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Design of Smart Meter using Atmel 89S52 Microcontroller

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Abstract

Smart meter is a progressive energy meter that processes consumption of electrical energy and provides extra information compared to a conventional energy meter. Incorporation of smart meters into electricity grid includes execution of a variety of techniques and software, depending on the features that the state demands. Outline of a smart meter relies on upon the necessities of the service organization and the client. This paper talks about different peculiarities and advances that can be incorporated in a smart meter. In fact, arrangement of smart meters needs legitimate choice and usage of a communication system fulfilling the security measures of smart grid communication and proposes a design model for smart meter to know the exact billing that each load is going to consume with the help of wireless technology. The microcontroller takes the reading from the energy meter via an Opto-coupler and displays the reading on the LCD duly interface to a microcontroller. The reading of the energy meter is also sent to user through GSM modem being fed from the microcontroller via level shifter IC and RS232 link.

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Keywords: Smart, Energy, Microcontroller, Utility, GSM.

1. Introduction

Smart grids give electricity request from the brought together and disseminated era stations to the clients through transmission and circulation technologies. The lattice is worked, controlled and checked utilizing data and communications advances (ICT). These innovations empower vitality organizations to flawlessly control the power request and take into account an effective and solid power delivery at lessened expense. Security stays to be a standout amongst the most critical issues in smart network technologies given the risk and impairment occupants and organizations alike may experience if the grid falls under assault.

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Three primary security targets must be joined in the keen framework: 1) accessibility of continuous power supply as per client necessities, 2) uprightness of conveyed data, and 3) privacy of client's information.Smart Metering (SM) is an imperative and crucial part of the forthcoming vitality network, instituted smart grid (SG). SM can be characterized as the communication framework and related information administration framework which permit gathering, preparing, and dispersion of data between smart meters, clients, and service organizations [1]. The significance of SM is that it interconnects SG parts and capacities inside a two-way communication network. The target is to backing a financially effective manageable power framework with amazing and security of supply. To attain to this target, progressed SM capacities may include automated meter readings (AMRs), appropriated vitality stockpiling (e.g., of electric vehicles or EVs), distributed energy resource (DER) administration (e.g., from renewable assets), and further vitality effectiveness systems, for example, motivator based direct load control and continuous improvements for burden moving/planning [2].It rises that SG and SM technologies are supported by the usage of data and communication technologies (ICTs). This symbolizes the expanding confidence of the general public on intricate technologies joining power and computerized control technologies, communication networks, and PC applications. [3].Hazard investigation and effect evaluation is a venture for securing (or redesigning the security of) any framework. The use of such a procedure is nontrivial in a SM system, thinking of it as' structural unpredictability and interfacing with digital physical SG functionalities, and the size of the potential harms brought about by assaults. The issue of security assurance is inborn in SM on the grounds that successive information gathering from smart meters uncovers an abundance of data about private apparatus utilization [4]. Data expansion besides lax controls consolidated with granular smart meter information gathering make a danger of protection intrusions.

2. Literature Review

Among all configuration contemplations, choice of the communication system and outline of the specialized gadgets are vital and must fulfill different complex prerequisites. As discussed about prior, usage of the smart meter framework includes a colossal measure of information exchange between the service organization, smart meter, and home apparatuses in the system. Along these lines, this information must be confirmed and ought to reflect data about the target right gadgets.

Communication technologies to be picked must be cost productive, ought to give great transmittable extent, better security characteristics, data transmission, power quality and with slightest conceivable number of repetitions. Bluetooth technology can be a conceivable alternative for communication of control signs and to transmit vitality utilization information. In view of the executing this procedure, B.S. Koay et al. proposed a Bluetooth based energy meter that can gather and transmit the vitality utilization information remotely to a focal base station [10]. Power Line Carrier (PLC) and Broadband Power Line (BPL) communication are the other conceivable alternatives of information exchange supporting the larger amount communication suites, for example, TCP/IP.[10], RS-232/485, Wi-Fi, WiMAX, and Ethernet with protocol to transfer information utilizing IEC DNP [11]. PLC innovation is deeply effective for automation of information in smart meter applications [12]. Despite significant overhead brought on by the huge IPv6 header, this protocol can be connected even at low PHY layer information rates. This invention, with the combination of the MAC algorithm can attain to tasteful deferral times and throughput. Despite the fact that this mixture may somewhat diminish the usable information exchange rate, it won't influence the overhead at MAC layer [13]. IP based system protocol would be an alternate guaranteeing alternative for communication in light of its preferences over different advancements while fulfilling the security measures of the smart framework communications. Moreover, TCP/IP innovation can likewise be utilized as a typical stage for numerous communication gadgets [14]. In addition above choices, Session Initiation Protocol (SIP) is a text based flagging protocol that is utilized for controlling media sessions, for example, feature and Voice over Internet Protocol (VoIP). Taste consolidates a few components of HTTP and Simple Mail Transfer Protocol (SMTP). SIP is an open and principles based technology, which gives a robust communication medium to the smart grid applications [15]. T. Mander et al. proposed a communication building design that uses DNP3 to create the convention brokenness between the DNP3 devices for managed power framework operations and TCP/IP devices for the smart load and interest administration. This irregularity in protocols constrains the quantity of defenceless assaults from other TCP/IP devices. Some security upgrades, for example, information object security and a security layer to

