

Design of an ARM-Based Power Meter Having WIFI Wireless Communication Module

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Abstract—AMR (Automatic Meter Reading) and PQ (power quality) management based on kinds of network technologies has become a trend. However, because of the high construction and maintenance costs with the existing meter reading technology, the applicability to different residential buildings and different network infrastructure should be improved. It is greatly significant to research new kind of power meter and the meter reading technology, which can accelerate the evolution of the Next Generation Network and facilitate people's lives. Now wireless broadband network develops rapidly. Generally WiFi is considered the commensurate scheme to resolve "the last 100 meters access problem", and WiMAX is regarded as the perfect scheme to resolve "the last 1000 meters access problem". At present, many cities in many countries are building or will build Wireless Metropolitan Area Networks. By WiFi and WiMAX, it provides the new connection ways to the AMR system. This paper presents an AMR system scheme using WiFi technology and an ARM-based PMWCM (Power Meter with WiFi Communication Module) scheme. On the basis of the schemes, this paper designs the PMWCM hardware system and software system. The ARM-based hardware system is consisted of processor core board and peripheral board, and the software program is based on embedded Linux. This paper also proposes the functions of wireless communication module and design detail and discuss the security of the communications.

Index Terms—Power meter, AMR, WiFi, WiMAX, ARM

I. INTRODUCTION

With the rapid development of science and technology, it is possible to read and manage power meter data of residents by network remotely. The traditional manual Meter-Reading was not suitable any longer. On the one hand, it spends much human and material resource and brings about additional problems such as the security of entering house. On the other hand, the power management department can not collect the real-time data electricity being used. And with the power price reform, in order to make account rapidly, the power management department also needs more power parameters such as power requirement, time-sharing power quantity and burden curve. AMR (Automatic Meter Reading) can meet above demands. So, remote AMR and management through kinds of network technologies has become a trend now.

At present, most AMR system are generally based on such media as RF (Radio Frequency) [1-3], PLC (power line carrier communication) [4-6], GPRS (General Packet Radio Service)

[7-8], HFC (Hybrid Fiber-Coaxial) [9], and so on, to transfer data between power meter and manage center. All the above communication media have merits, but also have some shortcomings, such as short transmission distance, high transmission cost, difficult maintenance and unsafe data transmission. The shortcomings of PLC are that its communication signals can not go through the transformer directly and the low-voltage power line carrier is vulnerable to be impacted by the environment. It is real-time, wireless and extensive to use GPRS meter reading, but the cost of current GPRS module and the communications-cost are high. Until the cost reduces to the extent that ordinary people can accept, it can not be used widely. Reading power meter by wire is costly too. For in some part it's hard to make net-line beyond the wall and make hole in the wall and in later period the maintenance cost is also high in network connection and security. In order to solve these problems, we can consider applying Wireless communication system WiFi (Wireless Fidelity), which is popularly used in the world, to transmit power data.

Now, Wireless broadband network develops rapidly. The WiFi [10-11] needs no wire and use the 2.4GHz frequency, which can be used needing no application in advance, so it is generally considered the ideal scheme to resolve "the last 100 meters connection". The network by WiFi can compose LAN (Local Area Network), and it is free to the user to communicate within LAN. So WiFi greatly reduces the construction and maintenance costs of AMR system. Further more, the WiFi LAN can connect to remote manage center by many ways, such as FTTH (Fiber to the Home), wire and the wireless. So power meter and AMR by WiFi is a preferable scheme to resolve the power data collection and the PQ (power quality) management.

Metropolitans like New York, Beijing and Shanghai are building Wireless Metropolitan Area Networks with WiFi and WiMAX. The Wireless Metropolitan Area Networks provide a new connection method to the meter reading. With the existing wire-broadband connection ways, meter reading by WiFi will certainly has a good market prospects.

