IOT BASED HYBRID SYSTEM FOR PRECISION AGRICULTURE MONITORING USING WSN INTO MODERN INFORMATION AND COMMUNICATION TECHNOLOGY(ICT)

Sangeetha A[1],Sarah prisella P [2],Poovarasi G [3], Mrs.kavitha subramani[4]

[1] *Student,Computer Science Engineering,Panimalar Engineering College,Tamilnadu,India*
[2] *Student,Computer Science Engineering,Panimalar Engineering College,Tamilnadu,India*
[3] *Student,Computer Science Engineering,Panimalar Engineering College,Tamilnadu,India*

ABSTRACT

Precision agriculture is the key to improve productivity and efficiency in the use of resources, thus helping to achieve this goal under the diverse challenges currently faced by agriculture mainly due to climate changes, land degradation, availability of farmable land, labor force shortage and increasing costs. To face these challenges, precision agriculture uses and develops sensing methodologies that provide information about the crop growth and health indicators. A decision support system based on the combination of the wireless sensor and actuation network technology to support the irrigation management in agriculture. The monitoring of agriculture precisely over a large scale is a challenging task. In this paper, an approach has been proposed for precision agriculture monitoring.

Index Terms—*IOT, Smart controllers, Precision Agricultural Monitoring, sensors, animal detection.*

1. INTRODUCTION

AGRICULTURE has a prime role in the Indian economy, as it shares about 17% of GDP and employs about 50% of the workforce. For better agricultural production and for food management, providing key ideas through precision agriculture monitoring is important. Precision agriculture is a crop management concept that is field specific and is more helpful for better productivity. Precision agriculture makes use of real-time information from sensors and geospatial techniques (remote sensing, geographic information system) and helps in making smarter decisions for better productivity. The use of wireless sensor networks for precision agriculture is widely discussed in and which employs wireless sensors directly in the field to collect and transmit information to data processing center through network. In this way, precision agriculture (PA) could be seen as a big control loop, where the machinery and the farm workers are the actuators which maintain a sustainable and profitable production. The farmers are in charge of taking the corrective actions according to both: the production needs and the environmental care. Sensing of the crop or the farm fields allows their status and health assessment providing the loop feedback and therefore the loop closure. The latter is a cornerstone of any information process, since it provides the means to acquire data upon which any corrective action can be performed. There are several ways to assess the status of crops and plants; however, their morphology and physical description (e.g., volume, leaf area index, and reflectance) have arisen as widely used parameters for these purposes.

Why do we need IOT in agriculture?

Agriculture is the basis for the human species as it is the main source of food and it plays important role in the Growth of country's economy. It also gives large ample employment opportunities to the people. So the crop yield

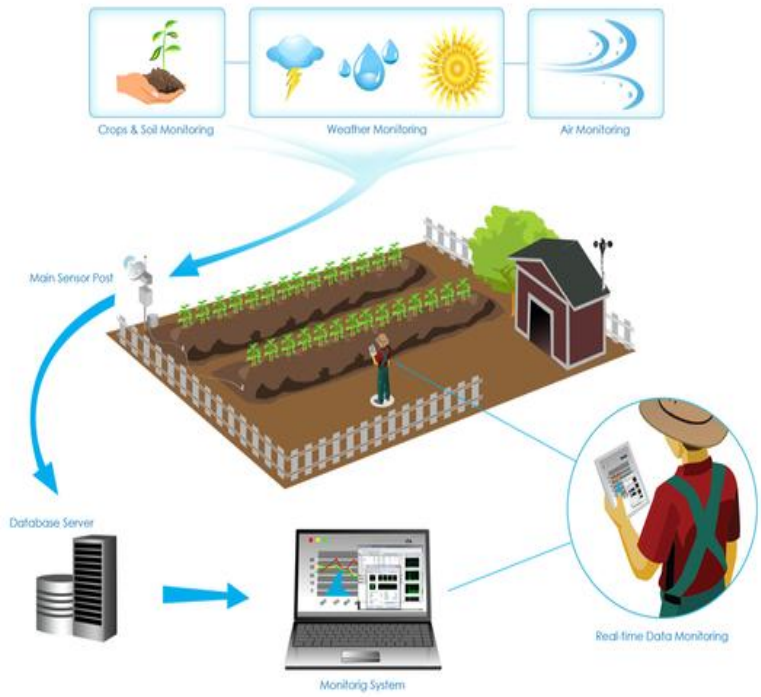
can be improved by using automatic machineries. There is need to implement modern science and technology in the Agriculture for increasing the yield. By using Iota, we can expect the increase in production with low cost by monitoring the efficiency of the soil, temperature and humidity monitoring, rain fall monitoring, fertilizers efficiency, monitoring storage capacity of water tanks and also theft detection in agriculture areas. The combination of traditional methods with latest technologies as Internet of Things and Wireless Sensor Networks can lead to agricultural modernization. The Wireless Sensor Network which collects the data from different types of sensors and send it to the main server using wireless protocol. There are many other factors that affect the productivity to great extent. Factors include attack of insects and pests which can be controlled by spraying the proper insecticide and pesticides and also attack of wild animals and birds when the crop grows up. Factors include attack of insects and pests which can be controlled by spraying the proper insecticide and pesticides and also attack of wild animals and birds when the crop grows up. The crop yield is declining because of unpredictable monsoon rainfalls, water scarcity and improper water usage. A Wireless Sensor Network (WSN) is a wireless network, in which various sensors are interconnected to monitor physical or surrounding environmental conditions. These WSNs are accepted as powerful networks to collect and process data in the agricultural domain with low cost and low power.

