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Controlling Renewable Energy Sources of Smart Grids using WOT Technology

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Abstract: This project describes a Smart Grid architecture implemented with the help of Web of Things .Web of Things comprise of a set of Web services provided on top of a number of Internet enabled Embedded devices .The Web browser on any computer can act as an interface to the services provided by these Web of Things. The Embedded devices are ARM7 Processor based devices with Ethernet capabilities. CMSIS Real Time Operating System is used for process control on each of these embedded devices. LwIP Protocol Stack is implemented on top of each of these devices so that IP connectivity can be established. The Web interfaces provide us real time information on each of the energy meters that are installed on site and communicate to the Embedded Internet devices using MODBUS communication protocol. Real Time energy source scheduling, energy source selection, power connection and disconnection are some of the services that are provided to an on-line authenticated user. The Embedded Systems lab Infrastructure at the TIFAC CORE for 3G/4G Communication at National Institute of Science and Technology was used for the hardware testing of the embedded modules. The Design and development of a smart monitoring and controlling system for household electrical appliances in real time has been reported in this paper. The system principally monitors electrical parameters of household appliances such as voltage and current and subsequently calculates the power consumed. Wireless mechatronic systems consist of numerous spatially distributed sensors with limited data collection and processing capability to monitor the environmental situation. Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. There has been design and developments of smart meters predicting the usage of power consumption. However, a low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have designed and implemented a WIFI-based intelligent home energy management and control service .In this design we implemented temperature controlling and fire safety system. The sensor information also update in IOT for every event occurrence.

Keywords: Web of Things, Wifi Module, LPC2148 (ARM7) Microcontroller, ADC, LM35 Temperature Sensor, Display Unit.

I. INTRODUCTION

Use of Renewable Energy Sources in House hold electrification has always been the most effective method to minimize the amount of carbon emissions that we contribute towards the cumulative carbon emissions of this planet earth. These carbon emissions have given rise to global warming due to depletion of the ozone layer. Use of alternatives like solar water heaters helps to reduce individual carbon emission footprint upon the environment. But the use of these alternatives is location and climate dependent. The power grid supply to our homes still remains the primary source of energy for most of the Appliances in our homes. Also the reconfiguration of the electrical circuitry of the entire home is a cumbersome process for the end user. If the users are provided with an inexpensive process to configure the power supply of their homes as per requirement, the use of generated renewable energy can be maximized. This would eventually put an impact on the total carbon emissions due to the generation process of power from non-renewable energy sources. The Web of Things comprise of a number of Internet enabled Embedded devices which provide such an interface to the user by means of Web services. The end user can access this through a web browser of any computer with an Internet connection.

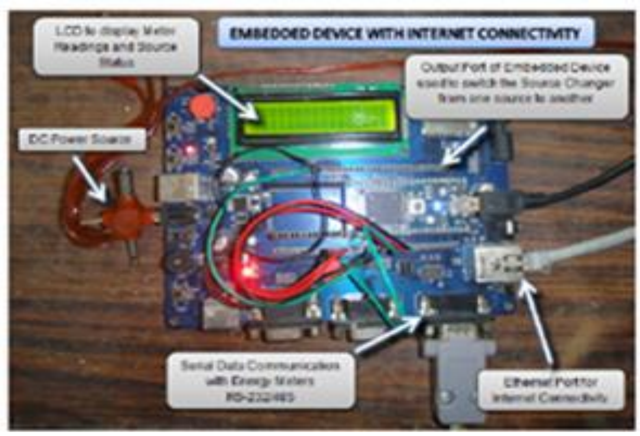

Fig.1. ARM Processor based internet enabled embedded device.

A. Internet Enabled Embedded Device

In this setup an ARM cortex M3 processor is utilized to plan an implanted system gadget. The LPC2148 processor from NXP [5] is utilized as our form of ARM processor. The processor is interfaced with a RS 232 port, LCD and Ethernet port. A Real time operating system called CMSIS [4] is utilized for undertaking improvement .On top of that a little convention stack called LwIP is utilized to bolster TCP/IP abilities on the load up. The gadget is appeared in Fig.1.

