International Journal of Current Research and Modern Education (IJCRME)
ISSN (Online): 2455 – 5428 & Impact Factor: 3.165
Special Issue, NCFTCCPS - 2016

AN INTEGRITY MONITORING & CONTROLLING SYSTEM FOR DEMAND RESPONSE BASED ENERGY MANAGEMENT SYSTEM

T. Chidhambaram*, P. Devendhiran, R. Harish*** & V. Vishnupriya******

Jayam College of Engineering & Technology, Dharmapuri, Tamilnadu

Abstract:

A Home Energy Management (HEM) system plays a crucial role in realizing residential Demand Response (DR) programs in the smart grid environment. A device which limits the usage of electrical power when it is used beyond the predefined KVA rating. It provides a homeowner the ability to automatically perform smart load controls based on utility signals, customer's preference and load priority. This paper presents the hardware demonstration of the proposed HEM system for managing end-use appliances. The HEM's communication time delay to perform load control is analyzed, along with its residual energy consumption. The HEM monitors the energy usage of domestic equipment's and automatically limits the power consumption, if the usage exceeds above the set limit.

Introduction:

In the United States, residential energy users spend over one-fifth of total energy in the nation. In the UK, domestic energy consumption represents about 30% of the overall CO2output. Further research has indicated that over 40% of supplied power for domestic users has been wasted by overheating, overcooling, leaving appliances in standby/off modes, heating/cooling unoccupied rooms, etc. To achieve domestic energy saving and efficiency, energy monitoring technologies that provide real-time feedback on energy consumption have been employed and can mitigate the usage by up to 15%. Unlike traditional methods where utility companies retrieve energy consumption via electricity meters and then report total consumption and cost back to corresponding households, an energy management system provides energy use information at the time of consumption.

Additionally, Home Energy Management Systems (HEMS) that provide direct feedback through a home network whilst (or shortly after) consumption occurs, have been considered and realized to achieve energy efficiency. In, a smart home and energy control system was designed to enable energy monitoring and control services via an embedded network. A new Smart Home Energy Management System (SHEMS) based on IEEE 802.15.4 was presented for sensing and control purposes.

Overview of System Architecture:

The proposed energy management solution learns and adapts to the residential energy usage patterns. This system consists of demand control switches, AT89S52 microcontroller, relay driver, Liquid crystal display unit, current transformer, optocoupler and power supply unit. The demand control switches are used to select the power supply range for customer utilization. The controller executes the corresponding predesigned program to energies the relay driver according to their input demand. The relay is used to controls the load as per demand. The current transformer connected with each load. The current ranges of each load sensed by current transformer and this output is applied to another input of the microcontroller through optocoupler which is used to act as an electrical isolator. The controller trips the load through relay driver when load current value greater than input demand level. The LCD unit is used to display the information about demand level of the utilization as well as input source.

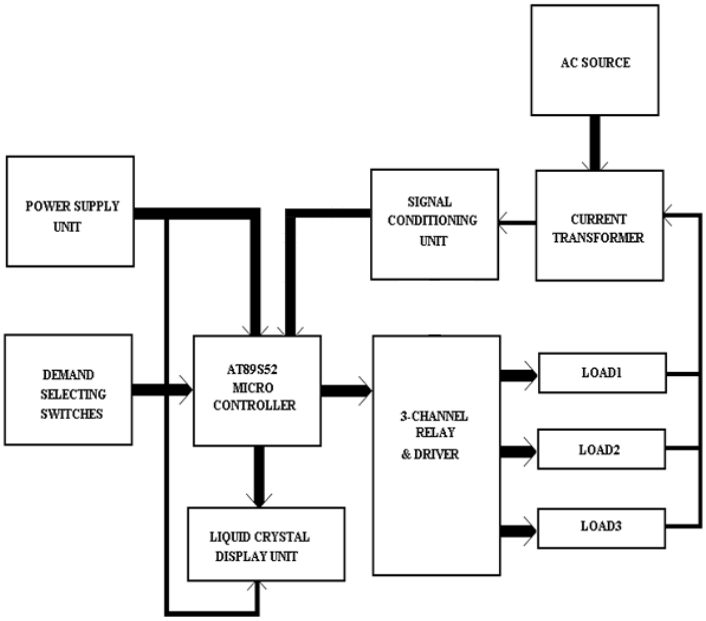

Figure 1: Functional Block Diagram

Power Supply Unit:

The regulated DC supply for the IC s and other parts of the circuit is provided by the separate DC power supply. A block diagram of a power supply system which converts a 230V AC mains supply into a regulated 5V DC supply is shown below:

The transformer used here is a step-down transformer which converts 230v AC into 12v AC.A full wave bridge rectifier made around the diodes converts the ac supply into a pulsating dc supply. Here the bridge consists of four IN4001 silicon diodes which are capable of delivering current up to 1 amps.

