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Wireless Power Transmission for the Internet of Things (IoT)

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Abstract

In some cases, long battery life may be essential to IoT devices, and early failures of actuators and sensors because of the rapid discharging of battery may lead to unacceptably high replacement costs. Critical to the implementation of this Internet Of Things (IoT) is the design of energy-efficient solutions aiming toward a low consumption current and create a green society. Many IoT devices rely on small, rechargeable batteries, so charging a wireless battery is essential for several reasons. Much research and development are working on how can is powering IoT devices wirelessly. Wireless power transmission technology is the diffusion of microwave power transmission without using any physical support. The vision of future technology is the Internet of Things IoT charging device without wires. The objective of the scope of work is to combine the wireless power technology with a smart house using IoT. In this research paper, we designed and realized a wireless lighting technology using the fundamentals of microwave radiation. We will send microwave energy from (Position 1) to the receiver (Position 2) to turn up an LED lamp 10 W a distance (50 meters). So the proposed prototype takes account of all parameters above to deliver sufficient energy to turn on the LED lamp 10 W wirelessly on the distance of 50 meters at the smart house.

Introduction

The Internet of Things is an increasing infrastructure of internet-enabled objects ranging from sensors to LED light, all aimed at increasing control, data collection, and even automation [1], [2], [3], [4]. IoT can be a massive benefit for houses when used appropriately. To solve the connection of the electrical problem with IoT devices will be using microwave power transmission technology for future smart city planning. The question arises on how long-distance Wireless Power Electricity will change the concept of IoT [5], [6]. Charging can be realized in various ways, and applications using wireless power technology are expanding to mobile and portable devices, home appliances and office equipment, and electric vehicles. In particular, WPT technology is useful in providing electrical power to the Internet of things (IoT) devices in constrained environments. Wireless Power Transmission (WPT), the Internet of things (IoT), and wireless power technology will become a cornerstone in the design of new and growth of human settlements [7], [8], [9]. In smart cities, legislation is requiring a change of old practices towards efficient use of resources. Nevertheless, Fig. 1. How can is powering IoT devices wirelessly electricity distribution still relies on cables for its delivery. The novelty of the system is that IoT devices and household use WPT for electricity supply. The energy is wirelessly supplied from an access local power station already fixed at the top of the house. Both industry and academia know that WPT will be the solution to a variety of problems, including IoT devices [10], [11]. With WPT, the device has three significant advantages to contribute to the IoT and smart house positively. Firstly, the increase in renewable electricity integration decreases the change of batteries many times. Secondly, house growth will have a lesser impact on distribution and transmission capacity. Lastly, the proposed system will promote industrial investment by increasing IoT technology at the smart city, lowering implementation cost prices. This research is toward creating a smart house can combinate between IoT and wireless power electricity. By the way, in this study, already the portable microwave station exists and will be used in this research and the testing phase.

Literature survey

Ahmed and Kim, " Attack Mitigation in Internet of Things Using Software Defined Networking," Proceedings of the IEEE Third International Conference on Big Data Computing Service and Applications, San Francisco, USA. 69 April 2017

Software-Defined Networking (SDN) and Internet of Things (IoT) are the trends of network evolution. SDN mainly focuses on the upper level control and management of networks, while IoT aims to bring devices together to enable sharing and monitoring of real-time behaviours through network connectivity. On the one hand, IoT enables us to gather status of devices and networks and to control them remotely. On the other hand, the rapidly growing number of devices challenges the management at the access and backbone layer and raises security concerns of network attacks, such as Distributed Denial of Service (DDoS). The combination of SDN and IoT leads to a promising approach that could alleviate the management issue. Indeed, the flexibility and programmability of SDN could help in simplifying the network setup. However, there is a need to make a security enhancement in the SDN-based IoT network for mitigating attacks involving IoT devices. In this article, we discuss and analyse state-of-the-art DDoS attacks under SDN-based IoT scenarios. Furthermore, we verify our SDN sEcure COntrol and Data plane (SECOD) algorithm to resist DDoS attacks on the real SDN-based IoT testbed.

Shervin Erfani, Majid Ahmadi and Long Chen, " The Internet of Things for smart homes: An example," 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), 16-18 Aug. 2017.

