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Optimal Home Energy Management Systems in Smart Grids

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I. ABSTRACT:

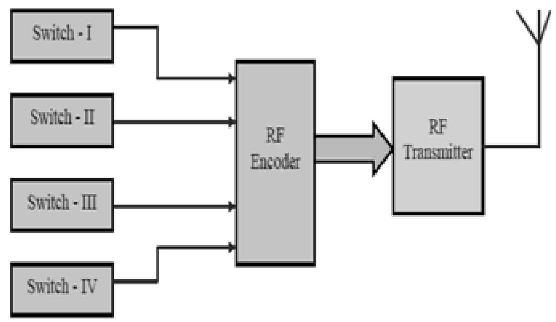
The advent of smart grid era and the arrival of improved communication and information infrastructures have facilitated an expansion in the field of home automation. A smart home is building, usually a new one, that is equipped with special structured technology to enable residents to remotely control or program an array of automated home electronic devices. In this paper we have proposed a system that saves energy by efficient power management of a room by employing certain controlling mechanisms managed by a microprocessor.

The mechanisms include light control relative to the natural light intensity in the room, fan control relative to the room temperature. The LPC2148 controller reads light intensity level from an LDR voltage divider circuit. If the natural light intensity is below the preset value then the lights are turned on and vice versa. Room temperature readings are taken from an Lm35 sensor and compared with the user defined preset value. If the readings are above or equal to the present value then the fans runs at full speed. If it is below the present value then the fans are turned off. This smart control of electrical appliances can significantly reduce the power consumption and will result in the optimal usage of available energy.

II. EXISTING SYSTEM:

Controlling domestic or industrial appliances is a very interesting and useful project. This project is designed to control up to four electrical appliances. This project used popular RF encoder and decoder IC's. Four Switches are connected to the RF Encoder. This encoded data is transmitted through a RF transmitter module. In the receiver side, the RF receiver module receives the encoded data and decodes using an RF Decoder. This decoded output data is given to triac driver. Loads are driven through triacs. Up to 7A load can be connected to these loads.

TRANSMITTER:



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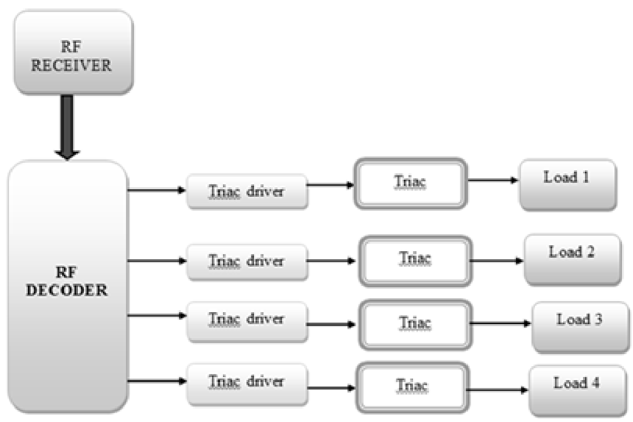

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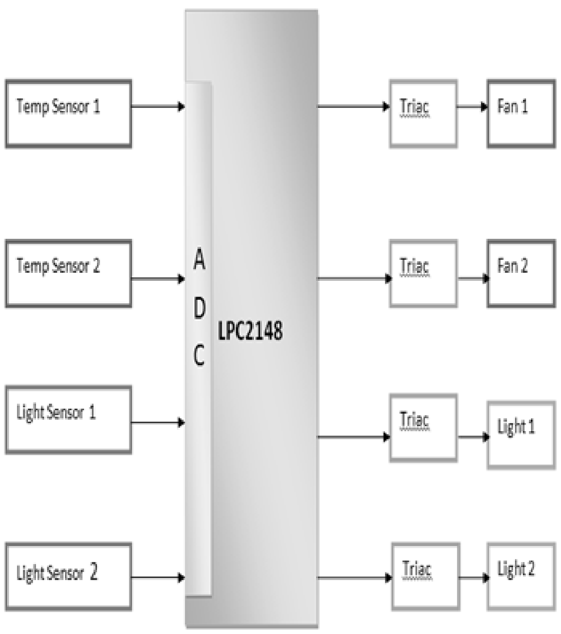
III. DRAWBACK OF THE EXISTING SYSTEM:

In the above given method, the loads are operated using RF wireless technology but this is done manually. By using proposed method automatic operation of loads can be done.

IV. PROPOSED SYSTEM

This project uses sensors such Temperature sensor (LM35), LDR. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the micro controller through ADC. The analog signal is converted into digital format by the analog-to-digital converter (ADC). As the particular temperature sensor is activated high, the load (Fan) is ON. In the same way the LDR senses night, the load (bulb) will be ON. Here two temperature sensors and two LDR sensors are used. This project uses two power supplies, one is regulated 5V for modules and other one is 3.3V for MCU. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output from secondary of 230/12V step down transformer.