DNP3, as this convention independent from anyone else is not satisfactorily alright for community oriented operations. Information object security gives a few principles to getting to the information to keep away from unapproved access that controls the information and gadget operations [16]In this figure, gadgets in the transmission part guarantee legitimate transmission of generated energy, control technologies in distribution segment guarantee checking and controlling issues, communication devices like protocol gateways, data collectors and repeaters and system operations coordinates information and control motions between all the gadgets in the communication network. A smart meter or an apparatus that has a place with a client can be identified by a unique personality doled out to it. By and large, characters given to all parts are secured by cryptographic methods [6]. The communication system chose needs to help operation of the smart meter framework even on force blackout recognition and help delivery computerization moreover, the chose system and its segments must be practical and must help "traffic prioritization" i.e., organize the delivery of information in light of its time and direction sequence [7].

3. Proposed Method

Fig. 1 represents the architecture of the proposed smart meter. The output of power supply which is 5v is connected to 40th pin of microcontroller and Gnd is connected to 20th pin of microcontroller. Pin 2.0 to pin 2.7 of port 2 of MC is connected to data pins i.e., D0 to D7 of LCD display. Pins 4, 5, 6 i.e., RS, RW, EN. Of LCD are given to p 0.0 to p 0.2 of port of 0 of MC. Pin 3.0 and pin 3.1 of port 3 of MC are connected to pin 11 and pin 12 of Max232. Pin 3.3 of port 3 of MC is connected to pin 5 of Opto coupler. Pin 1 & 2 of Opto coupler are connected to energy meter. Pin 14 & 13 of Max232 are given to pins 2 & 3 of DB9 male connector. Pin 2 & pin 5 of DB9 Female Connector are given to GSM modem.

4. Result Analysis

The AT89S52 is Atmel's derivative of the 8052. It is compatible with Atmel's In-System Programming (ISP) via an on chip SPI interface, which allows it to be programmed via Atmel's AT89ISP programmer while the MCU is in the target circuit. Intel has provided evidence that substantiates that 89S52 has a faster programming time than 8051.Therefore, in short the basic advantage between 8051 and 89S52 is the difference in ROM memory. Atmel 89S52 also has advanced (flash) EEPROM. Fig. 2(a) and Fig. 2(b) show the comparison results with respect to features and performance respectively.

5. Conclusion

The SMS based electricity energy meter billing system using GSM modem was implemented, to let the consumer know electricity bill has reached a certain threshold. It informs the customer through a SMS sent on the mobile through the GSM modem attached to it. The system consists of the electricity meter which measures the electricity bill and informs the consumer about the number of units consumed and associated costs with it. The microcontroller coordinates the whole system with the help of its different components connected to it. This embedded system can further be developed to measure more complex and high voltage systems which consume a high load of electricity and energy. The information transmission can be extended to include other information exchanges like Internet, Email, WhatsApp messages, Smartphone Applications, Bluetooth devices, Facebook messages and so on.

