A REVIEW ON INCREASING AGRICULTURE YIELDS BY CONTINUOUS MONITORING USING IOT

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ABSTRACT

Despite the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of the Internet-of-Things (IoT) based technologies redesigned almost every industry including "smart agriculture" which moved the industry from statistical to quantitative approaches. Such revolutionary changes are shaking the existing agriculture methods and creating new opportunities along a range of challenges. This article highlights the potential of wireless sensors and IoT in agriculture, as well as the challenges expected to be faced when integrating this technology with the traditional farming practices. IoT devices and communication techniques associated with wireless sensors encountered in agriculture applications are analysed in detail. What sensors are available for specific agriculture application, like soil preparation, crop status, irrigation, insect and pest detection are listed. How this technology helping the growers throughout the crop stages, from sowing until harvesting, packing and transportation is explained. Furthermore, the use of unmanned aerial vehicles for crop surveillance and other favourable applications such as optimizing crop yield is considered in this article. State-of-the-art IoT-based architectures and platforms used in agriculture are also highlighted wherever suitable. Finally, based on this thorough review, we identify current and future trends of IoT in agriculture and highlight potential research challenges. Internet of things (IoT) is a promising technology which provides efficient and reliable solutions towards the modernization of several domains.

Keywords: Data, Internet of Things, intergrating, sensors, surveillance

1. INTRODUCTION

IoT based solutions are being developed to automatically maintain and monitor agricultural farms with minimal human involvement. It presents many aspects of technologies involved in the domain of IoT in agriculture.

It explains the major components of IoT based smart farming. A rigorous discussion on network technologies used in IoT based agriculture has been presented, that involves network architecture and layers, network topologies used, and protocols. Furthermore, the connection of IoT based agriculture systems with relevant technologies including cloud computing, big data storage and analytics has also been presented. In addition, security issues in IoT agriculture have been highlighted. A list of smart phone based and sensor based applications developed for different aspects of farm management has also been presented. Lastly, the regulations and policies made by several countries to standardize IoT based agriculture have been presented along with few available success stories. In the end, some open research issues and challenges in IoT agriculture field have been presented. The IoT is the current domain and a unique for technology to transform many smart agriculture in the world. Smart agriculture is to provide farmers and to help sustainable agriculture techniques such as spaying, sensing, scaring, keeping, vigilance, weeding, moisture, humidity, bird, animal, etc. They are effects and factors that relate the method of technological and smart agriculture requirements, monitoring environmental from various aspects and controlled by an automatic system. The "Smart" a major of IoT technology has attracted the various of network physical objects and connected to the internet of a global infrastructure of the network at very fast and applications link [9]. The word of "Smart" refers to the environment and communicate controlled such as smart home, smart agriculture, smart energy, smart grid, smart water, smart city, smart industry and so forth includes cloud-based data, sensors, and a variety to identify and approach to support the system. Smart agriculture is the use of IoT technologies to control smart farming as need precision agriculture to ensure exact coverage of a field.

2. LITERATURE SURVEY

- Nikesh Gondchawar et al., [1] proposed work on IoT based smart agriculture. The aim of the paper is making agriculture smart using automation and IoT technologies. Smart GPS based remote controlled robot will perform the operations like weeding, spraying, moisture sensing etc. It includes smart irrigation with smart control and intelligent decision making based on accurate real time field data and smart warehouse management. It monitors temperature maintenance, humidity maintenance and theft detection in the warehouse. All the operations will be controlled by smart device and it will be performed by interfacing sensors, ZigBee modules, camera and actuators with microcontroller and raspberry pi. All the sensors and microcontrollers are successfully interfaced with three Nodes using raspberry pi and wireless communication. This paper gives information about field activities, irrigation problems, and storage problems using remote controlled robot for smart irrigation system and smart warehouse management system respectively.