The internet of things (IoT) has a variety of application domains, including smart homes. This paper analyzes distinct IoT security and privacy features, including security requirements, threat models, and attacks from the smart home perspective. Further, this paper proposes an intelligent collaborative security management model to minimize security risk. The security challenges of the IoT for a smart home scenario are encountered, and a comprehensive IoT security management for smart homes has been proposed. IoT is a network system in both wired and wireless connection that consists of many software and hardware entities such as manufacturing management, energy management, agriculture irrigation, electronic commerce, logistic management, medical and healthcare system, aerospace survey, building and home automation, infrastructure management, large scale deployments and transportation [1]. "The IoT is the infrastructure of the information society [2]." Fig. 1 shows the conception of IoT [1].

Tiago, Radu, Eduardo, Matias, and Joo, "Smart home communication technologies and applications: Wireless protocol assessment for home area network resources," Energies, vol. 8, no. 7, pp. 7279-7311, 2015.

The paper discusses Home Area Networks (HAN) communication technologies for smart home and domestic application integration. The work is initiated by identifying the application areas that can benefit from this integration. A broad and inclusive home communication interface is analysed utilizing as a key piece a Gateway based on machine-to-machine (M2M) communications that interacts with the surrounding environment. Then, the main wireless networks are thoroughly assessed, and later, their suitability to the requirements of HAN considering the application area is analysed. Finally, a qualitative analysis is portrayed. The advancement of the human race has been driven to a great extent by the innovation, expansion, and diffusion of new technologies, which play a central role in modern societies by enhancing social welfare and defining new ways for humans to interact with their environment. In the last century, humans achieved unprecedented levels of comfort and wellbeing. Naturally, this progress was due to the large scale introduction of technologies in all aspects of human existence.

Martin, Lars, Daniel, Roger, Bernhard, and Klaus, "A comprehensive approach to privacy in the cloud-based Internet of Things," Future Generation Computer Systems, vol. 56, pp.701-718, 2016

In the near future, the Internet of Things is expected to penetrate all aspects of the physical world, including homes and urban spaces. In order to handle the massive amount of data that becomes collectible and to offer services on top of this data, the most convincing solution is the federation of the Internet of Things and cloud computing. Yet, the wide adoption of this promising vision, especially for application areas such as pervasive health care, assisted living, and smart cities, is hindered by severe privacy concerns of the individual users. Hence, user acceptance is a critical factor to turn this vision into reality. To address this critical factor and thus realize the cloud-based Internet of Things for a variety of different application areas, we present our comprehensive approach to privacy in this envisioned setting. We allow an individual user to enforce all her privacy requirements before any sensitive data is uploaded to the cloud, enable developers of cloud services to integrate privacy functionality already into the development process of cloud services, and offer users a transparent and adaptable interface for configuring their privacy requirements.

Existing system

Wireless Power Transmission (WPT) for the Internet of Things (IoT) represents a cutting-edge technology aiming to address power-supply challenges in interconnected devices. In the existing system, traditional power sources such as batteries or wired connections are supplemented or replaced by wireless power transfer mechanisms. This system often leverages technologies like resonant inductive coupling or radio frequency (RF) energy harvesting.

In the context of IoT, where devices are often deployed in diverse and hard-to-reach environments, the implementation of WPT provides a scalable and convenient solution. The traditional reliance on batteries is mitigated, eliminating the need for frequent replacements or recharging, which is particularly advantageous in applications where device accessibility is a challenge.

The existing WPT system typically involves a transmitter and receiver pair. The transmitter, often a power source connected to the electrical grid, emits electromagnetic fields or waves. The receiver, embedded in the IoT device, is equipped with a compatible technology that captures and converts these waves into electrical energy to power the device. This wireless energy transfer allows for continuous and seamless operation of IoT devices, reducing downtime and maintenance requirements.

One of the significant advantages of WPT in IoT is the potential for increased deployment flexibility. Devices can be deployed in locations where traditional power sources are impractical or expensive to install, facilitating the expansion of IoT applications in smart infrastructure, agriculture, healthcare, and more.

While the technology is advancing, challenges such as efficiency, distance limitations, and standardization are being addressed to ensure widespread adoption. Security considerations are also paramount to prevent unauthorized access to power transmission and protect IoT devices from potential tampering.

In conclusion, Wireless Power Transmission for IoT presents a transformative solution to power-supply challenges, fostering the growth of interconnected devices by providing a more sustainable and flexible energy source. As the technology continues to evolve, it holds the potential to redefine the landscape of IoT applications, enabling a more pervasive and resilient deployment of smart devices.

Proposed system

The proposed system for Wireless Power Transmission for the Internet of Things (IoT) represents a significant advancement in addressing the power requirements of IoT devices by eliminating the need for conventional wired power sources. This system leverages wireless power transmission technologies to provide a seamless and efficient means of powering a multitude of IoT devices. Central to this system is the use of resonant inductive coupling or radio frequency (RF) energy harvesting, allowing for the wireless transfer of power over short to medium distances.

