

Implementation Of Ac Power Stand By Switch-Off Outlets Using Arduino Mega2560

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Abstract -- As more and more domestic appliances and consumer electronics are installed, house usage energy consumption tends to grow rapidly. A large number of domestic devices increase power consumption in two features, standby power and normal operation power. These two kinds of power consumption are proportional to the number of domestic devices. As a result, operational cost in domestic area is also increasing. to achieve efficient domestic energy management in addition to the technology of standby power reduction.

Keywords— stand-by power, current transformer, relay, Arduino mega2560.

1. INTRODUCTION

Here's a concept being introduced to save energy. Most of the times when systems like TV, Computers, DVD/CD players etc., are being run we just turn off the device with remote control but the AC supply keeps running. There is still power consumption (less of course) in such cases and most ICs in the device are still operating. This proposed project looks for such devices and put them off automatically.

The proposed project is built around Arduino Mega 2560 which is the heart and brain of the system, 3 electrical devices are sensed using individual current sensors whose current is continuously monitored by Arduino Mega 2560 and displayed on a 16x2 alpha numeric Liquid Crystal display . Arduino Mega 2560 differentiates between the working or standby of the device by the difference in the current monitored, if any device is found to be in standby mode Arduino Mega 2560 sends appropriate signals to the driver circuit which drives the relay to disconnect the device there by saving power.

2. ARDUINO

Arduino simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$80

Some people think of the entire Arduino board as a

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Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino

Open source and extensible software- The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

microcontroller, but this is inaccurate. The Arduino board actually is a specially designed circuit board for programming and prototyping with Atmel microcontrollers.

The nice thing about the Arduino board is that it is relatively cheap, plugs straight into a computer's USB port, simple to setup and use (compared to other development boards).

3. HISTORY

Arduino started in 2005 as a project for students at the Interaction Design Institute Ivrea in Ivrea, Italy. At that time program students used a "BASIC Stamp" at a cost of \$100, considered expensive for students. Casey Reas, one of the founders, taught at Ivrea.

An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components to facilitate programming and incorporation into other circuits. An important aspect of the Arduino is the standard way that connectors are exposed, allowing the CPU board to be connected to a variety of interchangeable add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus, allowing many shields to be stacked and used in parallel. Official Arduino have used the megaAVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560. A handful of other processors have been used by Arduino compatibles. Most boards include a 5 volt linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer.

OFFICIAL BOARDS

The original Arduino hardware is manufactured by the Italian company Smart Projects.^[3] Some Arduino-branded boards have been designed by the American company Spark Fun Electronics. Sixteen versions of the Arduino hardware have been commercially produced to date.

SHIELDS

Arduino and Arduino-compatible boards make use of shields—printed circuit expansion boards that plug into the normally supplied Arduino pin-headers. Shields can provide motor controls, GPS, ethernet, LCD display, or bread boarding (prototyping).

POWER

The Arduino Mega can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts..

ARDUINO MEGA2560



Fig 1: MEGA board

The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

The Mega 2560 R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Mega 2560 R3 works with all existing shields but can adapt to new shields which use these additional pins

COMMUNICATION

The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega2560 provides four hardware UARTs for TTL (5V) serial communication. An ATmega16U2 (ATmega 8U2 on the revision 1 and revision 2 boards) on the board channels one of these over USB and provides a virtual com port to software on the computer (Windows machines will need a .inf file, but OSX and Linux machines will recognize the board as a COM port automatically. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the

ATmega8U2/ATmega16U2 chip and USB connection to the computer

A Software Serial library allows for serial communication on any of the Mega2560's digital pins.

The ATmega2560 also supports TWI and SPI communication. The Arduino software includes a Wire library to simplify use of the TWI bus; see the documentation for details. For SPI communication, use the SPI library.

PROGRAMMING

1) The Arduino Mega can be programmed with the Arduino software. The ATmega2560 on the Arduino Mega comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). *You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.*

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU boot loader). See this user-contributed tutorial for more information.

AUTOMATIC (SOFTWARE) RESET

Rather than requiring a physical press of the reset button before an upload, the Arduino Mega2560 is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2 is connected to the reset line of the ATmega2560 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Mega2560 is connected to either a computer running Mac

OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Mega2560. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Mega2560 contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line



Figure2. Experimental set up

ATMEGA 2560 MICROCONTROLLER

The ATmega2560 provides the following features: 256K bytes of In-System Programmable Flash with Read-While-Write capabilities, 4Kbytes EEPROM, 8Kbytes SRAM, 54/86 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), six flexible Timer/Counters with compare modes and PWM, four USARTs, a byte oriented 2-wire Serial Interface, a 16-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator, an SPI serial port, IEEE® std. 1149.1 compliant JTAG test interface, also used for accessing the On-chip Debug system and programming and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or Hardware Reset.

10. Lcd And Power Supply

16x2 LCD

A Liquid Crystal Display (LCD) is a low cost, low-power device capable of displaying text and images. LCDs are extremely common in embedded systems, since such systems often do not have video monitors like those that come standard with desktop systems. It can be found in numerous common devices like watches, fax and copy, machines and calculators.

The most fundamental control of any equipment is the ability to turn it "ON" and "OFF". The easiest way to do this is using switches to interrupt the electrical supply. Although switches can be used to control something, they have their disadvantages. The biggest one is that they have to be manually (physically) turned "ON" or "OFF". Also, they are relatively large, slow and only switch small electrical currents.