They offer a high spatial and temporal resolution to monitor crops through various sensor nodes deployed across the agricultural field, which are connected wirelessly and send data automatically via multi-hop communication.Recent developments in information and computer technology and in wireless sensor networks have made maintaining and functioning of agro-based industries like Greenhouse, Floriculture and Horticulture etc. easier than ever before. The need for intelligent farming has grown to a larger extent in the production of various crops. Recently Internet of Things (IoT) has revolutionized all the major business sectors and industries across the world. IoT involves many things interacting with each other to produce actionable information.IoT technology is allowing farmers to connect various devices to the internet and it has resulted in significant increase in crop yield, reduce waste,better pest control and streamline livestock management.This paper presents various works related to the existing system ,the design and implementation of the proposed system using Raspberry Pi 2 Model B.

II. AGRICULTURAL MONITORING SYSTEM BASED ON SENSORS

A. Precision Agricultural

Precision agriculture (PA) is playing a vital role mainly in developing countries. In PA, there are many types of the agriculture related parameters such as humidity,temperature, rainfall, soil moisture among different fields are considered.Based on these parameters we can analyzed how far these required resource efficiently utilized like utilizing water, fertilizer, pesticides, seeds etc in fields.Wireless communication cameras, sensor networks provide a low cost technological solution for PA where wireless cameras, sensor networks monitor crop conditions/growth for a longer period of time without fail and they also made a decision remotely and generate or evaluate the potential of new crops. The PA can evaluate agriculture area fields differently based on the ground level of water, saline, area field structure etc. In this connection, different agriculture area field management zones can be defined based on the humidity, temperature, sand quantity and water availability etc.



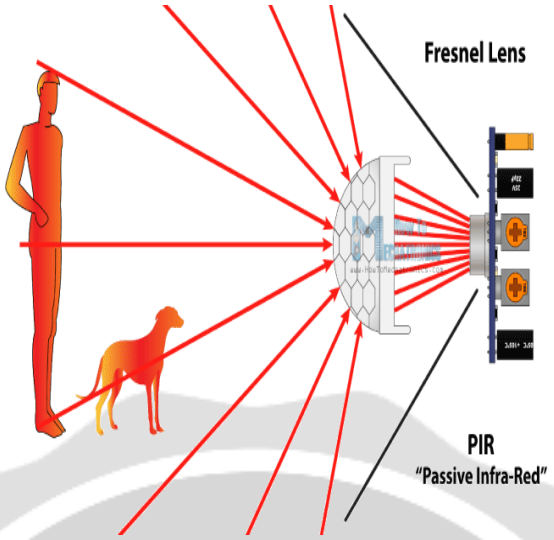
B. Field Assessment

Agriculture farmers are follows methods that require the state of the crop field to irrigation.Hence we propose wireless camera and sensor network based area field management and monitoring system.Hence, the collected information from cameras and sensors are in two different sources are available for assessment, comparison and analysis. long performance sensor, cameras,,measures heigh through IR sensor and greenness information of the agriculture area field grass through wireless sensor and camera networks to the base server.The wireless camera nodes to send images.The camera, sensor nodes can also be used to observe cattle position and behavior.

