

An IoT Based Smart Irrigation System for Precision Farming

V. P. Pandagale¹ A. R. Mhaske² R. S. Patode³ S. N. Dongardive⁴ and R. S. Mali⁵

¹Ph.D. Scholar, Dept. of Soil and Water Conservation Engg., Dr. PDKV, Akola

²Professor and Head, Dept. of Soil and Water Conservation Engg., Dr. PDKV, Akola

³Senior Scientist, AICRP for Dryland Agriculture, Dr. PDKV, Akola

⁴ Ph.D. Scholar, Renewable Energy Engg., Dr. BSKKV, Dapoli- Ratnagiri.

⁵Senior Research Fellow, AICRP for Dryland Agriculture, Dr. PDKV, Akola

*Corresponding Author: ravikiranmali111@gmail.com, vpandagle@gmail.com

Internet of Things (IoT) is an emerging technology in the world. There are numerous advantages gained using IoT in various sectors. Agriculture is an important industry as well as the foundation of the economy. Agriculture automation is a major concern and emerging topic for all countries. The world's population is rapidly increasing, and as the population grows, the demand for food increases. The developing need for food, as well as changing consumer demands, have made it extremely difficult for the agriculture industry to develop techniques and practices that will allow them to fully satisfy the increasing needs and requirements.

Smart irrigation is emerging as new scientific disciplines that use data-intensive methods to increase agricultural productivity while reducing its environmental impact. Modern agricultural operations generate data from a variety of sensors, leading to a better understanding of both the operation environment and the operation activities. The water is conserved when implementing these technologies in irrigation systems such that it plays as an important contributor to Sustainable Development Goals.

The SMART irrigation system enhances the performance and is an emerging technique that automates irrigation systems and conserves water usage. This technique adjusts irrigation based on actual soil and weather conditions; therefore, it allows farmers to meet their demand with a new adopted technique which conserves the water for irrigation process. IoT can be thought of as an extension of the current internet to all devices that can communicate with electronic equipment and are linked to the internet, making devices user friendly and easy to handle. Correspondingly, IoT is linked to automation of all areas of agriculture and farming processes in

order to make the entire process more productive and efficient.

Advantages of IoT based automatic irrigation systems

- i. **Efficient water usage** – Automatic irrigation systems use sensors and technology to accurately measure and distribute water, reducing water waste and ensuring plants receive the right amount of water they need.
- ii. **Convenience and time-saving** – Automatic irrigation systems can be scheduled to run at specific times, saving farmers the time and effort of manually watering their crops.
- iii. **Customizable irrigation** – Automatic irrigation systems can be customized to suit different crops, soil types, and weather conditions, providing the flexibility needed for optimal growth.
- iv. **Monitoring and control** – Automatic irrigation systems allow farmers to remotely monitor and control their irrigation systems, making it easy to make adjustments as needed.
- v. **Cost-effective** – In the long run, automatic irrigation systems can be more cost-effective as it reduces water wastage and labour costs, thus increasing the yield and profitability of the farm.
- vi. **Soil and weather monitoring** - Monitoring in the particular context of precision irrigation inculcates collecting data, which adequately leads to reflect the real-time status of the plant, soil, and weather of irrigation areas through the use of the Internet of Things (IoT) and Wireless Sensor Networks (WSN). In order to establish a real-time system of monitoring, IoT has led to establish a low-cost technology

method that leads to improve the control and monitoring system for the irrigation process.

IoT and smart systems used in irrigation

1. Communication technologies

The main technologies that are used in IoT for irrigation could be classified into two categories. One could be regarded as the devices that function as nodes and lead to forward or transmit small data amount at short distances along with having low consumption of energy. Consequently, the other devices are the ones that have the ability to transmit huge amounts of data over long distances, having high-energy consumption. There are various wireless standards that could be used in the communication of IoT devices and they could generally be classified between devices that communicate at long or short distances.