CURRENT TRANSFORMER

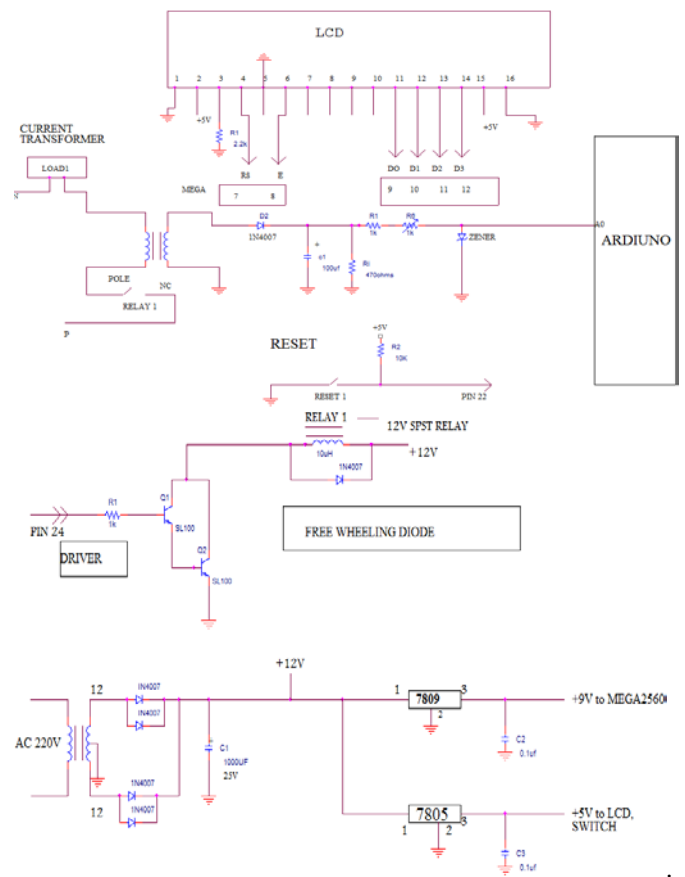
A **current transformer (CT)** is an electric device that produces an alternating current (AC) in its secondary which is proportional to the AC in its primary.

When a current is too high to measure directly or the voltage of the circuit is too high, a current transformer can be used to provide an isolated lower current in its secondary which is proportional to the current in the primary circuit. The induced secondary current is then suitable for measuring instruments or processing in electronic equipment. Current transformers also have little effect on the primary circuit. Often, in electronic equipment, the isolation between the primary and secondary circuit is the important characteristic.

Current transformers are used in electronic equipment and are widely used for metering and protective relays in the electrical power industry..

The most basic current transformer comprises the secondary wound around the primary conductor, but typically current transformers consist of a silicon steel ring core wound with many turns of copper wire as shown in the right illustration. The conductor carrying the primary current is then passed through the ring; the CT's primary therefore consists of a single 'turn'. The primary 'winding' may be a permanent part of the current transformer, with a heavy copper bar to carry current through the core. Window-type current transformer are also common, which can have circuit cables run through the middle of an opening in the core to provide a single-turn primary winding.

CIRCUIT DIAGRAM



We use a current transformer to sense current , it is a step up transformer with few number of primary turns and more number of secondary turns, one side of the primary winding is connected to load, and another side is connected to relay which is normally closed , another side of the relay is connected to phase of supply.

Once a load is connected current flows through the primary winding a small EMF gets generated, once it gets generated, its in step up mode a large voltage gets induced in secondary windings. Ac voltage gets rectified by a half wave rectifier, to convert ac to dc, and 1000uf capacitor for filtering in the harmonics to limit the current and voltage we go for 1kohm resistor Load resistor of 470ohms is used, potentiometer is used in order to set the reference value. we use a zener diode normally open which is in reversed biased cathode is connected to positive and anode is grounded and it is connected to analog pin of Arduino.

To reset the load we are going for reset switch,the type of reset switch used is PUSH to ON, when it is closed its in zero condition. When it is open condition its in undefined state neither 1 nor 0 hence we use a pull up resistor to make it 1 when it is in open condition. Its is connected to pin 22 of Arduino mega2560.

The output from Arduino mega2560 is 5v,20mA we need more current to operate the relay ie 100mA hence we use Darlington emitter follower as a driver circuit which

provides a good current gain and the voltage gain is unity, it consists of 2 transistor of npn combination, which is connected to a resistor of 1kohm. This is connected to pin24 of Arduino mega2560, as relay is inductive load we use a freewheeling diode to suppress back EMF.

Power supply AC 230 V is step down to 12v using step down transformer, full wave rectifier is used to convert ac to dc. 1000uf capacitor is used for filtering the harmonics, two voltage regulator is used one for Arduino mega2560, and another for LCD to regulate the voltages and we use 0.1uf capacitor to eliminate the ripples

4. CONCLUSION

This project is used to eliminate power consumed at standby mode. In this we are building a device that helps to save electrical energy. Finally the experimental results with respect to different labs in college campus has been tabulated. In future by using mobile phones we can off the standby power by message itself. When a domestic device is moved to the different outlet, the energy information of the domestic device is consistently and seamlessly regardless of location change.

We implemented the power outlet with a power measuring function. The proposed MODEL is expected to contribute to reduce domestic energy usage in the future. Furthermore, we actively reduce standby power consumption by turning off a device and the power outlet simultaneously through the ARDUINO MEGA2560. This method eliminates the waiting time of a typical automatic power cut-off outlet. The appliances will be physically disconnected from mains supply whenever device remains in standby mode for some

specific time. The system has three modes of operations – compulsory ON mode, compulsory OFF mode and Intelligent mode. In compulsory ON mode all the appliances will perform their primary function, in

compulsory OFF mode all the appliances will be detached from the mains supply. In this way the intelligent mode will save the energy by making the standby power equal to zero and if the standby power gets reduced then the total power consumption also gets reduced and it reduces our electricity bill too.

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