Block Diagram:



V. HARDWARE MODULES

1. LPC2148 controller:

The **LPC2148** are based on a 16/32 bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT,PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. With a wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

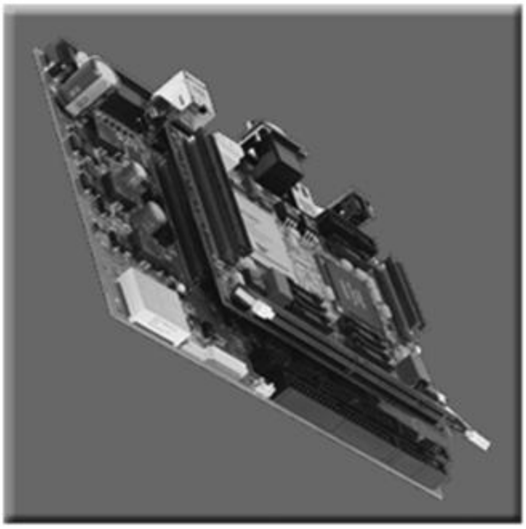


Figure: ARM7 board

2. Temperature Sensor:

The LM35 series are 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 Centigrade scaling.

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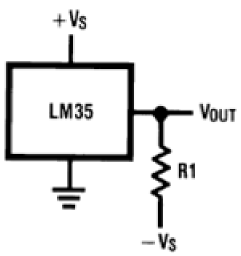
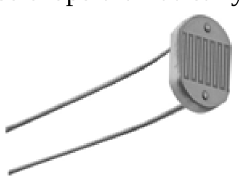
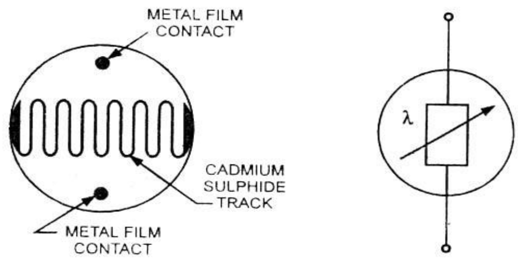
The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated 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-220 package.



3. Light Dependent Resistor:

An LDR is an input transducer (sensor) which converts brightness (light) to resistance. It is made from cadmium sulphide (CdS) and the resistance decreases as the brightness of light falling on the LDR increases**.** LDR's or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1,000,000 ohms, but when they are illuminated with light, the resistance drops dramatically.





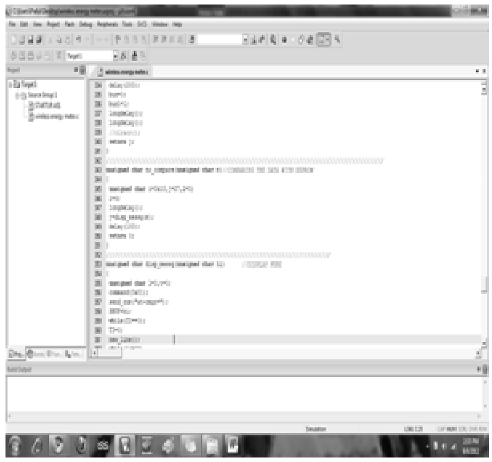
(a) Basic Structure *(b) Symbol*

LDR

VI. SOFTWARE TOOLS

1. Keil Software:

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.



2. Flash Magic:

Flash Magic is a tool which is used to program hex code in EEPROM of micro-controller. It is a freeware tool. It only supports the micro-controller of Philips and NXP. It can burn a hex code into that controller which supports ISP (in system programming) feature. Flash magic supports several chips like ARM Cortex M0, M3, M4, ARM7 and 8051. Flash Magic is an application developed by Embedded Systems Academy to allow easily access the features of a microcontroller device. With this program it can erase individual blocks or the entire Flash memory of the microcontroller.

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The kit can be programmed through serial port using 'Flash Magic'. 'Flash Magic' is a freeware windows utility used download the hex file format onto the kit. The Flash Magic utility is provided in CD along with the KIT. If your PC does not have a serial port; use a USB to serial converter to download the hex file using the Flash Magic utility.

ADVANTAGES:

- Highly sensitive
- Fit and Forget system
- Night – Day mode sensing
- Low cost and reliable circuit with high performance.
- Complete elimination of manpower

VII. APPLICATIONS:

- Street lights
- Garden Lights
- Hotels, hostels and house hold applications
- Offices
- Industries

VIII. CONCLUSION:

This project presents a high sensitive sensors based automotive device control. The tracking controller based on the closed loop algorithm is designed and implemented with MCU in embedded system domain. The light sensitivity resistors are used to determine the night – day vision. The proposed system can control devices automatically. Thus, the power can be saved. Experimental work has been carried out carefully. The proposed method is verified to be highly beneficial for all the electrical appliances.

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