B. Serial Communication with Energy Meters

The ARM processor board speaks with the RS 232 port by interfacing its UART (Universal Asynchronous Serial Transmission) Port with MAX232 IC .So, a few vitality meters inside 1 km (hypothetically 1km, tried around 200m) can be suited with a solitary processor board. The meters are associated with the different Non-Renewable and Renewable vitality Sources straightforwardly to record the voltage and current readings. In the event that voltage is more than 450V, Voltage Transformer is required and for present, Current Transformer is required for current more than 5A.The Transformers likewise disconnect the meters from the high present and voltage of the info supply. These readings can be caught by the controlling implanted gadget by method for a progression of charges. The decision of current transformers relies on upon the greatest current that is required to be measured.

II. SYSTEM ARCHITECTURE

A. Block Diagram

Slave Mode:

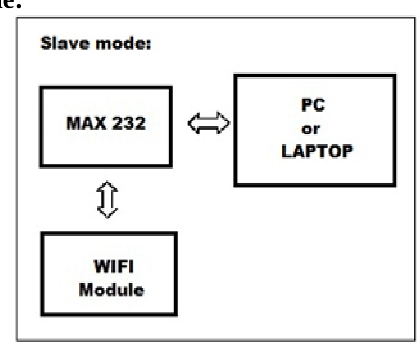

Fig.2. Block Diagram of Slave mode.

Master Mode:

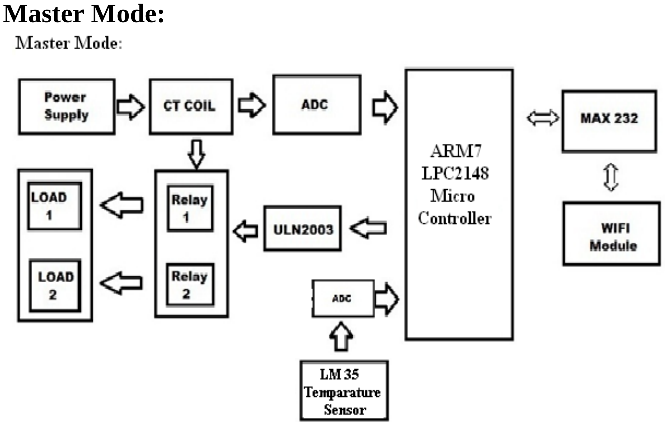

Fig.3.Block Diagram of Master mode.

B. Over View Of Block Diagram

We have developed a platform for the IoT as a scalable distributed system that can seamlessly support an in-home smart grid and different concurrent applications for remote monitoring and control. The platform architecture is illustrated in Figs.2 and 3. It consists of three main parts: the sensor and actuator networks, the IoT server and the user interfaces for visualization and management. Sensor and actuator nodes communicate in a reliable bi directional way with the IoT server. The communication between the nodes and the IoT server follows the TCP/IP client-server model. Sensors send messages in their native format to the IoT server (through a gate way, if needed), over an encrypted link. The IoT server converts the raw payload, containing information from heterogeneous nodes, into a standard format, containing object identifier, object type, measurement unit, data field, geographical position, and timestamp. In this way, data can be easily represented, manipulated and aggregated without considering the communication protocol of the originating source.

