ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

Precision Agriculture using Real Time Environmental Parameters and Internet of Things

Ketan Prakash Kandagale, P Kumaresan

M.Tech, Department of Computer and Communication Engineering, VIT, Vellore, India

Assistant Professor, Department of Computer and Communication engineering, VIT, Vellore, India

ABSTRACT: This paper involves the application of real-time analytics in the field of agriculture. Much of conventional agricultural based data involves around cropping patterns, weather cycles that are based on assumptive and non-predictive facts. This kind of agriculture is hence prone to irregular and unusual patterns in agriculture, which can be destructive to crops and agricultural produce. This paper presents a solution in the form of 'precision agriculture' that involves collecting real time data to make smarter decisions. This collection of real –time data such as the water content of soil and the weather forecast via sensors, has been discussed in this paper extensively. This raw data is further used for appropriate resource management and adapting to the unexpected changes in farming patterns. Also the same data is uploaded to the cloud from where it is accessed for the benefit of making right decisions which in the long run result in maximizing food production, minimize environmental impact and reduce cost.

KEYWORDS: precision agriculture, environment, parameters, agriculture, greenhouses, sensors

I. INTRODUCTION

Some of the major issues that are currently challenging researchers worldwide include: globalization, urbanization, global warming and food supply. The later challenge urges for developing of modern solutions for optimizing costs and increasing yields, as population growth is soon to surpass the current production capacities.

IT has influenced many areas of society helping to develop various systems to meet the needs of humanity. In the last decade people intended to integrate the concept of Internet of Things (IoT) in the field of agriculture, aiming the evolution to a precision agriculture. [1]

Current solutions for recording specific parameters for agriculture applications suffer for a range of limitations: high power requirements, low autonomy, and restricted communication range [2].

Current solutions for crop monitoring based on WSNs - Wireless Sensor Networks have known different degrees of optimization in terms of energy consumption and range [3]. A common technology is Zigbee, device which offers data communication up to 1-2 km depending on the network architecture (mesh, star, tree) [4].

In the last 2 years, a new technology was brought forward which aims at increasing the transmission distance and, at the same time, maximizing autonomy by reducing power consumption. This technology is LoRa LPWAN (Long Range Low- Power Wide-Area Network). In terms of distance it can achieve ranges of up to 20 km [5] while using a single central node (Gateway) for up to 10.000 nodes

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering
(An ISO 3297: 2007 Certified Organization)
Website: www.ijircce.com
Vol. 5, Issue 4, April 2017

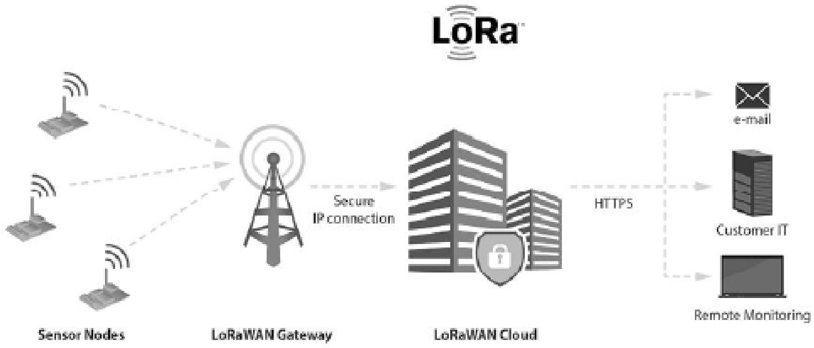

Fig LoRa network

II. Related work

Currently, multiple products are available for measuring environmental parameters both indoors and in the open-field. In the following description we will approach 3 of the most popular available solutions.Parrot Flower Power [6] is a Parrot licensed product dedicated to both indoor and outdoor environments. The main limitation for this product is that every module must be connected to a mobile device using Bluetooth. Thus, it cannot scale into a multi-point measuring system. The options for environment parameters are limited to light, temperature, soil fertility and humidity. The reliance of Bluetooth connectivity also limits the range and autonomy of the device, given the high power consumption. The maximum device autonomy I graded at 6 months. This product is more suitable to small spaces, such as flats or small home gardens. An advantage for the Parrot module is the measurement of the soil quality.

Edyn Smart Garden System is a similar product to the Parrot module, that uses photo-voltaic panels for improved autonomy. The designers also opted for WiFi rather than Bluetooth, and incorporated a broader range of measurements: light, air humidity, temperature, soil nutrients and soil humidity. It also offers advices for gardening strategies based on the measured parameters and weather forecast, for a range of over 5000 plants [7].

