A SURVEY ON AUTOMATIC IRRIGATION SYSTEM USING WIRELESS SENSOR NETWORK

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ABSTRACT
Wireless sensor network (WSN) contain various sensor nodes with the capacity of sensing, computing, and wireless communications. WSN technology is uses to control and monitor the environmental and soil parameter in field. WSN employ as a part of agriculture for few reasons like gives high Interpretation, increase the production of the crop, low-power consumption and gather distributed data. Efficient management of water assumes an important part in agriculture. Shortage of water resources and high cost of pumping are making good water management more critical. Today, an automated irrigation system (AIS) utilized for improving utilization of water resources in agricultural for increase production. This irrigation system framework permits development in different places with water shortage. In this way, productive planning of watering system gives the highest return at the low amount of water.
Keywords: WSN, AIS, WSU, WIU, PA.

1. INTRODUCTION
1.1 WIRELESS SENSOR NETWORK
WSN consists of different independent devices like sensor node, communication device, power supply and processors [1]. Sensor nodes deploy in the interested area and sense data. The sensor nodes send data to base station by different communication ways as direct or clustering. Wireless Sensor network provide characteristics like fault tolerance, low cost, high sensing capability [2]. Sensor network provide an improvement over traditional sensors like random deployment of nodes in the field [3]. Wireless sensor network faced a few challenges like energy limitations, scalability, security and reliability [1].

1.2 AGRICULTURE
In the agriculture country like India [4] most of the people are fully dependent on the agriculture [5]. Without agriculture, they have no other resource of their income. Irrigation becomes most important part in agriculture [6, 7] because high productivity of the crops depends on irrigation. Agriculture uses 85% fresh water resources [8] for irrigation [9]. Many areas mainly affected by over or under irrigated water during to irrigation and in an unconditional season like rainfall [10]. Over irrigated areas are suffers from plant disease and under irrigated areas are subject to water stress and results occur in the loss of production. Traditional field irrigation system is usually manned and needs a lot of labor and material resources and it goes against the development of long-term agricultural production and sustainable utilization of water resources [11]. A farmer spends all the time in the field to manage their field efficiently to achieve high productivity but one cannot be successful because of the unavailability of any information [12]. Farmer can irrigate to the fields using some traditional water resources as canal, tube wells [13, 14]. They do not know exactly how much watering to the field. By making few estimations in own mind, a farmer irrigate to the field. Without proper utilization of the water that deliver to the field some area of the field affected by fully irrigate and some area of the field not. Along with this, a farmer faced one more problem while irrigation is the electricity [14], because they

irrigate their field only when the electric power is available [13]. In addition, the water is polluting by using high quantities of artificial manure [15], chemical and acid pollution [16]. By these varieties of reasons, water resources are severe shortage day by day.

Therefore there is a need to monitor environmental parameter as soil moisture, soil temperature, soil humidity [11], air temperature, air pressure, wind speed, pH, salinity level, turbidity, groundwater, water required to the crop. Based on the result of these values the farmer irrigate field only when required. Thus, the farmer save natural water resources, also save the time, and increase the productivity of the crops.

1.3 AGRICULTURE WITH WSN

Efficient water management plays an important role in agriculture [17, 18]. Wireless sensor based irrigation control system provide a best solution to optimize use of water [19]. Using WSN, automated irrigation helps the farmer in a best way by avoiding money loss usually spend on labor to do the watering [4] and avoid the wastage of water [20]. Automated irrigation proceeds with the help of solenoid valve [8] and pumps [4]. By Using information, the AIS proceed their task to automatically open or closed [22] the motor [13, 21] to irrigate the field when there is a need occur for the water in the field or not. AIS are able to control the water during unconditional season like rainfall [23, 24] by equally distribute water in the whole farm.

In this paper, we represent a literature review on AIS in agriculture by using WSN. Our aim is to provide a better understanding of the current research issues in this field. The remainder part of the paper has organized as follows: We discuss different protocol and software in literature review that developed to increase the productivity of the field and next comparison by considering different parameters. We then conclude our paper.

