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Automatic irrigation Control System Using Zigbee and GSM

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ABSTRACT- *In India 60%-70% economy depends on agriculture, there is a need to modernize the conventional agricultural methods for the better productivity. Due to unplanned excess use of water the ground water level is decreasing continuously. An automatic irrigation system is developed to optimize water use for agriculture. The system has a distributed wireless sensor network of soil-moisture sensor, temperature and humidity sensor placed in field. In system these field parameters are monitored and irrigation is controlled according to requirements. The system designed also checks the water availability and sends regarding message to user. A PC is used in this system offers stable remote access to field conditions and real-time control and monitoring of irrigation controller.*

Keywords: ***Sensing unit, sensors, base station, Zigbee, GSM, Automatic Control and monitoring****.*

1. INTRODUCTION

Agriculture uses 85% of available freshwater available worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand [1]. There is an urgent need to create strategies based on science and technology for efficient use of water, including technical, managerial, agronomic and institutionally improved technology. In present drip irrigation system water is provided to root zone of plants drop by drop which results in saving of huge amount of water. Many types of solutions have been proposed before in the past a well one was build to improve crop productivity and also about selection methods of irrigation based on different parameters. Some of them are also using soil fertility meter and pH meter. They are measuring important ingredients of soil such as Potassium, Phosphorus, and nitrogen (NPK) [2].

The main technology used here Wireless Sensor Networks (WSNs) have attracted much attention in recent years. They are used for collecting, storing and sharing sensed data. The potential applications of WSNs are numerous that includes cattle monitoring, agriculture, nuclear reactor controlling, security surveillance etc. The architecture of a WSN system consists of a set of sensor and a base station that can communicate the information recorded in the field. With the recent developments in wireless networks regarding power requirements and cost, it has become possible to conceive an Automated Model for Precision Agriculture. The process is that the conditions of the temperature, humidity and moisture in the crop field are transmitted to the central station using ZigBee wireless sensor modules and the information is further compared with threshold values which are programmed in the controller at the base station. If it is necessary to water the plant then water level is tested by using water level sensor in the water source and irrigation is controlled automatically. If water is not available in the source then such message is transmitted to the users mobile by using GSM technology and he can take the necessary action thereupon [3].

In this paper system designed measures only soil environmental parameters like soil moisture, temperature and humidity. An electromagnetic sensor to measure soil moisture was the basis for developing an irrigation system at a savings of 53% of water compared with irrigation by sprinklers in an area of 1000 m2 of pasture [1]. A reduction in water use under scheduled systems also have been achieved, using temperature sensor and an air humidity sensor which allowed for the

adjustment of irrigation to the daily fluctuations in weather or volumetric substrate moisture content .

II. SYSTEM ARCHITECTURE

System designed in this paper mainly consists of two parts sensing unit and Base station connected by wireless transceiver Zigbee module as shown in fig 1.Sensing unit consists of microcontroller, power supply, temperature sensor, soil moisture sensor humidity sensor and Zigbee module. In our system controller used is a AVR 8 bit controller (Atmega 16). It's a 40 pin IC with 32 I/O pins, 4 ports A,B,C and D. It has 10bit 8 channel inbuilt ADC at port A. In the name Atmega 16, 16 indicates 16Kb self programmable flash. Also has In System Programming.

The ZigBee is a low rate WPAN technology that consumes much less energy, thus it is suitable for a long period operation. The Wi-Fi is a WLAN technology that consumes more energy, but it can provide a much higher data rate. Moreover, in our real world networking experiments on the nodes with regular antennas, the ZigBee can support a longer-range outdoor communication up to 300 meters, while the Wi-Fi is only up to 100 meters [4].

Temperature sensor: National Semiconductor LM 35 IC is being used for sensing the temperature. It is a integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in 0C). The temperature can be measured more accurately with it than using a thermistor. The sensor circuit is sealed and not subject to oxidation. As soon as the temperature in the greenhouse increases than the preset value, the slave will send the information about present status to the master controller. Then the master will switches on the cooling system such as Ventilators, Exhaust Fans and Swamp coolers [5].

