FEATURE

AUTOMATED IRRIGATION SYSTEM USING IoT

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Water is vital to life and, with greater demand due to the increase in world population, the ground water level is decreasing day by day. Lack of rain and the scarcity of land water have also resulted in a decrease in the volume of water on the planet [2]. The decrease in water supply has resulted in food shortage and this is a major concern around the world.

Agriculture is one area where water is required continuously and in tremendous quantities. At the same time, agricultural land use must be improved to provide good harvest of crops in an efficient and fast way [3].

Agricultural productivity enhancement is advancing progressively through the use of more technological and innovative sensors and network technologies. These advancements, along with multichip networks which exploit the mesh network topology, can help monitor and control agriculture activities over the years.

Today irrigation is practised mainly using canal systems in which water is pumped into agricultural land without any feedback on the water level or moisture condition of the land [4]. This type of irrigation can affect crop health and produces a poor yield because some crops are extremely sensitive to water content of the soil [5].

To overcome these issues, it is necessary to implement automation for the irrigation of fields. It is necessary to develop an integrated system which can effectively and efficiently deliver water to crops.

This is where the Internet of Things (IoT) can play an important role. Drip irrigation, for instance, helps save water but when deployed on a large scale, there may be problems with manual control.

One common solution is to set up a Wireless Sensor and Actuator Network (WSAN) but the use of wireless technology in agriculture is not without technical challenges which include battery life and long-range capabilities [1].

Technologies such as ZigBee™ and Bluetooth have long been used to establish a low-power, short-range system [6]. Although these standards are considered low-cost systems, their limited coverage (~100 metres) is a major drawback that makes them difficult for deployment in large-scale irrigation systems.

On the other hand, cellular networks such as GSM or LTE can provide long-range transmission to form WSANs; these have been successfully tested to control irrigation systems [7]. These systems require solar panels for each node to compensate for the higher power consumption of the cellular network. The dependence on the availability of mobile networks also makes them questionable for use in remote rural areas.

An alternative solution for establishing long-range, low power and low-cost is the Low Power Wide Area Network (LPWAN) [8]. The main differences between LPWANs and the previous technologies are the use of long-range radio links, deployment of the star network topologies and low data transmissions rate.

Sigfox, Ingenu, NB-IoT, DASH7, and LoRaWAN are examples of LPWAN. These have a coverage distance of a few kilometres and have both advantages and disadvantageous in terms of cost, scalability, power consumption and data transmissions rate.

Since wireless technology controls drip irrigation, it requires minimal data exchange, so any of these network types can serve the purpose.

Among them, LoRa is a relatively new technology that operates on the LoRaWAN protocol. Among its competitors, it has the highest radio link budget and the best "cost vs range & power" tradeoff [9] and for this reason, the LoRa modem was chosen for a radio link in this project.

In this article, we look at how we can overcome these technical challenges using LoRa technology, a simple, yet cost-effective protocol designed specifically for the control of drip irrigation systems.

LoRa technology can cover distances of 15-20 km with minimal consumption of energy; this means batteries can operate for a much longer period of time. The system can detect soil moisture, ambient temperature and humidity via the wireless.

PROPOSED WORK

In the agricultural field section, sensors, such as those used to detect soil moisture levels, are deployed in the field. Figure 1 shows how data collected from these sensors are sent to the Gateway Point by LoRa, and then to the database by LoRaWN.

In the control section, the system is turned on using the on/off buttons; it can also be turned on automatically

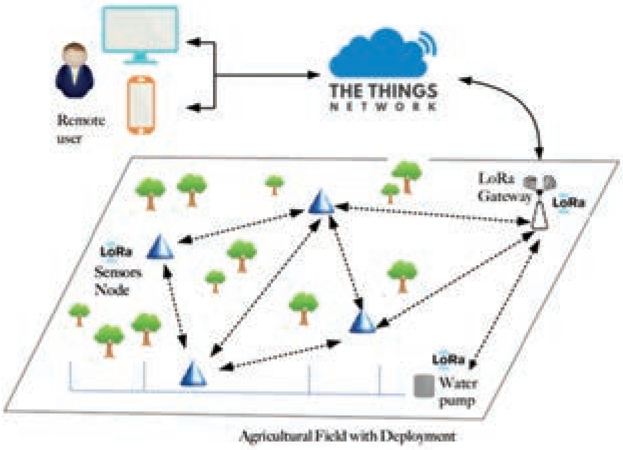

Figure 1: Proposed design using LoRa Technology

when the soil moisture level dips below the set point. Upon receiving a signal from the control, the unit pump will release water till the soil moisture level reaches the moisture set point. For manual mode, there is a manual switch in the field which ensures that should the system fail, the farmer can turn the water supply on and off.

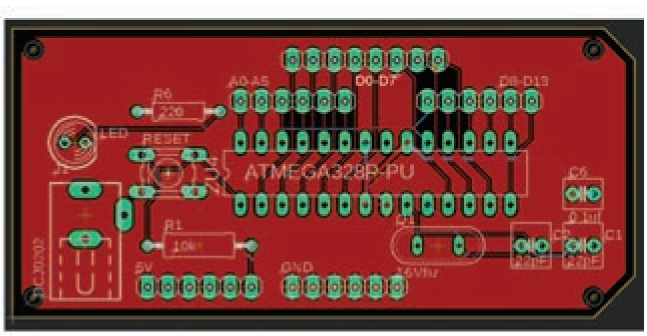

Figure 2: Mega-based Own microcontroller module

DEVICES USED IN THE PROPOSED SYSTEM

1. At mega 329p Microcontroller own board

Figure 2 shows the microcontroller used to read the data and to control the whole system logic.

2. Soil Moisture Sensor

Figure 3 shows soil moisture sensors which measure the volumetric water content in the soil. This sensor has two probes through which current passes in soil and then read the resistance of soil moisture level.

3. Temperature & Humidity Sensor

Figure 4 shows a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air and spits out a digital signal on the data pin.

4. LoRa Wireless Technology

Figure 5 shows LoRa technology which is used to transmit bi-directional information over a long distance without the need for a lot of electrical power. Typically, LoRa can achieve 15-20 km and can work on battery for years [9].

Figure 3: Soil moisture sensor

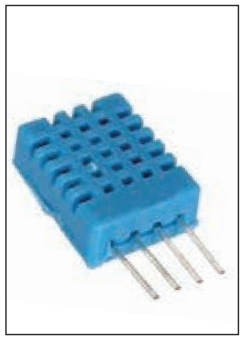

Figure 4: Temperature and humidity sensor

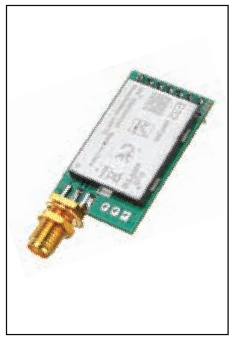

Figure 5: SX1278 LoRa module

SUMMARY

An efficient and reliable irrigation system for agricultural land is vital for producing large quantities of healthy crops. LoRa is a reliable and efficient low power technology which is also long range at low costs. Compared to existing systems, this proposed system works well for large irrigation systems in a sustainable way. ■

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