SMART HOME ENERGY MANAGEMENT SYSTEM USING SENSORS

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Abstract : Nowadays without electricity we cannot imagine our daily life because electricity has become a necessity for all, without which day-to-day life chores & daily activities become stand still. Due to the depletion of non-renewable resources, conservation of energy has become mandatory and by doing so we can reduce electricity bills as well.

This Project is used to control the home loads such as Fan and light. This project will do by using 8051 micro controller .We are using two sensors LDR for detecting light and Temperature sensor LM35 to find room temperature. We also using PIR sensor to identify the human presence. The system will get the temperature from the IC (LM35) and it will control the fan either it is night or day time. Whereas LDR detects it is day or night and depends on the human presence light will ON or OFF. The System is fully controlled by the microcontroller AT89S52. It is a popular 8 bit microcontroller.

IndexTerms - Eembedded Systems and Micro controllers and keil software

I. INTRODUCTION

Microcontrollers play a very vital role in the development and implementation of automation technology. Automation is the process of controlling system and information to decrease the need of human participation. Home automation represents the idea of controlling of home appliances in an integrated system. It may include the control of lighting, heating, ventilation, air-conditioning, security, and other appliances. Several sensors i.e. detector for temperature, smoke, fire, gas, PIR, light etc are used for smart home. These sensors use the input signal to control home appliances. But implementation of a unified connectivity between devices and the main controller in cost effective way is very decisive this works includes the control of switching of lights and fan according to the attendance of person, speed control of DC motor(fan) according to the variation of temperature. Thus the speed of dc motor is controlled through duty/PWM signal. In this paper, we present a flexible and reliable control scheme for controlling the dc motor and light control. Results obtained are found in good agreement with the available in data acquainted.

The project designed here is a microcontroller based embedded system. In this design, an 8-bit 8052 microcontroller is used. The microcontroller has been programmed using C language according to the required features and hence, Keil has been used to compile the code written in programming language C and generate hex file, which is loaded to microcontrollers flash memory with programmer and the circuit configuration has been simulated in PROTEUS software. The system here has been designed configuring temperature and IR sensor. Temperature sensor senses the temperature of a room and it gives the microcontroller signal. The speed of fan will increase if the temperature of the room is high and decrease if the temperature of the room is low. PIR sensor senses the presence of person. If there is any person in the room the light & fan will be ON after a man entering the room. The more light will be ON according to attendance of person. The light & fan will be only switched OFF until all the person in the room goes out. The total number of persons inside the room is also displayed on the liquid crystal display.

II. LITERATURE SURVEY

In literature review, this is to be found that in recent years the energy crisis has become main problem which the whole world must confront. Home power consumption makes up the largest part of energy consumption in the world. This is to be found that the automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. Home automation is a widely used automated system. There is an approach to control the electrical and electronic home appliances according to the attendance of persons. Implementation of the Atmel microcontroller for Speed control of DC motor fed by a DC chopper has been investigated. The chopper is driven by a high frequency PWM signal. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn adjusts directly the motor speed .The design and simulation of a novel fan speed control system based on room temperature using Pulse width Modulation Technique. The duty cycle is made to vary according to the room temperature and the fan speed is controlled accordingly.

EMBEDDED SYSTEM

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market.

An Embedded System is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end

embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc .Lower end embedded systems - Generally 8,16 Bit Controllers used with an minimal operating systems and hardware layout designed for the specific purpose.

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III INTRODUCTION TO MICROCONTROLLERS

A micro-controller consists of a powerful CPU tightly coupled with memory, various I/O interfaces such as serial port, parallel port, timer or counter, interrupt controller, data acquisition interfaces like A/D converter, D/A converter integrated on single silicon chip.

If a system is developed with a microprocessor, the designer has to go for external memory such as RAM, ROM, EPROM and peripherals. But controller is provided withal these facilities on a single chip. Development of a micro-controller reduces PCB size and cost of the design.