Humidity sensor: The humidity sensor HIH4000, manufactured by Honeywell is used for sensing the humidity. It delivers instrumentation quality RH (Relative Humidity) sensing performance in a low cost, solder able SIP (Single In-line Package). Relative humidity is a measure, in percentage, of the vapor in the air compared to the total amount of vapors that could be held in the air at a given temperature. Some of the features are-

- Linear voltage output VS. % RH.
- Laser trimmed interchangeability.
- Low power design.
- High accuracy.
- Fast response time stable.
- low drift performance and Chemically resistant. [5]

GSM: GSM is used to send message to user when there is no water available for irrigation We are using SIM 300Designed for global market, SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz. SIM300 features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 40mm x 33mm x 2.85mm , SIM300 can fit almost all the space requirements in your applications, such as smart phone, PDA phone and other mobile devices. The physical interface to the mobile application is made through a 60-pin board-to-board connector, which provides all hardware interfaces between the module and customers' boards except the RF antenna interface.

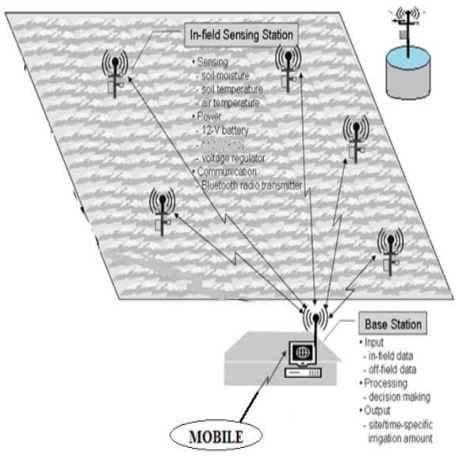


Fig 1.: idea of on field operation [6]

In the field of soil environmental monitoring, real-time monitoring the temperature and humidity of soil can correctly guide agricultural production and improve crop yield. It also can provide scientific basis for high-precision monitoring . Traditional wired communications exist many problems that are wiring complex, maintenance difficulties; wiring of sensor nodes cannot be flexibly deployed. This design uses a wireless sensor network as information acquisition and processing platform. The coverage is big, effectively resolves the disadvantages of wired communications. It has broad application prospects in soil environmental monitoring field .Wireless sensor networks

Fig 1. Block diagram of system

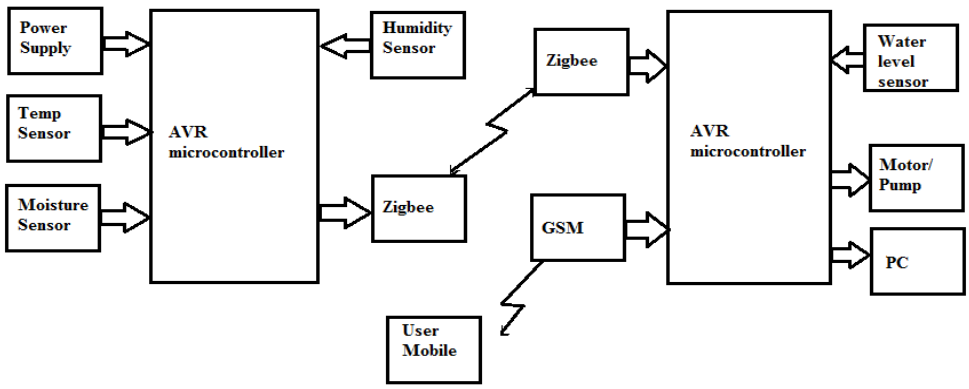


Fig:2. Block Diagram of Automatic Irrigation control System

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 Zigbee, GSM designing a set of low cost, low power 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 system consists of wireless sensor network nodes and network management platform. Zigbee node respectively transmits acquisition of the temperature and humidity data to the Zigbee stations of gateways node. The automatic networking realizes through the many jump routing form between each node and tuner network. Then transmits the data through zigbee to the pc through a serial port to PC to view real-time data. If there is any error in the system the text message will be send to the user through GSM. This whole operation is as shown in fig 2 above [7]. Dataflow of proposed system in this paper is as shown above. All decision making, comparing, calculating, storing is done by controller used in the system.