C. Cattle Monitoring and Behavior Control

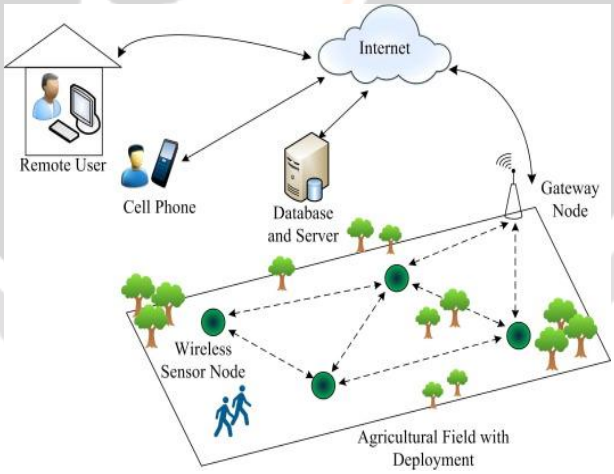
Observing and monitoring the behavior of humans animals and cattle that is, how they interact to destroy in area field each other and movements towards to the field are very important in order to utilize properly the limited field resources.Controlling animals from craft is a challenge in the agricultural monitoring systems because their mental and positional state (e.g., stress, desire, mood) are very difficult to calculate or measure. Moreover, the animal's behavior depends on many factors such as season, age, temperature, food availability etc. Sensor-based M2M networks can play a vital role in behavior measure/control.A sensor calibration/monitoring model is developed based on the distribution of inertial or position data. For example, during day time, the activities of animals are a lot more than that of during night time. Hence, their ruminating, sleeping, grazing, (behavioral) data will have different time in different shape (e.g., day and night). Calibration model is based on comparing these dataset to different parameters.

From inertial sensors can collecting data about the speed,movement energy and turning rate of cattle with wireless camera, sensor networks to record/track the amount of food each animal takes and send this information through the wireless network communication.



III.SENSOR-BASED AGRICULTURE MONITORING SYSTEMS IN DEVELOPING COUNTRIES

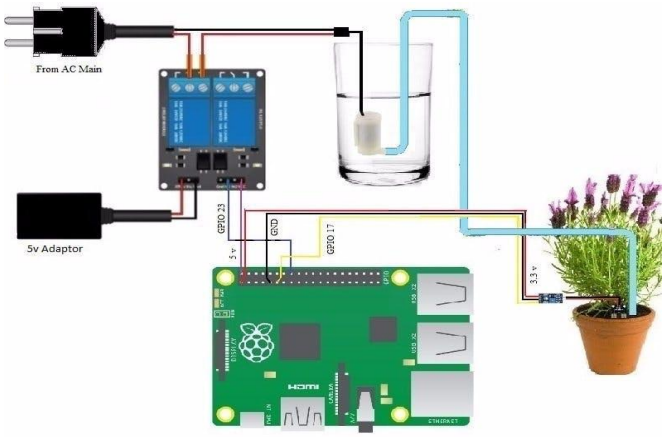
This sensor based agriculture monitoring system should include a decision support system to maximize production, optimize resource utilization and can decrease environmental hazards. Moreover, this system should be autonomous, affordable (by poor farmers), accurate and remotely controllable. The lifetime of this sensor based agriculture monitoring system should be at least one crop season (4 -6 months) in developing countries.Though sensor-based agriculture monitoring systems



had a high potential in traditional agriculture in developing countries, only a few projects have been implemented in developing regions.

A. Design Challenges in Developing Countries

As sensor based agriculture monitoring networks are application specific, designing a sensor network for each application leads to the problem with limited resources and cost. On the other hand, sensor-based agriculture systems used in the precision agriculture of developed countries are not suitable in developing countries because almost throughout world 87% farmers are depending on labor.Sensor-based M2M agriculture monitoring systems are required to be modified in this context.



- **Cost**- is the most important factor in the case of developing countries.Cost can be reduced by using sensor based agriculture monitoring communication networks
- **Reliability** – in all most developing countries, sensor and camera nodes are climates extreme and scarce
- **Resource** - throughout world most of poor farmers are relying on rain fed farming for production of food. Moreover,traditional irrigation methodology is not efficient in semiarid areas in developing countries.

B. Technical Frameworks of Sensor-based Monitoring Systems

Topology - one of the important primary requirement of this sensor based agriculture monitoring network fields in developing countries are homogeneous in terms of soil type crop which requires less number of sensor-based MTC devices. Then, each node identifies their neighboring nodes by broadcasting node/zone ID that is assigned by the gateway/coordinator nodes. Each zone node elects nodes in the neighboring zones to which they can connect with a minimum transceiver power. This generates several connected graphs, and the graph that requires minimum transmission power is selected for routing.