Pycno represents a more complex product compared to the previous two. This module is able to take data from multiple points using network connection based on the master-slave concept [8]. The system is based on a master – slave solution, with the master offering gateway capabilities through a GSM connection. The basic solution offers a maximum range of 2000m, but while using multiple master nodes, it can extend the sensor network up to 10 km. Measurements include light, air humidity, soil temperature, and a special multipoint soil humidity sensors, that offers readings at multiple depths up to 1,2m. The solution also incorporates a photo voltaic panel and a battery recharge system that theoretically would offer an unlimited working time

III. Hardware architecture

MoniSen is a complete hardware system and embedded software which is able to monitor environmental parameters at up to 10 kilometres. The proposed hardware architecture is designed for continuous monitoring of five environmental parameters: temperature and air humidity, soil temperature, soil moisture and light intensity.
The complete solutions will be able to:

- Monitoring and Recording Sensor Measurements
- Immediate Notification and Alerting
- Network Scalability

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

- Extended Power through Solar Energy
- Flexible Sensor Interface
- Plug-and-Play for Sensors and Nodes

Basic scheme for the monitoring system architecture:

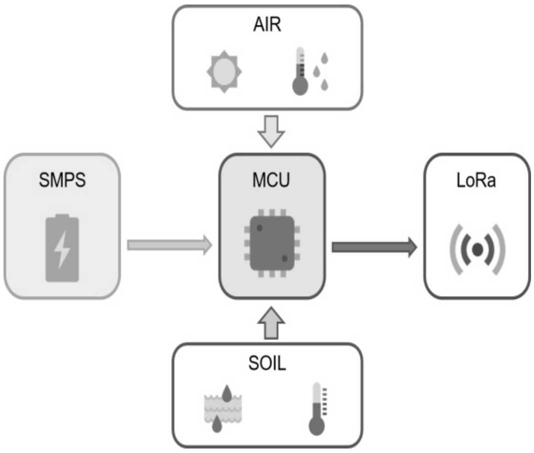

Fig: Hardware Architecture

The casting: Was manufactured using 3D printing techniques, the base material of the module is thermoplastic, ABS (acrylonitrile butadiene styrene), resistant to corrosion. ABS is a hard material, but also less flexible so the module is mechanically resistant to deformation at/on impact. In terms of heat it can withstand high temperatures up to 100 °C. In order to prevent water infiltration into the housing, all its joints were provided with gaskets.

Processing system: Each module has a MCU for data registration and data transmission based on AVR 8-bit ATMEGA324P architecture. The frequency of the MCU is 4 MHz in the active mode, after the data is registered from the sensors, the module enters in the sleep mode (power saving mode). This controller has an intern RTC (Real Time Clock) with a quartz oscillator with the frequency of 32.768 kHz, which helps us to maintain a constant time (1 hour) between 2 consecutive measures.

IV. SENSORS

A. Soil temperature

Soil temperature is measured using a TCN75A sensors, manufactured by Microchip, with a 12-bit precision. Temperature measurement is done by reading the base-emitter voltage difference of a transistor and converting the value in decimal value, while the current collector from IC1 to IC2 changes. Thus, the voltage across the base-emitter junction is dependent only on the ratio of the two currents above the ambient temperature.

B. Soil Moisture

To scale the amount of water in the soil we established a relationship between it and the high density electrical ground. When the soil is wet, the electrical resistance decreases. To determine the electrical resistance of the soil, we measure the amount of electrical charge between the two electrodes, made of stainless steel, from the ground.

C. Air temperature and humidity

These two parameters are measured with the same sensor HDC1050, a low-power solution from Texas Instruments. The maximum resolution measurement parameters are 14 bits, an accuracy of

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

± 3% humidity and ± 0.2 ° C temperature.

D. Light intensity

For measuring the light intensity, we used a group of a resistors in series with a photo-resistance. The measurement unit for this sensor is “lux”. Dependence EB light intensity, depending on the resistance of photoresist.

F. Power source

The power source of the entire module consists of two LR6 batteries in series (2.4V), while the working voltage for all the ICs is 3.3V. For this reason, we chose a solution based on Microchip’s MCP1640, boost converter, to increase and stabilize the supply voltage. In this application mode, the power boost has an efficiency of over 90%..

