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A PROPOSED MODEL FOR SMART FARMING IN RURAL AREAS USING IoT ADVANCED TECHNOLOGIES

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Abstract: In India about seventy five percentages of peoples are directly or indirectly depending upon agriculture only. As per the latest statistics there are about twelve percentages of farmer suicides in India due to unaware of techniques to get minimum cultivation. To revamp our farming methods and to save the life of hardworking farmers a proposed model using advanced technologies is developed in this research. Activists and scholars have offered a number of conflicting reasons for farmer suicides, such as monsoon failure, high debt burdens, government policies and public mental health. Due to sudden rain and without accurate weather forecast, Indian farmers are facing the problems such as damage of crops in their field also they do not have an adequate knowledge about their soil. In recent years, the development of information and communication technology resulted in the emergence of two important concepts of internet of things and cloud computing which affects the world around us. Both concepts are expected to be put to use in agriculture on a much larger scale in the near future. From the results it was observed that, farmers should be trained to get familiarized to these new concepts and hence if it's once implemented, even they can share this knowledge to other farmers. Finally, this will also helps farmers to learn newer things and take a modern approach towards farming problems.

Keywords: Smart Forming, IoT, Wireless Sensor Networks, Cloud Computing, Farmer

INTRODUCTION

Internet of Things (IoT) is one of the most advances and new generation technology includes a variety of areas like sensors, communication and storage. IoT is a network of physical objects instrumented with embedded electronics, sensors, software, and networking connectivity, enabling these objects to collect and exchange data [1-5]. The IoT equips objects of interest to be sensed and controlled remotely over existing and future network infrastructure, which creates various opportunities to integrate physical objects with computer-based systems [6-10]. From the very beginning of the civilization the farmers are the one who have come up with the lots of the facility for the survival in

the world. India is an agricultural based country in which more than half of the population depends on agriculture sector [11-15]. The farmers of the India are the hardest working farmers from farmers all over the world. They don't have the fear of the any kind but one fear that their crops will grow good or not? Not getting the desired output from the crops leads to poor profit of the farmers because of which they are not able to pay their debts in time, which intern makes them to take suicidal steps [16-20]. Because of this both the citizens and economic condition of the country take a hit. Now not getting desired outputs from the crops has numerous reasons, such as lack of soil nutrients, polluted ground water, weather factor, over use of pesticides, poor knowledge of the field, etc. To avoid all these problems, this paper deals with the IoT based solutions to help farmers deal with the issues. IoT can change the ways by connecting real time objects. For better results wireless sensor networks can be used, which can work in any weather conditions [21-25]. Nowadays, there is a scarcity of water, rainfall percentage has also decreased. So, to preserve water, we can adapt various irrigation techniques such as drip irrigation, sprinkler techniques using these wireless sensor networks [26-30]. Wireless Sensor Network (WSN) refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location as shown in Figure 1. These sensor senses the different parameters such as humidity and nutrition in the soil, pesticide content of acidic content of the soil. The data sensed by these sensors will be sent to central monitoring system using a network protocol. Central based monitoring system will work like a base station where all the data will be recovered through sensors. The data will be stored in a private cloud, using cloud computing. Cloud computing is based on the utilization of computer resources such as processors, memory, storage and network which can be located and managed remotely. Its capacity can be scaled up and down easily according to the need and it's free from the high cost of hardware.

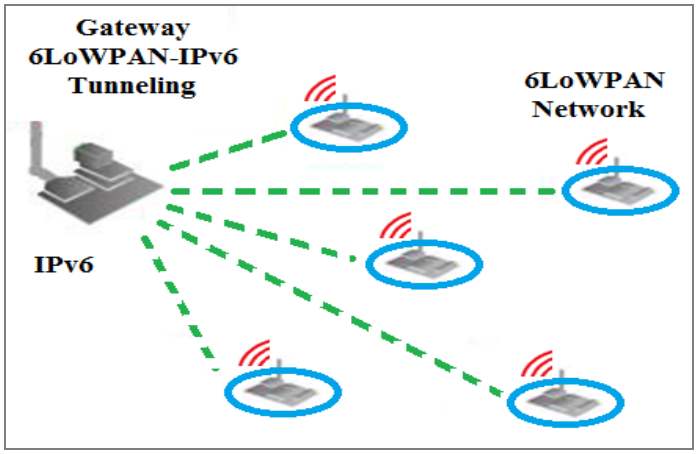

Figure 1. Wireless Sensor Network

PROPOSED METHODOLOGY

In this research, idea of smart farming in rural area using IoT is proposed as shown in Figure 2. The sensors present in the module such as temperature sensor, humidity sensor and nutrition sensor will send the data to the private cloud. The panchayat of the village would be provided with an internet connection through the BharatNet project, a government of India's initiative to provide internet connectivity to every village. A private cloud will be created, data from the sensors will be stored in the cloud and through the internet connection the weather forecast information can also be retrieved. By all this information a farmer would be able to know on which season s/he has to grow his/her crop and after how much time s/he has to harvest it. WSN node contains several technical components like radio, battery, microcontroller, analog circuit and sensor interface. When using WSN radio technology, you must make important trade-offs. In battery-powered systems, higher radio data rates and more frequent radio use consume more power. Often three years of battery life is a requirement, so many of the WSN systems today are based on ZigBee due to its low-power consumption. This

