



Zigbee-based data acquisition system for online monitoring of grid-connected photovoltaic system



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ABSTRACT

For grid-connected photovoltaic (PV) system, monitoring is considered as a crucial aspect for observing the stability and performance of the system. The simplest method is to have the data collected and transmitted across data cables. Due to the cost and technical limitations of the data cable, the monitoring station needs to be located reasonably close to the monitored plant. Apart being inconvenient, the use of data cable often adds capital and maintenance cost to the system. In this research project, a Zigbee-based wireless monitoring system is developed for online monitoring of a grid-connected photovoltaic system. Parameters like temperature, irradiation, PV power output and grid inverter power output are monitored. The implementation process, including design and development of the hardware and software, is explained in detail. A user-friendly web-application is also developed, such that the monitored data is easily accessible via internet. To validate the performance, the system has been implemented on 1.25 kW_p grid-connected photovoltaic system.

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1. Introduction

As the global energy demand increases with the growing world population, countries all over the world are putting more and more emphasis on the development of renewable energy. Among the many sources of renewable energy, solar energy is considered the most promising and reliable energy source (Tyagi, Rahim, Rahim, & Selvaraj, 2013). In the light of this, governments in many countries have provided various incentives to setup solar energy-based power plants, to complement the existing power plants which are running on fossil fuel. In order to ensure stability and reliability of a PV system, monitoring system is often preferred. As matter of fact, many recent solar energy conversion systems have included monitoring function as an integral part of the systems to ensure data can be collected and analyzed in systematic manner.

Conventional wired monitoring system provides reliable solution in data transmission but suffers from several limitations. Apart from the physical constraints during laying of the data cables, the use of these cables also increases installation and maintenance

cost. Besides, for outdoor application such as PV systems, continuous exposure to sun beam and rains may reduce the lifespan of the system (Spertino & Corona, 2013). To overcome these issues, wireless monitoring system is favored over its cable-based counterpart. In this project, a Zigbee-based wireless monitoring system is designed and built as a replacement to the conventional cable-based monitoring system for a grid-tied PV system. Various aspects of the system, from design to construction and testing, are detailed here. Besides that, a PC-based application integrated with web-based function is designed and implemented in order to allow remote control of the system as well as easy access of the data over the internet.

2. Literature review

In order to develop an effective yet low cost monitoring system, a number of previous works, which are related to solar energy monitoring system, have been reviewed and summarized in Table 1. Even though the focus here is on grid-connected PV system, monitoring systems for similar applications such as weather station, stand-alone PV system as well as hybrid systems are also included, to gain a better picture on this area of work.

Based on the surveyed literature, the main characteristics of these monitoring systems are categorized into six main aspects, i.e. the data transfer mechanism, controller, monitored parameters,

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