- Rajalakshmi P.et.al., [2] described to monitor the crop-field using soil moisture sensors, temperature and humidity sensor, light sensor and automated the irrigation system. The data from sensors are sent to web server using wireless transmission and JSON format is used for data encoding to maintain server database. The moisture and temperature of the agriculture field falls below the brink, irrigation system will be automated. The notifications are sent to farmers mobile periodically and farmers can be able to monitor the field conditions from anywhere. The parameters used here are soil moisture sensor, temperature and humidity sensor- DHT11, LDR used as light sensor and web server – NRF24L01 used for transmitter and receiver. This system will be more useful in areas where water is in scarcity and it is 92% more efficient than the conventional aii]pproach. Automation of irrigation system data was stored in MySQL database using PHP script. Total average power consumption is 2 Ah per day for a single motor pump and water requirement analysis.

- Tanmay Baranwal et al., [3] this project concentrates security and protection of agricultural products from attacks of rodents or insects in the fields or grain stores. Security systems are used to provide real time notification after sensing the problem. Sensors and electronic devices are integrated using Python scripts. Algorithm is designed based on collecting information to provide accuracy in notifying user and activation of repeller. Testing is done in an area of 10 sq. m. and the device is placed at the corner. The PIR sensor identifies heat it starts URD sensor and webcam. Based on attempted test cases 84.8% success is achieved. It will be helpful to extend the security system to prevent rodents in grain stores.

- Nelson Sales et al., [4] this paper describes Wireless sensor Networks. The network performs three nodes i.e. acquisition, collection and analysis of data such as temperature and soil moisture. The benefits of irrigation process in agriculture are decreasing water consumption and environmental aspects. Cloud Computing is an attractive solution for high storage and processing capabilities of large amount of data by the Wireless Sensor and Actuator Network. This work aims to agriculture, greenhouses, golf courses and landscapes. Architecture is divided in to three main components: a WSAN component, a cloud platform component and a user application component. It contains three different types of nodes such as sink node, a sensor node and an actuator node. SimplitiTI is a simple protocol for WSAN implementation in a cluster tree topology. The soil moisture monitors to assess the plants it need water for its proper development and optimization of natural resources.

- Mohamed Rawidean Mohd Kassim et al., [5] this work describes a Precision Agriculture (PA). A WSN is the best way to solve the agricultural problems like farming resources optimization, decision making support, and land monitoring. Using this approach provides real-time information about the lands and crops that will help the farmers to make right decisions. Precision agriculture systems based on the IOT technology explains the hardware architecture, network architecture and software process control of the precision irrigation system. The software collects data from the sensors in a feedback loop depending on that activates the control devices

based on threshold value. Implementation of WSN in PA optimizes the usage of water fertilizer through irrigation and also maximized the yield of the crops.

- LIU Dan et al., [6] this paper describes greenhouse technology in agriculture represents the design and implementation based on ZigBee technology using CC2530 chip. It is mainly used for environment monitoring system. The wireless sensor and control nodes uses CC2530F256 core for data acquisition, data processing, data transmission and reception. Here computer provides all the real time data for the concerned person using wireless communication like temperature control, fans condition. In this system uses intelligent monitoring and control of green house. It is helpful to farms for scientific and balanced planting crops.

3. PROPOSED WORK

We proposed model for smart agriculture to develop real time monitoring system for soil properties like temperature, moisture, pH and to implement decision support advisory models for Pest & Disease forewarning, Crop Disease identification using image analysis and SMS based alerts. It will also be possible to control various operations of the field remotely from anywhere, anytime by mobile as well as web application.

Proposed system has three modules –

- Farm side,

- Server side and

- Client side.

Farm side consists of six methods as follows.