article proposed an architecture which uses 6LoWPAN over ZigBee protocol which is an acronym for IPv6 over low-power wireless personal area networks. Both the protocols are built on the top of IEEE 802.15.4 layer, but the utilization of 6LoWPAN can be better as it is a low power protocol hence, smallest to smallest device can also be connected through the IoT. The target for internet protocol (IP) networking for low-power radio communication is applications that need wireless internet connectivity at lower data rates for devices with very limited form factor. The header compression mechanisms standardized in RFC6282 can be used to provide header compression of IPv6 packets over proposed networks advantage of using 6LoWPAN over ZigBee is that the former one can run on other physical layer. A physical layer device typically includes both Physical Coding Sub layer (PCS) and Physical Medium Dependent (PMD) layer functionality. PCS is responsible for the data encoding / decoding / scrambling / descrambling.

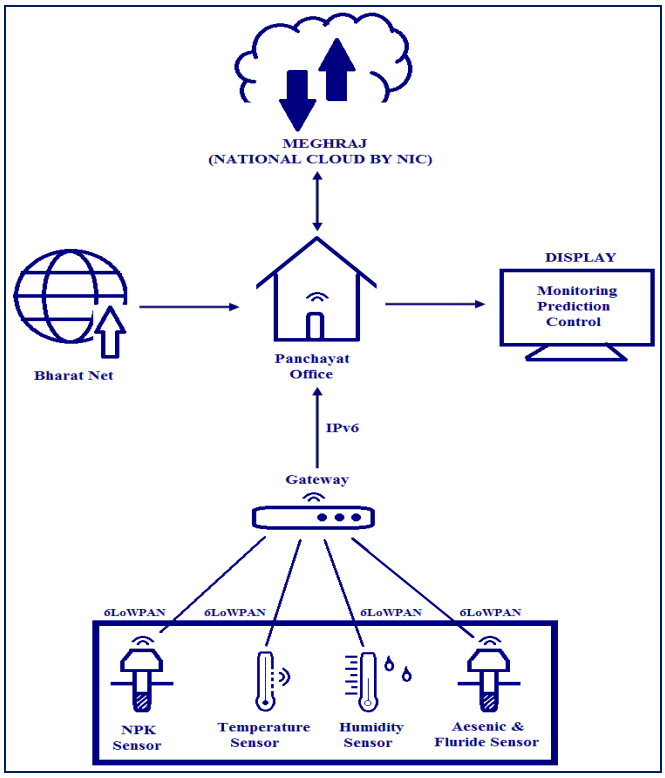

Figure 2. Proposed Concept

PMD provides the details of the transmission and reception of individual bits on a physical medium. These encompass bit timing, signal encoding, interacting with the physical medium. Therefore, adding physical layer security is a reasonable next step towards thwarting wireless network intrusion. 6LoWPAN cuts down on packet overhead and allows more room for the payload data as it does not necessarily require additional header information and also code size for a full-featured stack is 90KB for ZigBee and only 30KB for 6LoWPAN. This module contains four types of sensors temperature sensor, humidity sensor, nutrition sensor, water sensor used to measure arsenic and fluoride content. Soil temperature affects climate, plant growth, the timing of budburst or leaf fall, the decomposition rate of organic material, and other biological, chemical, and physical processes that take place in the soil. Like in spring season the soil is heated up by the warm air and sun radiations but in winter season it is opposite of the former one. Sensors will be connected in a star topology. The main advantage in this topology is that if any node dysfunctions the other nodes will not get affected and also, the management is centralized which helps in monitoring the system more efficiently. Fertility of the soil is measured by three elements nitrogen, phosphorous and potassium. The percentage of these elements will determine how much content of nutrition extra has to be added in the soil.

Figure 3. Base Station Approach (Source: http://www.csc.gov.in/)

Government is just setting up the connection point for optical fibers in each panchayat. Common service centers are established in each panchayat where the internet connection through optical fibers is provided as shown in Figure 3. Hence weather forecasting reports can be easily monitored. Information from these reports will be taken and send to the cloud-based storage systems. All the sensed data can be stored in a private cloud. To utilize the benefits of cloud computing National Informatics Centre (NIC) the premier science & technology organization of India's Union Government in informatics services and information and communication technology applications has embarked an initiative as GI Cloud which has been named as Meghraj. It provides a lot of services to host our websites, portals and web applications with the speed and scalability. A NIC cloud service provides a variety of service models like Platform as a Service (PaaS), infrastructure as a service, software as a service and storage as a service. PaaS provides environments and tools to create own web applications like google has its google app engine on which anyone can develop its own web application on google infrastructure. PaaS provides pre-installed web and database servers so that one can publish and run web application without worrying about server setup. The servers are pre-configured ready with basic security hardening. In this there is no requirement of any kind of hardware and to manage that and it is adaptable with respect to the circumstances. If there is a need to change something it can be easily changed.

