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Light Intensity and Temperature Parameters Study for Solar-powered Internet of Things to Improve Photovoltaic Energy Harvest

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Abstract: The Internet of Things (IoT) is an emerging technology that provides inter-device connectivity and is widely used in today's world. Maintaining battery life is one of the challenges of the technology mentioned and solar energy appears to be the solution. Solar energy is the conversion of energy from the sun to electricity, either directly with photovoltaic (PV), indirectly with concentrated solar energy, or a combination of both. In order to get the best out of photovoltaic energy, the development focus on improving the efficiency of the solar panels used. The variation in the intensity of sunlight contributes to a significant reduction in efficiency. The study aims to investigate the effect of light intensity and temperature parameters on the photovoltaic energy harvest. In this study, the light intensity was measured with a light-dependent resistance (LDR) sensor module. The analog output of the LDR sensor module was converted by the microcontroller to the digital output and computed using the voltage-resistance-intensity equation for the luminous intensity in lux. The solar efficiency towards the temperature was calculated based on the temperature coefficient of the solar panel used to identify the maximum output power. The solar panel efficiency graph providing insights into the maximum power that can be generated at a particular temperature. The study proves that the light intensity and temperature parameters make photovoltaic energy harvesting more efficient.

Keywords: Illumination intensity, LDR sensor module, photovoltaic energy, solar efficiency, temperature coefficient

INTRODUCTION

The focus on digital transformation has encouraged more companies to adopt the invention of the Internet of Things (IoT). At the 2016 World Economic Forum in Davos, Switzerland, the IoT was to be the fourth industrial revolution that would lead to a new age of machines. The IoT is expected to allow for complete digitization of business processes, unprecedented operational efficiencies and disruptive business model innovation [1].

IoT deployment is increasingly diversified, from consumer-based applications to mission-critical applications. Consumer applications referring to intelligent household appliances and wearables. Mission-critical applications range from public safety, industrial automation, autonomous vehicles and the Internet of Medical Objects (IoMT) to emergency response. As these mission-critical applications gain popularity, engineers and designers must consider important design and test considerations and compromise initial design and manufacturing results [3]. The five main design challenges of the IoT were simplified as "5C": Connectivity, Continuity, Compliance, Coexistence and Cybersecurity [4].

Conquering 5C's technical challenges ensures success for the IoT. An extensive understanding of these issues will provide a solid foundation for the implementation and deployment of the IoT system. Proper design and validation will ensure delivery of the IoT. Among the 5C, securing and extending the battery life is one of the most crucial challenges for IoT devices [5]. IoT opens the door to a variety of possibilities by facilitating a sustainable solution to access clean energy. In parallel, the challenges: energy management, sensing, security, complex design and wireless communication [6] needs to be monitored. For seamless integration of devices using the internet into the IoT, energy consumption should be carefully monitored and predicted on an ongoing basis.

LITERATURE REVIEW

Solar systems are regarded as a key tool in providing energy for current and future generations. A solar cell or photovoltaic cell is a device that transforms solar light into useable energy. The quantity of solar light

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