TABLE I: Main Components If The Internet of Things Platform

Parts of IoT Platform	Main components
Sensor and actuator networks	• Sensor and actuator nodes • IP gateways
IoT Server	• Message dispatcher • Data management unit and sensor DB • Configurator unit and database • Secure access manager
User interfaces	• Visualization interface • Configuration interface • Applications using the REST API

A web-based graphical interface allows users to access real time and historical sensor data. The same interface allows users with administration privileges to manage networks and single nodes. Third-party software can access the platform using a Representational State Transfer application programming interface (API). Due to the possibility of using the system to collect sensitive and confidential data, the platform ensures an adequate security level both to end-to-end communications and to data access. For this reason, users need to be authenticated before they can access the platform and can only access specific sets of sensor data through HTTPS. The IoT server support multiple encryption protocols (AES-128, SSH).At a finer level of detail, the IoT platform consists of several hardware and software components, each described by its functions and by its interfaces with other components. In this way, the architecture is easily scalable and robust. Each component can be modified, redesigned, and extended with minimum impact on the rest of the system. The components are indicated in Table I and are described in more detail in the following subsections.

Sensor and Actuator Nodes: The sensor and actuator nodes can be part of networks implemented with wired (e.g., controller area network (CAN), PLC) or wireless (e.g., ZigBee, Wi-Fi, Bluetooth) network protocols. The architecture can accommodate different and heterogeneous sensor and actuator networks. The data management unit is responsible for translating information to the format required by the sensor database. On the other hand, bidirectional communication channel stop/from the nodes enable the IoT server to interrogate, configure, and program them. Configuration messages mainly carry node-specific information (for example measurement thresholds, alarm settings) or firmware updates.

IP Gateway: The gateway is the element connecting a sensor/actuator network if it has no direct IP capability to the IoT server via an IP link. The gateway is bidirectional: for uplink communication it collects data received from the network nodes. Performs reformatting/encapsulation if required, and sends them over a secure TCP/IP link to the message dispatcher. The network nodes, performs reformatting/encapsulation if required, and sends them over a secure TCP/IP link to the message dispatcher. For downlink communication, it forwards to the receiver node(s) the commands received from the IoT server. We propose a different gateway concept with respect to the one commonly used to integrate heterogeneous network switch an external network. These systems use a gateway-based approach, where the gateway performs a conversion of data into a universal format. In our architecture, instead, it is the IoT server that performs such operation. Therefore, the gateway sends network packets over TCP/IP in the native format and both the gateway and the message dispatcher are transparent at the logical communication level between nodes and IoT server. This choice provides three meaningful advantages.

- The gateway can have reduced hardware requirements and computational complexity. Our gateway has only to ensure an IP connection, to implement the encapsulation of the nodes' native protocol into TCP/IP packets, and to ensure the security level required by the specific application.
- Different applications and new functionalities can be developed and added without modifying the gateway.
- The user side of the platform can communicate at the application level directly with network nodes.

C. Existing Method

THE SMART GRID is an intelligent power generation, distribution, and control system. The proposed system is helpful in collection and analysis of real time data along with the control of electrical loads for energy reduction. Emphasizing the importance of the communication infrastructures required to support device control and data exchange between the various domains which comprises the smart grid. Our proposed scheme is implemented with an ETHERNET protocol.

D. Proposed Method

This project describes a Smart Grid architecture implemented with the help of Web of Things .Web of Things comprise of a set of Web services provided on top of a number of Internet enabled Embedded devices .The Web browser on any computer can act as an interface to the services provided by these Web of Things. The Embedded devices are ARM7 Processor based devices with Ethernet capabilities. CMSIS Real Time Operating System is used for process control on each of these embedded devices. LwIP Protocol Stack is implemented on top of each of these devices so that IP connectivity can be established. The Web interfaces provide us real time information on each of the energy meters that are installed on site and communicate to the Embedded Internet devices using MODBUS communication protocol. Real Time energy source scheduling, energy source selection, power connection and disconnection are some of the services that are provided to an on-line authenticated user. The Embedded Systems lab Infrastructure at the TIFAC CORE for 3G/4G Communication at National Institute of Science and Technology was used for the hardware testing of the embedded modules. The Design and development of a smart monitoring and controlling system for household electrical appliances in real time has been reported in this paper. The system principally monitors electrical parameters of household appliances such as voltage and current and subsequently calculates the power consumed.