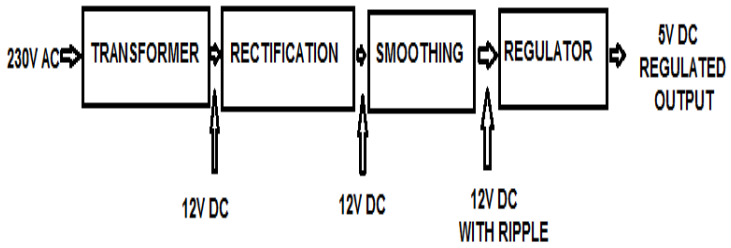

Figure .2: Power Supply Unit

The ripple content in the rectifier output is smoothened by adding a capacitor filter in parallel to the output. The value of capacitor may be from 100 to 4700 microfarads. Higher the chosen value more is the filtering.

The 12v dc is regulated to 5v dc using a 3-terminal series pass regulator with the input pin (pin1) to output of rectifier, output pin (pin3) to the supply output. The common pin (pin2) is connected to the supply ground. The output of the regulator will be 5volts.

Hardware Requirements:

Microcontroller:

Generally Microcontrollers have a CPU, Memory, Addressing Circuits, Interrupt handling circuits an internal UART, Ports, timers. The microcontroller models vary in data sizes from 4 to 32 bits. Four bit units are produced in huge volumes for very simple applications. 8-bit access is more versatile then others 16-32 bit words are used in high speed application in signal processing.

Practical Implementation of Controller

To develop a microcontroller application, a development system is required. A microcontroller kit along with an assembler usually constitutes a development system. Serial and parallel communication devices are like as RS232, data encoder, Data decoder and vice versa.

Advantages of Microcontroller:

- Increased reliability through a small part count.
- Reduced stock levels, as one microcontroller replaces several parts.
- Simplified product assembly.
- Greater product flexibility and adaptability.
- Rapid product changes or development by changing the product and not hardware

Description of Microcontroller:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry- Standard 80C51 instruction set and pin-out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with In-System Programmable Flash on a monolithic chip, the Atmel AT89S51 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

AT89S52 Pin Configurations:

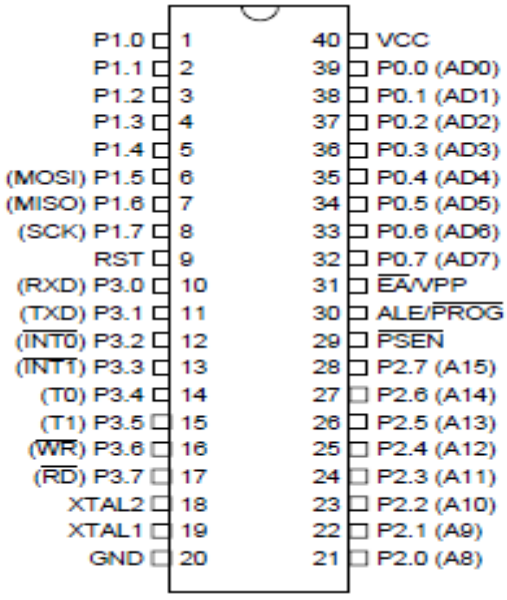

Figure 3: Architecture of Microcontroller

Basic Circuit Connection:

Port 0:

Port 0 is an 8-bit open drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming

and outputs the code bytes during program verification. External pull-ups are required during program verification.

Table: Port Function

Port Pin	Alternate Functions
P3.0	RXD (Serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T1 (Timer 1 external input)
P3.5	T0 (Timer 0 external input)
P3.6	WR (external data memory write strobe)
P3.7	WR (external data memory write strobe)

Port 1:

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2:

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3:

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 receives some control signals for Flash programming and verification. Port 3 also serves the functions of various special features of the AT89S51, as shown in the following table.

RST:

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives High for 98 oscillator periods after the Watchdog times out. The DISRTO bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DISRTO, the RESET HIGH out feature is enabled.

ALE/PROG:

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes.