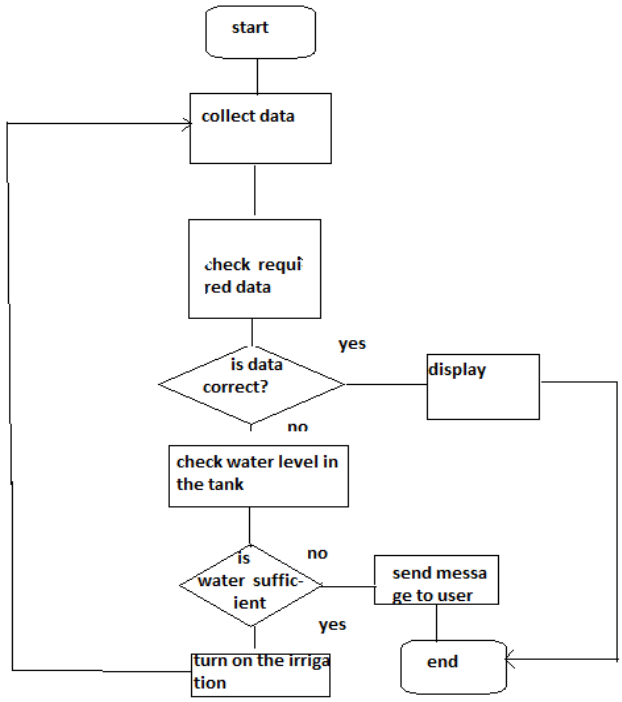
III. CIRCUIT DIAGRAM

Circuit of proposed system can be explained in two parts Sensing unit and Base station. Both are connected to each other by wireless communication medium Zigbee.As name itself indicates sensing units collects field parameters and sends it to base station.

IV. AVR MICROCONTROLLER:

Features:

- Advanced RISC Architecture
- 16K Bytes of In-System Self-Programmable Flash
- In-System Programming by On-chip Boot Program
- Inbuilt 8-channel, 10-bit ADC
- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- 40 pin IC 32 Programmable I/O Lines



