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Smart Agriculture System using IOT with Wireless Sensor Networks

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Abstract

We are all aware that no living thing can survive without food, so farming everywhere, not just in India, is crucial. Our nation's primary source of income is agriculture. Agriculture is reliant upon precipitation, soil, daylight and dampness etc. The present and future of this agriculture can be overseen by the innovation called the Internet of Things. For improved outcomes, it is a development process that transforms conventional agriculture into smart agriculture. This innovation builds the effectiveness of the harvest, diminishes the expense, increments yield, and can decrease wastage. The vermin and bugs that harm the yield can likewise be controlled and the harvest can be secured. With this technology, farmers can learn about temperature, humidity, soil moisture, and other factors that affect production to increase yield and save resources. The cloud-based storage of field-collected data enables IOT devices to function appropriately. This agricultural framework can be overseen from any place utilizing organizing innovation.The paper focuses on the social and technological trends that will be increasing when smart agricultural technologies are widely used by farmers around the world.

Keywords : Arduino, Temperature Sensor, Humidity Sensor, Soil Moisture Sensor, Raindrop Sensor, WIFI, Networking, Cloud computing.

1. Introduction

This is basically a technique to improve farming productivity. To meet their fundamental necessities, the majority of people in India rely on farming as their main source of income.The majority of farmers still cultivate crops using manual methods. In any case, because of unusual weather patterns, the production rate has reduced gradually. As a result, food prices went up and there was less of it available on the market. Crop production is impacted by different reasons like soil ripeness, environmental change, and so forth which can improve or diminish yield. Aside from these variables, appropriate booking of water systems and preparation can help in the great creation of harvests.

Several sensorsfor soil moisture, rainfall, humidity, temperature, and an infrared sensor are used in IOT-based smart agriculture to monitor the entire crop field. When compared to the manual method, this is extremely effective. This system's primary goal is to ensure that the crop grows in the best possible conditions at all times. Smartphones and computers alike can access the field's data. Farmers can monitor the yields and have some control over the water engines, lights, and so on.

Various pests, insects, and birds of all kinds can be detected with an IR sensor and reported to the user.

This model comprises three unique layers that incorporate the Actual layer, the IOT layer, and the Com-operation layer. This framework is equipped for overseeing different kinds of issues in farming, for example, animal control, quality administration, production network, etc.

2. Architecture/Designing

Architecture is proposed as shown in the figure 1 below. IoT provides many benefits such as effective and efficient management of resources, knowledge development, intelligent management, monitoring, etc...

It is divided into three layers namely,

a) Physical layer

b) IOT layer

c) Com-operation layer

2.1 Physical layer:

It controls the entire agribusiness framework. This regulator has sensors and a control-checking framework. Different sensors are utilized to quantify conditions like dampness, daylight, precipitation, and so forth dampness sensors, daylight sensors, precipitation sensors, temperature sensors, and water level sensors. This aids the automation process.

2.2 IOT layer:

It sends the data to the Com-operation layer for processing after collecting it from the physical field. All IoT devices are managed by the system controller in this layer, where data is collected and sent to a cloud server from a local server. Automation systems make use of digital cameras, embedded systems, and wireless sensors.

2.3 Com- operation layer:

Cloud services employ a variety of security protocols in this layer to ensure the safe transfer of data. Before and after processing, it serves as a storage manager for the data. This layer receives and processes alerts and notifications based on the field environment from cloud services.