2. LITERATURE SURVEY

Irrigation is most important for high yield of the farm. Today, by using WSN technology it is possible to monitor and control the environmental conditions as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity etc for irrigation. Automated irrigation performed by using solenoid valve and pump. Solenoid valve is an electromechanical valve used with liquid controller to control an electronic current through solenoid which is a coil of wire that uses to control the state of the valve according to need of irrigation.

M.Nesa Sudha et al., 2011 [4] proposed a TDMA based MAC protocol used for collect data such as soil moisture and temperature for optimum irrigation to save energy. MAC protocol plays an important role to reduce energy consumption. Two methods used for energy efficiency as Direct Communication method and aggregation method. Direct Communication method provides collision free transmission of data, because all the sensor nodes send data directly to the base station without the need of header node. This method is better where the base station is near but it is not optimum where the base station is far because sensor nodes consume more energy during transmission of data and if there is much data to the sensor node, sensor nodes quickly damaged. The data aggregation method is better to use rather than direct communication method. The sensor node senses the data and send to the head node. The head node collects data from the entire sensor node, performs aggregation using various aggregation techniques, and then sends data to the base station. Thus by using aggregation method overall energy consumption reduce of the network. The simulation result show that aggregation method provide better performance rather than direct communication method. It provides 10% increase in residual energy and 13% increase in throughput. Sensor nodes consume more energy while transmitting data.

Anuj Nayak et al., 2014 [9] describe that sensor nodes batteries are charged by using harnessing wind energy. A routing algorithm named DEHAR is proposed to extend overall batteries power. The proposed method is efficient where the amount of sensor nodes very low because of latency experienced due to synchronous sleep scheduling. A small band belt used to harness wind energy to sensor nodes. Wind belt is aero elastic flutter, which is capable for harnessing wind energy. Harnessing wind energy is a renewable energy source. However, the main problem using harnessing wind energy is the unreliability as the power of the wind is not permanent.

Man Zhang et al., 2012 [25] analysis the temporal and spatial variability of soil moisture for the realization of variable irrigation and for improve yield in the farm. Temporal variability adopts the changes of soil moisture at the place where the sensor nodes installed and analyze soil moisture variation at different times according to season. Spatial variability analyses calculate all parameter of soil moisture as average, maximum, minimum in whole area. The temporal variability curve has drawn according to measure data. It showed that the corn was in severe water stress state during the completely monitoring period.

Joaquin Gutierrez et al., 2013 [8] proposed an irrigation system that uses photovoltaic solar panel to power system because electric power supply would be expensive. For water saving purpose, an algorithm developed with threshold value of temperature and soil moisture programmed into a micro controller gateway. The system has a full duplex communication links based on internet cellular interface using GPRS based on mobile data for graphically display and stored in a database server. The automation irrigation system consists of two components were WSU and WIU. Wireless Sensor Units (WSU) components were used for minimize power consumption because microcontroller is well suited by its lower power current in sleep mode. Wireless Information Unit (WIU) transmits soil moisture and temperature data to a web server using GPRS module. The WIU identify recorded and analyzed received temperature and soil moisture data collected by WSU. WIU functionality is bases on microcontroller that programmed to perform different task as to download the date and time information from web server and compare the temperature and soil moisture value with maximum soil moisture and minimum temperature value so that irrigated pumps activated.

Sherine M.Abd El-kader et al., 2013 [26] proposed APTEEN (Periodic Threshold old-sensitive Energy-Efficient sensor Network) protocol. APTEEN is a Hierarchical based routing protocol in which nodes have grouped into clusters. Each cluster has a head node and head node is responsible for broadcast data to the base station. APTEEN broadcast parameters attribute, which is a set of physical parameters, in which the user is interested to obtain info, Thresholds value as Hard Threshold and Soft Threshold, Schedule as TDMA schedule uses to assign slots to save energy, which provide collision free transmission. It controls the energy consumption by changing threshold values and count time. The performance of proposed protocol is better than LEACH on average 79% and by LEACH-C on average 112%.

B. Balaji Bhan et al., 2014 [27] proposed a system to develop WSN based soil moisture controllers that determine the water requirement by comparing soil moisture with predefined threshold value. An intelligent remote system consists of wireless sensor nodes and computer system in which data is transmitted to a server system from where the data accessed by individuals for decision making for automated control of irrigation for the yield productivity. Field validation tests routinely performed on different soils to measure the soil moisture, water amount in soil for efficient irrigation system. If the stored data does not match with the soil-measured data, an interrupt sent to the pressure unit and stop irrigation automatically.