HARDWARE REQUIRED

The temperature sensor consists of a thermistor encapsulated in epoxy-filled aluminum housing. The housing protects the thermistor allowing burying the probe in soil. Humidity sensor measures the moisture content in the soil. The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance hence, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance hence, the moisture level will be lower. Arsenic and fluoride have been recognized by the world health organization as the most serious inorganic contaminants in drinking-water on a worldwide basis. Arsenic can be measured by simple voltammetry technique that allows user to detect both highly toxic As(III) and less toxic As(V) below ten parts per billion. The sensor measures in approximately ten minutes and can be reused with very little maintenance. Fluoride can be measured by dipping an ion selective probe into contaminated water. Nitrate, Phosphorous, Potassium sensors, contains Ion Selective Electrode (ISE). ISE contains different membranes, or pH based colorimetric soil contains the ion concentration of all these elements and electrochemical sensors are used to measure the ion concentration.

GATEWAY DESIGN

The gateway hardware is divided in two main components such as the mother board where the processor and other components of the gateway are plugged and connect the WSN gateway to the IPv6 network wirelessly. ARM cortex-7 has been chosen as the motherboard for the gateway. The ARM CPU is Reduced Instruction Set Computing (RISC). RISC instructions sets are smaller, more atomic means each instruction roughly translates to a single operation that the CPU can perform. Little architecture has introduced heterogeneous computing in which cores can be different in terms of performance and power. If the gateway is not busy, a low energy core can be used but in the case of extreme conditions high performance cores are used. In this the processing is regarding the data transfer on a network. So ARM Cortex-7 can be used because of its low cost effective property hence, it can be easily installed in villages. The gateway is connected ethernet cable from the panchayat office and wirelessly with WSNs as shown in Figure 4.

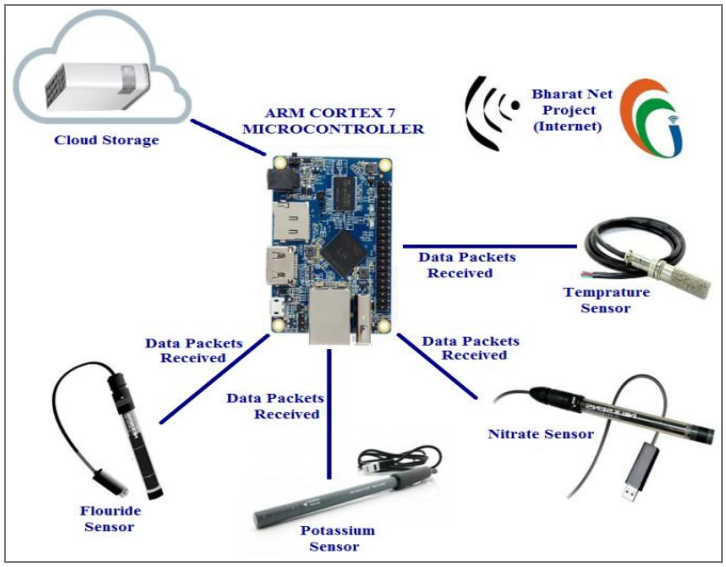

Figure 4. Proposed Gateway Design

The 6LoWPAN adaptation layer is the part of the gateway responsible for the compression of packets addressed to the WSN and the decompression of packets targeted to the IPv6 network. It fragments IPv6 packets larger than 128 bytes before forwarding data to the WSN. The reconstruction process is also made by the adaptation layer when a packet is addressed to IPv6 networks. In order to route IPv6 packets into the WSN, a virtual interface is used. It is configured to receive packets addressed to the WSN. The 6LoWPAN adaptation layer is attached to the virtual interface aiming to perform compression or fragmentation tasks before forwarding the packet into the WSN. Similarly, a packet received by the adaptation layer can be sent to the virtual interface, and then forwarded to the Internet using other network devices. In this research article storage in gateway is not proposed, it is just used as a medium to transfer data between the WSNs and the panchayat office.

CONCLUSION

A proposed model for smart farming in rural areas using IoT advanced technologies was developed. From the study and analysis the following conclusions were arrived.

- Once the model is implemented then this idea will be very economic due to the factors keeping in consideration like use of various government initiatives for weather monitoring, internet facilities, and cloud storage.
- If it is implemented by a company alone can make the finished product much more expensive as well as hard to use for farmers.

- The data collected from the sensors and weather department, will be used to help put a smart approach towards farming by calculating the soil type and what will grow best on it.
- Also, the crops harvesting time can be calculated by taking all-natural factors into consideration. This will intern help farmers grow quality crops.
- The intention is to use internet of things technologies to solve these issues in agriculture. In the field of agriculture internet of things could be used to reduce the issues in the areas of farming, soil quality/capabilities and reliable weather forecasts.

At the outset, farmers could be trained to get familiarized to these systems hence if the proposed system once implemented even it can pass to other farmers. By doing so this will also benefit farmers to learn newer things and take a modern approach towards farming problems.

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