1. Sensing local agricultural parameters.

2. Identification of location of sensor and data collection.

3. Transferring data from crop fields for decision making.

4. Decision support and early warming based on data analysis, domain knowledge and history generated.

5. Actuation and control based on decision.

6. Crop monitoring via camera Module.

It's wise agricultural model in integration with ICT. ICT have always mattered in Agriculture domain. Village farmers may have planted the "same" crop for centuries, but over period, weather patterns and soil conditions and epidemics of pests and diseases changed. By using the proposed approach, received updated information allows the farmers to cope with and even benefit from these changes. It is really challenging task that needs to provide such knowledge because of highly localized nature of agriculture information specifically distinct conditions. The complete real-time and historical environment information is expected to help to achieve efficient management and utilization of resources
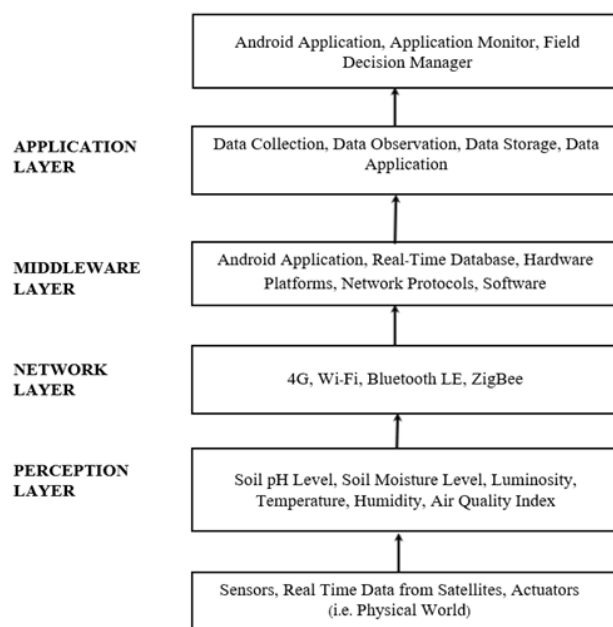
Figure 1: Structural flow of the system

4. EXPECTED OUTCOMES

- First and most important aspect is to provide more security by making use of less devices handling by user.

- It does not required manual triggering as with the previous devices.

- Hassle free use of system is possible.

- Its sensor increase the efficiency and less processing time to evaluate the condition and judge the scenario quickly.

- It can be used as a rechargeable device also.

- All parameters need to match which helps to reduce the redundant error occurred in the process.

- It makes the possibility of data entry easy for number of process accessibility.

- It makes the device much integrated for normal use.

- It is possible to increase the yield in farming by providing efficient use of technology.

REFERENCES

[1]   Pamidi Srinivasulu , R Venkat , M. Sarath Babu , K Rajesh " Cloud Service Oriented Architecture (CSoA) for agriculture through Internet of Things (IoT) and Big Data", 2017 International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE2017)

[2]   Christopher Brewster, Ioanna Roussaki, Nikos Kalatzis, Kevin Doolin, and Keith Ellis, "IoT in Agriculture: Designing a Europe-Wide Large- Scale Pilot", IEEE Communications Magazine • September 2017

[3]   Suraj Pandharinath Takekar , Sanket Pandharinath Takekar , "Plant And Taste to Reap with Internet Of Things", International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2017)

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International Journal of Applied Engineering & Technology

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International Journal of Applied Engineering & Technology

[4] Jaiganesh.S, Gunaseelan.K , V.Ellappan ,” IOT Agriculture to improve Food and Farming Technology ”, Proc. IEEE Conference on Emerging Devices and Smart Systems (ICEDSS 2017) 3-4 March 2017, Mahendra Engineering College, Tamilnadu, India.

[5] Carlos cambra , Sandra sendra , Jaime Loret , Laura Garcia , “An IoT service-oriented system for Agriculture Monitoring” , IEEE ICC 2017 SAC Symposium Internet of Things Track.

[6] Mahammad Shareef Mekala , Dr P. Viswanathan , “A Novel Technology for Smart Agriculture Based on IoT with Cloud Computing” , International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2017)

[7] Sahitya. Roy, Dr Rajarshi. Ray,Aishwarya Roy,Subhajit Sinha,Gourab Mukherjee,Supratik Pyne,Sayantan Mitra,Sounak Basu,Subhadip Hazra , “IoT, Big Data Science & Analytics, Cloud Computing and Mobile App based Hybrid System for Smart Agriculture”.