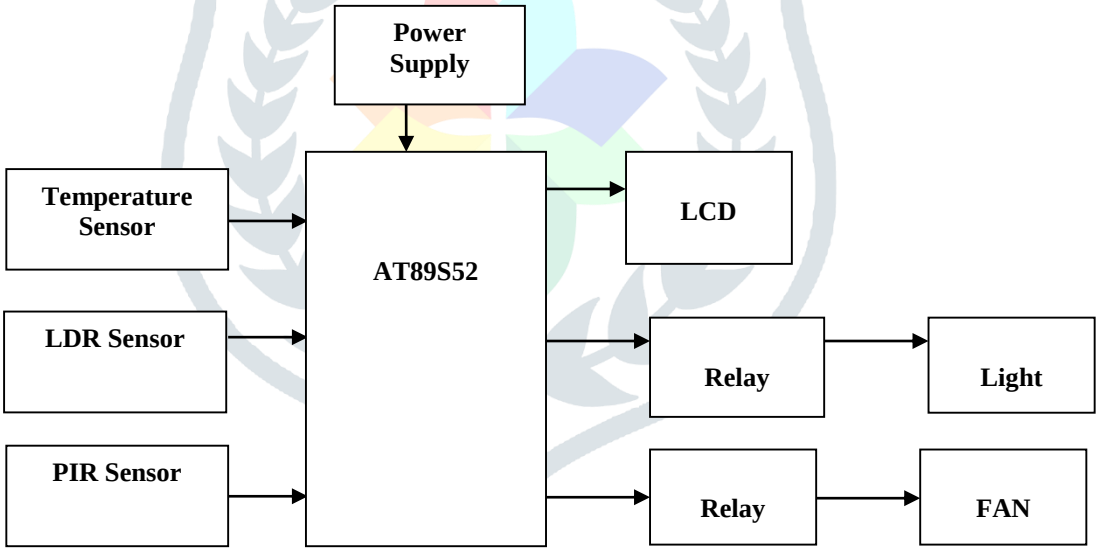
One of the major differences between a micro-processor and a micro-controller is that a controller often deals with bits not bytes as in the real world application. Intel has introduced a family of micro-controllers called the MCS-51.

3.1 FEATURES

Compatible with MCS-51 Products

- 8 Kbytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock
- 256 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-Bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low Power Idle and Power Down Modes

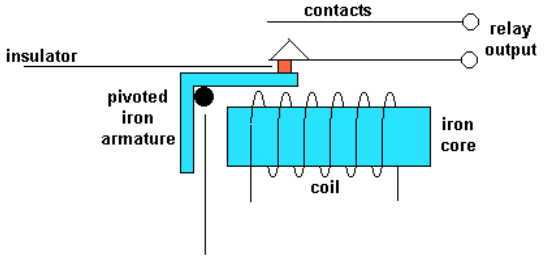
3.2. BLOCK DIAGRAM



3.1 Block Diagram

3.3 HARD WARE COMPONENTS

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, it can be considered to be, in a broad sense, a form of an electrical amplifier.



3.2 Relay Module

Relays are usually SPDT (single pole double through switch) or DPDT (double pole double through switch) but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available.

3.3.1 Basic Operation of Relay

An electric current through a conductor will produce a magnetic field at right angles to the direction of electron flow. If that conductor is wrapped into a coil shape, the magnetic field produced will be oriented along the length of the coil. The greater the current, the greater the strength of the magnetic field all over other factors being equal.

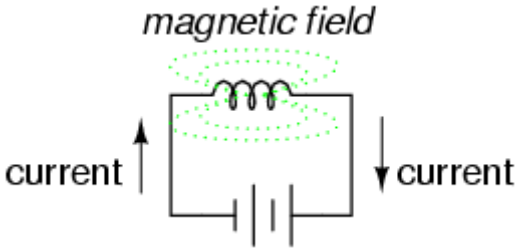


Fig 3.3:- Magnetic Field Production

Inductors react against changes in current because of the energy stored in this magnetic field. When we construct a transformer from two inductor coils around a common iron core, we use this field to transfer energy from one coil to the other. However, there are simpler and more direct uses for electromagnetic fields than the applications we've seen with inductors and transformers. The magnetic field produced by a coil of current-carrying wire can be used to exert a mechanical force on any magnetic object, just as we can use a permanent magnet to attract magnetic objects, except that this magnet (formed by the coil) can be turned on or off by switching the current on or off through the coil.