Wireless management systems consist of numerous spatially distributed sensors with limited data collection and processing capability to monitor the environmental situation. Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. There has been design and developments of smart meters predicting the usage of power consumption. However, a low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have designed and implemented a WIFI-based intelligent home energy management and control service .In this design we implemented temperature controlling and fire safety system. The sensor information also update in IOT for every event occurrence.

III. HARDWARE IMPLIMENTATION

A. ARM7 LPC2148 Controller

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. ARM7TDMI-S processor has two instruction sets

- the standard 32-bit ARM set.
- A 16-bit Thumb set.

The Thumb set's 16 bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM performance advantage over a Traditional 16-bit processor using 16-bit registers. This is Possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system. The LPC2148 incorporates a 128 KB and 256 KB Flash memory system respectively. This memory may be used for both code and data storage. Programming of the Flash memory may be accomplished in several ways. It may be programmed In System via the serial port. The application program may also erase and/or program the Flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc. When on-chip boot loader is used, 120/248 KB of Flash memory is available for user code. The LPC2148/LPC2129 Flash memory provides a minimum of 100,000 erase/write cycles and 20 years of data retention. On-chip boot loader (as of revision 1.60) provides Code Read Protection (CRP) for the LPC2148/LPC2129 on- chip Flash memory. When the CRP is enabled, the JTAG debug port and ISP commands accessing either the on-chip RAM or Flash memory are disabled. However, the ISP Flash Erase command can be executed at any time (no matter whether the CRP is on or off). Removal of CRP is achieved by erasure of full on-chip user Flash. With the CRP off, full access to the chip via the JTAG and/or ISP is restored. On-Chip static RAM may be used for code and/or data storage. The SRAM may be accessed as 8-bits, 16-bits and 32-bits. The LPC2119/LPC2129 provides 16 KB of static RAM. Which indicate that interfacing of CAN bus to microcontroller that gives structural view of the CAN bus protocol communication.

B. WIFI Module

Fig.4. Wifi Module.

HLK-RM04 is a new low-cost embedded UART-ETH-WIFI module (serial port - Ethernet -Wireless network) developed by Shenzhen Hi-Link Electronic co., Ltd. This product is an embedded module based on the universal serial interface network standard, built-in TCP / IP protocol stack, enabling the user serial port, Ethernet, wireless network (wifi) interface between the versions. Through the HLK-RM04 module, the traditional serial devices do not need to change any configuration; data can be transmitted through the Internet network. Provide a quick solution for the user's serial devices to transfer data via Ethernet. The HLK-RM04 module provides designers with a ready made component that provides a fully integrated solution for applications, using the IEEE802.11 standard in the 2.4-2.5GHz ISM frequency band, including802.11b/g/n and also provides IEEE802.3, can be quickly and easily included in product designs. The modules integrate all of the RF components required, removing the need to perform expensive RF design and test. Products can be designed by simply connecting sensors and switches to the module IO pins or uart interface as shown in Fig.4. The modules use reline's chip Wireless Microcontroller, allowing designers to make use of the serial interface to connect with their device Hence, this module allows designers to bring wireless applications to market in the minimum time with significantly reduced development effort and cost. This product is an embedded module based on the universal serial interface network standard, built-in TCP / IP protocol stack, enabling the user serial port, Ethernet, wireless network (wifi) interface between the conversions. Through the HLK-RM04 module, the traditional serial devices do not need to change any configuration; data can be transmitted through the Internet network. Provide a quick solution for the user's serial devices to transfer data via Ethernet Also the HLK-RM04 module have FCC modular approvals and is compliant with EU regulations.

