SASI: Smart Agriculture System Based On Iot

[1]Venkata Reddy P S, [2]Nandini Prasad K S, [3]Puttamadappa C

[1]Research Scholar, [2]Professor
[1] Dept. of ISE, Dr. AIT, Bangalore
[2] Dept., of ISE, Dr. Ambedkar Institute of Technology, Bangalore
[3]Registrar, Dayananda Sagar University, Bangalore

mailtovenkatps@gmail.com, iseofficial123@gmail.com, puttamadappa@gmail.com

Abstract

Many farmers adopt unconventional methods in farming. They water the crops manually without measuring the soil moisture or temperature conditions in the field. This method is unscientific, leads to wastage of water, manpower and will result in low yield and finally in less income for the farmer. The smart agriculture system that we have developed verifies water level and fertility quotient of the soil through various sensors (Temperature sensors, humidity sensors and soil moisture sensors) to measure the water level, humidity and temperature of the field. The MANETS based Wi-fi module in the system we have devised will transfer all the data that is collected by the sensor to the cloud via the raspberry pi component. The data that is generated by these sensors is later used to analyse the crop / field condition basis which the farmer can act on increase the water level etc., Alerts about variation in these parameters can be directly shared with the farmers through their mobile phones. The system that we have devised can check these factors and enable the farmer to take right decision in real-time.

Keywords: IoT, Agriculture, Sensors

1. INTRODUCTION

Agriculture is one of the most important occupations in many developing and developed countries. It produces the required a grains and food items to the growing world population. But due to non-availability of scientific approaches and methodologies in the agriculture sector, farmers are facing lot of difficulties like lower yields and hence lower annual income levels overall. Also, the United Nations estimates that the world population will reach 8.6 billion by 2030 and 9.8 billion by 2050.To avoid all of this and ensure optimal food supply for the growing world population, we need to follow scientific approaches powered by AI and IoT. In this approach, we will have series of sensors connected to a raspberry pi module. These sensors help in monitoring various parameters related to the crop like water level, light, temperature and humidity at regular intervals. Monitoring these parameters helps in evaluating whether the crop is receiving the optimal environmental conditions for optimal growth. There will be many such IoT devices along with sensors that will operate in real-time and all the generated data is pushed to cloud using wi-fi or GPRS cellular services. Farmers, State and district agriculture co-operative societies and Agriculture universities can consume this data in the form of dash boards powered by many charts and graphs. This large volume of data and analysis will help all these agencies take appropriate decisions so has to improve the crop or yield. Cost of the system we have developed depends on the various parameters we are planning to measure. Smart agriculture system should be quickly able to identify any variation in the parameters that were measuring and should be able to send alerts to the farmer quickly to take action. Smart agriculture system is developed for continuous field monitoring and real-time reporting of all the parameters measured from the field where the farmer can access the data using their smart phones through internet. The system devised by us employs multiple sensors to measure the parameters, measure the water level, temperature, light and humidity in real-time for immediate action, and the solution is accurate, reduces manpower, and improves the socio-economic status of the farmers. In this paper section II discusses about literature survey on smart agriculture system based on IoT while section III discusses on Internet of Things. Section IV discusses implementation of smart agriculture system, and results obtained through the system are discussed in section V. Section VI concludes the paper.

2. Literatrure Survey

Low use of farm technologies and best farming techniques, decrease of soil fertility due to over fertilization and sustained pesticide use, are leading contributors to low agricultural productivity. This leads to not having enough food supply to the growing world population, lower income level for farmers etc. In the technique that we have adopted, in Smart agriculture system based on IoT we have built a system for monitoring the crop field with the help of sensors like light, humidity, temperature, soil moisture, etc. Thereby we have automated the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach.

