AUTOMATED IRRIGATION SYSTEM USING IoT

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Abstract - Agriculture is one of the basic needs for human to survive. Agriculture plays indispensible role in the development of agricultural country. Agriculture has to tackle many problems like changing climate, water shortage, changing soil quality, etc. The only way to resolve this problem is smart irrigation by including the technology in traditional methods of agriculture. The purpose of this work is to provide a smart irrigation solution to the farmer with use of internet of things (IoT). An automated irrigation system is developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture sensor, ph sensor, gas sensor and temperature sensors are placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm is initiated with threshold values of temperature, soil moisture and toxic gases that were programmed into a processor to control water quantity. Cellular-Internet interface allowed for data inspection and irrigation scheduling to be programmed through a web page. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited areas.

***INDEX WORDS* – Smart irrigation, Internet of Things (IoT), Wireless Sensor Networks (WSNs).**

I INTRODUCTION

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. IoT enable objects to be monitored and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit."Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist fire-fighters in search and rescue operations.[20] These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.

Agriculture is the basis for the human species .It is the main source of food and it plays vital role in the growth of country's economy. It also provides ample employment opportunities to the people.[4] In developing countries still farmers are practicing the traditional methods for agriculture, which results in low yielding of crops and fruits. So that maximum yield can be attained by using automatic machineries. Hence there is a necessary for implementing technology in farming to increase the yield. By using IoT, we can look forward to increase in production with low cost by continuously observing the efficiency of the soil, temperature and humidity monitoring, rain fall monitoring, fertilizers efficiency, monitoring storage capacity of water tanks and also theft detection in agriculture areas.[6]

The fusion of traditional methods with latest technologies as Internet of Things and Wireless Sensor Networks can lead to agricultural modernization. The Wireless Sensor Network which integrate the data from different types of sensors and send it to the main server using wireless protocol. There are many other factors that affect the productivity to great extent. Factors include attack of insects and pests which can be controlled by spraying the proper insecticide and pesticides and also attack of wild animals and birds when the crop grows up. The crop yield is declining because of unpredictable monsoon rainfalls, water scarcity and improper water usage. [5] In this paper work section II describes about the literature survey. Proposed work is explained in section III. System model is discussed detail in section IV. Results and discussions are analyzed in section V.

II RELATED WORK

Joaquín Gutiérrez et al, [1] developed a system with distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page.

Rekha P et al, [2] developed a system to deploy a group of wireless sensor networks nodes deployed in the field for sensing agricultural parameters and the RF communication of WSN node was used to transmit the measured data to base station. Base station was connected to a decision support system. Based on the sensed parameters and the optimum values, the decision support system will generate an appropriate message for farmers. By using the collected data from the sensors, the proposed system would provide suggestions about the monitoring crop such as irrigation timings, directions for optimum usage of fertilizers etc. in accordance to the farmers' lands. An android application had been designed to deliver the messages to farmers in their regional language. The android app also gives information regarding the weather forecast and precaution to be taken based on the weather forecast.

Sanket Salvi et al, [3] designed and developed a new framework for multilevel farming in urban area where cultivation space was limited in addition to that, they had provided local node for each level with its individual local decision making system, sensors and actuators which was customized to the selected crop. These local nodes communicate to a centralized node via wireless communication. This centralized node was connected to a Cloud Server where the received data would be stored and processed. Cloud based data analysis and monitoring allows the user to analyze and monitor the irrigation system through internet providing ubiquitous access.

Mahammad Shareef Mekala et al,[4] proposed new IoT technology with cloud computing and Li-Fi. Li-Fi provides better bandwidth, efficiency, availability and security. First this project includes remote controlled process to perform tasks like spraying, weeding, bird and animal scaring, keeping vigilance, moisture sensing, etc. Secondly it includes smart warehouse management which includes temperature maintenance, humidity maintenance and theft detection in the warehouse. Thirdly, intelligent decision making based on accurate real time field data for smart irrigation with smart control. Controlling of all these operations would be achieved through any remote smart device or computer connected to Internet and the operations will be performed by interfacing cameras, sensors, Li-Fi or ZigBee modules.

Rajalakshmi.P et al,[6] developed a system to monitor crop-field using sensors (soil moisture, temperature, humidity, Light) and automate the irrigation system. The data from sensors are sent to web server database using wireless transmission. In server database the data are encoded in JSON format. The irrigation is automated if the moisture and temperature of the field falls below the brink. In greenhouses light intensity control can also be automated in addition to irrigation. The notifications are sent to farmers' mobile periodically.

Tanmay Baranwal et al,[7] developed a device for accentuate the methods to solve such problems like identification of rodents, threats to crops and delivering real time notification based on information analysis and processing without human intervention. In this device, mentioned sensors and electronic devices are integrated using Python scripts.

Dr. A. Sumithra et al,[12] proposed an idea to monitor pollution using IoT Techniques. The extent to which the environment gets affected is noted and corresponding control and prevention practices were implemented. The Higher Officials in that area gets notified about the pollution range and the necessary steps are taken. By controlling the environmental pollution the cities are devoid of health issues.