Note, however, that one ALE pulse is skipped during each access to external data memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN:

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

Output from the inverting oscillator amplifier

Current Transformer (CT):

In electrical engineering, a current transformer (CT) is used for measurement of electric currents. Current transformers are also known as instrument transformers. When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to m3easuring and recording instruments. A current transformer also isolates the measuring instruments from what may be very high voltage in the primary circuit. Current transformers are commonly used in metering and protective relays in the electrical power industry.

Opto Coupler:

The combined package of a LED and a photodiode is called opto-coupler. It is also called as opto-isolator or optically coupled isolator.

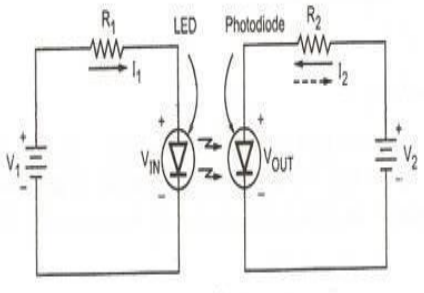

Figure 4: Basic circuit of optocoupler

The figure shows the basic circuit of an opto-coupler. It has LED on the input side and a photodiode on the output side. The source V_1 and series resistance R_1 decide the forward current I_1 through the LED. Thus LED emits the light. This light is incident on photodiode. Due to this, a reverse current is set up in the output circuit. The current produces drop across the output resistance R_2. The output voltage is the difference between the supply voltage V_2 and the drop across the resistor R_2.

$$V_{out} = V_2 - I_2R_2$$

Transformer:

A transformer is a static device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or *primary* winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the *secondary* winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

$$\frac{Vs}{Vp} = \frac{Ns}{Np}$$

The transformer is based on two principles: first, that an electric current can produce a magnetic field (electro magnetism), and, second that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). Changing the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil.

Relay:

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. A relay is able to control an output circuit of higher power than the input circuit, in the form of an electrical amplifier.

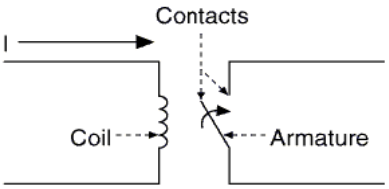

Figure 5: Symbol of Relay

Liquid Crystal Display Unit:

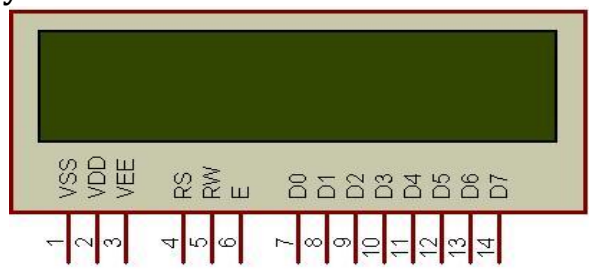

Figure 6: Character LCD type HD44780

The most commonly used Character based LCD's are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character based LCD's, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCD's which can give a new look to your application. The most commonly used LCD's found in the market today are 1 Line, 2 Line or 4 Line LCD's which have only 1 controller and support at most of 80 characters, whereas LCD's supporting more than 80 characters make use of 2 HD44780 controllers. Most LCD's with 1 controller has 14 Pins and LCD's with 2 controller has 16 Pins.

Conclusion:

In this system, a domestic energy monitoring and management system has been introduced, which implements direct feedback of electricity and gas energy consumption in over 250 UK and Bulgarian homes. Five Living Labs have been

established to create a motivating and interactive environment for participants. Diverse data visualization methods and persuasive interfaces allow households to explore their data in a simple and straightforward way. Both qualitative and quantitative data analysis have been conducted. The results indicate that households have consumed less energy during the experimental cycle, especially with appliance monitoring and the social networking application. In addition, 92% of participating users have declared positive behavior changes on energy consumption throughout the DEHEMS project.

Future Scope:

In this application can be made in android apps in future to control by wireless technique.

References:

1. Peter Palensky, Senior Member, IEEE, and Dietmar Dietrich, Senior Member, IEEE
2. Jinsoo Han, Haeryong Lee, Kwang-Roh Park U-Computing Department, ETRI, Daejeon, Korea
3. Irfan Quazi1 , Sachin Kumar Gupta2 and Rajendra Prasad Department of Electronics & Communication Engineering, Mewar University, Chittorgarh - 312901 (Rajasthan), India
4. Qing Ling, Zhi Tian, Senior Member, IEEE, Yuejun Yin, and Yue Li
5. Qi Liu, Member, IEEE, Grahame Cooper, Nigel Linge, Haifa Takruri and Richard Sowden