A smart agriculture system based on GSM based was suggested for automating multiple tasks involved in agriculture [1]. Smart irrigator is proposed in this automation using which water traverses over mechanical bridge equipment setup then the smart equipment in irrigator obtains signal from sensing system using a GSM module. The collected data is later moved into a central database management system using which the crop condition is analyzed and the actions based on analysis are shifted to the devised irrigator system to carry out the required analysis [1]. Smart Agriculture based on IoT [2] gives details about agriculture and it has modules including smart control that help in taking intelligent and effective decision based on real time data received from the sensors installed in the land. All these activities will be controlled and coordinated using smart phones remotely and the sensors are utilized to handle tasks via Wi-Fi module, controllers, actuator entities and many other hardware equipment. This complete arrangement was done basis sensors which collect details from farmland. Later by means of GPS technology data is passed into base station to determine necessary steps to control crop basis the data present in the central database. Recommendations can be taken from Researcher's on the soil conditions required for a crop like humidity and moisture. Automated mode and also manual operation mode are two operating states of the system. This system considered here makes decisions by itself and it monitors the other equipment and farmer to handle these tasks by android app / by triggering appropriate instructions in both modes as applicable. IoT is considered as a less cost and most consistent technology to implement smart systems in farming [5]. Web service used in case of smart village IoT system for latest rural connectivity measure many environmental conditions in real-time. In [6], the work demonstrated provides the advantages of IoT in almost all phases of the crop like sowing, growing, harvesting, watering, and in transportation considered. Real-time sensor data obtained in all these crop stages from instruments such as Radio Frequency Identification Systems and other sensors can assist farmers and other stakeholders interested in acquiring complete crop details from yield output to sales. The paper-specified agricultural device automation [7] records the soil moisture sensor moisture rates to transform the indicator light in the green room setting to ON / OFF depending on moisture condition, light detecting sensors and actuator entities are leveraged to stop or start the motor. This complete automation supports the farmer in improving the crop yield. An agricultural model based on IoT set up which is human dependent is demonstrated in paper [8]. It utilizes cloud based IoT infrastructure resources commonly to eliminate the insufficiency and unavailability of automated handling of many activities, which are actually the pivotal problems that are to be addressed in agriculture. In the research discussed in [9], the specified systems Wi-fi portion passes data collected by the sensors to the current microcontroller and then transfers data to smart devices such as smart phones / laptops.

3. Internet of Things

IoT — The Internet of Things is an interconnected network of physical objects called devices, mobile devices, sensors, vehicles, sensor-implanted homes, microcontroller devices, and network connectivity that enhances the capture and transportation of data by these involved devices. Internet of Things is a broad network of linked objects, combined with integrated networking devices and applications for sensing, controlling, tracking, connecting and governing them via the internet. Every computer has a specific ID number, which will be able to collect real-time data automatically. IoT 's constituent objects comprise sensors, gateways, processors, bridges, and apps. It is being estimated that 50 billion 'services' should be linked to the Internet backbone by 2020[10]. MANET technologies such as ZigBee Wi-Fi , Bluetooth, RFID sensors and Low Power Wireless Personal Area Networks allow the underlying devices to be interconnected through the Internet. The underlying cloud infrastructure service receives, stores, streams and analyzes the data generated by the devices and enable people to make decisions based on the generated data. Mobile data driven applications are increasing because of the quick increase in the use of handheld devices. Smart mobile phones are now serving as a platform for both processing and communication. Smart mobiles and other handheld devices are becoming considerably less costly, user friendly, and can be used for different kinds of information exchange. Desktop devices paired with sensors can improve the performance and precision of the IoT device data collection for water quality monitoring. Mobile phones and tablet computers that have sensors integrated with monitor boards and keyboards are wired to the Internet utilizing the IP address allocated and fulfill every IoT device's prerequisites. These tools can act as the center for the whole IoT network, or as remote control. Many smart devices are a part of the internet in a pervasive world. All needed users will have access to data of all kinds. Many servers are used to collect data from each of the linked devices.