Sbrine Khriji et al., 2014 [11] describe different type of sensor nodes for real monitoring and control of irrigation system. Each node consists of TelosB mote and actuator. TelosB mote is an ultra low power wireless module for monitoring applications. Soil nodes used to measure the soil moisture weather nodes used to measure environmental parameter and actuator used for controlling the opening of valves for irrigation. The system has cost efficient and reduce the power consumptionThe experimental result shows that the plants are well irrigate and if there is any change in threshold value the system alert to farmer about the problem to take the appropriate decision.

Yunseop Kim et al., 2008 [29] represents real time monitoring and control of variable rate irrigation controller. The sensor nodes measure environmental parameter and transmit data to base station where base station process data through a user-friendly decision making program and all data commands send to irrigation control station. The Irrigation control station sends machine location using GPS to the base station, send control signal back to irrigation control station based on GPS head location for real time monitoring, and remotely control of water.

T.C. Meyer et al., 2015 [30] represents the design of smart sprinkler system using mesh capable WSN for monitoring and control of field irrigation system. This system provides accuracy by controlling the soil moisture level between the thresholds. Sensor nodes send data to base station every time the timer variable overflows. Base station has an actuator interface to control solenoid valve using GUI. GUI provides system feedback to user and allows changing the parameter and initially setup the system. Air temperature, soil temperature and humidity greatly influence the tomato crop. Certain disease occurs in tomato crop due to high humidity and warm temperature such as gray mould and leaf mould.

Macro Mancuso et al. [31] the Rinnovando group (Rgroup) is working with agriculture experts that concentrate on monitoring microclimate in tomato greenhouse. The main goal of monitoring is to measure when the crop is on risk of developing and the farmer treat the field with fertilizer only when needed.

Nelson Sales et al., 2015 [28] proposed cloud based WSAN communication system, monitoring and control of a set of sensors and actuators to measure water plant needs. Cloud computing provide high storage capacity and high processing capability. The proposed architecture divided into three components such as a WSAN component, a cloud platform components and a user application component. WSAN contain three types of nodes are a sink node, a sensor node and an actuator node. Cloud computing provide attractive solution to large amount of data. In addition, the web application provides user interfaces that allow the user to visualize the location of the network nodes to access historical data.

K.Satish Kannan et al., 2013 [32] proposed a WSN based system that provides online system to control and maintain the farm remotely by logging into a farming website. Cameras used to capture live videos of the farm. By using these videos the user able to see the real condition of the farm and control the farm remotely from any part of the world. The proposed system divided into three modules: front end measure various parameters and capture live video of the farm, management module control the irrigation station by gathering real time data and monitoring and control module describe the software part through which the farming website is access.

Ravi Kishore Kodali et al.,2015 [33] represents the overall history of spices as black pepper, cardamom and clove in different states where these spices are cultivated and exporters of spices and the problem faced by farming community related to pest and irrigation. Therefore, WSN used to measure different soil and environmental parameter and the presence of pests among crops and provides measures value to the user to take appropriate decision to improve crop yield. MEMSIC eko nodes used for real time monitoring of parameters and control of irrigation system.

Zhang Feng, 2011 [22] emphasize on the analysis of routing protocols of sensor network nodes to achieve the hardware and software design. Use of mobile phones and wireless PDA makes able to easily monitoring to soil moisture content and control of an irrigation system. Results show that water use efficiently by using embedded control technology system.

Aqeel-ur-Rehman et al., 2010 [34] represents the Indigenous design and development of WSAN. For better control of irrigation process in third world countries like Pakistan, it is necessary to develop cost effective hardware system. They design system using three components as sensor node to sense data, Actuator node for switching on/off of the connected actuator devices and sink nod for gathering data for decision-making.