[8] Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018) IEEE Xplore Compliant Part Number:CFP18N67-ART; ISBN:978-1-5386-2456-2 978-1-5386-2456-2/18/$31.00 ©2018 IEEE 1055

[9] Ibrahim Mat, Mohamed Rawidean Mohd Kassim Ahmad Nizar Harun, Ismail Mat Yusoff , “IoT in Precision Agriculture Applications Using Wireless Moisture Sensor Network”, 2016 IEEE Conference on Open Systems (ICOS), October 10-12, 2016, Langkawi, Malaysia.

[10] Prof. K. A. Patil , Prof. N. R. Kale , “A Model for Smart Agriculture Using IoT ”, 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication

[11] Ahmed Khattab , Ahmed Abdelgawad, Kumar Yelmarthi , “Design and Implementation of a Cloud-based IoT Scheme for Precision Agriculture ” , ICM 2016

[12] Ayush Kapoor , Suchetha I Bhat , Sushila Shidnal, Akshay Mehra , “IMPLEMENTATION OF loT (INTERNET OF THINGS) AND IMAGE PROCESSING IN SMART AGRICULTURE”, 2016 International Conference on Computational Systems and Information Systems for Sustainable Solutions.

[13] Keoma Brun-Laguna, Ana Laura Diedrichs , Javier Emilio Chaar, Diego Dujovne, Juan Carlos Taffernaberry, Gustavo Mercado, Thomas Watteyne, “A Demo of the PEACH IoT-based Frost Event Prediction System for Precision Agriculture” , ©2016 IEEE

[14] Tanmay Baranwal , Nitika , Pushpendra Kumar Pateriya , “Development of IoT based Smart Security and Monitoring Devices for Agriculture” , 978-1-4673-8203-8/16/$31.00_c 2016 IEEE

[15] Ž.Nakutis, V.Deksnys, I.Jauruševi_ius, E.Marcinkevi_ius , A.Ronkainen, P.Suomi, J.Nikander , “Remote Agriculture Automation using Wireless Link and IoT Gateway Infrastructure ”, 2015 26th International Workshop on Database a nd Expert Systems Applications

[16] LIU Dan , Cao Xin , Huang Chongwei , JI Liangliang , “Intelligent Agriculture Green House Environment Monitoring System Based on IoT Technology ” , 2015 International Conference on Intelligent Transportation , Big Data & Smart City

[17] Prem Prakash Jayaraman, Doug Palmer, Arkady Zaslavsky , Dimitrios Georgakopoulos , “Do-it- Yourself Digital Agriculture Applications with Semantically Enhanced loT Platform” , 2015 IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) Singapore, 7-9 April 2015

[18] Yi Liu, He Wang, Junyu Wang, Kan Qian, NingKong, Kaijiang Wang, Yiwei Shi, Lirong Zheng, “Enterprise-Oriented IoT Name Service for Agriculture Product Supply Chain Management”, 2014 International Conference on Identification, Information and Knowledge in the Internet of Things.

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International Journal of Applied Engineering & Technology

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Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018) IEEE Xplore Compliant Part Number:CFP18N67-ART; ISBN:978-1-5386-2456-2 978

[19] Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari and M. Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," in IEEE Communications Surveys & Tutorials, vol. 17, no. 4, pp. 2347-2376, Fourthquarter 2015.

[20] D. Pimentel, B. Berger, D. Filiberto, M. Newton, B. Wolfe, E. Karabinakis, S. Clark, E. Poon, E. Abbett, and S. Nandagopal, "Water resources: agricultural and environmental issues," BioScience, 54.10, 909-918, 2004.

[21] Kim, Yunseop, Robert G. Evans, and William M. Iversen, "Remote sensing and control of an irrigation system using a distributed wireless sensor network," IEEE transactions on instrumentation and measurement, 57.7 (2008): 1379-1387.

[22] J. Gutiérrez, J. F. Villa-Medina, A. Nieto-Garibay and M. Á. Porta- Gándara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module," in IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 1, pp. 166-176, Jan. 2014.