The core components of the system include a power transmitter and IoT devices equipped with wireless power receivers. The power transmitter generates an electromagnetic field or RF signal, which is captured and converted into electrical power by the receivers embedded in the IoT devices. This wireless power transfer enables continuous and autonomous operation of IoT devices without the constraints of physical power cables or the need for frequent battery replacements.

One key advantage of this proposed system is the enhanced flexibility it offers in deploying and maintaining IoT networks. Devices can be strategically placed in locations that optimize their functionality without the limitations imposed by proximity to power outlets. This is particularly beneficial in applications such as smart homes, industrial automation, or environmental monitoring, where IoT devices may be dispersed across diverse and challenging environments.

The system also contributes to sustainability by reducing the environmental impact associated with battery disposal. By enabling devices to harvest power wirelessly, the need for disposable batteries is minimized, leading to decreased electronic waste and a more eco-friendly IoT infrastructure.

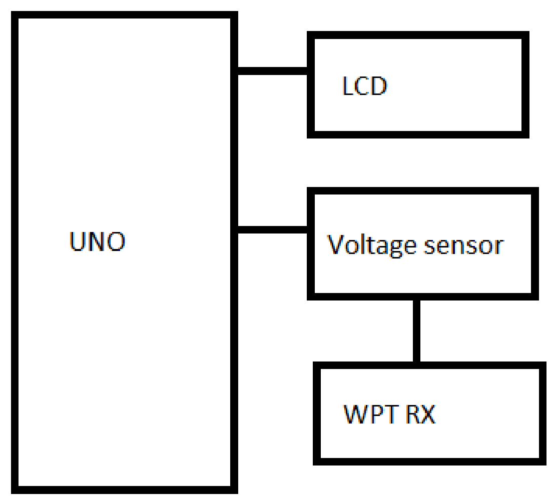
While challenges such as power transmission efficiency and signal interference need to be addressed, the proposed Wireless Power Transmission for the IoT holds immense potential in reshaping the power dynamics of IoT networks. As IoT applications continue to proliferate, this system offers a promising solution to the ever-growing demand for reliable and efficient power sources in a wireless and interconnected world.

Block diagram

Transmitter

WPT TX (coil + Mosfet)

Receiver



HARDWARE COMPONENTS

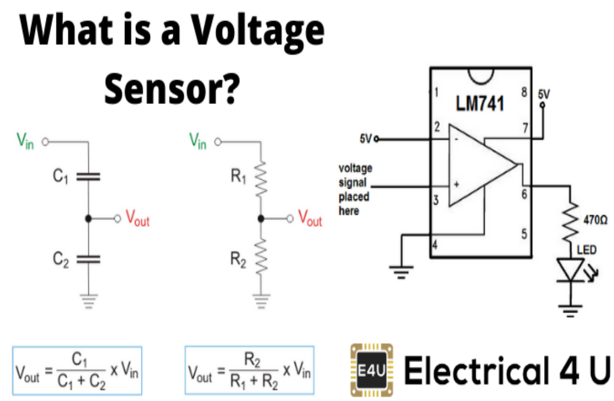
LCD (Liquid Cristal Display)

Introduction:

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

VOLTAGE SENSOR: WORKING PRINCIPLE, TYPES & CIRCUIT DIAGRAM



Conclusion

In this paper, we studied how can is powering IoT devices wirelessly. We proved the possibility of using the microwave system to transport energy from one side to the other inside a house. In this research, we tested, and we approved that we can produce electricity from S-band frequency to charge IoT electronic devices batteries. The coil receiver antenna achieves a reflection coefficient in a real test of -9.372 dB and the maximum gain direction at 5.399 dB at the operating frequency. All these performances measured results make this antenna suitable for S-band. As for the full-wave bridge rectifier topologies, we a choice of the Schottky diode HSMS2850 and the dimension of the receiver antenna; we tested it and approved. The multi-coil high-efficiency circuit achieves high output power and high output electricity efficiency. Each one harvester circuit can supply 1.92V, so the total of the multi-coil high-efficiency circuit can reach 11.4V and this power enough to turn up light wirelessly. The conversion efficiency of 10.75% was achieved at S-band at an input power level of 10.75W a distance of 50 meters. In this research, we approved that we can upgrade the structure of the IoT system and the smart house system and charging all IoT electronics devices wirelessly.

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