Alvindarjit Singh et al., 2010 [35] represents the design of a system which takes soil samples when an event triggered with an outside event such as rain event. The system has variable sampling rates with interface to soil sensors and rain gauge. Wireless soil sensor network monitor an event of rain and soil moisture content. Such system consists of rain detection module and sensory module. Rain detection module detect event of rain and Sensor module measure the soil moisture level and both module measure data based on sampling rate set by gateway. Star mesh hybrid topology used to organize sensor nodes in star topology around routers that provide fault tolerance.

Mauro Martinelli et al., 2009 [36] represents the use of WSN that provide real time data collected by sensor node. Each node collect data concerned with the voltage of the battery, internal voltage and current provided by solar panel and the temperature of the microcontroller to perform real time monitoring of the network stated. After measured data, the sensor board is switches off and RF sends the collected data over radio channel to sink node. After collect data, the sink node send collected data packet to a Gateway by measuring the RSS (Received Signal Strength) value of every packet and the gateway send data to a database for data management on a public website. The network has organized in star topology to improve the reliability of measurement system and reduce power consumption with respect to multihop network topology.

Zheng Yao et al., 2010 [37] proposed the design of water saving irrigation control system based on WSN which is the combination of fuzzy logic and neural network. Fuzzy logic is a mathematic model and neural network that has self-learning ability to adapt changing environment. Fuzzy neural network is an integrated set of fuzzy logic reasoning ability and powerful self-learning ability of neural network. Sensor nodes measure soil moisture, temperature, humidity, light intensity and through LAN or WAN data transmitted to gateway node to upper machine and irrigation control system control electromagnetic valve to precision irrigation according to real time feedback information collected by measuring data.

M. Usha Rani et al., 2014 [38] proposed an AIS based on moisture level by using Grove moisture sensor to control the water level available on the pipe. Depending on moisture level of the soil, the water flow sensor sense the flow range and operating pressure. The monitored data updated in a database along with the time and displayed in the web portal through the web service technology, the information updated via web technology and updated information will be available on the webpage from where the farmer checks the moisture level and motor status. By using GSM motor’s functionality status will also be sent to the farmer.

Xinrong Zhang et al., 2011 [39] represents the design of distributed control system of indoor wireless temperature and humidity to improve the overall performance of the system by detect change in the temperature and humidity. The fuzzy control algorithm used to control the system environmental factor and software tools have used for aided design of fuzzy control system. The real time data collected by monitoring software and the reports formed for decision-making.

Scott Fazackerley et al., 2009 [40] represents the design of an adaptive irrigation controller using WSN for monitoring the soil moisture status and controlling the irrigation program schedule irrigation based on input takes from wireless soil moisture sensor nodes and controller analyze the data to determine when and how much water is required to each part of the field. Water can be monitored by controller through a flow meter and it use time clock to control watering start and end times and when program event triggered it is added to a water queue and at one time delivered water only required part. Experimental results show that irrigation water consumption reduced by using adaptive water program in turfgrass.

Mahir DURSUN et al.,2010 [52] develop the prototype of remote controlled irrigation system for real time monitoring of soil content that is powered by solar panel to control drip irrigation. Sensor based remote controlled site specific irrigation prevents moisture stress of tree and salification. PC unit used to collect data and control values. The system provides efficient management and use of water resources.

Shaik Ameer et al., 2015 [41] describe the use of solar power for an automatic irrigation system to supply required water to the pump set. Solar module used to convert sunlight to electricity. The electricity produced from sunlight can be stored in batteries. Humidity sensors used to sense the wet and dry conditions of the soil. After sense the data, the sensor node sends signal to microcontroller and microcontroller give signals to relay which is an electrically controlled switch for on and off to turn on the motor if the soil is dry and off the motor in wet conditions. The system works automatically without the human interruption so there is no need for the farmer manually operations.

Xiaohong Peng et al., 2012 [42] develop an intelligent water saving irrigation system based on fuzzy control and WSN. The sensor node collect data such as soil humidity and air temperature and send to coordinator node and fuzzy controller embedded in coordinator node takes information as input, obtain water demand amount of crops, and output it to irrigation controller node. The irrigation controller node receive information and send irrigation command through Input / Output port to control the action of electric control valve to complete irrigation. Result shows that system consume less power and accurately calculate water demand amount of crops for irrigation water saving.