III PROPOSED SYSTEM

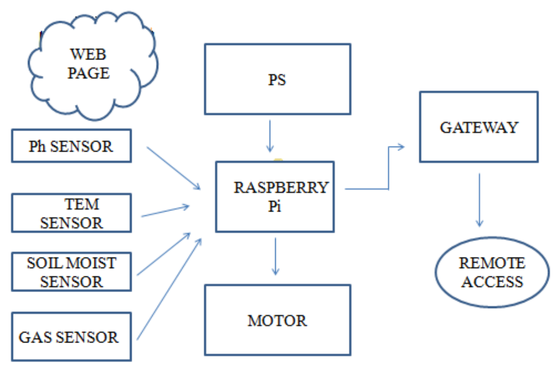

Fig.1 Block diagram of proposed system.

The Raspberry Pi is a series of small single-board computer .The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache. The Raspberry Pi 3 is equipped with 2.4 GHzWiFi 802.11n (150Mbit/s) and Bluetoot h 4.1 (24 Mbit/s) based on Broadcom BCM43438 Full MAC chip and the Pi 3 also has a 10/100 Ethernet port. The Raspberry Pi may be operated with any generic USB computer keyboard and mouse. It may also be used with USB storage, USB to MIDI converters and virtually any other device/component with USB capabilities. Other peripherals can be attached through the various pins and connectors on the surface of the Raspberry Pi. The GPU in the Raspberry Pi 3 runs at higher clock frequencies of 300 MHz or 400 MHz, compared to previous versions which ran at 250 MHz The

Raspberry Pi can also generate 576i and 480i composite video signals, as used on old-style (CRT) TV screens and less-expensive monitors through standard connectors – either RCA or 3.5 mm phono connector depending on models.[18]

IV SYSTEM DESIGN

ARMCortexA53 - Armv8-A architecture brings a number of new features. These include 64- bit data processing, extended virtual addressing and a 64-bit general purpose registers. The Cortex-A53 processor is Arm's first Armv8-A processor aimed at providing power-efficient 64-bit processing. It features an in-order, 8-stage, dual-issue pipeline and improved integer, NEON, Floating – Point Unit and memory performance. [19]

The Cortex- A53 can be implemented in two execution states: AArch32 and AArch64.The AArch64 state gives the cortex-A53 its ability to execute 64-bit applications, while the AArch32 state allows the processor to execute existing Armv7– A applications. The Cortex-A53 processor can be incorporated into a SoC using a broad range of Arm technology including graphics IP, System IP and Physical IP. The Cortex-A53 processor is fully supported by Arm development tools. [19]

Temperature sensor (LM35) – The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C).The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. [20]

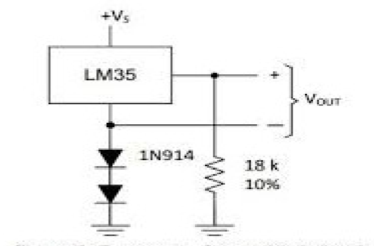

Fig.2 Circuit diagram of LM35

Soil moisture sensor - Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. [22]

Gas sensor (MQ-2) - Gas Sensor (MQ2) module is useful for gas leakage detection. It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer. [21]

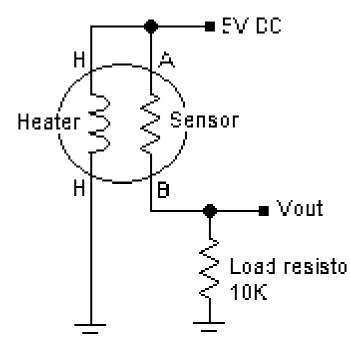

Fig.3 Circuit diagram of MQ2

Ph sensor - It measure pH by measuring the voltage or potential difference of the solution in which it is dipped. By measuring potential difference, hydrogen ion concentration can be calculated using the Nernst equation which gives the relationship between Hydrogen ion concentration and Voltage or Potential.

V RESULTS & DISCUSSIONS

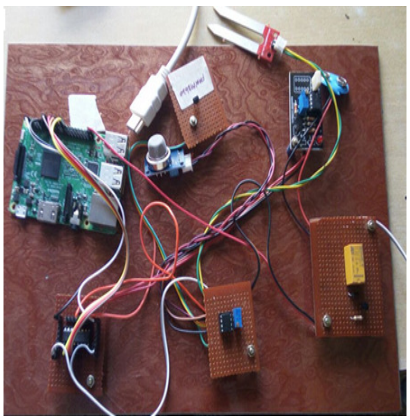

Fig.4 Hardware setup of proposed work

The system is developed and tested under various conditions. The soil moisture is tested and results are interpreted successfully. Different readings were taken under different condition. The temperature reading was taken at different weather conditions. The wireless transmission was achieved using Wi-Fi module. Wireless monitoring of field reduces the human power and it also allows farmers to see accurate changes in crop yield. It is cheaper in cost and draws less power. The smart agriculture system has been designed and synthesized. The developed system is highly efficient and beneficial for farmers. It gives the data about the temperature, humidity of the air in agricultural field through SMS to the farmer, if it exceeds optimal range. The application of such system in the field can definitely help to advance the harvest of the crops and global production.

VI CONCLUSION

We have imposed an automatic sensor-integrated smart farming system. It effectively detects the soil moisture, temperature, ph and toxic gases of the surrounding and will help the farmers for managing the farm task at great extent. This work is based on achieving IoT in farming. Remotely examined system for agriculture has become a new necessity for farmers to save water consumption, time and money.

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