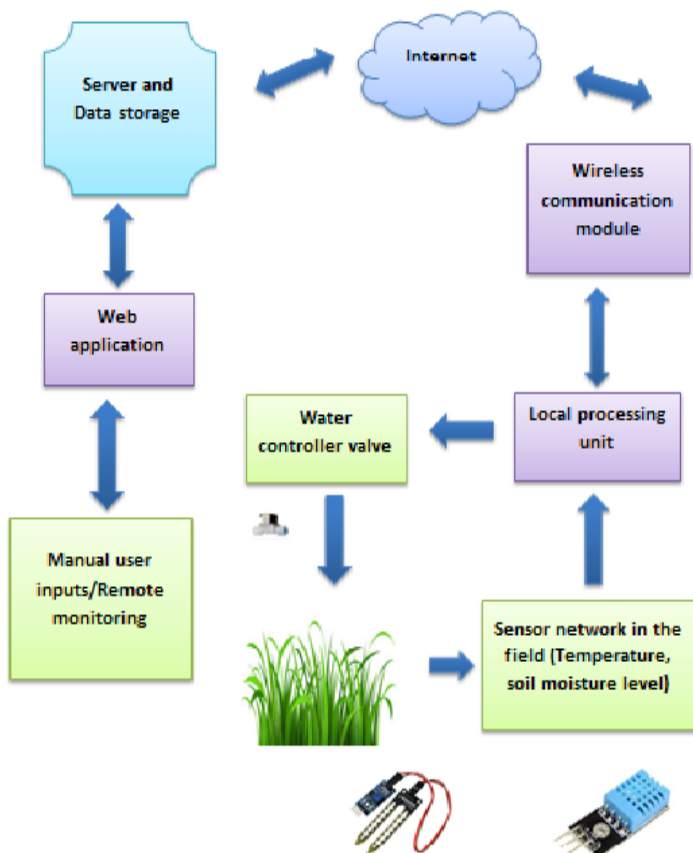


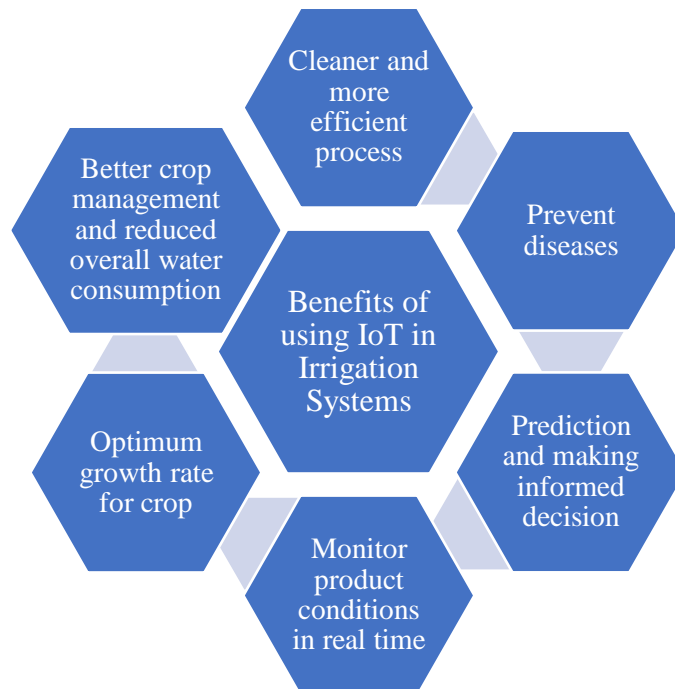
Fig. 1 IoT based smart irrigation systems

Cloud technologies

The usage of cloud in the agricultural sector and specifically in irrigation-based systems, data is gathered and processed by the use of sensors. In

several studies, it has further been deduced that the data is processed in the cloud itself, and the users of it are able to view the information by connecting to the cloud. The usage of cloud in irrigation is mainly taken in terms of storing the monitored data and then retrieving it when needed.

Fig. 2 Benefits of using IoT in Irrigation Systems



IoT system in irrigation

One of the main benefits of IoT systems in irrigation is associated with the lower water consumption. In traditional ways of irrigation where most of the handling and operations were carried out manually, an ample amount of water was wasted in the irrigation process where human intervention was required. With Smart irrigation, there is no or less human involvement and the resource of water is only used to the extent to which it is required only. Further, high cost-efficiency is one of the other benefits linked to it as lesser water utilization and precision in the process allows saving costs and overall expenses. Energy consumption is also reduced significantly through the approach as machines have to run for a lower amount of time and planned intervals take place during the process that lowers the utilization of overall energy.

Irrigation systems and sustainability

Sustainability could be considered as an essential aspect that is related to irrigation systems. To maintain the sustainability within any system, balance between the three pillars of sustainability should be ensured. The three pillars of sustainability are economic, social, and environment.

Agricultural cropping systems irrigation is necessary and considered as one of the main reasons that cause rapid increase in water scarcity in many regions. In order to conserve water, smart irrigation is crucial and plays key role in providing the required water amount to each crop. The process of irrigation may reach the plant late, causing the crops to get dried. An optimal solution for this problem is an automatic controller built based on drip irrigation system. Thus, the integration between the recent technology and irrigation can improve the use of irrigation water in many regions, the developed technology Internet of things (IoT) is proposed in this study. The IoT application can give objective information related to water resources, their use, and management, assisting

in the achievement of Sustainable Development Goals (SDG).

Conclusion

The use of these IoT-based systems allows the remote measure and automation of agricultural parameters such as soil moisture, temperature, field humidity, etc., as well as the ability to remotely control field irrigation. It leads to higher yields with less input. An automated irrigation system based on IoT to successfully manage the water requirement of crops. The system measures parameters such as soil moisture and field temperature and automatically supplies water to the field, constantly forwarding field data to the webpage so that the user can gain insight into the field's agricultural data and water supply. The use of this kind of system is expected to reduce the cost of manpower, Directing the busy people into the agriculture sector, and provide quick information of rapid changes in the field. This automatic irrigation system is a low-cost system as well as an easy-to-use system.

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