V. PROPOSED FLOW CHART

Fig: 3. Flow chart

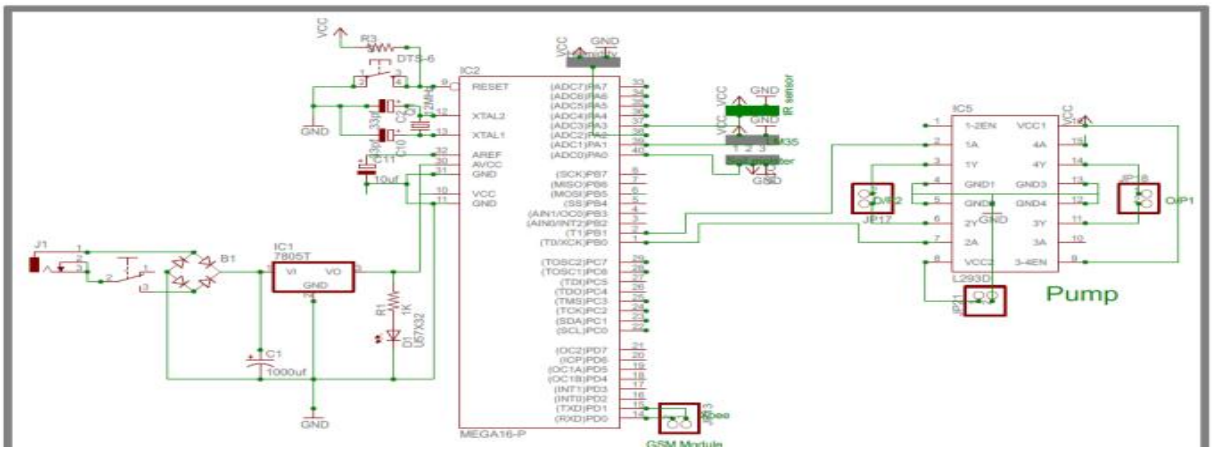


FIG: 4. CIRCUIT DIAGRAM

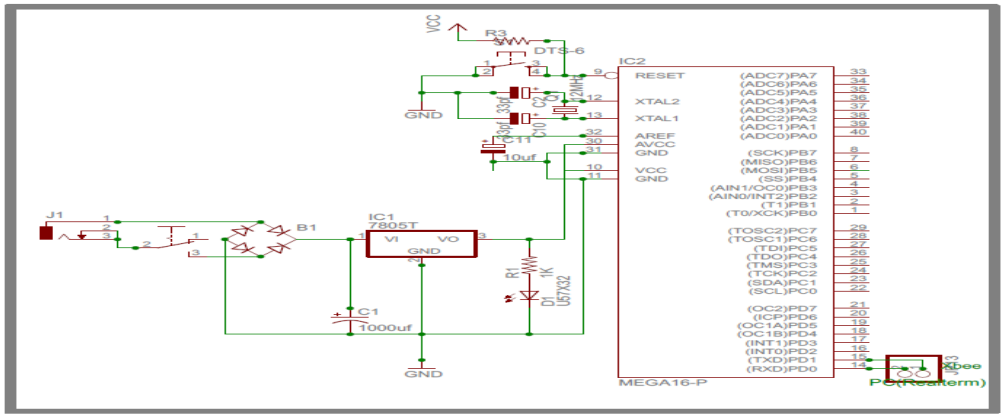


FIG: 5. CIRCUIT DIAGRAM

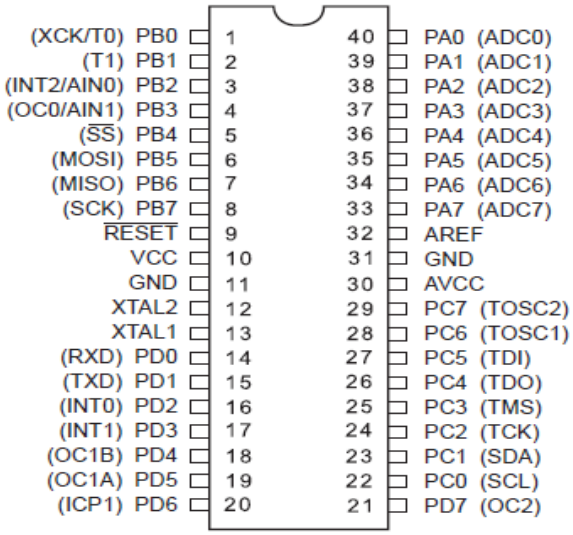


FIG: 4. PIN DIAGRAM

Pin Discription;

VCC: Digital supply voltage.
GND: Ground.
Port A (PA7..PA0): Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.
RESET: Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in Table 15 on page 38. Shorter pulses are not guaranteed to generate a reset.
XTAL1: Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.
XTAL2: Output from the inverting Oscillator amplifier.
AV_{cc}: AV_{cc} is the supply voltage pin for Port A and the A/D Converter. 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.
AREF: AREF is the analog reference pin for the A/D Converter.

Base station also contains AVR microcontroller Atmega16 Fig 5 as above shows that in proposed system we are interfacing PC to the microcontroller for real time observation on the parameters. PC will work as a display and it will show live parameter condition. This will help user to study and analyze on field parameters like moisture, temperature and humidity. User can also send some commands to system if needed.

VI. CONCLUSION AND FUTURE SCOPE

An automated closed-loop irrigation system requires three major components: data acquisition, monitoring, and control to support the solid communication protocol. This seminar is about conversion of a conventional irrigation system to an

electronically controllable system for individual control of irrigation methods and formulated the navigation of the irrigation system that was continuously monitored by a differential Zigbee and wirelessly transferred data to a base station for site-specific irrigation control.

The study has incorporated major WSN based automated irrigation system. The Zigbee module used has the range of about 300 meters. The readings of temperature, humidity and moisture were recorded, analyzed and sent to base station to take the proper action. This paper proposes the design of the innovative GSM and Zigbee based remote controlled embedded system for irrigation. The proposed system is a low cost system where information is exchange wirelessly by Zigbee and GSM network. As we know the appropriate level of water in the farm field contributes to the quality of grains and highly affects the incidence of pests and diseases on crops. By using this system the farmers can get the information of electricity status at farm field, warning message like smoke in farm field due to fire or due to burning of motor in the farm field and the environmental temperature exceeds information from home or any where using a mobile phone. With this the farmer can switch on the motor for irrigation/pesticide spray from anywhere far from the actual field. The availability of the GSM network is a prerequisite for the system implementation. The system is highly beneficial for precise irrigation in farm fields and thus responsible for efficient utilization of water resource and men power. The real time video of the field can also be integrated with other parameters that are sent to the base station. The ZigBee device here can further be attached with the camera module that can be placed in different locations of fields to take the snapshots of the plant at predefined intervals of time. Now these images can be used by the farmer to monitor the growth of the plant and also can control the population of the pests that may be growing symbiotically with the crop by applying proper pesticides. The pesticides can also be mixed with the water sprinkler or can be drizzled separately via valves controlled by the microcontroller. The fertilizers and pesticides can also be stirred and send through the pipe or sprayer.

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