Vasif Ahmed et al., 2010 [14] describe the design of low cost remote control irrigation system in which the information is exchanged in the form of message and miscalls between the system and user cell phone when normal conditions exist. The system provides automatic control based on parameter specified through SMS/miscalls or keyboard and provide protection against over-current, over voltage. When any normal condition occurs like power failure, dry and raining the system alert farmer by SMS or miscalls. By using relay-microcontroller, system sends signal based on commands received and present sensor conditions to switch on/off the motor. The developed system provide optimum water distribution in fields through water pump based on SMS or miscalls from cell phone and provide protection of motor against overload, overheating.

Ibrahim Mat et al., 2014 [43] describe the WSN technology that enabled automated irrigation for precision agriculture (PA) in a greenhouse. In this paper, greenhouse monitoring used to monitor temperature, humidity and soil moisture parameter. Data collected from sensors send to remote server for analysis. Based on threshold value of moisture data, automated irrigation value control operation perform. Using sensor automated integrated information technology and management; PA used to improve the product quality and efficient of crop chemical use. Result shows that automatic irrigation is better than scheduled irrigation because it optimize the use of water and fertilizer and maintains soil moisture.

Shaohua Wan, 2012 [44] proposed tree topology and cluster based multihop routing algorithm to reduce energy consumption while data transmission of nodes use of WSN for monitor and collect crop water requirements such as temperature, humidity, soil moisture and irrigation volume to built the machine learning model and data aggregation for collaborative signal processing. The processed data of crop water requirement converted into model based on machine learning to find accurate crop water requirement to improve crop productivity and thus remotely implement precision irrigation.

Nattapol Kaewmard et al., 2014 [45] describe the design of an automated irrigation system using WSN including soil moisture sensor, air temperature sensor and air humidity sensor in order to collect environmental data and controlling the irrigation system. By using smart phone, the irrigation system uses values to turn on/off the solenoid valve. The irrigation system control water by sending and receiving control commands from smart phone application via the internet. Result shows that proposed AIS is useful, cost effective and provides better performance than conventional system.

D. D. Chaudhary et al., 2011 [46] proposed and analyses the use of PSoC technology as a part of WSN to monitor and control various greenhouse parameter. To overcome the problem faced by management server as like data, congestion and intercommunication between nodes WSN based applications used with a specific protocol and system on chip based hardware with programmable radio, which would like to nominate the design of control for greenhouse. Greenhouse is an upcoming technology of agriculture, which helps the farmer in better yield of a crop. Fertilizer and water required by the plant is bases on climate conditions. So sensor sense the inside and outside climate of the greenhouse. It requires air temperature control, humidity control and soil condition control for better crop yield. Greenhouse climate control is an event based control system with level crossing sampling technique. This method is also known as adaptive sampling method.

Million Mafuta et al., 2012 [47] describe how an irrigation management system implemented based on WSN. This paper also describes the design and Implementation of low cost, robust and efficient IMS. It combines sensors and actuators in a WSN for successful deployment of WSN for PA. To charge electrical devices, it used solar photovoltaic and rechargeable batteries. The soil moisture sensors takes soil moisture and temperature samples also takes and send data to coordinator node for storing and forward data to remote server via gateway and open or closed the irrigation valves via cellular network. They also show the correlation between RSSI (Received signal Strength Indicator) of every packets and battery level.

Jorge Sales et al., 2014 [48] presents the implementation of GPRS communication as a gateway between WSN and internet. AIS connected to the internet by using GPRS. Various data transmission approaches used for implement closed loop irrigation system within PA. Closed loop irrigation system is uses to apply correct amount of water in correct place at right time and save the natural resources. For the reliable data, transfers over GPRS based on User Datagram protocol (UDP) two approaches had implemented such as byte stream and independent frame. It is important to maintain the sequence of packets during transmission. Go-back-end architecture allows receiving of packets in correct sequence. The transmission of independent packets with acknowledge gives the best result that ensures the arriving of information by retransmitting the non acknowledged packets and thus allow reliable transmission of information.