4. Implementation

Temperature and Humidity readings from farm field will be read from the sensors and data will be pushed to IOT cockpit using MQTT protocol. The live data from IOT cockpit will be pushed to IOT application enablement using Kafka message broker as illustrated in fig 1. Using IoT gateway edge data processing is done locally in a device at the edge of the network. The Message Management Service (MMS) is the component that is used for receiving data from sensors and routing messages to devices. The IoT service cockpit gives the user interface for users to interact with the RDMS (Remote Device Management Service). It is used to onboard new sensors, to arrive at the schema for new messages (Message Types and Device Types) they can share and obtain, alongside establishing the necessary trust relationship required by devices to connect ot with the MMS. Application Enablement services represent a network of physical objects known as devics that are used to collect and share data. The aggerate store data, time series data will be stored in big data store management. IOT application enablement provides wizard-based approach using standard UI templates to view the live data.

Sasi-Smart farming solution is built using sensors to monitor the crop fields. Throughout the framework several sensors are used to track light, humidity, temperature, soil moisture, etc. It lets the agricultural group simplify the various activities that are performed manually. Farmers can track the conditions in the field from everywhere using their handheld phones. This solution is very efficient in improving the yield of the crop and it in turn helps in managing the soil fertility as well. This solution has various features as illustrated below along with screenshots. The home screen of the solution gives a dashboard of the two major capabilities of the application as given below:

The application has an important tile, on click of the tile, it launches SASI application -the one which helps the farmer monitor the field condition. Farmer gets to visualize the data captured by the light, humidity, temperature and soil moisture sensors on click of parameters Analysis tile. The data is presented using graphs and charts on all these parameters so that the farmer can take quicker actions as required for the crop. That is if the moisture is lower, on a specific day, the customer can act on it to turn on the sprinklers which will eventually increase the soil moisture quotient. As illustrated in the graphs the farmer can analyze the farm condition using multiple type of graphs which is a core capability of the solution. Using SASI, farmer can visualize the humidity variation in the last 24 hours as shown below:

- The App offers a window to visualize the light variation. This helps the farmer in ensuring optimal light condition for the crops that are inside a greenhouse.
- This Solution facilitates the visualization of temperature based on weather conditions. This is illustrated in the below screenshot.
- The data captured using sensors can be seen using analysis grid or in tabular format as shown below:
- Many associated factors can be combined, and the variation can be observed graphically. This will facilitate to observe all the factors to be managed optimally together.

This Technology will grow to help farmers with a facility to gather data about their cattle 's position, well-being, and fitness. The knowledge obtained may be used to classify cattle's health status. One can also track the location of the cow in large farms with the help of IoT enabled things attached to the cows. All these features when adopted seamlessly, they help increase the yield, reduce labor and optimally supply food to the growing population.