B. LM35 Temperature Sensor

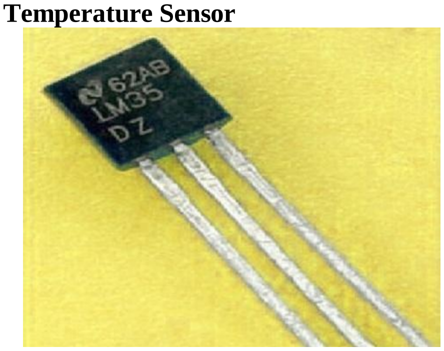

Fig.5. Temperature Sensor.

The LM35seriesare precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature, The LM35 thus has an advantage over linear temperature sensors calibrated in ˚ Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centi-grade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4$˚C at room temperature and $\pm 3/4$˚C over full −55to+150˚C temperature range as shown in Fig.5. Low cost is assured by trimming and calibration at the wafer level. TheLM35'slow output impedance, linear output, and precise inherent calibration make interfacing to read out or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60µA from its supply, it has very low self-heating, less than 0.1˚Cinstill air. The LM35 is rated to operate over a −55˚ to + 150˚ C temperature range, while the LM35 Cisrated for a −40˚ to +110˚C range (−10˚with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220package.

IV. SCALABILITY AND SELF SUSTAINABILITY

The proposed model is anything but difficult to set up on existing homes with meters introduced .The setup can be designed with the electrical segments being picked by size of the venture. It can be an ease establishment on a rustic home and can be stretched out to a high security setup for greater undertakings. As the greater part of the administrations is given through the web of things, the system of operation can be remotely reconfigured relying upon necessities and client input. The web administrations can be reconfigured every once in a while when the need emerges.

V. RESULTS

Results of this paper is as shown in bellow Figs.6 and 7.

A. Hardware Implementation

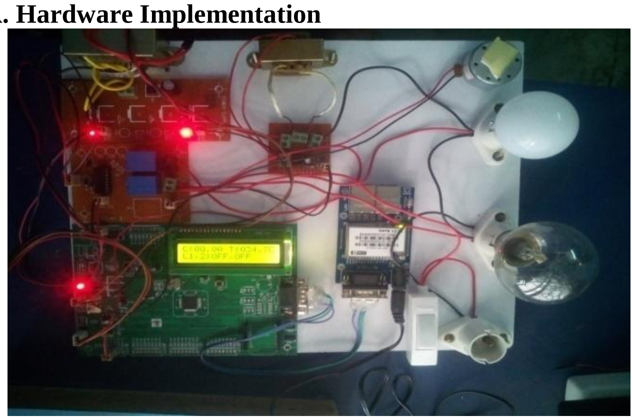

Fig.6. Hardware Implementation.

B. Output Results

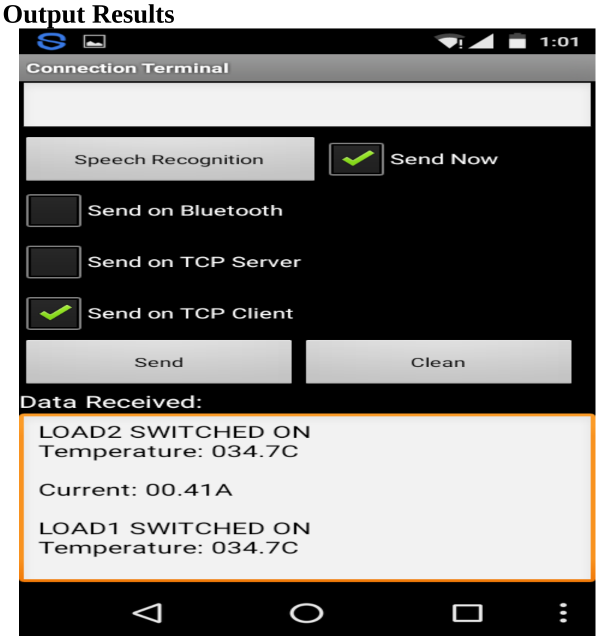

Fig.7. Output Results.