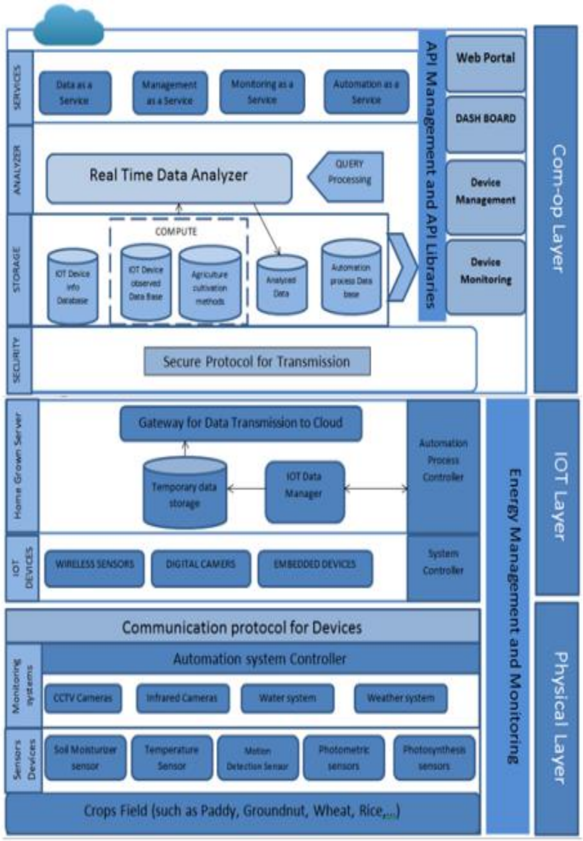

Figure1. Architecture

3. Proposed System

3.1 Soil Moisture Sensor

Soil moisture sensors are used to measure the water level in the soil, and it also helps to know the total amount of water stored in the soil. Soil moisture meters collect information about watering plants and provide moisture levels in the soil . This sensor shown in figure 2, productively help irrigation management. It helps the irrigators to know what is exactly happening inside the roots of the soil.

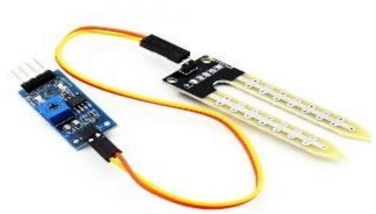

Figure 2. Soil moisture sensor.

3.2 Temperature & humidity Sensor

Temperature and humidity sensors shown in figure 3 are used to monitor humidity and temperature in surrounding environments. Water vapor as relative humidity is measured by a sensor transducer. Water vapor is converted to electrical signals through transducers. The humidity sensors are of 3 types they are resistive, capacitive, and thermal. DHT 11 is used in this model as it is a low-cost and well-known sensor. To measure the temperature and humidity values as serial data DHT11 has a feature of NTC (negative temperature coefficient). Humidity sensors and thermistors are present in DHT11. This can calculate the temperature from 0c to 50c and humidity from 20% to 90%.

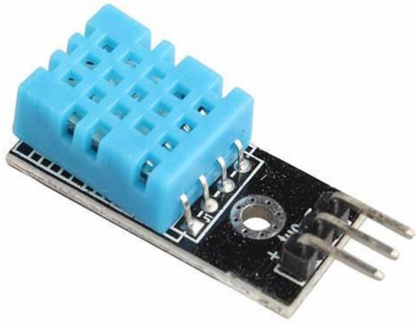

Figure 3. Temperature & Humidity sensor.

3.3 Light Sensor

A photoelectric sensor shown in figure 4, is another name for a light sensor. Light sensors can convert light energy into electrical energy. Changes in the amount of light that is received are used to illuminate with light sensors. Since the light sensor functions as a particle, it is referred to as a photon. Electrons will observe the energy of light, which increases kinetic energy and will be emitted from light energy when this particle (photon) hits the metal surface.

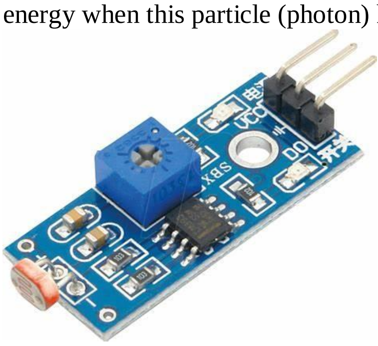

Figure 4. Light sensor

3.4 IR Sensor

An IR sensor which is shown in figure 5 is used to measure an object's heat. This Sensor senses some objects by releasing light. Thermal radiation is released by some of the objects. IR sensors can detect these radiations because they are typically invisible to the human eye. LEDs and IR photodiodes typically serve as the IR sensor's emitter and detector. The received infrared light affects both the photodiode's resistance and the output voltage. When the object receives the IR light from the emitter, it reflects the detector photodiode.

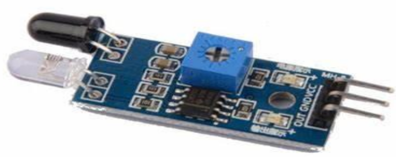

Figure 5. IR sensor.