II. READING POWER METER BY WIFI

WiFi belongs to the short-range wireless technology which is used in offices and buildings. This technology is based on the IEEE 802.11 of wireless communications technology. It can work in the bandwidth near the 2.4 GHz which do not need any permission for use. Its currently communications standards is IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and IEEE

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Smart Metering Vijay K. Sood, Monalisa Biswal, saumendra sarangi, Hassan Haes Alhelou, 2024-02-26 *Smart Metering Infrastructure Methodologies Applications and Challenges* combines the fundamentals of smart meters in smart grids with the latest advances and technologies in advanced smart infrastructure With a strong focus on practical guidance and applications this book examines the design and implementation of smart meters as well as cyber security and data management challenges Following an introduction to smart grid architecture the book details design elements of smart meters to enable them for specific applications such as recording the energy consumption of users load forecasting resilience enhancement and energy theft detection A deep dive into smart meter data analytics is then presented accompanied by load forecasting methods and their advantages and challenges Subsequent chapters also discuss outage management fault identification and other applications of smart meters including power network connection verifications This is a comprehensive resource on smart metering and a valuable read to students researchers and engineers interested in power systems engineering smart grids and smart energy technologies Discusses advanced architecture in the context of establishing smart meters in smart grids for enhanced operation and data utilization Provides detailed discussions on smart meter data analysis Explores the design of smart meters and possible implementation of AI ML and other advanced methodologies to enhance the functions of power systems using smart meter data *Emerging Technologies in Computer Engineering: Microservices in Big Data Analytics* Arun K. Somani, Seeram Ramakrishna, Anil Chaudhary, Chothmal Choudhary, Basant Agarwal, 2019-05-17 This book constitutes the refereed proceedings of the Second International Conference on Emerging Technologies in Computer Engineering Microservices in Big Data Analytics ICETCE 2019 held in Jaipur India in February 2019 The 28 revised full papers along with 1 short paper presented were carefully reviewed and selected from 253 submissions ICETCE conference aims to showcase advanced technologies techniques innovations and equipments in computer engineering It provides a platform for researchers scholars experts technicians government officials and industry personnel from all over the world to discuss and share their valuable ideas and experiences *Cyber-physical Systems and Digital Twins* Michael E. Auer, Kalyan Ram B., 2019-07-10 This book constitutes the proceedings of the 16th International Conference on Remote Engineering and Virtual Instrumentation REV held at the BMS College of Engineering Bangalore India on 3-6 February 2019 Today online technologies are at the core of most fields of engineering as well as of society as a whole and are inseparably connected with Internet of Things cyber physical systems collaborative networks and grids cyber cloud technologies service architectures to name but a few Since it was first held in 2004 the REV conference has focused on the increasing use of the Internet for engineering tasks and the problems surrounding it The 2019 conference demonstrated and discussed the fundamentals applications and experiences in the field of online engineering and virtual instrumentation It also presented guidelines for university level courses on these topics in view of the increasing

globalization of education and the demand for teleworking remote services and collaborative working environments

Sustainability Challenges and Delivering Practical Engineering Solutions Gasim Hayder Ahmed Salih, Rashid A.

Saeed, 2023-05-08 This book highlights the recent findings and advances in science engineering technology and sustainability issues. It aims to discuss, reflect and share experience in addressing the findings in science engineering technology and sustainability. The book aims to report the various interrelated disciplines from different institutions to discuss, reflect and share technology and experience in addressing new findings and strategies. This book presents the proceedings of the Science Engineering Technology and Sustainability International Conference SETS2021 which was held virtually as sustainable virtual conferences become the new normal during December 23-25, 2021. This book is presenting latest research findings and it is suitable for researchers, postgraduate students, professionals and experts. The book includes interesting and top research in fuzzy modeling and decision making applications in computer science. Several chapters address trending research about bioremediation and phytoremediation. There are mainly three research findings that cover artificial intelligence, sustainability and new technologies. Proceedings of the International Conference on Internet of Things, Communication and Intelligent Technology Jian Dong, Long Zhang, 2023-04-23

This book includes original peer-reviewed research papers from the International Conference on Internet of Things, Communication and Intelligent Technology IoTCIT 2022. It contains the application of communication and IoT engineering in the age of intelligent technology from the standpoint of disciplinary integration, combining theory and associated IoT and intelligent technology algorithms. The topics cover the full range of IoT solutions from IoT to network security and focus on many forms of communication such as Next Generation 6G Mobile Communication, D2D and M2M Communication. Additionally, it examines Intelligent Technology with a focus on Information System Modeling and Simulation. It also explores Cloud Computing, Pervasive and Mobile Computing, Distributed Computing, High Performance Computing and Ubiquitous Computing. **Analysis for Power Quality**

