

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

Li Li, Xiaoguang Hu

School of Automation Science and Electrical Engineering
Beihang University
Beijing China
lilihe@buaa.edu.cn

Weicun Zhang

Department of Automation
University of Science and Technology Beijing
Beijing, China
weicunzhang@263.net

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 IoT CIT 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 the 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 *Smart Wireless Acoustic Sensor Network Design for Noise Monitoring in Smart Cities* Rosa Ma Alsina-Pagès, Patrizia Bellucci, Giovanni Zambon, 2021-01-15 The Environmental Noise Directive END requires that a five year updating of noise maps is carried out to check and report on the changes that have occurred during the reference period The updating process is usually achieved using a standardized approach consisting of collecting and processing information through acoustic models to produce the updated noise maps This procedure is time consuming and costly and has a significant impact on the financial statement of the authorities responsible for providing the maps Furthermore the END requires that easy to read noise maps are made available to the public to provide information on noise levels and the subsequent actions to be undertaken by local and central authorities to reduce noise impacts In order to update the noise maps more easily and in a more effective way it is convenient to design an integrated system incorporating real time noise measurement and signal processing to identify and analyze the noise sources present in the mapping area e g road traffic noise leisure noise etc as well as to automatically generate and present the corresponding noise maps This wireless acoustic sensor network design requires transversal knowledge from accurate hardware design for acoustic sensors to network structure design and management of the information with signal processing to identify the origin of the measured noise and graphical user interface application design to present the results to end users This book is collection in which several views of methodology and technologies required for the development of an efficient wireless acoustic sensor network from the first stages of its design to the tests conducted during deployment its final performance and possible subsequent implications for authorities in terms of the definition of policies Contributions include several LIFE and H2020 projects aimed at the design and implementation of intelligent acoustic sensor networks with a focus on the publication of good practices for the design and deployment of intelligent networks in other locations Machine Learning and Autonomous Systems Joy Iong-Zong Chen, Haoxiang Wang, Ke-Lin Du, V. Suma, 2022-02-10 This book involves a collection of selected papers presented at International Conference on Machine Learning and Autonomous Systems ICMLAS 2021 held in Tamil Nadu India during 24 25 September 2021 It includes novel and innovative work from experts practitioners scientists and decision makers from academia and industry It covers selected papers in the area of emerging modern mobile robotic systems and intelligent information systems and autonomous systems in agriculture health care education military and industries **Proceedings of International Conference on Wireless Communication** Hari Vasudevan, Zoran Gajic, Amit A. Deshmukh, 2019-11-16 The book comprises selected papers presented at the International Conference on Wireless Communication ICWiCOM which is organized by D J Sanghvi College of Engineering s Department of Electronics and Telecommunication Engineering The book focuses on specific topics of wireless communication like signal and image processing applicable to wireless domains

networking microwave and antenna design and telemedicine systems Covering three main areas networking antenna designs and embedded systems applicable to communication it is a valuable resource for postgraduate and doctoral students

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

IoT and Analytics in Renewable Energy Systems (Volume 2) O.V. Gnana Swathika, K. Karthikeyan, Sanjeevikumar Padmanaban, 2023-08-11 Smart cities emanate from a smart renewable energy aided power grid The smart grid technologies offer an array of benefits like reliability availability and resiliency Smart grids phenomenally contribute to facilitating cities reaching those sustainability goals over time Digital technologies such as the Internet of Things IoT automation artificial intelligence AI and machine learning ML significantly contribute to the two way communication between utilities and customers in smart cities Five salient features of this book are as follows Smart grid to the smart customer Intelligent computing for smart grid applications Novel designs of IoT systems such as smart healthcare smart transportation smart home smart agriculture smart manufacturing smart grid smart education smart government smart traffic management systems Innovations in using IoT and AI in improving resilience of smart energy infrastructure Challenges and future research directions of smart city applications