3.5 Block Diagram

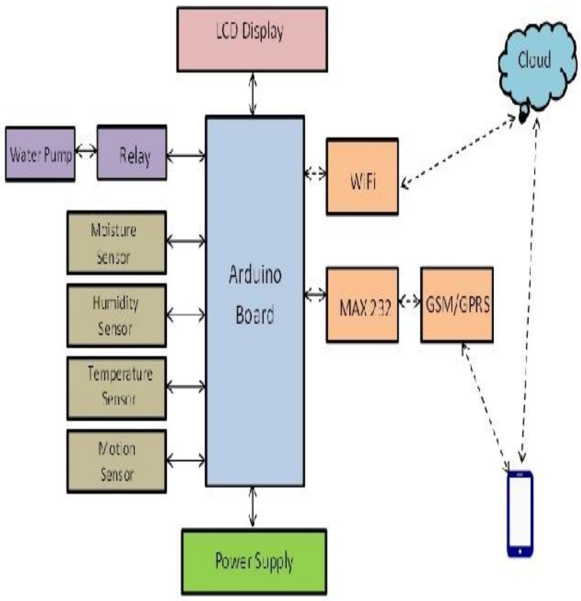

Figure 6. Block diagram

4. Literature survey

A brief synopsis of the work that has been done in various papers and has been referred for implementation.

[1] K. Lakshmi Sudha et al. al, "Shrewd Accuracy Based Farming Utilizing Sensors"; It concentrates on creating tools and devices for managing, displaying, and notifying users while utilising the benefits of a wireless sensor network system.

In"IoT Based Smart Agriculture," by [2] G. Sujatha and Sushanth. The paper aims to use IOT and smart agriculture, two emerging technologies, with automation. The most important step in increasing the yield of productive crops is to monitor the conditions of the environment. the creation of a system that can track crop-damaging animals' movements while keeping an eye on temperature, humidity, and moisture with the aid of sensors and an Arduino board.

In "Providing Smart Agriculture Solutions to Farmers for Better Yielding Using IoT," by [3] M.K. Gayatri and J. Jayasakthi, the authors discuss cloud computing devices that can construct a full computing system from sensors to tools that accurately feed data into repositories along with the location as GPS coordinates from human actors on the ground and images of agricultural fields.

[4] "Design and Development of a Wireless Sensor Network-Based Precision Agriculture System" by Chetan Dwarkani et al. This proposal suggests a revolutionary method for smart farming by utilising wireless communication technology to link a smart sensor system and a smart irrigator system.

[5] Dr. V. Vidya Devi and G. Meena Kumari's "RealTime Automation and Monitoring System for Modernized Agriculture"; suggests a strategy for developing an automated irrigation system that maximizes crop water use efficiency. A gateway unit is also in charge of handling the sensor data.

[6] S. R. Nandurkar and colleagues al, "Agricultural Protection System Based on IoT"; It is designed for an IoT-based monitoring system that can examine harvest statistics and crop environments to make quicker decisions.

5. Related work

IoT-based smart farming has been actively developed since the 1990s, when wireless sensor technology first gained popularity.[13] A working smart greenhouse (SGH) with a remote monitoring option made possible by WSN technology was presented by Farooq et al, Ayaz et al, and Li et al. They offered a thorough analysis of the IoT's function in SAS. Since the introduction of intelligent, wireless sensor technology that requires less power and can be deployed in high densities, micromanagement concepts for SAS have started to develop quickly. It was possible to closely monitor soil properties, which led to the development of water saving measures like smart irrigation systems. Hydroponics and aeroponics are two of these cutting-edge, medium-based, soil-free water management approaches.[8] Nalwade and Mote discussed a hydroponically based smart irrigation system in which plants are suspended in nutrient solutions rather than soil so that water can be delivered directly to the roots of crops as needed. A water irrigation system based on aeroponics was utilised by Idris et al. [16] to spray water directly at the roots of crops as needed. To use sensor nodes in applications for smart agriculture, a distinctive hardware architecture has been actively developed.

IoT-based SAS experiments have drawn the attention of researchers as well. These have been used to effectively control and monitor agricultural systems from a distance, often with the possibility to store data in the cloud for other farmers working in related fields, such as crops and weather.