Monitoring Juan-José González de la Rosa, Manuel Pérez Donsión, 2020-05-22 We are immersed in the so-called digital energy network continuously introducing new technological advances for a better way of life. Numerous emerging words are in the spotlight, namely Internet of Things, IoT, Big Data, Smart Cities, Smart Grid, Industry 4.0, etc. To achieve this formidable goal, systems should work more efficiently and this fact inevitably leads to power quality (PQ) assurance. Apart from its economic losses, a bad PQ implies serious risks for machines and consequently for people. Many researchers are endeavoring to develop new analysis techniques, instruments, measurement methods and new indices and norms that match and fulfil the requirements regarding the current operation of the electrical network. This book offers a compilation of some recent advances in this field. The chapters range from computing issues to technological implementations going through event detection strategies and new indices and measurement methods that contribute significantly to the advancement of PQ analysis. Experiments have been developed within the frames of research units and projects and deal with real data from

industry and public buildings Human beings have an unavoidable commitment with sustainability which implies adapting PQ monitoring techniques to our dynamic world defining a digital and smart concept of quality for electricity *Electric Power Distribution, Automation, Protection, and Control* James A. Momoh, 2017-12-19 New methods for automation and intelligent systems applications new trends in telecommunications and a recent focus on renewable energy are reshaping the educational landscape of today's power engineer Providing a modern and practical vehicle to help students navigate this dynamic terrain *Electric Power Distribution Automation Protection and Control* infuses new directions in computation automation and control into classical topics in electric power distribution Ideal for a one semester course for senior undergraduates or first year graduate students this text works systematically through basic distribution principles renewable energy sources computational tools and techniques reliability maintenance distribution automation and telecommunications Numerous examples problems and case studies offer practical insight into the concepts and help build a working knowledge of protection schemes fault analysis and synthesis reliability analysis intelligent automation systems distribution management systems and distribution system communications The author details different renewable energy sources and teaches students how to evaluate them in terms of size cost and performance Guided firmly by the author's wealth of industrial and academic experience your students will learn the tools and techniques used to design build and operate future generations of distribution systems with unparalleled efficiency robustness and sustainability

Middleware Solutions for Wireless Internet of Things Paolo Bellavista, Carlo Giannelli, Sajal K. Das, Jiannong Cao, 2019-07-15 The proliferation of powerful but cheap devices together with the availability of a plethora of wireless technologies has pushed for the spread of the Wireless Internet of Things WIoT which is typically much more heterogeneous dynamic and general purpose if compared with the traditional IoT The WIoT is characterized by the dynamic interaction of traditional infrastructure side devices e.g. sensors and actuators provided by municipalities in Smart City infrastructures and other portable and more opportunistic ones such as mobile smartphones opportunistically integrated to dynamically extend and enhance the WIoT environment A key enabler of this vision is the advancement of software and middleware technologies in various mobile related sectors ranging from the effective synergic management of wireless communications to mobility adaptivity support in operating systems and differentiated integration and management of devices with heterogeneous capabilities in middleware from horizontal support to crowdsourcing in different application domains to dynamic offloading to cloud resources only to mention a few The book presents state of the art contributions in the articulated WIoT area by providing novel insights about the development and adoption of middleware solutions to enable the WIoT vision in a wide spectrum of heterogeneous scenarios ranging from industrial environments to educational devices The presented solutions provide readers with differentiated point of views by demonstrating how the WIoT vision can be applied to several aspects of our daily life in a pervasive manner Functional Reverse Engineering of Strategic and Non-Strategic Machine Tools Wasim Ahmed Khan, Khalid Rahman, Ghulam

Hussain, Ghulam Abbas, 2021-06-20 This book describes capacity building in strategic and non strategic machine tool technology It includes machine building in sectors such as machine tools automobiles home appliances energy and biomedical engineering along with case studies The book offers guidelines for capacity building in academia covering how to promote enterprises of functional reverse engineering enterprises It also discusses machine tool development engineering design prototyping of strategic and non strategies machine tools as well as presenting communication strategies and IoT along with case studies Professionals from the CNC Computer Numeric Control machine tools industry industrial and manufacturing engineers and students and faculty in engineering disciplines will find interest in this book **Machine**

