REGULATING WATER SUPPLY AND WATER CUTBACKS IN AGRICULTURE USING IOT BASED SMART IRRIGATION SYSTEM

Prabhas Kumar Gupta[1], Dr. Nagendra Tripathi[2]
[1]Assistant Professor, CSIT DURG, [2] Associate Professor, BIT DURG

Abstract: Involvement of Machine Learning, Real-time Data Analysis and IOT are critically contributing factors in contemporary technical scenarios. Utilization of these three technologies can play a major role in the success of farming thereby modernizing the irrigation system. This paper is focused on the Smart Irrigation System which draws a lot from real-time data analysis, IOT and Machine Leaning. It also presents a study of a system that processes real time data and takes decision about to what extent the field needs to be irrigated. In this way water is saved, its misuse regulated and can be restored for future use if required. Here we rely on cloud data and some other agri-factors which help in decision making. The Smart Irrigation System discussed here shall also regulate the use of underground water my incorporating IOT and weather forecast. The system will also contribute to effective irrigation taking in view the contemporary weather conditions and the requirement of water in the crop.

Keyword: Internet of Things, IOT, PLC, Machine Learning, Cloud Data, Temperature sensor , Humidity Sensor.

Introduction

Effective irrigation is a crucial factor in the field of agriculture, horticulture, floriculture. While a large farming area in India depends on the rains and traditional methods of farming, some of the farmers have taken up to use underground water for irrigation. Tube-wells are largely used to draw underground water. In the contemporary scenario it has been observed that the underground water level is drastically decreasing. Keeping this in view, apt use of underground water is very necessary. Success of farming totally depends on effective irrigation. Machine Learning, Real-time Data Analysis and IOT are three very effective technologies that can revolutionize not only irrigation system but also the farming sector. A combination of these three technologies will result in Smart Irrigation System which will reduce not only risk-of-weather but only labour cost in farming sector. Modernization of farming sector will contribute not only in economical progress but also in environmental conservation. Drip Irrigation System is one of the examples of modern techniques used to save the water but if it is coupled with sensor based modern technology and IOT, it shall be very efficient at all the fronts. As the underground water-table is decreasing day by day, requires modern irrigation system which can cater to the varying demands of irrigation. In India agriculture plays an important role in economy and social development.

In India agriculture plays an important role in economy and social development. A large country like India, where the climatic conditions vary due to huge differences in geographical parameters, and the underground water is decreasing day by day, requires modern irrigation system which can cater to the varying demands of irrigation. Modernization of irrigation system is very necessary because of the following reasons-

- The continuous increasing demand of food requires the rapid improvement in crop production. Indian economy is mainly based on agriculture.
- Availability of water for agricultural purposes is a major challenge. The main reason is the scarcity of land reservoir water.
- A major amount of water is wasted due improper and indecisive irrigation methods.

Looking into this, an irrigation system that can save water by using IOT is very required as it shall be very helpful in timely irrigation and saving water.

LITERATURE REVIEW

Some scholars have researched various technologies to modernize irrigation system. Their findings have stimulated studies in modernizing the irrigation system.

A paper by Yunseop (James) Kim, Robert G. Evans, and William M. Iversen, (2008),details the design and instrumentation of variable rate irrigation system. It has a wireless sensor network, and software for real-time in-field sensing and control of a site-specific

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precision. The System is completely based on sensor and bluetooth technology. [1]

In a paper, Shifeng Fang, Li Da Xu, Yunqiang Zhu, Jianwu Yan, and Zhihui Liu, (2014), discuss about an IIS (integrated information system) that has a combination of Internet of Things (IOT), Cloud Computing, Geoinformatics [remote sensing (RS), geographical information system (GIS), and global positioning system (GPS)], and e-Science for environmental monitoring and management. The system presented in this more efficient and successful on account of the heterogeneous technologies it incorporates. [2]

A moderate review about the requirement of wireless sensors in agriculture is discussed by Aqeel-ur-Rehman , Abu Zafar Abbasi b and Zubair Ahmed Shaikh (2014). The paper discusses WSN technology and other applications in the field of agriculture. [3]

Joaquín Gutiérrez and Juan Francisco (2015) present the design and functioning of a prototype cloud-connected sensor based irrigation system in their paper. The paper claims that the system has been and tested on the farming of basil. However, the researchers quote that "more work is needed to identify the practical effects of irrigation set-points on crop performance."But their proposed system may be adapted to other crops. [4]