IoT, sometimes known as the Internet of Underground Things, is a novel concept. Monitoring soil characteristics and weather patterns significantly contributes to the health of the crops. Similar to the Internet of Things, it deals with a network of remote sensors and actuators that are buried underground and used to monitor and manage soil properties like wetness, nutrients, corrosiveness, pH levels, and electrical conductivity. The loss of wireless signal propagation and the preservation of delicate electronics inside wireless sensor nodes provide a challenging issue for IoT technology. Single-hop, wireless, and underground sensor networks have been thoroughly discussed by Tiusanen et al. [7].

6. Current Challenges and Future Expectations

In the 2030 Targets for Sustainable Development, the world community and the United Nations set the deadline for eradicating hunger as 2030. According to the World Health Organization[10], there are now food shortages affecting more than 800 million people worldwide.

Additionally, as the world's population grows, there is a greater need for nutritious food, which could lead to an overall increase in crop productivity if food and cash crops are grown together. Figure 8 shows the difficulties that agriculture is anticipated to encounter in 2050. This illustration highlights three major issues: Inventive concepts regarding water scarcity, declining agricultural land, rural labour, climate conditions, and many other issues that emerge as a result of these challenges include reducing greenhouse gas emissions, controlling land growth, and feeding 10 billion people. Not only are rural communities becoming smaller as a result of urbanization, but they are also getting older as a result; Consequently, younger growers must assume responsibility. The workforce and production are further affected by the generational shift and population imbalance.

The continuing loss of agricultural land and the suitability of certain crops in specific regions can be attributed to geographical and biological reasons. Acute weather fluctuations worsen environmental issues like drought, groundwater depletion, and degraded soil, all of which have an impact on agricultural productivity. Additionally, conventional agricultural practices have historically used fertilizers and pesticides to meet food demands; nevertheless, it raises only producing food up to a certain point, and using chemicals carelessly degrades the environment. The agricultural sector in developing countries struggles with a number of challenges, such as inadequate crop selection, soil testing, efficient irrigation systems, weather forecasting, animal husbandry, etc. Technological advancements have improved both quantity and quality in wealthy countries, but in developing countries, 50% of the population is already occupied in agriculture.

6.1 Communication

The success of the IoT in agriculture mostly hinges on device connection [11]. The majority of telecom companies offer connectivity services, but they only make up a minor portion of the overall smart farming market. Particularly in rural regions, cellular providers now offer innovative services to target producers and improve market infrastructure. Its success is feasible when service providers offer cellular technology's benefits, such as adaptability, mobility, and the luxury of two-way communication, at a low cost. Thanks to mobile services and smartphone technology, farmers in developing countries have a bright future since they will be able to enhance agricultural production. Low power wide area technology (LPWA) is anticipated to play a large part in smart agricultural agriculture as a result of its improved facilities, effective coverage, low power consumption, and cost economics.

6.2 Wireless Sensors and IoT

Farmers are given immediate information in real-time to make judgments and take action to increase crop yields by placing wireless sensors across the field[12].

All information on crop growth and topographic parameters is regularly updated by GPS-enabled wireless sensor networks (WSNs). Recent advancements in digital imagery and signal processing have increased the capabilities of WSN and enabled precise crop quality and health evaluation. By identifying the requirements of each crop, Internet of Things (IoT) technologies can predictably streamline operations.

6.3 Drones and Unarmed Vehicles

Drones are frequently used by farmers to monitor crop development, spray water, nutritional solutions, and pesticides in difficult terrain and for various crop heights. Using drones Compared to conventional technology, they have demonstrated their usefulness for spraying speed, area coverage, and accuracy. Due to technological improvements, drones are outfitted with a variety of 3D cameras and sensors provide extensive potential in land management by farmers.The use of UAVs in agriculture addresses a number of difficulties, such as technological integration and use in bad weather [9]. Robots in agriculture have increased production in addition to drones since they can get higher yields while weeding and spraying without human aid. Robotic fruit harvesting, picking, and sowing have recently improved productivity compared to traditional methods. UAV technology in smart agriculture provides data on crop disease, weed control, pesticide use, irrigation, fertilisation, and irrigation. Field-level phenotyping and management are utilised to enhance farming methods. The height of maize and sorghum plants was measured in the field using a unique 3D modelling technique. With hand-sampled field data, the average root mean square error (RMSE) for sorghum height was 0.33 m [15]. To determine the leaf area index (LAI) of the soybean plant, 3D models and UAV data were also collected; The destructive LAI measures were associated with the measured LAI predicted accuracy (R2 = 0.89) and matched the portable device (R 2 = 0.92) [15].

