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SMART ENERGY METER USING IOT

[1]S.RUKSANA, [2]N.MD.MOHASINUL HUQ, [3]S. MOHAN DAS

[1]M.Tech Student, [2]Assistant Professor, [3]Associate Professor

DEPT OF ECE

SVR Engineering College, Nandyal

Abstract:

In recent years, smart devices are increasingly. These devices allow making cities smart, enabling communication not only among people but also among things, creating a new system nowadays known by the term IoT (Internet of Things). A smart city is based on a smart grid that allows to intelligently manage the power grid. In order to do this, the network must have intelligent meters that can communicate bidirectionally with the network. This market has led to a proliferation of smart meters that give the opportunity to measure the consumption of each single device in homes. The most part of smart meters are based on a chip that calculates the parameters needed to estimate energy consumption. In this paper, the authors consider a smart meter based on a common chip that calculates the power consumption and the meter characterization is reported.

Keywords: Smart Meter, Open metering, IoT.

INTRODUCTION

The smart city [1] in urban planning and architecture is a set of urban planning strategies (see Fig. 1) aimed at optimizing and innovating public services so as to link the material infrastructures of cities "with capital human, intellectual and social lives of those who live in them" thanks to the widespread use of new technologies for communication, mobility, the environment and energy efficiency, in order to improve the quality of life and meet the needs of citizens, businesses and institutions [2]. Urban performance depends not only on the provision of material infrastructures in the city (physical capital), but also, and increasingly, from the availability and quality of communication, knowledge and social infrastructure (intellectual capital and social capital). This latter form of capital is particularly important for urban competitiveness.

Figure 1. The concept of Smart City.

The intelligent city concept has been introduced in this context as a strategic device to contain modern urban production factors in a common framework and to emphasize the growing importance of information and communication technologies (ICT), social and environmental capital in defining the competitiveness profile of cities, moving towards sustainability and ecological measures both in control and energy saving, optimizing mobility and security solutions The significance of the two sets of social and environmental capital points to the need for a long way to go to distinguish intelligent or smart cities from those with a greater technological burden, drawing a clear line between them, what goes below the name of smart cities and digital cities respectively. The first thing to take into account, in order to have a smart city is to consider the smart grid opportunity. It is clear that the grid of the 21st century will be a "Smart Grid". Due of the global demand for worldwide electricity, and to the ground gained by renewable energy and distributed generation, most electric grids, designed and built decades ago, are now struggling to meet these new challenges. In this context, the study of smart grids is introduced, which provides the network of intelligent and optimized elements and configurations that can facilitate management operations. First of all, it

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should be specified that the experimentation pursues two different strands, namely network intelligence at national level and the creation of as independent networks as possible, the size of which varies according to initial production and consumption hypotheses. In the second line there are the most futuristic solutions, but already in the first there are important novelties that will revolutionize the way to consume energy of individual; one of the key assumptions in fact is in both cases centrality of the consumer, as the active protagonist of energy management and no longer as the end user of the production chain. In the middle of these two streets, the idea of smart cities is taken up, strongly encouraged by the more accurately and farsighted local governments, which consists in applying the concept of an autonomous network to the management area of a single city, and then providing the same links intelligent with other cities and the national network. The Smart Grid will be characterized by bidirectional data communication among all relevant users of the energy conversion chain [3], [4]. The result is a participatory network (as depicted in Fig. 2) in which consumers, utilities, and service providers share responsibilities and benefits [5]. In this scenario Smart Meters, capable of bidirectional data communication in the connection of consumers to the Smart Grid, are among the fundamental building blocks of Smart Grid deployments. At first, outage detection and power restoration and verification will be improved by smart metering. Mainly smart metering solutions will help empower consumers with information to monitor, manage, and control energy usage and optimize performance and reduce energy losses. With smart-grid-enabled net metering benefits can be mutual: utilities could be able to manage peak demand, whilst consumers can monitor and optimize their energy consumption based upon the real-time price of energy and individual needs and offset rising power bills [6],[7]. The implementation of a Smart Metering solution means that utilities will be able to offer better targeted tariffs and introduce new business models based on real-time pricing or active load control, which can be used to reduce high-cost consumption [8]. In order to unfold its full potential, Smart Metering requires an Advanced Metering Infrastructure (AMI) for full-scale bidirectional data communication to be in place. Data collected through an AMI can be captured, stored, and forwarded to a central computer. Moreover, AMI aims at an open system with a connection to the Home Area Network (HAN). Particularly relevant in this field is the OPEN Meter project, which aims to specify a comprehensive set of open and public standards for AMI. More in details the research activities will be focused on the measurement devices, communication technologies (transmission medium and interfaces), protocols and data structures suitable for data exchange between the systems and devices, which constitute the network. In the market the number of smart meters are increasing, and the cost are decreasing, but the question to answer is: are the smart meters good for estimate the Energy consumption? What is the accuracy? In concordance with this trend and starting from previous experience in the field of remote metering and wireless sensor networks [8]-[10], the authors propose to evaluate the performance of a smart meter based on a common chip to measure the energy consumption. In the paper, after a brief review of grid architectures, the chosen smart meter will be discussed in detail and its characterization will be reported.