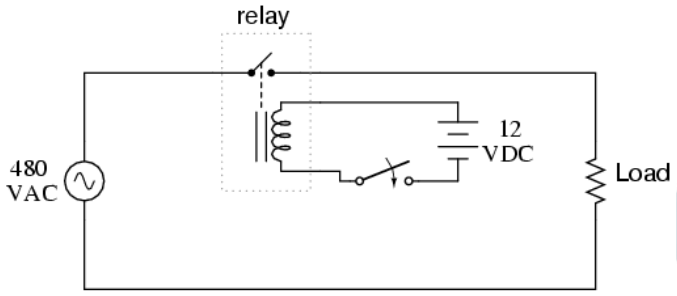


Fig 3.4:- Relay Circuit

If we place a magnetic object near such a coil for the purpose of making that object move when we energize the coil with electric current, we have what is called a *solenoid*. The movable magnetic object is called an *armature*, and most armatures can be moved with either direct current (DC) or alternating current (AC) energizing the coil. The polarity of the magnetic field is irrelevant for the purpose of attracting an iron armature. Solenoids can be used to electrically open door latches, open or shut valves, move robotic limbs, and even actuate electric switch mechanisms and is used to actuate a set of switch contacts.

3.3.2 Different Categories in Relays

1. **Neutral Relays:**

   This is the most elementary type of relay. The neutral relays have a magnetic coil, which operates the relay at a specified current, regardless of the polarity of the voltage applied.

2. **Biased Relays:**

   Biased relays have a permanent magnet above the armature. The relay operates if the current through the coil winding establishes a magneto-motive force that opposes the flux by the permanent magnet. If the fluxes are in the same direction, the relay will not operate, even for a greater current through the coil.

3. **Polarized Relays:**

   Like the biased relays, the polarized relays operate only when the current through the coil in one direction. But there the principle is different. The relay coil has a diode connected in series with it. This blocks the current in the reverse direction.

   The major difference between biased relays and polarized relays is that the former allows the current to pass through in the reverse direction, but does the not operate the relay and the later blocks the current in reverse direction. You can imagine how critical these properties when relays are connected in series to form logic circuits.

4. **Magnetic Stick Relays or Perm polarized Relays:**

   These relays have a magnetic circuit with high permanence. Two coils, one to operate (pick up) and one to release (drop) are present. The relay is activated by a current in the operate coil. On the interruption of the current the

armature remains in picked up position by the residual magnetism. The relay is released by a current through the release coil.

5. **Slow Release Relays:**

These relays have a capacitor connected in parallel to their coil. When the operating current is interrupted the release of relay is delayed by the stored charge in the capacitor. The relay releases as the capacitor discharges through the coil.

6. **Relays for AC:**

These are neutral relays and picked up for A.C current through their coil. These are very fast in action and used on power circuits of the point motors, where high current flows through the contacts. A normal relay would be slow and make sparks which in turn may weld the contacts together.

All relays have two operating values (voltages), one pick-up and the other drop away. The pick-up value is higher than the drop away value.

3.3.3. Applications

- To control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers.
- To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile.
- To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays).
- To isolate the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains powered device from a low-voltage switch. The latter is often applied to control office lighting as the low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors in an effort to conserve energy.
- To perform logic functions. For example, the Boolean AND function is realised by connecting NO relay contacts in series, the OR function by connecting NO contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using NC contacts. The Ladder programming language is often used for designing relay logic networks.
- Early computing. Before vacuum tubes and transistors, relays were used as logical elements in digital computers. See ARRA (computer), Harvard Mark II, Zuse Z2, and Zuse Z3.
- Safety-critical logic. Because relays are much more resistant than semiconductors to nuclear radiation, they are widely used in safety-critical logic, such as the control panels of radioactive waste-handling machinery.
- To perform time delay functions. Relays can be modified to delay opening or delay closing a set of contacts. A very short (a fraction of a second) delay would use a copper disk between the armature and moving blade assembly.