AlirezaFarhadi and Ali Khodabandehlou (2016), present a research paper which is concerned with a distributed model predictive control (DMPC) method. It is based on a distributed optimisation method with two-level architecture for communication. The paper is concentrated on communication technologies uscd for forecasting. [5]

A paper by George Mois, SilviuFolea, and TeodoraSanislav(2017), discusses remote sensing and wireless sensor networks for gathering data about the environment. It claims that refinement of the protocol and the addition of mesh networking capabilities to BLE devices will enhance the functionality of the system in irrigation. The findings are useful, as they can be well incorporated in smart irrigation system. [6]

G. Nagarajan, R. I. Minu (2017) worked on to automate the whole wireless sensor network (WSN) system with a control over water pumps and dripper valves. This system leaves a large scope for study as it has not practically involved smart phone app for real time data display and other facilities. A User Interface system and design of the mechanical structure also needs to be incorporated in it. [7]

J. Uddin, R. J. Smith, M. H. Gillies, P. Moller and D. Robson (2018), notes aboutthe automation of furrow irrigation in row crops is feasible and practical with commercially available equipment. The research provides the potential for water, labor, and energy savings. But, the limitation is the high cost of the implementation. [8]

Francesco Fabiano Montesanoa, Marc W. van Ierselb, Francesca Boaria (2018), discuss prototype cloud-connected system for wireless, sensor based irrigation management, which worked well for farming of basil.Their approach to irrigation can be adopted for other species if combined with precise information. [9]

METHODOLOGY

This research deals with design and development of an auto irrigation system with the help of IOT. It relies on IOT for data collection of weather condition. The sensors involved in the system will sense the water content in the soil, temperature and humidity. The collected data shall be processed by Raspberry pi and with reference to the parameters obtained from different sensors it will regulate the irrigation system.

The two major sources of data for this system are: internet and the sensors. IOT (Internet of Things) gets data related to humidity, temperature, solar intensity, cloud and rainfall from internet and sensors provide data to Raspberry pi for analysis and working. The acquired data shall be sent to the computer system. After analysis, this data shall be stored in certain specified data store in a certain location. The agricultural data pertaining to the area of implementation shall be obtained by from the sensors. The data obtained from sensors and internet will be compared.

The above flow-chart represents the working of the smart irrigation system's model. The system starts working from agriculture land where Physical sensors are present. The sensor measures temperature, humidity, PH Soil of agricultural land. The data is collected by Raspberry pi 3 in different manners viz. current change, voltage change and resistance change. It also gathers data online from Google API through IOT. After collecting these data, the deice processes real-time data using Python programming. The Real-time data set is then compared with the contemporary weather conditions and weather forecast data. Based on the data analysis, the system regulates water for irrigation.

The system can accommodate data 5 days for analysis. A striking feature of the system developed here is that it is capable of referring to the weather forecast of five upcoming days from Google API. The data is received by Raspberry pi 3. It analyses the

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collected data, monitors the current situation and then decides as to how much water is required as per the plant categorisation and identification. The water dissipation is controlled with the help of final control element. The final control elements sends the signal to Activator which control timing of water dissipation process. This system can also be incorporated in the drip irrigation system to optimise its functionality.