6.4 Vertical Farming and Hydroponics

Greater strain is placed on the environment due to the decline of arable land and growing urbanization. Available resources [14], makes it difficult to produce food with current agricultural methods. The constraints of a lack of land and water are navigated by vertical farming (VF) and are ideal for adoption in the cities surrounding. The use of hydroponics is crucial in reducing the amount of water needed. Together with VF, hydroponics expands the amount of area that may be used for agriculture while preserving forests and other natural ecosystems. The existence of cutting-edge technology, particularly the Internet of Things, makes the agriculture business more lucrative by lowering labor and other resource needs and minimizing environmental effects.

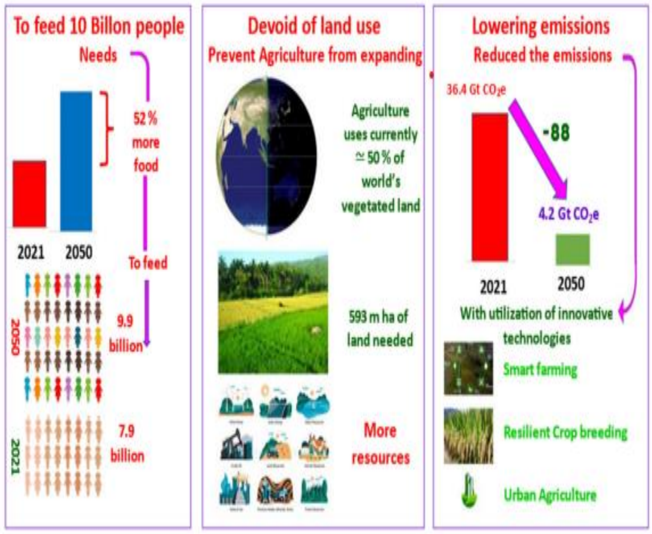

Figure 8. Challenges in sustainable future agriculture.

7. Results and Discussion

The temperature, soil moisture content, and gatecrasher discovery are all represented by the yield that can be seen in figure 9. The yield from the Smartphones function that was built into the mobile device is the following outcome. It controls the temperature, stickiness, moisture, and the interloper's detection.

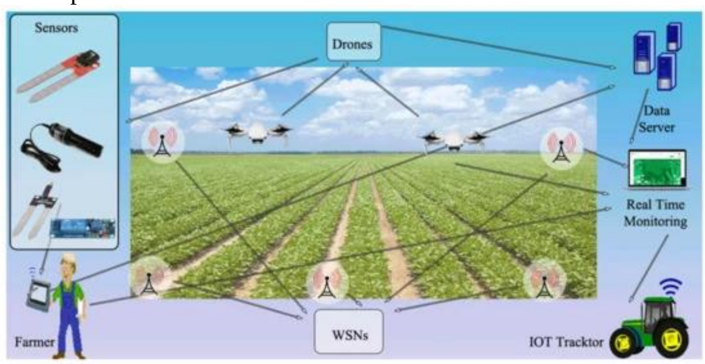

Figure 9. IoT based smart agriculture monitoring system with wireless sensor networks.

Smart farming is now viewed as an essential requirement by the Indian agriculture industry. It is much more successful than conventional agricultural practices. Smart farming can monitor the temperature, moisture, and other characteristics of agricultural land by utilizing sensors and automated watering methods. Then, farmers can monitor their crops from anywhere. Additionally, small farmers may benefit from integrating digital and physical infrastructures through smart farming. It is difficult for India's small and marginal farmers to combine the physical and digital infrastructures, preventing them from increasing their earnings. Start-ups that focus on agriculture may be able to connect with farmers and assist them in gaining access to such cost-effective solutions.

8. Conclusion

This study offers a prototype for IoT-enabled smart agriculture. We center the model on a descriptive investigation of how IoT-based smart agriculture satisfies SDG objectives. The research reveals that the approach is projected to achieve several of the SDG objectives.