3.3.4. LDR (Light Dependent Register)

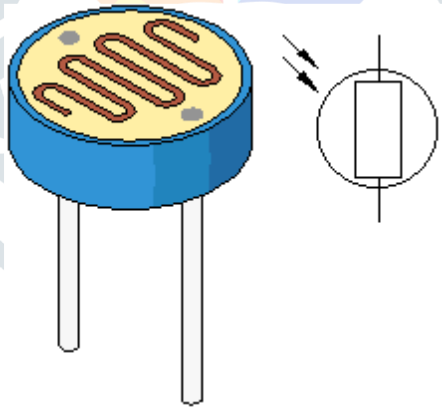


Fig 3.5:- LDR

3.3.5. Introduction

A photo resistor or Light Dependent Resistor or CdS (Cadmium Sulphide) Cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons don't have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

3.3.6. Cadmium Sulphide Cells:

(CdS) cells rely on the material's ability to vary its resistance according to the amount of light striking the cell. The more light that strikes the cell, the lower the resistance. Though not accurate, even a simple CdS cell can have a wide range of resistance from less than 100 Ω in bright light to in excess of 10 MΩ in darkness.

Standard cadmium based LDRs have a frequency response that varies according to light level, but typical fall times range from 15ms to 25ms and typical rise times range from 50ms to 70ms, so they may be unsuitable for data links and picture scanning.

Probably the best known LDR is the ORP12. Smaller cheaper devices are more popular today.

3.3.7. A sample LDR light sensor circuit:

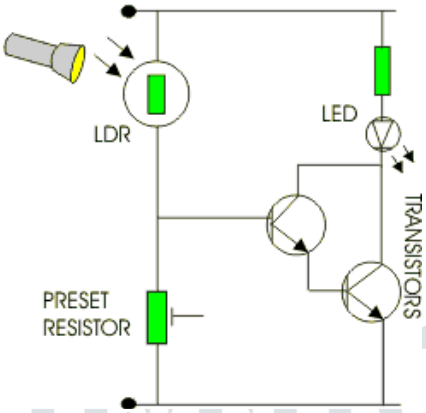


Fig 3.6:- LDR Circuit

When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.

3.3.8. Applications

1. Photo resistors come in many different types. Inexpensive cadmium sulphide cells can be found in many consumer items such as camera light meters, clock radios, security alarms, street lights and outdoor clocks.
2. They are also used in some dynamic compressors together with a small incandescent lamp or light emitting diode to control gain reduction.
3. Lead sulphide and indium antimonite LDRs are used for the mid infrared spectral region.
4. Ge:Cu photoconductors are among the best far-infrared detectors available, and are used for infrared astronomy and infrared spectroscopy

3.3.9 PIR SENSOR

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation. For numerous essential projects or items that need to discover when an individual has left or entered the area. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface with.

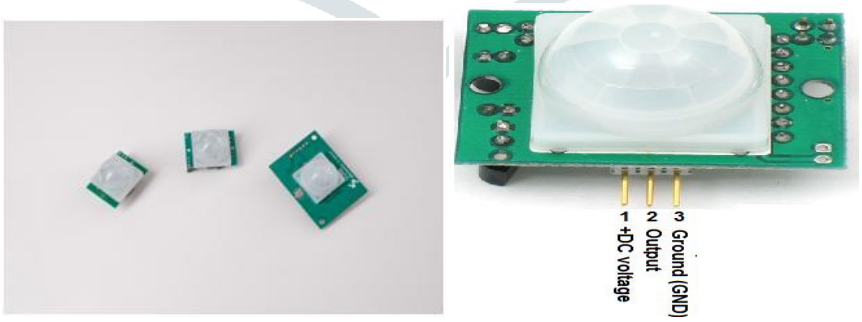


Fig 3.7:- PIR Sensor Module

Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. Sometimes bigger modules don't have direct output and instead just operate a relay which case there is ground, power and the two switch associations. Interfacing PIR with microcontroller is very easy and simple. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again. The PIR sensor needs a warm-up time with a specific end goal to capacity fittingly. This is because of the settling time included in studying nature's domain. This could be anyplace from 10-60 seconds.