V. Hardware Implementation

The following diagram is the monisen module. Using this module, the date is stored in database every 6 hrs and the tracking is done on the real-time bases**.**

Fig: Monisen module

VI. Software implementation

This paper basically involves three stages. The first stage involves the collection of data from various sensors that are deployed on the field. Raw data collected includes water level in the soil, humidity level, water level in the well, fertilizer amount in the soil and other relevant data. The second stage involves working on this huge amount of data that gets updated by the most recent responses from the sensors, to provide a background check of the area that in turn tells us what crops are suitable for that particular area, for what period of time, and the expected profits when related to the current market rates. This brings us to the third stage that matches the processed data with data on the cloud and helps in making smart decisions.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

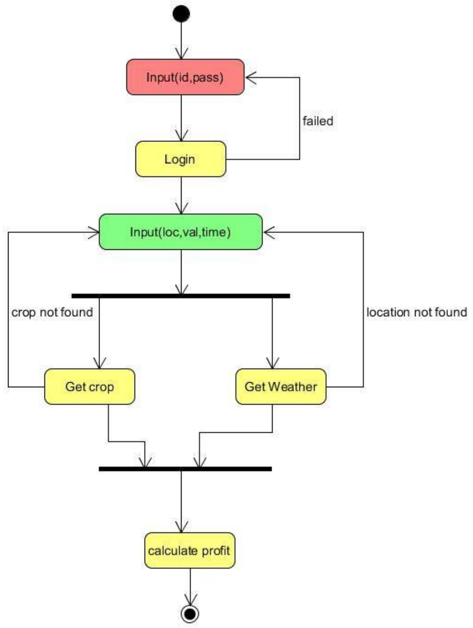

Fig: flow diagram (weather module)

For having the maximum profit the market value is also important, so we fetch the market value of the crop in real-time from cloud. For analysis purpose python is used. Which is very simply and easy to use. Following chart shows the output of the crop having maximum profit

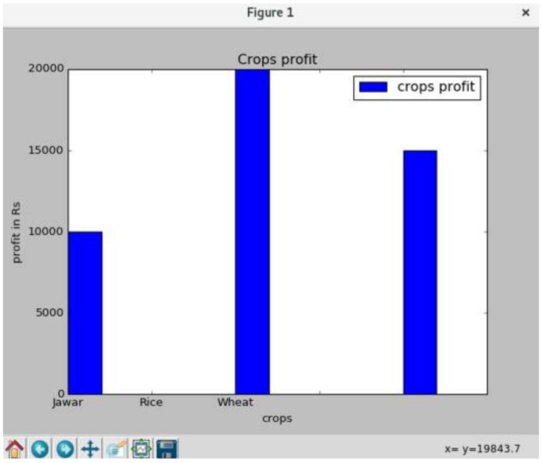

Fig: analysis graph for maximum profit

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

VII. TESTING

Component	Running supply current	Sleep supply current
µC	3.7mA	0.3mA
SMPS	0.02mA	-
LightSensor	2mA	0
SoilTemperature	0.2mA	0.002mA
Airtemperatureand Humidity	0.225mA	100nA
Moisture	1mA	0
LoRaModule	39mA(max)	0.001mA

VIII. CONCLUSION AND FUTURE WORK

A fully functional software and hardware embedded module was developed, optimized for large scale applications, using a distributed sensors architecture. The module empowers the module to measure environmental parameters as needed, while displaying multiple parameter evolution on a mobile application.

Future work will focus on further power consumption optimizations, for increasing the autonomy from 6 months to 3 years.

REFERENCES

[1] H. D. D. ,. F. W. ,. H. Y. Weimin Qiu, "Design of intelligent greenhouse environment monitoring system based on ZigBee and embedded technology," in Consumer Electronics - China, 2014 IEEE International Conference on, Shenzhen, 2014.
[2] H. E. S. Y. ,. Y. X. Wang Yitong, "Design of Multi- parameter Wireless Sensor Network Monitoring System in Precision Agriculture," in Instrumentation and Measurement, Computer, Communication and Control (IMCCC), 2014
[3] Fourth International Conference on, Harbin, 2014.
[4] C. S. a. H. Y. Jeonghwan Hwang, "Study on an Agricultural Environment Monitoring Server System using Wireless Sensor Networks," in School of Information and Communication Engineering, Sunchon National University, Maegok-dong, Suncheon-si, Jeollanam-do, Korea, 2010.
[5] Y. H. Baishun Su, "Design of Greenhouse Wireless Monitoring System Based on ZigBee," in E-Product E-Service and E-Entertainment (ICEEE), 2010 International Conference on, Henan, 2010.
[6] K. M. Juha Petäjäjärvi, M. Hämäläinen and J. Iinatti, "Evaluation of LoRa LPWAN technology for remote health and wellbeing monitoring," in 2016 10th International Symposium on Medical Information and Communication Technology (ISMICT), Worcester, MA, 2016.
[7] Parrot, "Parrot," 10 6 2016. [Online]. Available:
[8] http://www.parrot.com/usa/products/flower-power
[9] "Pycno," 10 6 2016. [Online]. Available:
[10] http://pycno.co.uk/product
[11] Tudose, Dan Stefan, Tapus Nicolae, Energy Harvesting and Power Management in Wireless Sensor Networks, in 18th International Conference of Control Systems and Computer Science CSCS18}, pp 174-180, 2011