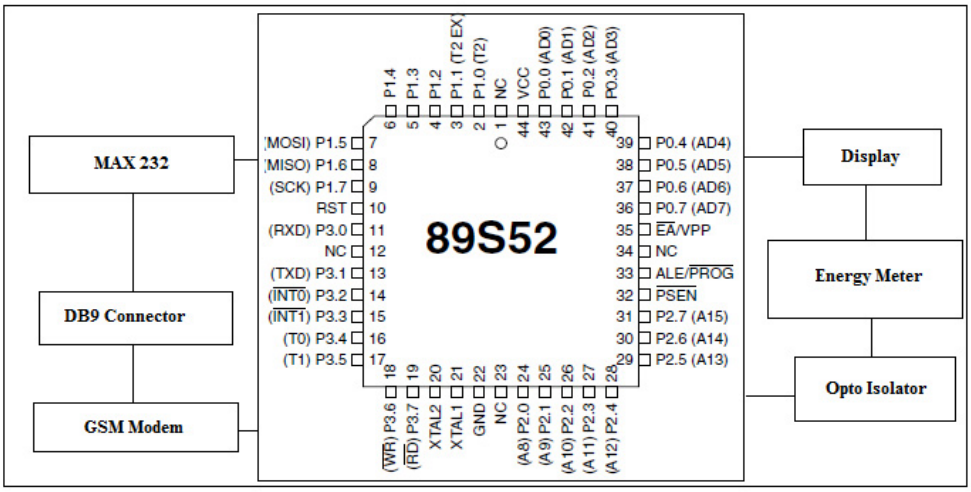

Fig. 1. Architecture of Smart Meter

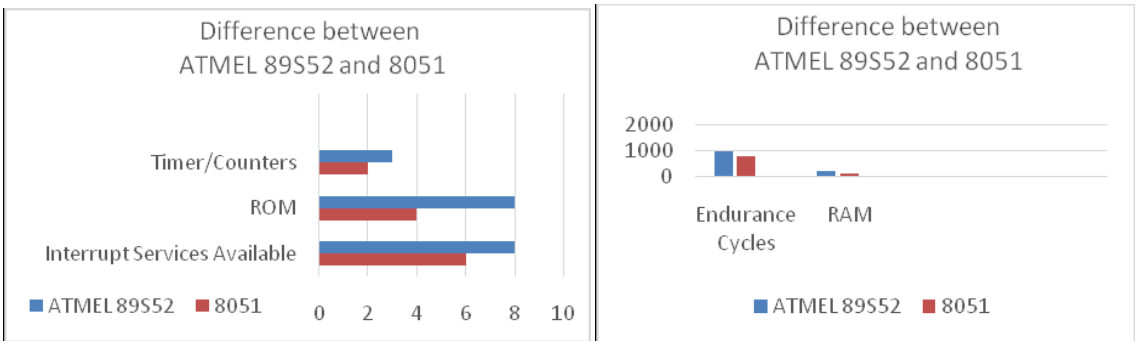

Fig. 2. (a) Features Comparison;(b) Performance Comparison

References

[1] A. Vojdani, Smart Integration, IEEE Power & Energy Magazine, vol.6, p. 71 – 79, Nov. 2008.

[2] D.G Hart, Using AMI to realize the smart grid," Proc. IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy, Pittsburgh, PA, July 2008, p. 1 – 2.

[3] R. Gerwen, S. Jaarsma, and R. Wilhite, Smart metering, [Online]. Available: http://www.leonardo-energy.org/webfm_ send/435

[4] S.S. Depuru, L. Wang, and V. Devabhaktuni, A conceptual design using harmonics to reduce pilfering of electricity, IEEE PES General Meeting, Minneapolis, MA, July 2010.

[5] M. Chebbo, EU smart grids framework: electricity networks of the future 2020 and beyond, Proc. IEEE Power Engineering Society General Meeting, Tampa, FL, June 2007, p.1 – 8.

[6] V.V. Das, Wireless communication system for energy meter reading, Proc. International Conference on Advances in Recent Technologies in Communication and Computing, Kottayam, India, Oct. 2009, p. 896-898.

[7] E.W.Gunther, NIST Conceptual Model: Overview and Evolution, [Online]. Available: http:/ /www.etf.org/proceedings/10ma /slides /intarea-7.pdf .

[8] Smart Grids, Carbonmetrics [Online] Available :http://www.carbon metrics.eu/Smart-Grids.phppage=car

[9] B.S. Koay, S.S. Cheah, Y.H. Sng, P.H.J. Chong, P. Shum, Y.C. Tong, X.Y. Wang, Y.X. Zuo, and H.W. Kuek, Design and implementation of bluetooth energy meter,Proc. Fourth International Conference on Information, Communications & Signal Processing, Singapore, Dec. 2003, p. 1474 – 1477.

[10] Y.S. Son, T. Pulkkinen, K.Y. Moon, and C. Kim, Home energy management system based on power line communication, IEEE Trans.on Consumer Electronic, vol. 56, p: 1380 – 1386, Aug. 2010.

[11] P.K. Lee and L.L. Lai, A practical approach of smart metering in remote monitoring of renewable energy applications, Proc. IEEE Power & Energy Society General Meeting, Calgary, Canada, July 2009, p. 1 – 4.
[12] M. Huczala, T. Lukl, and J. Misurec, Capturing energy meter data over secured power line, Proc. International Conference on Communication Technology, Guilin, China, Nov. 2006, p. 1 – 4.
[13] M. Bauer, W. Plappert, W. Chong, and K. Dostert, Packet-oriented communication protocols for smart grid services over low-speed PLC, Proc. IEEE International Symposium on Power Line Communications and Its Applications, Dresden, Germany, Mar. 2009, p. 89 – 94.
[14] Press release: cisco outlines strategy for highly secure, 'Smart Grid' Infrastructure,[Online]. Available: http://newsroom.cisco.com/dlls/2009/prod_051809.html
[15] J.DiAdamo,SIP: the clear choice for smart grid communications,[Online]. Available: http://www.smartgridnews.com/artman/publish/Technologies_Standards_News/SIP_The_Clear_Choice_for_Smart_Grid_Communications-604.html
[16] T. Mander, H. Cheung, A. Hamlyn, W. Lin, Y. Cungang, and R.Cheung, New network cyber-security architecture for smart distribution system operations,Proc. IEEE Power and Energy Society GeneralMeeting - Conversion and Delivery of Electrical Energy, Pittsburgh,PA, July 2008, p. 1 – 8.