IV. RESULTS AND DISCUSSION

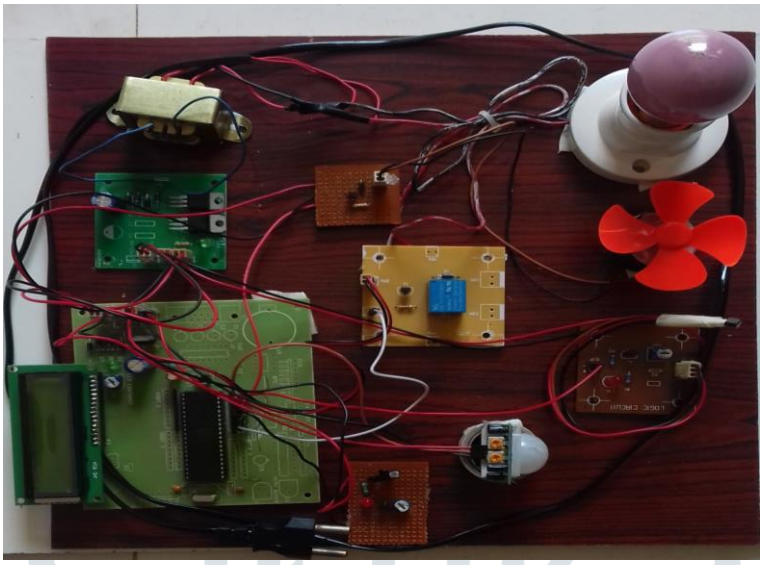


Fig 4.1:- Snapshot of the Project Kit

4.1. RESULT

The result shows the developed system is useful for controlling the household appliances automatically by using sensors successfully.

4.2. ANALYSIS

Controlling of loads is done automatically according to person's requirement.
Wastage of energy is reduced in this process. Hence, electricity bills are also reduced.

4.3. FUTURE SCOPE

Future of Automation: Future will be of Automation of all products. Each and every product will be smart devices that we use daily and that will be controlled through a smart chip called microcontrollers. Each and Every home appliances will be controlled either by PC or hand held devices like PDA or mobile handsets. Some examples of it are when you want you can switch on/off Fan of your home by mobile handset or PC.

4.4. CONCLUSION

The microcontroller based control scheme has been developed for the control of DC motor and LEDs. The demonstrated project used Passive infrared sensor to count the attendance and based on that microcontroller controls light and fan. Sensor LM35 (-55°C to +150°C) senses the temperature of the room and based on that microcontroller controls the motor fan. The home appliances include light & fan control system algorithm provides high efficiency, low noise and low power consumption. The system requires only 5V dc voltage. The work includes knowledge regarding architecture of microcontroller. Hardware and software implementation provide the work more acceptable as the cost is less and other features are more useful. The work can be harmonious with some other equipment to employ in case of greater place such office and industry.

REFERENCES

[1]. http://en.wikipedia.org/wiki/Smart_grid accessed on10-Aug-2012

[2]. http://www.netl.doe.gov/smartgrid/referenceshelf/whitepapers/AMI%20White%20paper%20final%20021108%20%282%29%20APPROVED_2008_02_12.pdf accessed on 05-Aug -2012.

[3]. http://www.eetasia.com/ART_8800638918_765245_NT_6c0a1ec2.HTM accessed on 13-Aug-2012.

[4]. http://www.smartmeters.com/the-news/3449-zigbee-allianceexamining-japans-new-smart-home-recommendations.html accessed on 13-Aug-2012

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