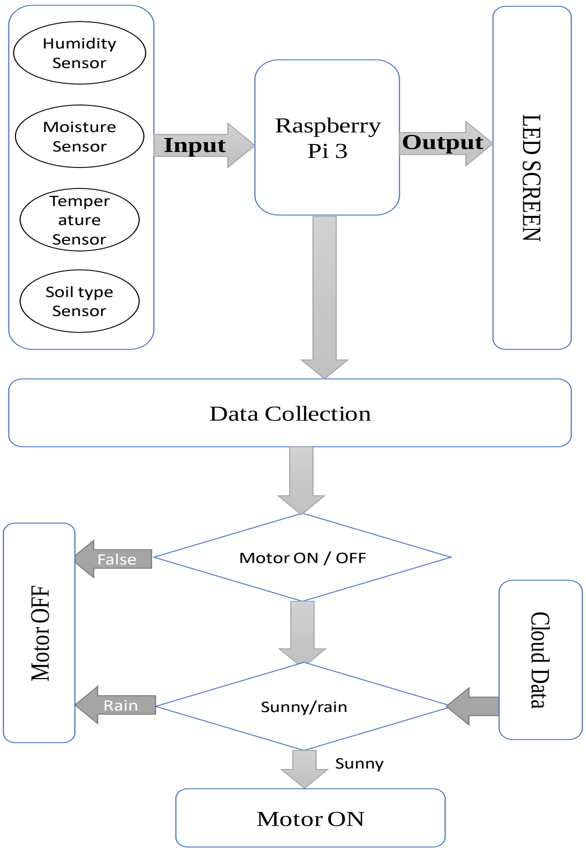

Figure 1 Schematic diagram about functioning

RESULTS AND DISCUSSION

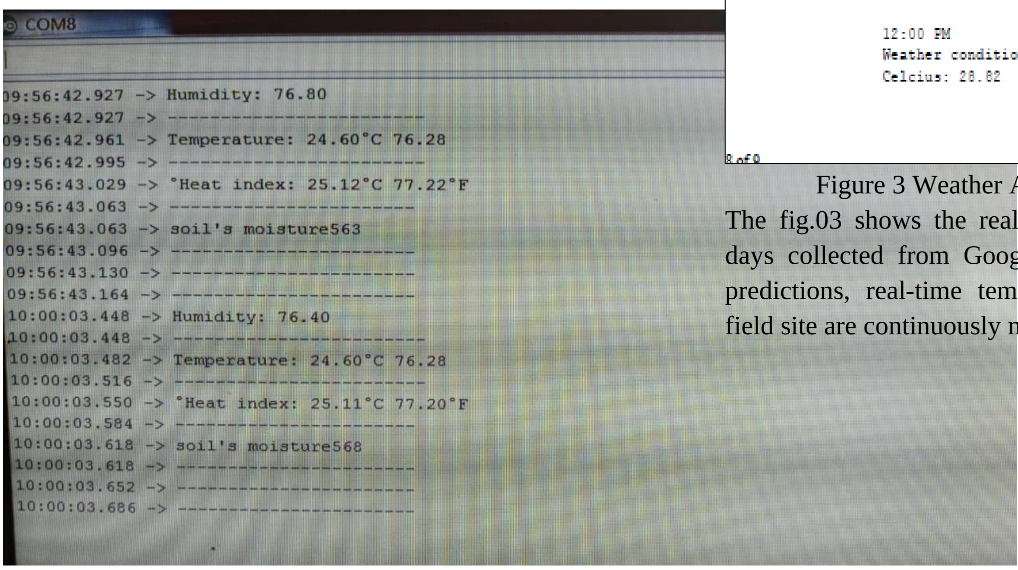

Figure 2 Data gather for sensor.

This fig. 02 shows real time humidity, temperature and moisture. The data is monitored and analysed as per the programming done; the data processing is done by Python programme. If real time values obtained by the sensorsare more than the set point value or reach the threshold value, the programme stops the pump. On the other hand if the values obtained by physical sensors are lower than the threshold values, it starts the pump immediately.