Task Scheduling – This is another important basic requirement for better performance.Task scheduling considers or includes the parameters for sensing data, environmental factors (that affect sensing and network operations)and energy of the resources.This mechanism effectively schedules three system parameters frequency of transmission,sampling rate and bit resolution.Initially,all values of these parameters are optimized for assigned or scheduled and then,adaptively rescheduled by a trigger from another neighbor environmental sensor(as agriculture parameters are inter-dependent).For example, a rainfall or humidity sensors are triggered with soil moisture of sensors.On other hand to adjust the parameters is based on the profile of the parameters available node energy is the based on depending of system parameters.For instance,when the energyis crucial,the bit resolution can be decreased to save the energy in conversion process and analog-to-digital converter .Task scheduling is done at application layer by coordinator nodes and external server.

IV.PROPOSED SENSOR-BASED AGRICULTURAL MONITORING SYSTEM

Based on the design challenges and existing technical framework of the agriculture monitoring systems we identify and present differences in sensor-based agriculture monitoring systems of developed and developing countries.

Considering all these challenges and technical frameworks, we propose a novel agriculture monitoring systems (with improved Li-Fi technology, topology and routing protocol) for farmers in developing countries.

In this proposed technology is proved with the below mentioned results. Usually low level network system was fixed in with IoT devices. Like sensors, relevant object and cameras are covered with communication network.(i.e) Li-Fi technology which is clearly mentioned in above phases.

A. Block diagram of proposed system architechture

The below mentioned diagram represents with new technology.At first relevant fields data are collected from relative sensors and that data/information sends to data collection server. This communication done with new Li-Fi technology because that area was fixed with topology based on area structure. But lack of communication leakage we are forwarded to this present technology for better must transfer to cloud server with the help of GPRS and WImax technologies. Than cloud server take a responsible to analysis the data based on requirement.

Base server/station-A base station is a wireless communication station.A base station is used to communicate and is installed at a fixed location.It is also called as a push-to-talk two-way radio system data analysis

NAME OF SENSOR	***ST VALUE***	***ST VALUE <***	***ST VALUE >***
Soil temperature	**~21-25**	**Action**	**No action**
Light value	**~20-50**	**Action**	**No action**
Moisture value	**±25**	**Normal**	**Normal**
Rainfall value	**~0-120**	**Normal**	**No action**
Water level	**±6.89**	**Action**	**No action**

Based on collected data sever will take a decision and that decision need to distribute over the subscribed users. Mean while any disturbance are accrued than that notification must received through mobile. This process is called alarm with beep sound.

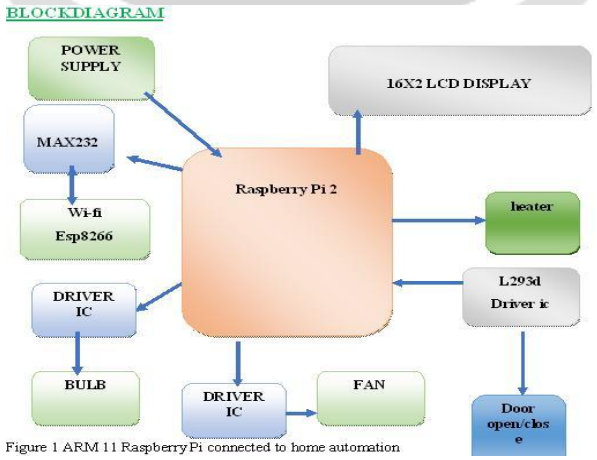


Figure 1 ARM 11 Raspberry Pi connected to home automation

B. Crop Monitoring System Based on Wireless Sensor Network

Wireless sensor network crop monitoring application is useful to farmer for precision agriculture. The application monitors the whole farm from remote location using IOT (Internet of Things). Application works on sensor network and two types of nodes. Energy saving algorithm is used in node to save energy. System having two nodes sensor node which collect all environmental and soil parameters value soil moisture, temperature, air, humidity, light, etc. and second node consist of cam to capture images and monitor crops. Crop monitoring application consists of two sensor node image sensor and environment parameter collector. These two sensors collect the information about crops. Image sensor collect crop growth, height and second sensor node collect data about humidity, soil condition, etc. and this information is collected at base station and then get transfer to internet (web application). Data analysis is get done at server side.