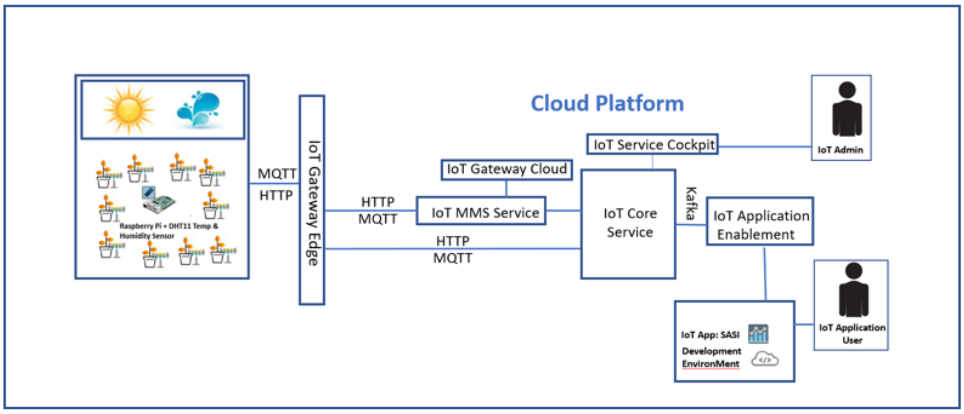

Figure 1. Block diagram of proposed system

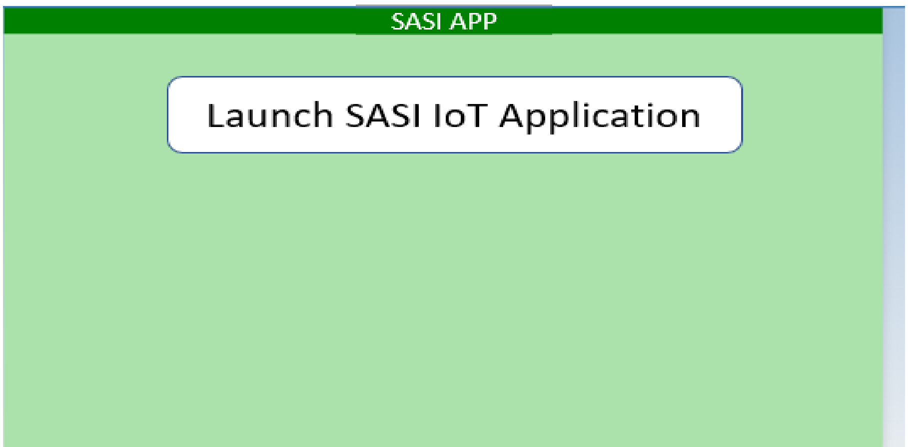

Figure 2. Main Page of SASI Application

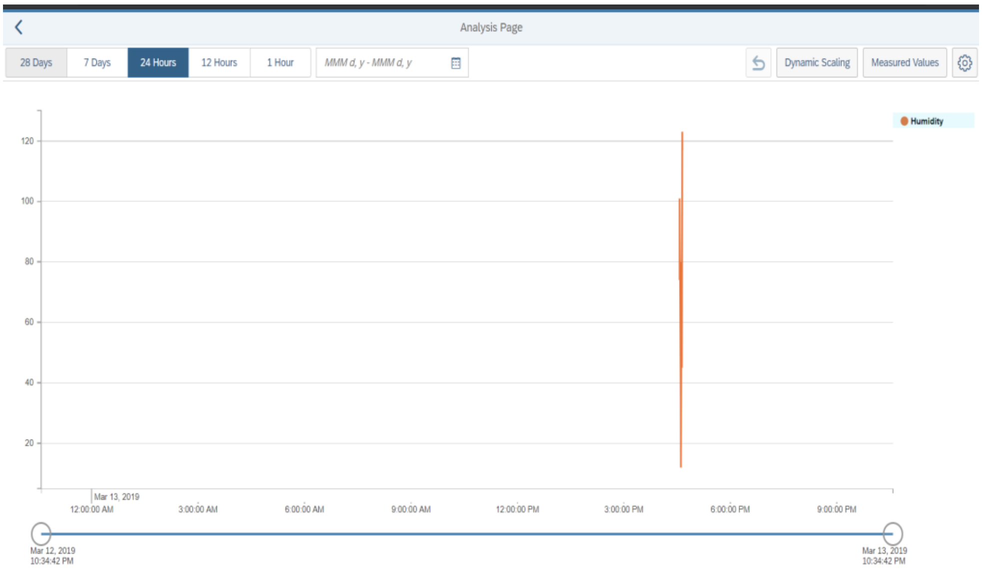

Figure 3. Humidity variation against time

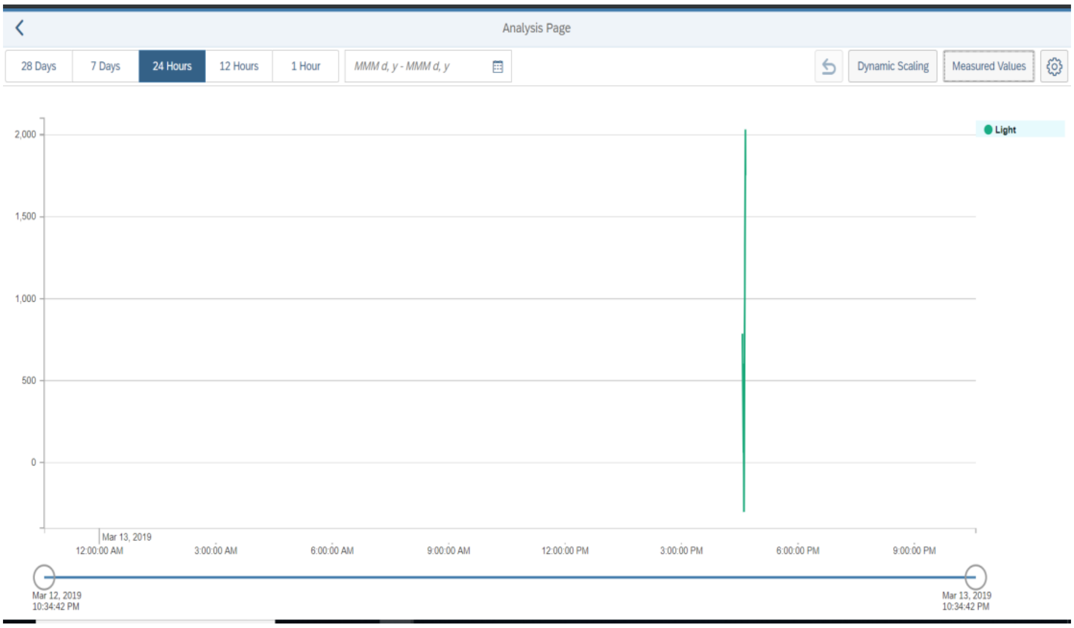

Figure 4. Light variation against time

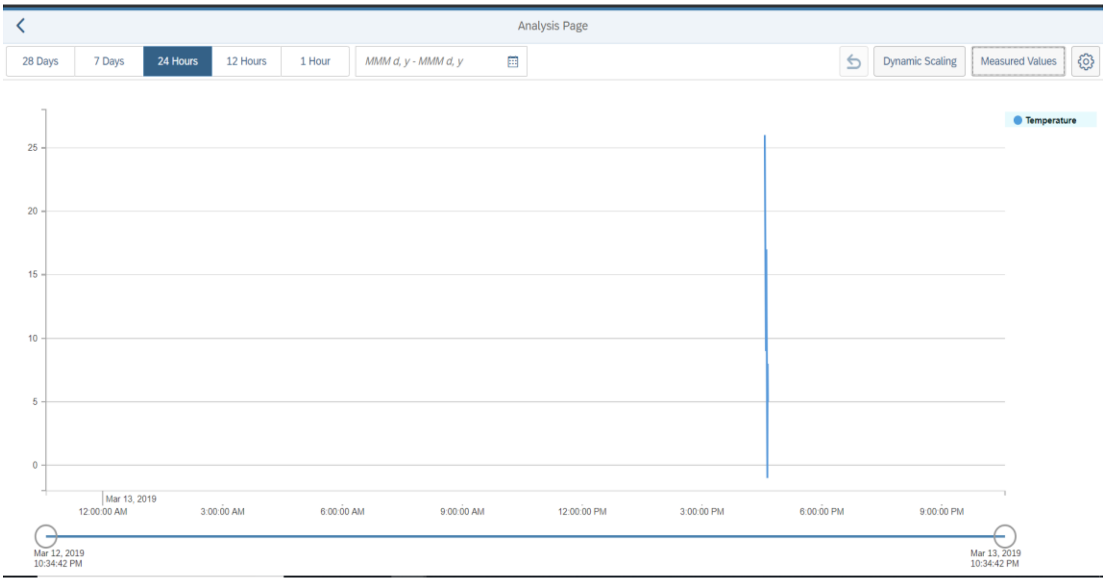

Figure 5. Temperature variation against time

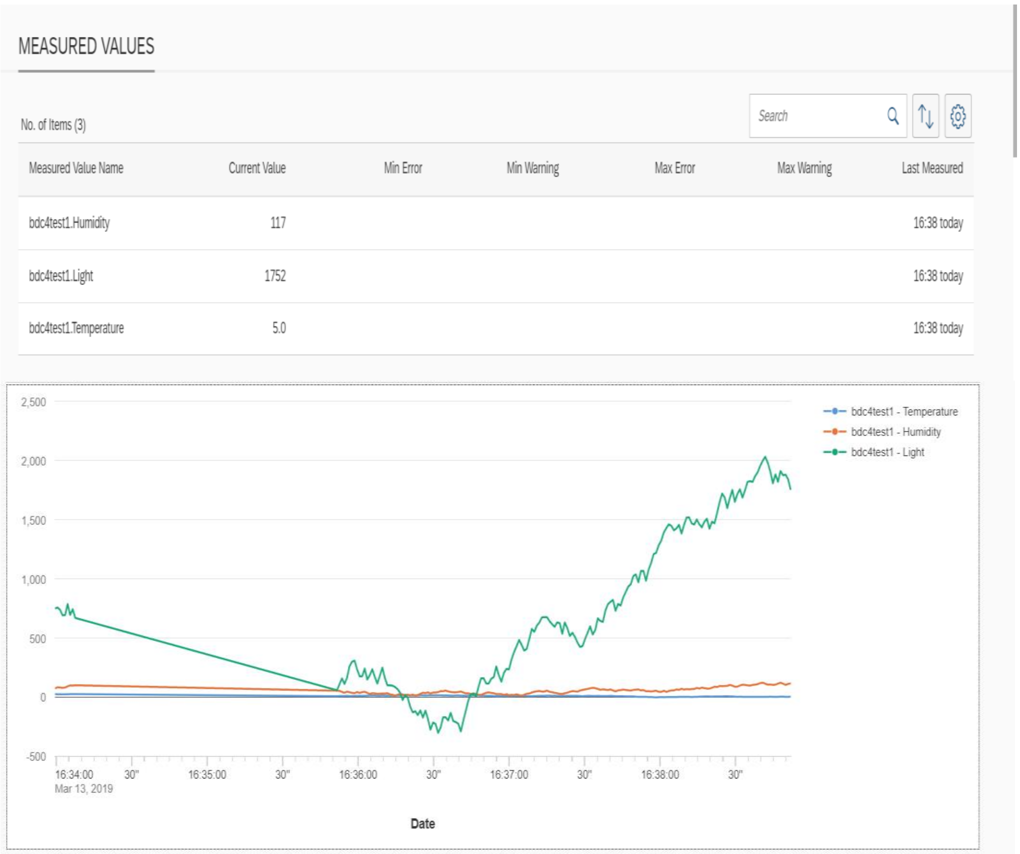

