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Design of Energy Efficient Wireless Monitoring System for Agriculture Using Wi-Fi Module

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Abstract: The age of the Internet of things comes; wireless sensor networks become the core of networking. In order to achieve greater things on the technical requirements of the Internet of things, we adopt the technology of wireless sensor network based on WIFI, PC technology designing a set of low cost, low power. The system consists of wireless sensor network nodes and network management platform. Wi-Fi node respectively transmits acquisition of the temperature and humidity data to the PC stations of gateways node. The automatic networking realizes through the many jump routing consumption, flexible automatic networking temperature humidity monitoring system of soil. And the system is a complete set of wireless sensor network induction, acquisition, storage, application, reporting, solution, has a good man computer exchange interface. Users need not go into farmland, in a corner anywhere in the world, could prompt understand the changing condition of farmland soil temperature and humidity, and scientifically guide agricultural production. The automated irrigation system will develop proves that the use of water can be diminished for a given amount of fresh biomass production India is an agricultural country. The Indian economy is basically agrarian. In spite of economic development and industrialization, agriculture is the backbone of the Indian economy Agriculture uses most of available fresh water resources and this use of fresh water resources will continue to be increases Because of population growth and increased food demand. Increased labor costs, stricter Environmental regulations and increased competition for water resources from urban areas Provide strong motivation for efficient Irrigation system. In this propose system presents implementation of agricultural automation system using Wireless Sensor Unit (WSU) and Wireless Information Unit (WIU) connected with Wi-Fi transceiver. This project will be used to optimize water use for agricultural crops

KEYWORD: WSU (WIRELESS SENSOR UNIT), WIRELESS INFORMATION UNIT (WIU) ,WI-FI TRANSCEIVER.

I. INTRODUCTION

Water is an insufficient natural resource, which is very essential thing to life, livelihood, food security and sustainable enlargement. Water requirement is increasing rapidly due to population growth, urbanization and lifestyle. Owing to increasing the requirement of water for domestic, industrial and energy uses, there are severe limitations in the accessibility of water for agriculture. Due to the dissimilar climatic condition, it makes difficult for further existing sequential and spatial difference in availability of water. The tremendous action like floods and drought are happened more frequently and affects livelihood and food security. Agriculture recognition plays an important role in improving agricultural production, productivity and mitigating the distress of farmers.

The Indian government has taken several actions for improving agricultural credit flow for farmers. But some of the farmers committed suicide by consuming pesticides, crop failure and inability to repay the debt. Essential motives behind all these suicides were lack of enough water and inadequate rainfall. Farmer's suicide mainly happens in the area of Maharashtra, delta regions of Tamilnadu, Punjab, Andhra Pradesh, Karnataka and Kerala. So, the research is conducted on field survey in Tamilnadu particularly in the districts of Namakkal, Salem and Tiruchy. The field survey is taken from the planted crops like turmeric, onion, banana, tomato, com and tapioca. After that some data are gathered and sorted out

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some requirements of these crops as per the information given by the farmers around. [4]Based on these information, three sensors are selected namely, temperature, soil moisture and rain sensor. The data collected from the sensors are given to the remote base station through wireless sensor networking that has been confirmed with well distinct architecture.

India is an agricultural country. The Indian economy is basically agrarian. In spite of economic development and industrialization, agriculture is the backbone of the Indian economy Agriculture uses most of available fresh water resources and this use of fresh water resources will continue to be increases Because of population growth and increased food demand. Increased labor costs, stricter Environmental regulations and increased competition for water resources from urban areas Provide strong motivation for efficient Irrigation system. In this propose system presents implementation of agricultural automation system using Wireless Sensor Unit (WSU) and Wireless Information Unit (WIU) connected with Wi-Fi transceiver. This project will be used to optimize water use for agricultural crops

II. PROPOSED SYSTEM

The automated irrigation system consists of two units, Wireless Sensor Unit (WSU) and Wireless Information Unit (WIU) connected with Wi-Fi transceiver. It permits the transfer of soil moisture, temperature and solar charging data that implemented in wireless sensor unit. If the data's are reached above the threshold value, it activates the automated irrigation system. WIU also has Wi-Fi module to transmit the data's to the monitor unit through local access and the information were monitored offline by using graphical application on mobile or PC. A Wireless Sensor Unit A wireless sensor unit consists of Wi-Fi transceiver, sensor, a microcontroller and power source. Number of wireless sensor units can be arranged in field at different places to construct a distributed sensor network for automated irrigation system. All units are based on the microcontroller Atmega328, which control Wi-Fi module and collect the measured data from the Humidity/soil moisture sensor DHT11/VH400 and temperature sensor DS18B20. Each component is powered by rechargeable batteries. The charge is preserved by a photovoltaic 12V crystalline panel to achieve full energy autonomy. The microcontroller, Wi-Fi transceiver, rechargeable batteries and electronic components were encapsulated in a plastic pail container. These components are preferred under the basis of power consumption minimization.