C. Automatic Irrigation System using Wireless Sensor Network

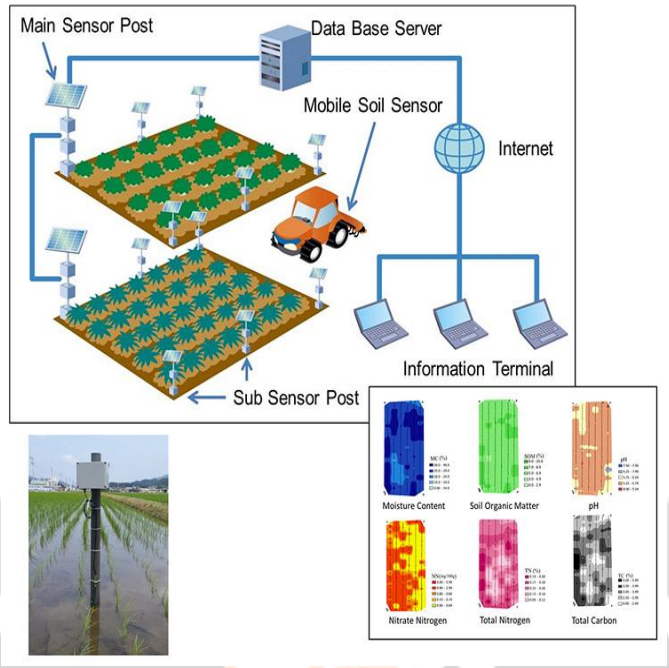
Data mining algorithm are used to take decisions on drip irrigation system.Automated drip irrigation system having WSN placed in all over farm and different type of sensors like soil moisture sensor, wind direction, wind speed, soil temperature gives reading to control station and base station.WSN uses ad hoc network which gives self-configuration and flexibility. Sensor data is given to base station and data is received using ZigBee. Data processing is done at base station for decision making. Data mining algorithm is used to take decision on data from sensor to drip. All observation are remotely monitor through web application. Algorithm check probability of each attribute. Drip irrigation on and off decision are made. Previous data set of agriculture is provided to take decision. All data of field is given to web application for observation.

D. WSN with irrigation valve control

Wireless sensor network with valve control unit is developed with actuator hardware and software. Irrigation is control by actuator.Web application is used for manual control and schedule irrigation timing. Water meter indicate the requirement of water.Node unit contain soil moisture sensor and actuator. Two way communications take place from actuator to node and base station. Packet with control commands are sent between node and actuator. Actuator control solenoid valve depending upon water meter value and scheduling timing for water supply.Packet loss between node and actuator communication degrade performance of system. Power requirement for actuator and node unit is high. Water requirement for different crop is different also depends on other factor like soil type, temperature, etc. This system measures only soil moisture parameter to take irrigation decision.

E. Wireless sensor network infrastructure for agriculture

Existing wireless sensor networks that monitor agriculture infrastructure measures different soil parameter and environment conditions. This WSN is composed of node with software and hardware units. Node has control unit which control sensors and communicate with base station. At mega and ARM are frequently used as control unit. ZigBee, Bluetooth, Wi-Fi used for transceiver in WSN.Wireless communications take place between networks. Network report soil value, volumetric water contains,landscape movement, earthquakes and volcano information. Hybrid sensor network combine advantages of these two infrastructure system. When WSN is out offline of sight WUSN collect the information from node. Mobile information collected by terrestrial WSN.



V.CONCLUSION AND FUTURE WORK

It explores the part of Internet of Things (IOT) in Agricultural Sector. Today farming is implanted with propel benefit like GPS, sensors that empower to convey to each other dissect the information and likewise trade information among them. IT gives benefit in the type of cloud to farming. Agriculture cloud and IT benefit gives a unique expertise administration to agriculturists with respect to development of yields, evaluating, manures ,illnesses detail strategy for cure to be utilized Scientist chipping away at agriculture will give their revelations, recommendations in regards to advanced methods for development ,utilization of manures can get the historical backdrop of the district. The review depended on applying a cloud construct application with respect to agriculture. This is in light of agro-cloud that improve agricultural generation also, accessibility of information identified with research extends in the fizzled, the effect of doing this will spare the cost and time make the correspondence less demanding and quicker. This paper would advance a great deal of research in the range of utilization of IOT in agriculture.

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