IOT TECHNOLOGY

The internet of things (IoT) is a computing concept that describes the idea of everyday physical objects being connected to the internet and being able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it also may include other sensor technologies, wireless technologies or QR codes.

1.1 INTERNET OF THINGS

Connecting everyday things embedded with electronics, software, and sensors to internet enabling to collect and exchange data without human interaction called as the Internet of Things (IoT).The term "Things" in the Internet of Things refers to anything and everything in day to day life which is accessed or connected through the internet.

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Fig 1.1: Internet of Things

IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance. As we have a platform such as a cloud that contains all the data through which we connect all the things around us. For example, a house, where we can connect our home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since we have a platform, we can connect our car, track its fuel meter, speed level, and also track the location of the car.

HOW DOES INTERNET OF THING (IoT) WORK?

The working of IoT is different for different IoT echo system (architecture). However, the key concept of there working are similar. The entire working process of IoT starts with the device themselves, such as smartphones, digital watches, electronic appliances, which securely communicate with the IoT platform. The platforms collect and analyze the data from all multiple devices and platforms and transfer the most valuable data with applications to devices.

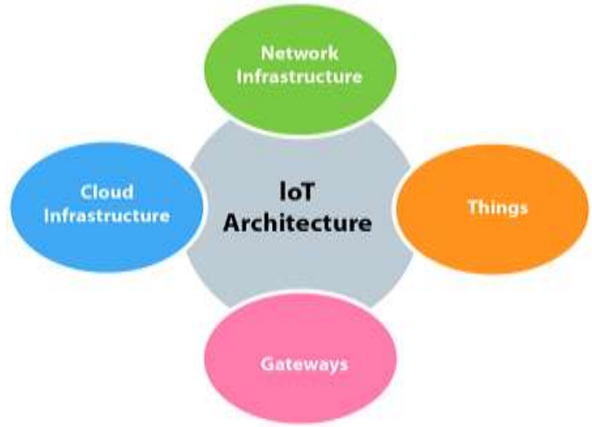


Fig 1.2: IoT Architecture

HARDWARE DESIGN

Design phase consists of both project design and hardware design

5.1 DESIGN OF HARDWARE

5.1.1 ARDUINO UNO

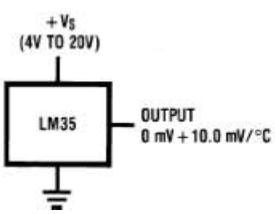
Fig 5.1 Arduino Uno

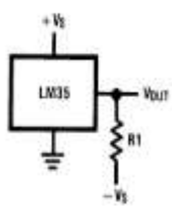
Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

TEMPERATURE SENSOR (LM35):

in order to monitor the temperature continuously and compare this with the set temperature preprogrammed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus a sensor has to be used and the sensor used in this project is LM35. It converts temperature value into electrical signals.