The PC Unit

The control of devices is established and their condition is monitored through online/offline. As the manager unit a computer has been used. The programs that are running on the computer are listed as follows:

- Database and its platform
- User Interface Program

Using PC various controlling program are established for interfacing with the devices & their control. Many languages are available for programming for the same purpose. The connection to the devices made controlled for the switching application.

III. DESIGN AND ANALYSIS

Block Diagram

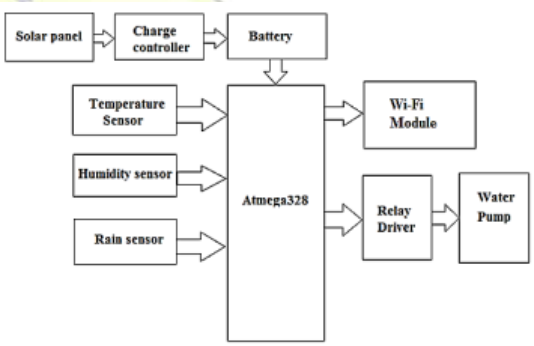

Fig.3.1 Block Diagram of Wireless sensor unite (WSU)

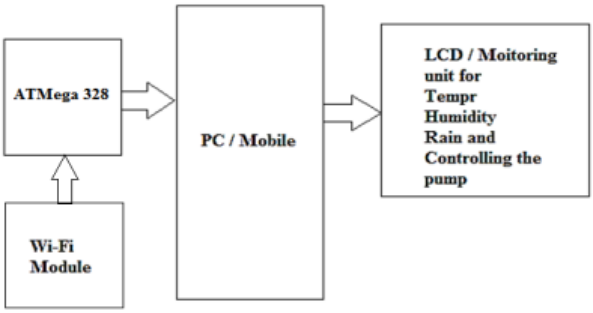

Fig.3.2 Block Diagram of Wireless Information Unit (WIU)

The proposed system has two main units one is field sensor unit and another is field information unit. Field sensor unit transmits the sensors data to the field information unit. Here field information unit receives sensor data from field sensor unit.

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- **Wireless Field Sensor Unit-**

This section describes about wireless field sensor unit. The Fig3.1. Shows the block diagram of a field sensor unit. A field sensor unit contains, AVR micro-controller, WIFI module, different sensors, motor and power supply circuit. Several field sensor units are placed in-field to configure sensor network for the automated irrigation system.

- **Wireless Field Information Unit-**

The Fig.3.2Shows the block diagram of a wireless field information unit. The soil moisture sensor, temperature sensor and water level sensor values from each field sensor unit information are send through WIFI module, identified, recorded, and analyzed in the field information unit. The field information unit consists of AVR micro- controller, WIFI module. This processed information i.e., status of all these sensors is send to PC by using WIFI technology.

AVR (ATMEGA 328)-

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

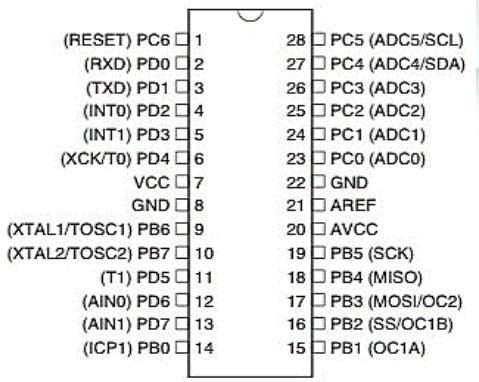

Fig.3.3 Pin diagram of ATMEGA328

Key Parameters-

Parameter	Value
Flash (Kbytes):	32 Kbytes
Pin Count:	28
Max. Operating Freq. (MHz):	20 MHz
CPU:	8-bit AVR
No. of Touch Channels:	16
Max I/O Pins:	23
Ext Interrupts:	24

Table No.3.1 Parameters of ATMEGA328

8. ESP8266 WIFI Module

Fig.3.13 ESP8266 WIFI Module

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi 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 Wi-Fi-ability as a Wi-Fi 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

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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. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

Features:

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balloon, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)

9. DHT11 basic Temperature + Humidity sensor-

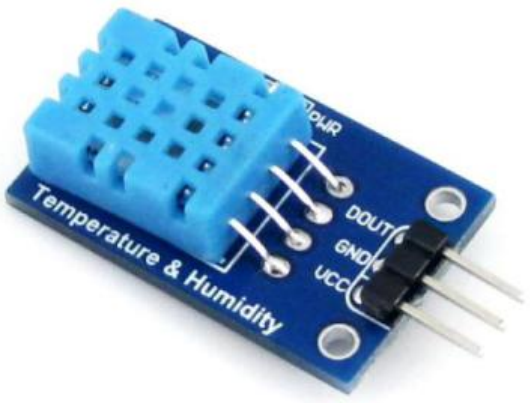

Fig.3.14 DHT11 basic Temperature + Humidity sensor module

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.