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

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Measurement, Instrumentation, and Sensors Handbook John G. Webster, Halit Eren, 2017-12-19 The Second Edition of the bestselling Measurement Instrumentation and Sensors Handbook brings together all aspects of the design and implementation of measurement instrumentation and sensors Reflecting the current state of the art it describes the use of instruments and techniques for performing practical measurements in engineering physics chemistry and the life sciences and discusses processing systems automatic data acquisition reduction and analysis operation characteristics accuracy errors calibrations and the incorporation of standards for control purposes Organized according to measurement problem the Spatial Mechanical Thermal and Radiation Measurement volume of the Second Edition Contains contributions from field experts new chapters and updates to all 96 existing chapters Covers instrumentation and measurement concepts spatial and mechanical variables displacement acoustics flow and spot velocity radiation wireless sensors and instrumentation and control and human factors A concise and useful reference for engineers scientists academic faculty students designers managers and industry professionals involved in instrumentation and measurement research and development Measurement Instrumentation and Sensors Handbook Second Edition Spatial Mechanical Thermal and Radiation Measurement provides readers with a greater understanding of advanced applications

Management, Information and Educational Engineering Hsiang-Chuan Liu, Wen-Pei Sung, Wenli Yao, 2015-06-11 This book contains selected Computer Management Information and Educational Engineering related papers from the 2014 International Conference on Management Information and Educational Engineering MIEE 2014 which was held in Xiamen China on November 22-23 2014 The conference aimed to provide a platform for researchers engineers and academic

Windows Phone 7 Programming for Android and iOS Developers Zhinan Zhou, Robert Zhu, Pei Zheng, Baijian Yang, 2011-08-15 Learn to develop for the new Windows Phone 7 platform With a special focus placed on the new Windows Phone 7 WP7 design guidelines and technologies this reference helps you extend your knowledge so that you can learn to develop for the new WP7 platform The team of authors presents topic by topic comparisons between WP7 and Android and the iPhone enabling you to learn the differences and similarities between them This indispensable coverage prepares you for making the transition from

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Implementation of Smart Healthcare Systems using AI, IoT, and Blockchain Chinmay Chakraborty, Subhendukumar Pani, Mohd Abdul Ahad, Qin Xin, 2022-09-27 Implementation of Smart Healthcare Systems using AI IoT and Blockchain provides imperative research on the development of data fusion and analytics for healthcare and their implementation into current issues in a real time environment While highlighting IoT bio inspired computing big data and evolutionary programming the book explores various concepts and theories of data fusion IoT and Big Data Analytics It also investigates the challenges and methodologies required to integrate data from multiple heterogeneous sources analytical platforms in healthcare sectors This book is unique in the way that it provides useful insights into the implementation of a smart and intelligent healthcare system in a post Covid 19 world using enabling technologies like Artificial Intelligence Internet of Things and blockchain in providing transparent faster secure and privacy preserved healthcare ecosystem for the masses Explains how IoT can be integrated into the healthcare ecosystem for better diagnostics monitoring and treatment Includes AI for predictive and preventive healthcare Describes blockchain for managing healthcare data to provide transparency security and distributed storage Offers effective remote diagnostics and telemedicine approaches Highlights the importance of gold standard medical datasets for improved modeling and analysis

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 *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 Broadband Communications, Networks, and Systems Xiaochun Cheng,2025-02-06 This two volume set LNICST 601 and LNICST 602 constitutes the refereed post conference proceedings of the 14th International Conference on Broadband Communications Networks and Systems BROADNETS 2024 held in Hyderabad India in February 16 17 2024 The 49 full papers presented here were carefully reviewed and selected from 122 submissions These papers have been organized under the following topical sections in the two volumes Part I Communications Networks and Architectures Smart City Smart Grid Communication inspired Machine Learning ML for 5G 6G Part II Wireless Network Security and Privacy AI applications for 5G 6G *Local Area Networks* Keiser Gerd E,1997

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