Figure 6. Temperature, Humidity and Light variation on a given date

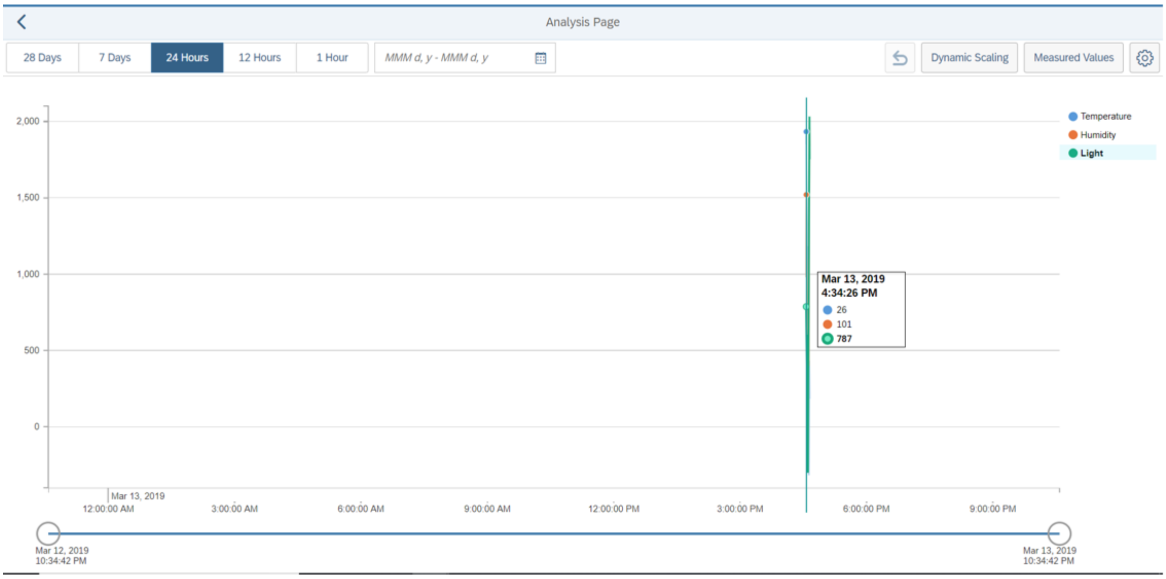

Figure 7. Temperature, Humidity and Light variation over time

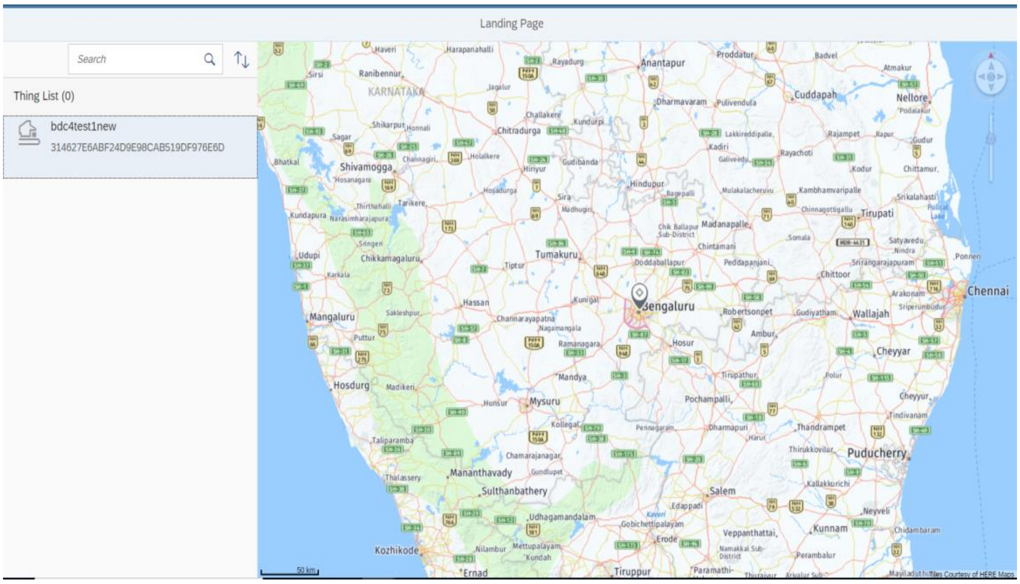

Figure 8. Locating Cattle position in the Field

5. CONCLUSION

The less costly, more efficient and effective real-time smart IoT-based farming device has been developed and tested. The farmers and agricultural scientists / agencies will use this device to keep track of the soil and the overall crop condition by various sensors. This can help in maintaining better fertile soil condition and water levels to the crop at different levels to increase the yield. Fast steps can be taken, although there is variability in the criteria being tracked at every point that warnings can be issued. The network can be easily set up, with a base station very close to the farming field, and the farmers can easily carry out surveillance operations. The Internet of Things (IoT) and its applications are an integral part of our daily life, lives, infrastructure and industry. There are many research efforts underway in developing key IoT building blocks and models for the potential Industrial Internet of Things systems which will include embedded sensors.

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