P. Alagupandi et al., 2014 [49] proposed a simple and cost effective smart irrigation system. The system is modeled in outdoor environment using Tiny OS based IRIS motes to measure the moisture level of the paddy field. Moisture sensors measure the soil moisture level. The system set a threshold value and if the voltage exceeds that threshold then it represents the driest soil. Proposed system has better visualization and monitoring GUI. The motor automatically switch on by pressing the button task of visualization panel. AIS work with the help of MOTEWORKS visualization tool. The visualization tool provided by the MOTEVIEW software does the automatic control of the motor to switch on/off the motor on server side.

Bhushan G. Jagyasi et al., 2011 [50] proposed agro- adversary system which provide an event based querying modeling which helps to query the history of events and their linkage in spatial-temporal dimensions. mKRISHI mobile phone application can be used by farmers to raise a query using text, voice, picture and video. All the information stored in the form of events in Event-Base. In mKRISHI architecture various events defined such as sensor based events, an event occur when any parameter observed by a sensor is abnormally high or low, any query made by farmer is an event and responses of experts o the query is an another event. Many actions like irrigation performed by the farmer also an event and many other events occur. The event-based approach provides past experience to improve decision-making. This approach provides the history of agriculture experience to agricultural experts, to improve responses of the farmer’s query. For the mKRISHI agro-advisor system the model provides an experience sharing platform between different experts.

Hema N. et al., 2014 [16] propose a technique to predict real-time local weather parameter of interpolation using Automated Weather Station. Using sparse WSN with soil moisture sensor, this paper provide error correction and accuracy about 99.59% for real time interpolated data. This system provide past, present predict and future predict using nearby ASW data and control the irrigation in conditions like rainfall. For irrigation control, soil moisture and AWS data used and for error correction, interpolated data is comparing with soil moisture data.

Anurag D et al., 2008 [51] design a WSN to remotely monitor the agriculture parameter and automated control the irrigation and fertigation for a precision agriculture. Static routing algorithm develops to prevent the wastage of address space and using tree-based structure maintains efficient routing. When the threshold value increases, the system can be generate an automated alert message on the console about which appropriate action performed. The valves automatically open according to the value to start irrigation and fertigation according to the need.

For communication, the wireless mesh network used. The actuators controlled at the controller end using electrical switches. The algorithm has tested on CC2420 board based on Texas Instrument.

Jaume Cosadesur et al., 2012 [53] proposed an algorithm using feedback mechanism that gives response about the effect of applying the schedule it generate for the crop water needs. The goal of this algorithm is to schedule irrigation according to requirements of each grove and to the variability during the season caused by weather conditions and other factors. The algorithm performs seven different tasks as firstly it measures the amount of water given each day to the farm depending on weather conditions and crop growth. It implements the installation of the water management system to manage the amount of water delivered to the crops in the farm, execute the irrigation schedule, and measure the effects of the schedule on the crop and the data collected by the sensors processed to extract meaningful information for decision-making. The algorithm detect an event will trigger the execution of specific procedures for that type of event and at last implement the feedback mechanism for close the loop of the algorithm. The result shows that the simple water balance gives fast response rather than feedback mechanism for weather conditions.

LI You-zhu et al., 2010 [54] proposed support vector machine to forecast water consumption and genetic algorithm is used to select parameter of SVM. GA-SVM is more robust and accurate because of its strong global search capability. Experimental result shows that GA-SVM can achieve greater forecasting accuracy then ANN (Artificial Neural Network) in forecasting the water consumption used in agriculture.

Manijeh Keshtgary et al., 2012 [55] 26 propose two topologies for PA are - In first topology, each sensor is placed at the corner of each grid and in second technology; nodes are placed at random position. In grid topology, access points placed on the middle of the farm where in random topology access points distributed in an unexpected situation. Each access point connects with the server using wire and two routers. Both topologies has evaluated by using OPNET Modeler. Sensor node collect data such as water level, rain fall and soil moisture. The collected data send to the sink node via Wi-Fi, data stored and processed by information center and a set of performance metrics used for comparing topologies including delay, load and throughput.

Fiona Regan et al., 2009 [56] develop heterogeneous real time water monitoring network system to monitor water quality parameter such as pH, temperature, turbidity and conductivity. The implementation of intelligent sensors incorporating TEDS (Transducer Electronic Data Sheet) which is a machine-readable specification of the sensor characteristics, enable sensors to interfaced with the system in a plug and play fashion. PSOC system used to create generic sensor interface. The plug and play capabilities enabled by the developed WSN platform allow for integration of any commercially available water quality sensors. PSOC plug and play system capable of transmitted data to the sensor that processed data for transmission to the web.