[23] Ji-chun Zhao, Jun-feng Zhang, Yu Feng and Jian-xin Guo, "The study and application of the IOT technology in agriculture," 2010 3rd International Conference on Computer Science and Information Technology, Chengdu,pp. 462-465, 2010.

[24] Y. Liu, C. Zhang and P. Zhu, "The temperature humidity monitoring system of soil based on wireless sensor networks," 2011 International Conference on Electric Information and Control Engineering, Wuhan, pp. 1850-1853, 2011.

[25] S. Ivanov, K. Bhargava and W. Donnelly, "Precision Farming: Sensor Analytics," in IEEE Intelligent Systems, vol. 30, no. 4, pp. 76-80, July- Aug. 2015.

[26] M. Ammad-udin, A. Mansour, D. Le Jeune, E. H. M. Aggoune and M. Ayaz, "UAV routing protocol for crop health management," 2016 24th European Signal Processing Conference (EUSIPCO), Budapest, pp. 1818-1822, 2016.

[27] P. Lottes, R. Khanna, J. Pfeifer, R. Siegwart and C. Stachniss, "UAVbased crop and weed classification for smart farming," 2017 IEEE International Conference on Robotics and Automation (ICRA), pp. 3024- 3031, 2017.

[28] I. F. Akyildiz, T. Melodia and K. R. Chowdury, "Wireless multimedia sensor networks: A survey," in IEEE Wireless Communications, vol. 14, no. 6, pp. 32-39, December 2007.

[29] C. F. Wang, J. D. Shih, B. H. Pan and T. Y. Wu, "A Network Lifetime Enhancement Method for Sink Relocation and Its Analysis in Wireless Sensor Networks," in IEEE Sensors Journal, vol. 14, no. 6, pp. 1932- 1943, June 2014. [12] K. O. Flores, I. M. Butaslac, J. E. M. Gonzales, S. M. G. Dumlao and R. S. J. Reyes, "Precision agriculture monitoring system using wireless sensor network and Raspberry Pi local server," 2016 IEEE Region 10 Conference (TENCON), Singapore, pp. 3018-3021, 2016.

[30] A. Khattab, A. Abdelgawad and K. Yelmarthi, "Design and implementation of a cloud-based IoT scheme for precision agriculture," 28th International Conference on Microelectronics (ICM), Giza, pp. 201-204,2016.

[31] P. Kumar and S. R. N. Reddy, "Design and development of M3SS: A Soil Sensor Node for precision agriculture," 2016 International Conference on Recent Advances and Innovations in Engineering (ICRAIE), Jaipur, pp. 1-10, 2016.

[32] P.RajalakshmiIITH Mote-Wireless Sensor Communication Module, http://www.iith.ac.in/raji/downloads/IITHmote-webpage.pdf. 613

[33] Huan, Zhan, Hui Wang, Chen Li, and Caiyan Wan, "The soil moisture sensor based on soil dielectric property," Personal and Ubiquitous Computing, vol. 21, no. 1, pp. 67-74, 2016.

[34] O. Georgiou and U. Raza, "Low Power Wide Area Network Analysis: Can LoRa Scale?," in IEEE Wireless Communications Letters, vol. 6, no. 2, pp. 162-165, April 2017.

[35] Abdelraouf Ouadjaout, Noureddine Lasla, Miloud Bagaa, Messaoud Doudou, Cherif Zizoua, Mohamed Amine Kafi, Abdleouahid Derhab, Djamel Djenouri, Nadjib Badache, "DZ50: Energy-Efficient Wireless Sensor Mote Platform for Low Data Rate Applications," 5th International Conference on Emerging Ubiquitous Systems and Pervasive Networks (EUSPN, 2014.

[36] Atis Elsts, Rihards Balass, Janis Judvaitis, Reinholds Zviedris, Girts Strazdins, Artis Mednis, and Leo Selavo, " SADmote: A Robust and Cost-Effective Device for Environmental Monitoring," ARCS, LNCS, vol. 7179, pp. 225–237, 2012.