A certain amount of automation is provided, enabling the concept of using cloud services to monitor field and product conditions over great distances. Sensors that operate logically as they are changed are used to launch the points of interest, such as water and work sparing. The concept of modernising agriculture is simple, rational, and workable. In light of these parameter values, a rancher can easily decide which fungicides and insecticides to use to increase crop production.

In order to modernise the traditional irrigation approaches, the paper suggests combining the most recent innovation with the agricultural sector by making straightforward profitable and moderate lowering of wastage in this manner.

10. Acknowledgement

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References:

[1] Lakshmisudha et al. al, "Smart Precision Based Agriculture Using Sensors," July 2011 issue of the International Journal of Computer Applications (0975-8887).

[2] IoT Based Smart Agriculture System, G. Sushanth and S. Sujatha, IEEE, 2018.

[3] Gayatri, M.K., and al., IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development (TIAR 2015), "Providing Smart Agriculture Solutions to Farmers for Better Yielding Using IoT."

[4] Chetan Dwarkani et al. al, "Smart Farming System Using Sensors for Agricultural Task Automation," presented at the 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development.

[5] The article "Real-Time Automation and Monitoring System for Modernised Agriculture" by G. M. Kumari and Dr. V. Vidya Devi, which appeared in the International Journal of Research in Applied Sciences and Engineering (IJRRASE) Vol. 3, No. 1 PP 7-12, 2013.

[6] "Design and Development of Precision Agriculture System Using Wireless Sensor Network," by S.R. Nandurkar, others, and others, was presented at the 2014 IEEE International Conference on Automation, Control, Energy, and Systems.

[7] "Soil scouts: Description and performance of single hop wireless underground sensor nodes," M. J. Tiusanen Ad Hoc Network, July 2013, vol. 11, no. 5, pp. 1610–1618, doi: 10.1016/j.adhoc.2013.02.002.

[8] In Proc. Int. Conf. Trends Electron. Inform. (ICEI), Tirunelveli, India, May 2017, pp. 645–650, R. Nalwade and T. Mote, "Hydroponics farming," doi: 10.1109/ICOEI.2017.8300782.

[9] Unmanned aerial vehicles (UAV) in precision agriculture: Applications and difficulties, P. Velusamy, S. Rajendran, R. K. Mahendran, S. Naseer, M. Shafiq, and J.-G. Choi, Energies, vol. 15, no. 1, p. 217, Dec. 2021, doi: 10.3390/en15010217.

[10] The Challenge of Feeding the World, D. Fróna, J. Szenderak, and M.H. Rákos. Sustainable Development 2019, 11, 5816. [CrossRef]

[11] Internet of Things in agriculture: current developments and upcoming difficulties, by Tzounisa, A., Katsoulasa, N., Bartzanasb, and Kittas.2017; Biosyst. Eng. 164: 31–48.

[12] Internet of Things in arable farming: Implementation, applications, problems, and possibilities, Henriksen, A.V., Edwards, T.C.G., Pesonen, L.A., Green, and Srensen, C.A.G. 2019; 191; 60–84; Biosyst. Eng.

[13] "A survey on the role of IoT in agriculture for the adoption of intelligent farming" by M. S. Farooq, S. Riaz, A. Abid, K. Abid, and M. A. Naeem, 10.1109/ACCESS.2019.2949703 IEEE Access, vol. 7, pp. 156237–156271, 2019.

[14] The Vertical Farm: A Review of Developments and Implications for the Vertical City, by Khaled Al-Kodmany. Buildings: 8, 24, 2018.

[15] Colombo, A., Fini, P.H., Villas, L., Osrio, F.S., Vargas, P.A., et al.; Faial, B.S.; Costa, F.G.; Pessin, G.; Ueyama, J.; Freitas, H. the application of pesticides using wireless sensor networks and unmanned aircraft. 2014, 60, 393–404, J. Syst. Archit.

[16] In Proc. IEEE Conf. Control, I. Idris and M. I. Sani published a paper titled "Monitoring and Control of Aeroponic Grow- ing System for Potato Production."

System Informatics in Indonesia, Bandung, Indonesia, September 2012, pp. 120–125, doi: 10.1109/CCSII.2012.6470485.