Cosmina Illes et al., 2013 [57] describe the design and implementation of low cost water level control system using Programming Logic Controller and WSN that represent maximum water level, minimum water level in the tank. The motor error and correct function of the motor visually signaled by LED connected to the programming logic controller. The sensor sends information signal to the pump to turn on the motor when the water level is under the minimum level and when the pump motor speed not high the motor has turned off.

Joaquin Gutierrez et al., 2015 [58] represents that the sensors use Smartphone to capture and process images of soils. Images can be capture to estimate the water content of the soil. The router node is used to forward collected values to the gateway that provide automatically pump the water to the crop in a field. An Android app used for connectivity such as Wi-Fi. Android app wakes up the Smartphone by using given parameters. In-built camera takes an RGB picture of the soil through an anti-reflective glass window to take estimation of wet and dry area. The mobile app enables the Wi-Fi connection of Smartphone to transmit the estimation value to the gateway via a router node for control an irrigation water pump.

3. COMPARISON

	Sensor	Soil moisture	Temp erate	Hum idity	Air temp	pH	Light Intensity	Weed detection	Solar radiation	rain fall	Wind speed	Wind direction
[4]	VG400/ LM35	Yes	Yes	No	No	No	No	No	No	No	No	No
[9]	Moisture	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No
[25]	Moisture	Yes	No	No	No	No	No	No	No	No	No	No
[8]	VH400/ DS1822	Yes	Yes	No	No	No	No	No	No	No	No	No
[26]	MTS400/ MDA300	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No
[27]	Soil moisture	Yes	No	Yes	No	Yes	No	No	No	No	No	No
[11]	VH400/ DS18B20	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes
[29]	HMP35C	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes
[30]	Watermark soil moisture	Yes	Yes	No	No	No	No	No	No	No	No	No
[31]	SHT71/ PT100	No	Yes	Yes	Yes	No	Yes	No	No	No	No	No
[28]	Soil moisture	Yes	Yes	No	No	No	No	No	No	No	No	No
[32]	Moisture	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No
[33]	Soil moisture	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No
[22]	Temperature/ humidity/ EC/ pH	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No
[34]	LM35/ SHT71	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[35]	EC-5	Yes	No	No	No	No	No	No	No	No	No	No
[36]	Soil moisture	No	Yes	Yes	No	No	No	No	No	No	No	No
[37]	SHT75/ ECH5TE/ TBQ-6	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No
[38]	Moisture/ water flow	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[39]	Temperature/ humidity	No	Yes	Yes	No	No	No	No	No	No	No	No
[40]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[52]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[42]	SHT11	No	No	Yes	Yes	No	No	No	No	No	No	No
[14]	DS1307/ DS18S20	No	Yes	No	No	No	No	No	No	No	No	No
[43]	Soil moisture	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[44]	Soil moisture	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[45]	DHT22/ AM2302	Yes	No	No	Yes	No	No	No	No	No	No	No
[46]	Temp, humidity, Co2, soil	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
[47]	Soil moisture	Yes	Yes	No	No	No	No	No	No	No	No	No
[48]	Soil moisture/ soil temp.	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
[49]	Yes	Yes	No	No	No	No	No	No	No	No	No	No
[50]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[16]	Soil moisture	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
[51]	Soil moisture	Yes	Yes	No	No	Yes	No	No	No	No	No	No

4. CONLUSION

In this paper, we review different emerging techniques related to WSN and irrigation in agriculture. Like low power of batteries is a major problem in WSN. Various technologies are uses to recharge sensor batteries like harnessing wind energy, photovoltaic panels. Energy efficient routing protocols used to manage energy like APTEEN. The AIS provides efficient use of water resources. The system provides real time monitoring and control of environmental, soil parameters and collects data, and provides results to the farmer via internet or on mobile phone by SMS. Thus, the farmer exactly knows whether a field required water or not. Thus, a farmer saves time, money and water resources by using AIS.

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