VI. CONCLUSION

The composed framework is anything but difficult to actualize and exceptionally adaptable as indicated by requirements. It gives exceptionally compelling strategies of utilizing our renewable vitality assets which would some way or another has been underutilized. At last it gives an exceptionally successful strategy for executing environmentally friendly power vitality idea on a bigger scale .The mix of Web of Things with existing force framework engineering will give us various chances to enhancements in our vitality sparing strategies.

VII. REFERENCES

[1] Dominique Guinard, Vlad Trifa and Erik Wilde ,"A Resource Oriented Architecture for the Web of Things". Proc. of IoT 2010 (IEEE International Conference on the Internet of Things). Tokyo, JapanNov. 29 2010-Dec. 1 2010 ,ISBN:978-1-4244-7413-4

[2] Dominique Guinard and Vlad Trifa,"Towards the Web of Things: Web Mashups for Embedded Devices". Proceedings of the International World Wide Web Conferences. Madrid, Spain.

[3] N Bui, A.P Castellani,P Casari and M Zorzi, "The internet of energy: a web-enabled smart grid system," Network, IEEE ,vol.26,no.4,pp.39,45,July-August2012

[4]ARM."CMSIS S,"arm.com.[Online].Available:http: //www.arm.com/products/processors/cortex-m/cortex -microcontroller-software-interface-standard.php [Accessed:Aug. 27, 2013].

[5]ARM."LPC1768Datasheet,"keil.com.[Online]. Available: http://www.keil.com/dd/docs/datashts/philips/lpc176x_ds.pdf[Accessed: Aug. 27, 2013].

[6] X. P. Liu, W. Gueaieb, S. C. Mukhopadhyay, W. Warwick, and Z. Yin, "Visitor publication prologue to the engaged segment on remote mechatronics," IEEE/ASME Trans. Mechatronics, vol. 17, no. 3, pp. 397–403, Jun. 2012.

[7] D. S. Ghataoura, J. E. Mitchell, and G. E.Matich, "Systems administration and application interface innovation for remote sensor system observation and checking," IEEE Commun. Mag., vol. 49, no. 10, pp. 90–97, Oct. 2011.

[8] P. Cheong, K.- F. Chang, Y.- H. Lai, S.- K. Ho, I.- K. Sou, and K.- W. Tam, "A zigbee-based remote sensor system hub for bright identification of fire," IEEE Trans. Ind. Electron., vol. 58, no. 11, pp. 5271–5277, Nov. 2011.

[9] J. Misic and V. B. Misic, "Span execution in a multitier remote system for medicinal services observing," IEEE Wireless Commun., vol. 17, no. 1, pp. 90–95, Feb. 2010.

[10] M. Erol-Kantarci and H. T. Mouftah, "Remote sensor systems for cost efficient private vitality administration in the keen framework," IEEE Trans. Keen Grid, vol. 2, no. 2, pp. 314–325, Jun. 2011.

[11] ZigBee partnership looking at Japan's new shrewd home suggestions (got to on 8 Aug., 2012). [Online]. Accessible: http://www.smartmeters.com/the-news/3449-zigbee-organization together

[12] The expenses and advantages of savvy meters for private clients (got to on 4Apr. 2012).[Online].Available: http:// www.edisonfoundation.net/iee/Documents/IEE_BenefitsofSmartMeters_Final.pdf

[13] L. Li, H. Xiaoguang, H. Jian, and H. Ketai, "Outline of new engineering of AMR framework in Smart Grid," in Proc. sixth IEEE Conf. Ind. Electron. Appl., 2011, pp. 2025–2029.
[14] E. Andrey and J. Morelli, "Configuration of a shrewd meter techno-monetary model for electric utilities in Ontario," in Proc. IEEE-Electric Power Energy Conf., 2010, pp. 1–7.
[15] D. Man Han and J. Hyun Lim, "Brilliant home vitality administration framework utilizing IEEE 802.15.4 and zigbee," IEEE Trans. Shopper Electron., vol. 56, no. 3, pp. 1403–1410, Aug. 2010.

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