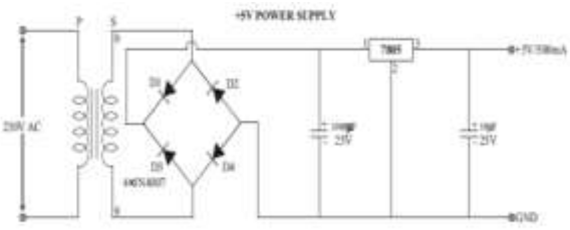
LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.





POWER SUPPLY:

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.



ENERGY METER:

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device.

Electric utilities use electric meters installed at customers' premises for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour (*kWh*). They are usually read once each billing period.

When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a day, to record usage during peak high-cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods

History

Direct current

An Aron type DC electricity meter showing that the calibration was in charge consumed rather than energy

ESP8266 WIFI

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The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]

The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

ESP8266

ESP-01 module by Ai-Thinker

Manufacturer	Espressif Systems
Type	32-bit microcontroller
CPU	@ 80 MHz (default) or 160 MHz
Memory	32 KiB instruction, 80 KiB user data
Input	16 GPIO pins
Power	3.3 V DC

GSM

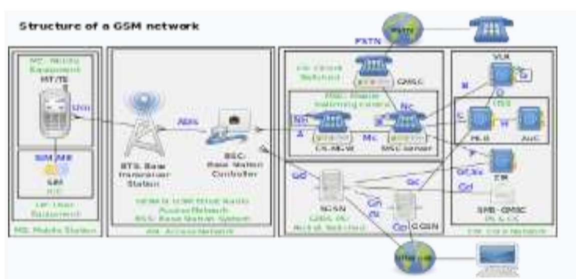
The **Global System for Mobile Communications** (**GSM**) is a standard developed by the European Telecommunications Standards Institute(ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991.[2]By the mid-2010s, it became a global standard for mobile communications achieving over 90% market share, and operating in over 193 countries and territories.[3]

2G networks developed as a replacement for first generation (1G) analog cellular networks. The GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via General Packet Radio Service (GPRS), and Enhanced Data Rates for GSM Evolution(EDGE).

Subsequently, the 3GPP developed third-generation (3G) UMTS standards, followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard.

"GSM" is a trade mark owned by the GSM Association. It may also refer to the (initially) most common voice codec used, Full Rate.

Technical details



The structure of a GSM network

Alphanumeric LCD

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible

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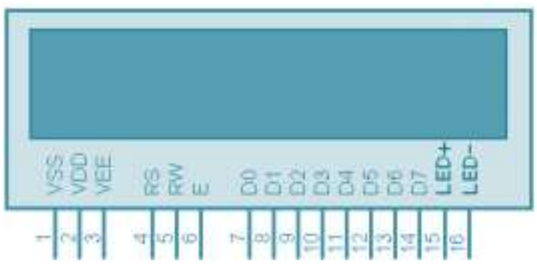
with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

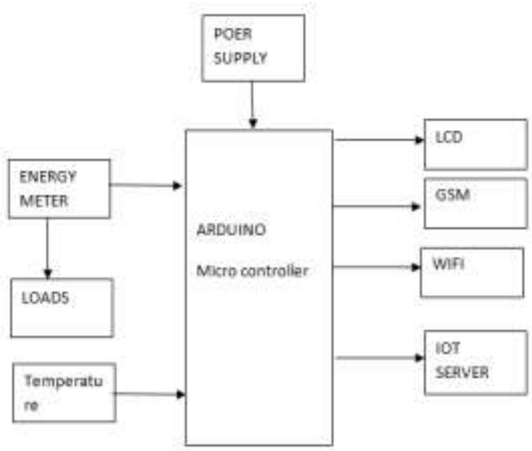
Pin Description



6. PROJECT DESCRIPTION

This project ensures that the customers can easily identify the

6.1. BLOCK DIAGRAM:



6.2. SOFTWARE REQUIREMENTS:

- Arduino IDE
- Arduino programming

6.3. HARDWARE REQUIREMENTS:

1. Arduino UNO
2. Wifi module
3. Relays
4. GSM
5. Mobile phone
6. 7805 for external power supply

7. ENEG=RGY METER

CONCLUSIONS

An attempt has been made to make a practical model of 'IoT Based Smart Energy Meter.' The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be handy. Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

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