IOT based Smart Irrigation

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***Abstract*—Water scarcity is one of the major problems faced by the whole world. In India, this situation is aggravated since agriculture is one of the major economies. As per the statistics of 2012, India has 35.12% of total land under irrigation. The objective of this work is to reduce the water usage in irrigation processes and also to improve the quality of the crop. In this regard, we have proposed a context aware wireless sensor network system for irrigation management. Environmental Monitoring Systems and Sensors systems have increased in importance over the years. However, increase in measurement points mean increase in installation and maintenance cost. Not to mention, the measurement points once they have been built and installed, can be tedious to relocate in the future. Therefore, the purpose of this Master's thesis is to present a project called "IOT based Smart Irrigation" which is capable of intelligently monitoring agricultural conditions in a pre-programmed manner. This multi-sensor system will continuously monitor the relevant environmental parameters like soil moisture, rain, humidity in terms of percentage. These derived contexts will be used for automatic and manual control as well as adaptation of the irrigation system. This context aware system uses the real-time sensor data to minimize the wastage of water used in the irrigation process. Simultaneously all the sensor values will be updated in the IOT this helps us to track the system which we have designed and this process also helps to improve the agricultural productions.**

***Index Terms*—Internet of Things; Context Awareness; Sensor Networks; Sensor Data.**

1. INTRODUCTION

Efficient water management is a major concern in many cropping systems in semiarid and arid areas. Distributed in-field sensor-based irrigation systems offer a potential solution to support site-specific irrigation management that allows producers to maximize their productivity while saving water. In order to the increasing demand for the food production we implemented the new dimension in the irrigation field with less utilization of humans, this method is totally different from the conventional irrigation method used by our Indian farmers which involves manual operation and control, in this electronic era farmers not willing to face the challenges creating by these conventional methods, so we provide this automatic irrigation system which waters the plants based on the atmospheric conditions detecting the dryness of the soil. Farming and all kind of activities which require irrigation of land such as in green house and labs also, needs a continuous monitoring and careful handling of the irrigation system for proper growth to plant. To save time for irrigation systems and to make system more precise we are using automatic sensing and wireless transmission techniques in this project. With the advancement of technology many kind of devices and modules are being developed everyday which are able to perform various tasks. Soil Moisture sensor is a sensor developed to measure the quantity of water content present in the soil. Using this sensor in the irrigation fields automatically solves the problem of water level availability inspection for the farmers. For automatic handling of devices on a remote or distant location we are using RF transmission technique, which is a low cost and easy to use wireless link device.

A. What is Internet of Things?

During the past decade, the IoT has gained significant attention in academia as well as industry. The main reasons behind this interest are the capabilities that the IoT, will offer. It promises to create a world where all the objects(also called smart objects) around us are connected to the Internet and communicate with each other with minimum human intervention. The ultimate goal is to create 'a better world for human beings', where objects around us know what we like, what we want, and what we need and act accordingly without explicit instructions. The term 'Internet of Things' was firstly coined by Kevin Ashton in a presentation in 1998. He has mentioned *"The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so"*. Then, the MIT Auto-ID centre presented their IoT vision in 2001. Later, IoT was formally introduced by the International Telecommunication Union (ITU) by the *ITU Internet report* in 2005. The IoT encompasses a significant amount of technologies that drive its vision. In the document, *Vision and challenges for realising the Internet of Things*, by CERP-IoT, a comprehensive set of technologies was listed. IoT is a very broad vision. The research into the IoT is still in its infancy. Therefore, there aren't any standard definitions for IoT. The following definitions were provided by different researchers.

• Definition: *"Things have identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environment, and user contexts."*

• Definition: *"The semantic origin of the expression is composed by two words and concepts: Internet and Thing, where Internet can be defined as the world-wide network of interconnected computer networks, based on a standard communication protocol, the Internet suite (TCP/IP), while Thing is an object not precisely identifiable Therefore, semantically, Internet of Things means a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols."*
• Definition: *"The Internet of Things allows people and things to be connected Anytime, Anyplace, with Anything and Anyone, ideally using Any path/network and Any service."*