[37] Chulsung Park, Jinfeng Liu, and Pai H. Chou, "Eco: an Ultra-Compact Low-Power Wireless Sensor Node for Real-Time Motion Monitoring", IPSN Fourth International Symposium on Information Processing in Sensor Networks, pp. 398-403, 2005.

[38] Mridula Maurya, Shri R. N. Shukla, "Current Wireless Sensor Nodes (Motes): Performance metrics and Constraints," International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), vol. 2, no. 1, 2013.

[39] Vinayak N. Malavade, Pooja K. Akulwar. "Role of IoT in Agriculture", IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p- ISSN: 2278-8727 PP 56-57.

[40] Vandana Sharma, Ravi Tiwari, "A review paper on "IOT" & It"s Smart Applications", International Journal of Science, Engineering and Technology Research (IJSETR), Volume 5, Issue 2, February 2016

[41] Jim Chase: The Evolution of the Internet of Things. White Paper, Texas Instruments, September, 2013.

[42] Saurav Verma, Chetana Prakash, "Internet of Things (IoT): A vision, architectural elements, and security issues": IEEE I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2017.

[43] Xiaohui Wang and Nannan Liu, "The application of internet of things in agricultural means of production supply chain management", Journal of Chemical and Pharmaceutical Research, 2014, 6(7):2304-2310, ISSN :09757384,2014

[44] Karimi, Kaivan, and Gary Atkinson. "What the Internet of Things (IoT) needs to become a reality." White Paper, FreeScale and ARM (2013).

[45] Stankovic, John. "Research directions for the internet of things." Internet of Things Journal, IEEE 1.1 (2014): 3-9.

[46] N. Jagan Mohan Reddy , G. Venkareshwarlu, et al. "Wireless Electronic Display Board Using GSM Technology", International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084 Volume-1, Issue- 10, Dec-2013

[47] S. R. Nandurkar, V. R. Thool, R. C. Thool, Design and Development of Precision Agriculture System Using Wireless Sensor Network, IEEE International Conference on Automation, Control, Energy and Systems (ACES), 2014.

[48] AnjumMei Fangquan. Smart planet and sensing chinaanalysis on de-velopment of IOT [J]. Agricultural Network Information, Vol.12, pp. 5-7, 2009. 2012.

[49] Q. Wang, A. Terzis and A. Szalay, A Novel Soil Measuring Wireless Sensor Network, IEEE Transactions on Instrumentation and Measure-ment, pp. 412415, 2010.

[50] Yoo, S.; Kim, J.; Kim, T.; Ahn, S.; Sung, J.; Kim, D. A2S: Automated agriculture system based on WSN. In ISCE 2007. IEEE International Symposium on Consumer Electronics, 2007, Irving,TX, USA, 2007.

[51] N. Kotamaki and S. Thessler and J. Koskiaho and A. O. Hannukkala and H. Huitu and T. Huttula and J. Havento and M. Jarvenpaa(2009). Wireless in-situ sensor network for agriculture and water monitoring on a river basin scale in Southern Finland: evaluation from a data users perspective. Sensors 4, 9: 2862-2883. doi:10.3390/s90402862 2009.

[52] S.K. DhurandherSun Qi-Bo, Liu Jie, Li Shan, Fan Chun-Xiao, Sun Juan-Juan, Internet of things: Summarize on concepts, architecture and key technology problem, Beijing YoudianDaxueXuebao/Journal of Beijing University of Posts and Telecommunications, Vol. 33, No. 3, pp.1-9, 2010, 2008.

[53] Baker, N. ZigBee and bluetooth - Strengths and weaknesses for indus-trial applications. Comput. Control. Eng. 2005, 16, 20-25.

[54] Shilpajain and Sourabhjain,Energy Efficient Maximum Lifetime Ad-Hoc Routing (EEMLAR), international Journal of Computer Networks and Wireless Communications, Vol.2, Issue 4, pp. 450-455, 2012.

[55] Garg, Saurabh Kumar, and Rajkumar Buyya. "Green cloud computing and environmental sustainability." Harnessing Green IT: Principles and Practices (2020): 315-340.