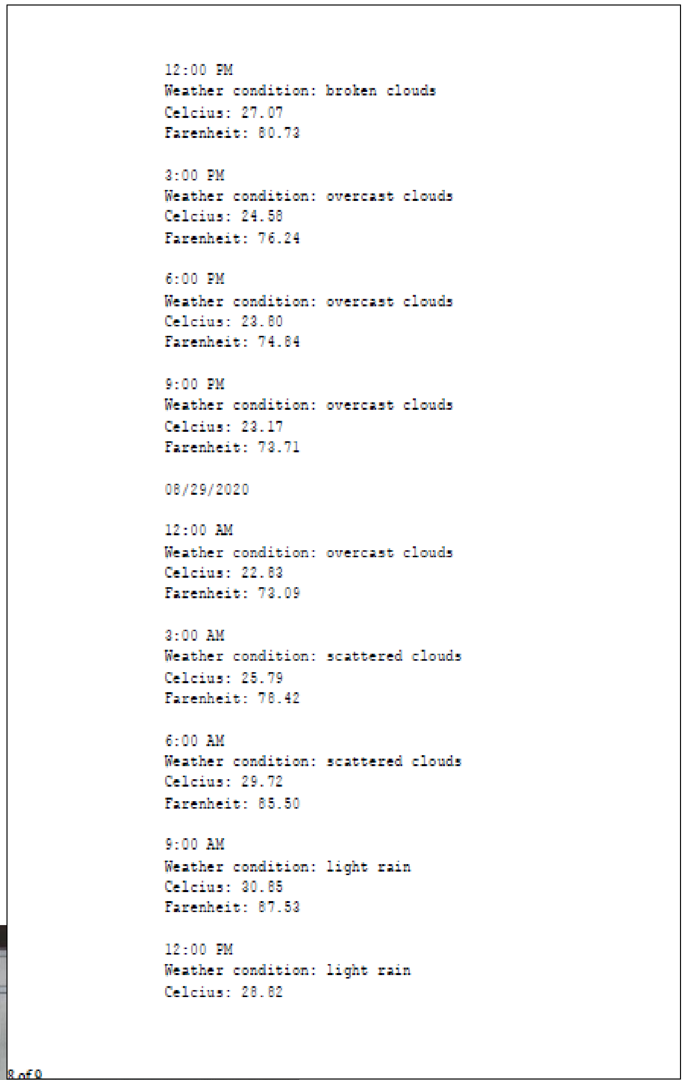

Figure 3 Weather API Data.

The fig.03 shows the real-time data set for next 5 days collected from Google API in which rainfall predictions, real-time temperature humidity of the field site are continuously monitored.

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Out[5]:

	CropType	SoilType	Temperature	Moisture	Ph	Humidity	Wind	Landsize	Lattitude	Longtitude
count	18396.0	18396.000000	18396.000000	18396.000000	18396.000000	18396.000000	18396.000000	18396.0	18396.000000	18396.000000
mean	1.0	2.500000	27.990596	55.024081	49.386013	77.459285	9.983149	1.0	-31.160785	119.497423
std	0.0	1.118064	2.578555	20.481399	28.802376	7.481617	3.150987	0.0	14.394584	55.200655
min	1.0	1.000000	24.000000	20.000000	0.006282	65.000000	5.000000	1.0	-38.182550	0.000000
25%	1.0	1.750000	26.000000	37.000000	24.255897	71.000000	7.000000	1.0	-37.846680	144.868275
50%	1.0	2.500000	28.000000	55.000000	49.061158	77.000000	10.000000	1.0	-37.783900	144.980600
75%	1.0	3.250000	30.000000	73.000000	74.327270	84.000000	13.000000	1.0	-37.711515	145.046870
max	1.0	4.000000	32.000000	90.000000	98.999071	90.000000	15.000000	1.0	0.000000	145.526350

Figure 4 Data analysis for decision support

This is a data set collected from a well renowned agricultural institution. The categorization for irrigation has been done on the basis of crop type, soil type, temperature, moisture requirement, pH values, humidity, wind speed and the landmark area. We can calculate and identify the set point values with the help of this data set. The data set is extensively used by the smart irrigation system to regulate the water-supply.

Outcome of the proposed system:

- Effective irrigation system that works on weather forecast using IOT.
- Cost effective Raspberry pi 3 and sensor based irrigation system.
- Smart irrigation system is a combination of Machine Learning and IOT
- Better crop yield and 15- 25% saving of water as compared to traditional irrigation methods.

Advantages:

- Water and energy saving
- Programming is less complex
- Computational abilities
- Trouble shooting aids and reduce downtime
- Reliable components
- A real time feedback control system
- Can be integrated with existing Drip irrigation system
- Optimum expenditure
- Proper utilization of sources to improve production and profit.
- Protection of system from undesirable electrical activity
- Handles multiple input/output
- Reduced manual efforts

Applications:

- The system is useful for farmers and gardeners who do not have much experience in irrigating crops/plants.
- The project can be extended to greenhouses where GUI based supervision is possible.
- In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve results with most types of soil.

CONCLUSION

The developed Smart Irrigation System is capable of irrigation in all types of fields. It not only optimizes the proper use of underground water, but is also capable of regulating the irrigation supply based upon crop, nature of soil and weather conditions. This feature makes it very efficient. It is a technically advanced irrigation system which is capable of using real-time data and forecast too. The Raspberry pi 3 uses Python efficiently, and is capable of correlating real-time soil information with the Google API to irrigate the fields. The system is very advantageous as for small as well big farms, and for all types of crops.

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