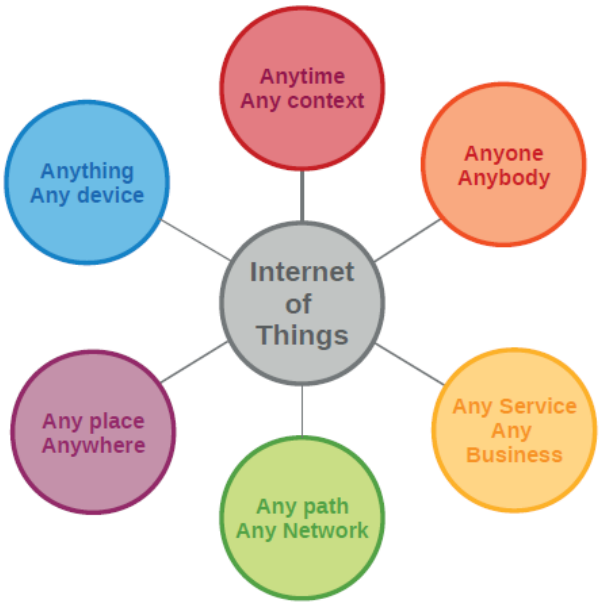


Fig.1. Definition of the Internet of Things: The Internet of Things allows people and things to be connected anytime, anyplace, with anything and anyone, ideally using any path/network and any service.

B. Working Principle

The working principle of this project is the automatic sensing and wireless transmission of data. To sense the presence of water or moisture in the soil we are using moisture sensor modules. The output of this sensor will be analog which will vary according to the amount of moisture present in the soil. This analog output of sensor will be given to an Analog-to-Digital converter (ADC). The ADC will process this signal using sampling technique and will convert it into corresponding digital values. This value will be then provided to microcontroller and then microcontroller will make the decision whether and when to start and stop the pump motor this process will done accordingly. In the same way we are using rain sensor if in case motor is on when it's raining so it Leeds to the waste of water, So this situation easily can be handled by the rain sensor, whenever we detect rain the sensor send the command to microcontroller to off the motor This system uses the real-time sensor data to minimize the wastage of water used in the irrigation process. Simultaneously all the sensor values will be updated in the IOT this helps us to track the system which we have designed and this process also helps to improve the agricultural productions.

C. Essential Component of IoT: Sensor Network

We provide a brief introduction to sensor networks in this section as it is the most essential component of the IoT. A sensor network comprises one or more sensor nodes, which communicate between themselves using wired and wireless technologies. In sensor networks, sensors can be homogeneous or heterogeneous. Multiple sensor networks can be connected together through different technologies and protocols. One such approach is through the Internet. The components and the layered structure of a typical sensor network are discussed below. However, there are other technologies that can complement the sensing and communication infrastructure in IoT paradigm such as traditional ad-hoc networks. These are clearly a different technology from sensor networks and have many weaknesses. There are three main architectures in sensor networks: flat architecture (data transfers from static sensor nodes to the sink node using a multi-hop fashion), two-layer architecture (more static and mobile sink nodes are deployed to collect data from sensor nodes), and three-layer architecture (multiple sensor networks are connected together over the Internet). Therefore, IoT follows a three-layer architecture. Most of the sensors deployed today are wireless. There are several major wireless technologies used to build wireless sensor networks: wireless personal area network (WPAN) (e.g. Bluetooth), wireless local area network (WLAN) (e.g. Wi-Fi), wireless metropolitan area network (WMAN) (e.g. WiMAX), wireless wide area network (WWAN) (e.g. 2G and 3G networks), and satellite network (e.g. GPS). Sensor networks also use two types of protocols for communication: non-IP based (e.g: Zigbee and Sensor-Net) and IP-based protocols (NanoStack, PhyNet, and IPv6). The sensor network is not a concept that emerged with the IoT. The concept of a sensor network and related research existed a long time before the IoT was introduced. However, sensor networks were used in limited domains to achieve specific purposes, such as environment monitoring, agriculture, medical care, event detection, structural health monitoring, etc. Further, there are three categories of sensor networks that comprise the IoT: body sensor networks (BSN), object sensor networks (OSN), and environment sensor networks (ESN). Ten challenges that need to be considered when developing sensor network middleware solutions: abstraction support, data fusion, resource constraints, dynamic topology, application knowledge, programming paradigm, adaptability, scalability, security, and QoS support. A comparison of different sensor network middleware solutions is also provided based on the above parameters. Several selected projects are also discussed in brief in order to discover the approaches they take to address various challenges associated with sensor networks. Some of the major sensor network middleware approaches are IrisNet, JWebDust, Hourglass, HiFi, Cougar, Impala, SINA, Mate, TinyDB, Smart Object, Agilla, TinyCubus, TinyLime, EnviroTrack, Mires, Hood, and Smart Messages.