Learning and the Internet of Things in Solar Power Generation Prabha Umapathy, Jude Hemanth, Shelej Khera, Abinaya Inbamani, Suman Lata Tripathi, 2023-07-14 The book investigates various MPPT algorithms and the optimization of solar energy using machine learning and deep learning It will serve as an ideal reference text for senior undergraduate graduate students and academic researchers in diverse engineering domains including electrical electronics and communication computer and environmental This book Discusses data acquisition by the internet of things for real time monitoring of solar cells Covers artificial neural network techniques solar collector optimization and artificial neural network applications in solar heaters and solar stills Details solar analytics smart centralized control centers integration of microgrids and data mining on solar data Highlights the concept of asset performance improvement effective forecasting for energy production and Low power wide area network applications Elaborates solar cell design principles the equivalent circuits of single and two diode models measuring idealist factors and importance of series and shunt resistances The text elaborates solar cell design principles the equivalent circuit of single diode model the equivalent circuit of two diode model measuring idealist factor and importance of series and shunt resistances It further discusses perturb and observe technique modified P O method incremental conductance method sliding control method genetic algorithms and neuro fuzzy methodologies It will serve as an ideal reference text for senior undergraduate graduate students and academic researchers in diverse engineering domains including electrical electronics and communication computer and environmental **Local Area Networks** Keiser

Gerd E, 1997 *Wireless Broadband* Vern Fotheringham, Chetan Sharma, 2009-03-27 Wireless Broadband utilizes a reader friendly approach to clearly explain the business regulatory and technology issues of the future market for wireless services It covers broadband and the information society drivers of broadband consumption global wireless market analysis broadband IP core networks convergence and contention and conflict Complemented with more than eighty illustrations this book provides unparalleled insight into the emerging technologies service delivery options applications and digital content that will influence and shape the next phase of the wireless revolution *EDN, Electrical Design News*, 2007 **Memories for the Intelligent Internet of Things** Betty Prince, David Prince, 2018-06-11 A detailed practical review of state of the art implementations of memory in IoT hardware As the Internet of Things IoT technology continues to evolve and become

increasingly common across an array of specialized and consumer product applications the demand on engineers to design new generations of flexible low cost low power embedded memories into IoT hardware becomes ever greater This book helps them meet that demand Coauthored by a leading international expert and multiple patent holder this book gets engineers up to speed on state of the art implementations of memory in IoT hardware Memories for the Intelligent Internet of Things covers an array of common and cutting edge IoT embedded memory implementations Ultra low power memories for IoT devices including plastic and polymer circuitry for specialized applications such as medical electronics are described The authors explore microcontrollers with embedded memory used for smart control of a multitude of Internet devices They also consider neuromorphic memories made in Ferroelectric RAM FeRAM Resistance RAM ReRAM and Magnetic RAM MRAM technologies to implement artificial intelligence AI for the collection processing and presentation of large quantities of data generated by IoT hardware Throughout the focus is on memory technologies which are complementary metal oxide semiconductor CMOS compatible including embedded floating gate and charge trapping EEPROM Flash along with FeRAMS FeFETs MRAMs and ReRAMs Provides a timely highly practical look at state of the art IoT memory implementations for an array of product applications Synthesizes basic science with original analysis of memory technologies for Internet of Things IoT based on the authors extensive experience in the field Focuses on practical and timely applications throughout Features numerous illustrations tables application requirements and photographs Considers memory related security issues in IoT devices Memories for the Intelligent Internet of Things is a valuable working resource for electrical engineers and engineering managers working in the electronics system and semiconductor industries It is also an indispensable reference text for graduate and advanced undergraduate students interested in the latest developments in integrated circuit devices and systems

Fundamentals of IoT and Wearable Technology Design Haider Raad, 2021-01-20 Explore this indispensable guide covering the fundamentals of IOT and wearable devices from a leading voice in the field Fundamentals of IoT and Wearable Technology Design delivers a comprehensive exploration of the foundations of the Internet of Things IoT and wearable technology Throughout the textbook the focus is on IoT and wearable technology and their applications including mobile health environment home automation and smart living Readers will learn about the most recent developments in the design and prototyping of these devices This interdisciplinary work combines technical concepts from electrical mechanical biomedical computer and industrial engineering all of which are used in the design and manufacture of IoT and wearable devices Fundamentals of IoT and Wearable Technology Design thoroughly investigates the foundational characteristics architectural aspects and practical considerations while offering readers detailed and systematic design and prototyping processes of typical use cases representing IoT and wearable technology Later chapters discuss crucial issues including PCB design cloud and edge topologies privacy and health concerns and regulatory policies Readers will also benefit from the inclusion of A thorough introduction to the applications of IoT and wearable technology including biomedicine and healthcare

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