Technical Details-

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

10. Solar panel:-

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar PV panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module

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can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

11. Rain Sensor Module-

Fig.3.15 Rain Sensor Module

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level.

Specifications-

- Adopts high quality of RF-04 double sided material.
- Area: 5cm x 4cm nickel plate on side,
- Anti-oxidation, anti-conductivity, with long use time;
- Comparator output signal clean waveform is good, driving ability, over 15mA;
- Potentiometer adjust the sensitivity;
- Working voltage 5V;
- Output format: Digital switching output (0 and 1) and analog voltage output AO;
- With bolt holes for easy installation;
- Small board PCB size: 3.2cm x 1.4cm;
- Uses a wide voltage LM393 comparator

Pin Configuration

Fig.3.16 Pin diagram of Rain Sensor Module

1. VCC: 5V DC
2. GND: ground
3. DO: high/low output
4. AO: analog output

- **Design of Individual Module-**

A] Power Supply-

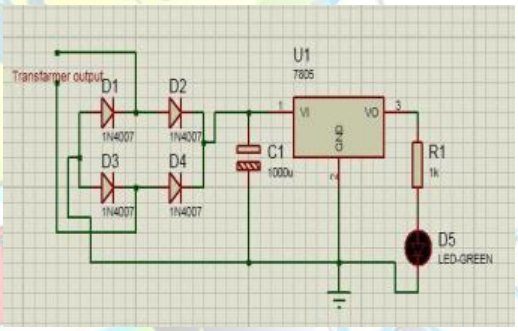

Fig.3.17 Circuit diagram of power supply

Power is derived initially from standard 12V AC/DC adapter or 12V_500ma Transformer. This is fed to bridge rectifier D1 ~ D4, the output of which is then filtered using 1000uf electrolytic capacitor and fed to U2 (voltage regulator). U2 +5V output powers the PIC micro controller. LED L10 and its associate 1K current limiting resistors provide power indication. The unregulated voltage of approximately 12 V is required for relay driving circuit.

Micro controller required 5V DC supply for operation, we used USB +5V Power from PC or External +5V power supply via CN10. External Power and USB power cab be selectable via J1**.** There is need 12V external Power supply for relay's and its driver circuits.

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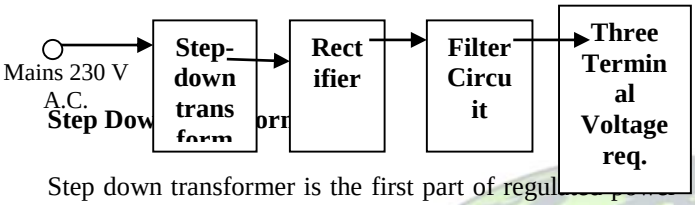
3.3 Power Supply Design-

Power supply is the most important part of the project. For project +5V regulated power supply with maximum current rating 500mA. Following basic building blocks are required to generate regulated power supply.



Step down transformer is the first part of regulated power supply. To step down the mains 230V A.C. we require step down transformer. Following are the main characteristic of electronic transformer.

1) Power transformers are usually designed to operate from source of low impedance at a single freq.
2) It is required to construct with sufficient insulation of necessary dielectric strength.
3) Transformer ratings are expressed in volt–amp. The volt-amp of each secondary winding or windings is added for the total secondary VA. To this are added the load losses.
4) Temperature rise of a transformer is decided on two well-known factors i.e. losses on transformer and heat dissipating or cooling facility provided unit.

Rectifier Unit-

Rectifier unit is a circuit which converts A.C. into pulsating D.C. Generally semi-conducting diode is used as rectifying element due to its property of conducting current in one direction only. Generally there are two types of rectifier.

1) Half wave rectifier
2) Full wave rectifier

In half wave rectifier only half cycle of mains A.C. is rectified so its efficiency is very poor. So we use full wave bridge type rectifier, in which four diodes are used. In each half cycle, two diodes conduct at a time and we get maximum efficiency at o/p. Following are the main advantages and disadvantages of a full-wave bridge type rectifier circuit.

IV. CONCLUSION

The Automated Irrigation System Will Be Found To Be Sufficient Energy Efficient In The Field Of Agriculture Production For Water Resource Optimization. Thus, The Irrigation System Allows Optimized Cultivation In Places Of Water Scarcity, Usage Of Pesticides And Fertilizers. The Automated Irrigation System Is Important For Organic Crops By Usage Of Solar Power. The Battery Management Algorithm Will Be Provides 24 Hour Power Utilization for Day And Night Operation. The Irrigation System Required Only Minimum Maintenance and Can Be Adjusted For Variety of Crops According To Soil Calibration Procedure. The Already Existing System Uses Simple Water Pumps To Supply Water to the Crops As and When Required By Manual Control.

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