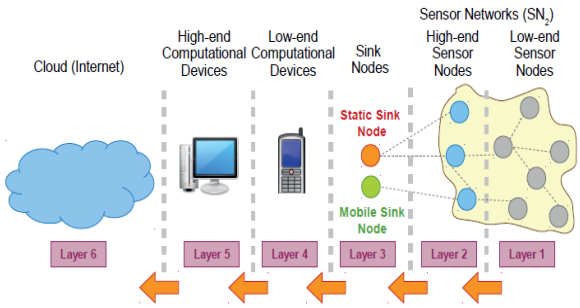


Fig.2. Layered structure of a sensor network: These layers are identified based on the capabilities posed by the devices. In IoT, this layered architecture may have additional number of sub layers as it is expected to comprise large variety of in sensing capabilities.

D. System Design

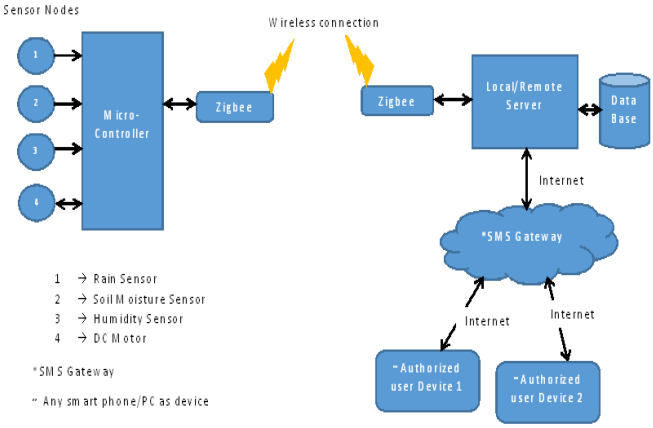
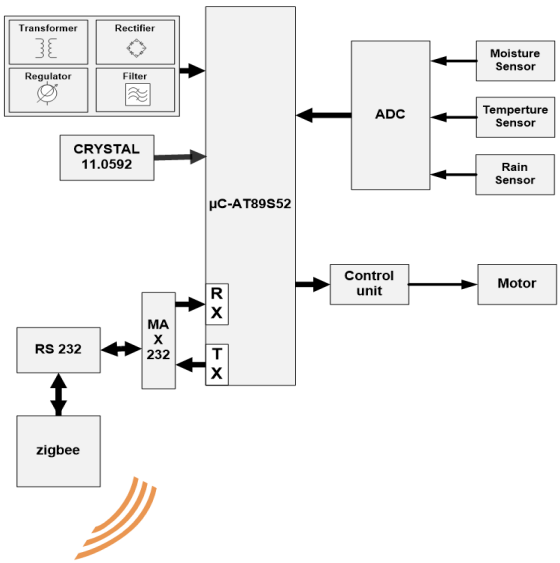


Fig.3. Design of the proposed system with a sensor node.



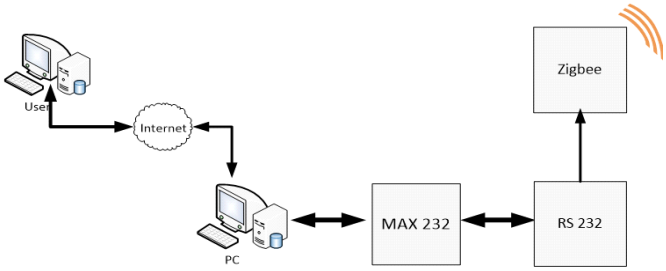


Fig.4. Detailed Architecture Layout of the proposed system.

E. Conclusion

The process needs of soil environmental monitoring system and analysing those problems with existing monitoring system; we implemented a wireless sensor network based on the soil moisture level monitoring system to control the water flow available on the pipe. This system can rapidly realize the automatic networking irrigation system, transmission and display. Through the technologies and Web Services technology, we can realize the function of remote monitoring and the retrieved sensor details are updated via web technology. It shows that the system can meet the requirements of the moisture level of the soil and water flow level for the agricultural field monitoring and the updated information will be available on the webpage. The user can anytime view their sensor data details and the intimation about the water flow level will be sent via SMS to the user's mobile phone.

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