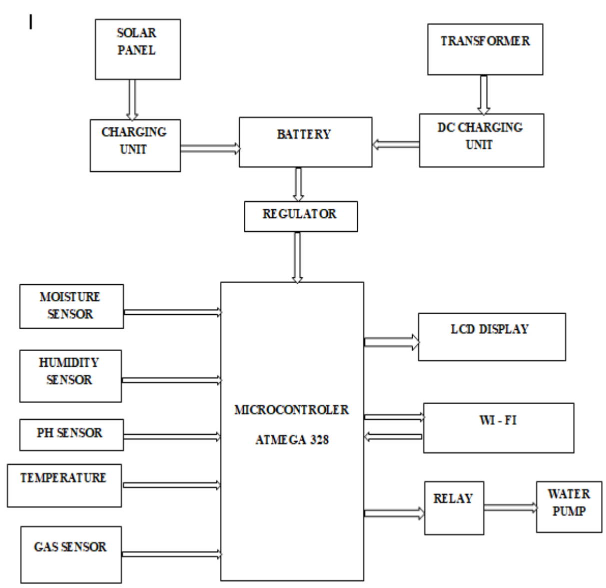


Fig 3.1 IOT based Automatic Agriculture System

## 3.2 Prototype:

WSN based IOT agriculture monitoring and control system is developed in a prototype model to understand the operation of moisture sensor, temperature sensor and crop health level sensor on enhancing the productivity of crops grown. Different methods of signalcommunication is adapted totransmit the collected data from various levels of the soil and environment to the processor and internet but in this work Wi-Fi technique has been implemented based on the due futures.

Fig3.2 shows the prototype model of the WSN coordinated IOT based agriculture parameter control method towards enhancing the productivity. High accuracy LM393 soil moisture sensor, LM35 and PH sensors are implemented in this project to control the supply of water based on the signals from moisture and temperature sensors. The PH sensor data is compared with the reference values and stored in the cloud storage memory for further action on controlling the PH value of the soil.

In this prototype a DC motor pump, operated with 12V supply is used for pumping the water. When the moisture level is higher than the reference value then the motor is not operated and it comes into action when the moisture level is lower than the reference value.Similarly the pump is brought into action based on the temperature level of the environment. Sometimes the pump is controlled considering the two signals of the moisture and temperature sensor. The crop health sensor will show the health condition on which the fertilizer, pesticides and water level maintenance decisions are made. The architecture pin configuration details are given in appendix A.

## *3.3 Prototype of IOT controller*

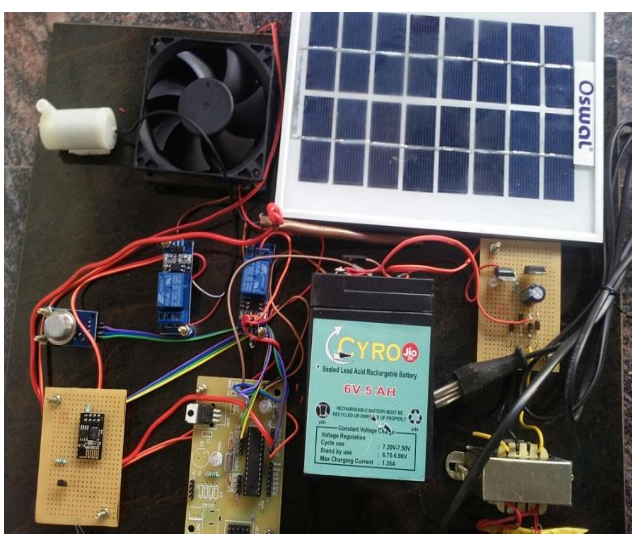


Fig 3.2 Prototype of IOT controller

## 4. CONCLUSION

Wireless sensor network coordinated IOT based agriculture monitoring and control method using Wi-Fi technology is built as a prototype model and functions of the sensors are observed on controlling the pumping motor. Wi-Fi technique has transmitted the nature of the control signals with date and time to internet and cloud storage system. The owner of the land can know the monitoring and control action taken in the land staying anywhere and also the data stored in the mass storage device can be referred in future for the intelligent control action better than the existing.

## 5.APPENDIX A

### PIN DIAGRAM OF ATMEGA 168

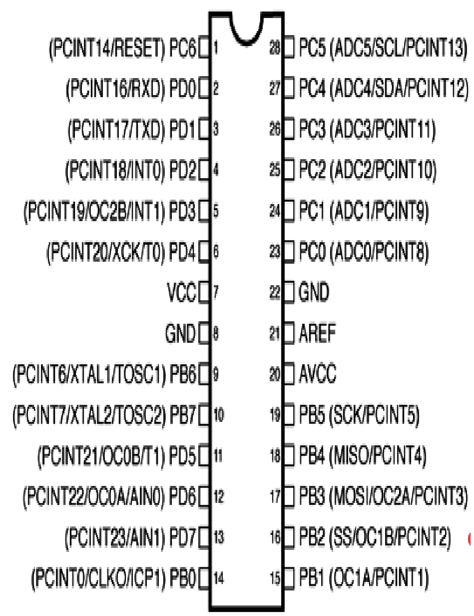


Fig A1 Pin diagram of ATMEGA328

### PIN DESCRIPTIONS

**VCC (7)**

- supply voltage between 1.8 – 5.5
- 

**GND (8, 22)**

- Ground has 0V

**Port B7 (9, 10, 14, 19, 17, 16, 15)**

- Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit).
- The Port B output buffers have symmetrical drive characteristics with both high sink and source capability.
- Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.
- **Port C7 (1, 23, 24, 25, 26, 27, 28)**
- Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit).
- If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin.
- **Port D7 (2, 3, 4, 5, 6, 11, 12, 13)**
- Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up4 2545T–AVR–05/11 ATmega48/88/168resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

**AVCC (20)**

AVCC is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC6..4 use digital supply voltage, VCCG.

**AREF (21)**

AREF is the analogue reference pin for the A/D Converter.

**ADC7:6 (TQFP and QFN/MLF package only)**

In the TQFP and QFN/MLF package, ADC7:6 serve as analogue inputs to the A/D converter. These pins are powered from the analogue supply and serve as 10-bit ADC channel

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