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Home Appliance Based Device Monitoring and Control Inputting Through Capacitive Touch

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ABSTRACT
Home automation meant to reduce human efforts and also provides energy efficiency and time saving. The aim is to develop a device that allows for a user to control and monitor multiple appliances like fan, light and HVAC system through capacitive touch. The major design is involved with the adjustment of Fan speed and the intensity of the light can be controlled by inputting through capacitive touchpad. The system involves in establishment of device control and monitoring in manual and automatic control. Rather than the on and off condition the device can be controlled based on speed variation and intensity variation. If overload occurs in the device then the device could be turned off automatically. The load in the device is measured by using current sensor. Based on the intensity in the room the light can be dimmed and based on the room temperature the speed of fan could be also adjusted automatically and also inputted through capacitive touch panel to control the devices. The light intensity and temperature in the environment is measured by light dependent resistor (LDR) and temperature sensor of lm35 respectively. The PWM is used to vary the intensity and speed of the devices. The temperature, current and the intensity of the devices are measured and Zigbee communicates over the device and ARM LPC2148 to invent the control and monitoring of devices.

Keywords:- ARM-LPC2148, Capacitive touch panel, LM35, LDR, Current sensor, Zigbee.

I. INTRODUCTION\

Home Automation provides the ease of using appliances and convenience to control and monitor the appliances remotely. Internet, Mobile phone and wireless technology makes it easy to access and control the appliances. Home automation integrates devices with each other. It provides improved convenience, comfort, energy efficiency and security. There are various system used in home automation, which may be controlled wirelessly or by a hard-wired system connected to the home's electrical grid. This implementation is mostly present in older systems. In newer home automation schemes, the various devices can be connected to home network and controlled by personal computer and can be remotely accessed through internet it is made through the concept of internet of things. The wireless communication also allows controlling the devices remotely.

Most of the wireless communication used is GSM, Bluetooth and ZIGBEE. Home automation eliminates the wiring complexity and also involves with power saving of the devices. A lot of methods have been developed for device monitoring and control. Some of the methods involved only with on and off condition to the devices. Physical communication between the devices is required in some of the methods. Voice control over the devices is also used. Home automation is based on different control systems, they are discussed as follows. The Individual control systems used in earlier years to control the appliances like heater or air conditioner based on individual control dedicated to it. The distributed control systems are used to preset or change the control parameters of several similar devices. These systems are used to switch on and off of the devices. The distributed control systems have the main feature of emergency shut-down. The central control systems are computerized systems programmed to handle all functions of multiple utilities like air conditioning system, home entertainment, cooking systems, doors and windows control. Many appliances can be controlled at the same time either directly or can be controlled remotely. The control system can be connected through telephone or internet from anywhere in the world.

The power line carrier systems is used to control the appliances through the power line with the X.10 controller. The wireless systems are used with the radio frequency of many protocols like Bluetooth, Zigbee and RFID. The hardwired control systems are reliable and expensive. The hard wired systems can perform more tasks at a time with

reliability. It can able to integrate many appliances to be efficiently controlled. The internet protocol control systems uses the internet, it gives each device under its control with the IP address and creates a local area network in the home. It gives the real time control of the devices. Thus home automation could be implemented with different type of control systems which provides the climate control, door and window control, light, fan and HVAC systems. The new stream of home automation systems has developed into a vast one and the current market is flooded with a furry of home automation systems and device manufactures.

II. LITERATURE REVIEW

` R. Chutia B *et al* [1] this paper presents the appliance is controlled through GSM technology, where SMS is sent to control the device remotely. The system is wireless and uses mobile handset. Commands are sent as messages. Remotely, the system allows the homeowner to monitor and control his house appliances via his mobile phone set by sending commands in the form of SMS messages and receiving the appliances status as well. This system provides ideal solution to the problems caused in situations when a wired connection between a remote appliance/device and the control unit might not be feasible. The system is wireless and uses the user's mobile handset for control and therefore the system is more adaptable and cost-effective. The system uses GSM technology thus providing ubiquitous access to the system for appliance control.

Jaypal J. Baviskar, *et al* [2] presented a design where Zigbee is used as the wireless communication medium. The power utilization of the devices is manipulated. The system demonstrates the designing and implementation of HAS for remote controlling and monitoring of various domestic loads/appliances using ZigBee protocol. The system using Zigbee protocol is divided into two parts viz. User Control Unit (UCU) and Home Automation Controlled Unit (HACU). The UCU mainly consists of User terminal and ZigBee RF module interfaced with PC via UART (Universal Asynchronous Receiver/Transmitter) port. An efficient method of power utilization through real-time power monitoring with the help of a PC-based GUI application is illustrated.

Muhammad Izhar Ramli *et al* [3] proposed a system where web plays an important role to control almost every electrical device connected to internet that enable the user can control. Home control network is designed to control all electronic appliance and Information appliance in the home environment. The main function of home control network is to make all the electronic appliance can be controlled and can share information with one another. Using Internet access, home owners can remotely monitor and control almost any appliance at home. The development of web-based controller for control electrical device is designed. The system is developed using Microsoft Visual Studio and DOTNET. Security is imposed when logging into the system using active server pages by the user. The rapid growth of the World Wide Web, has made the web is not just use for delivering information. This will assist in energy safety, and security. For this prototype, the server is set with auto restart if the server condition is currently down. The extension of the technology in web is used to deliver signals. The smart home concept in which web plays an important roles to control almost every electrical devices connected to internet that enable the user can control it everywhere. The web-based controller is developed to control electrical device. The prototype as the future advancement intends to develop the system to include SMS module so that controlling can be done through SMS from the hand held device.

Yavuz Erol *et al* [5] implemented Secure PIC based remote control system to safely control electricity operated domestic devices by the help of public or mobile phones from any places all over the world. Developed remote control device has been optically and electrically isolated to secure the system. Controller detects the number of ringing, then decodes DTMF signal and then checks pin numbers which are entered. When the pin numbers have been entered correctly, the controller gives to right to control devices. The command transmitted through telephone line or electromagnetic waves as DTMF signal.

Rifat Shahriyar *et al* [6] proposed a system to control the home appliances through mobile phone can communicate with the computer or microcontroller. The remote home appliance controller is employed in the system to access the device. The home appliances in the smart home using mobile phones can be controlled from anywhere. The X10 Active Home Pro is used to take care of the real appliance control mechanism once fed enough input to it. The home computer is responsible to receive the commands from the mobile phone and to forward the commands in appropriate format to the X10 controller. The communication protocol required and compatible to the mobile is used to communicate the commands in the system. X10 works across home power lines. The mechanism to the ordinary services of the mobile phones can be leveraged to communicate with and control the home appliances.

H Malik Sikandar Hayat Khiyal *et al* [7] proposed system SMS based and uses wireless technology to control device. It have three components of PC, GSM modem, mobile device. The PC have two subsystems; one being appliances control is responsible for ubiquitous access of appliances and the second subsystem being security alert is responsible for security intrusion detection. GSM modem is a plug and play device and is attached to the PC which then communicates with the PC via RS232 port. Both subsystems work on GSM technology for transmission of instructions from sender to receiver. GSM modem is a bridge responsible for enabling disabling of SMS capability. The system is wireless therefore more adaptable

and cost-effective. The HACS system provides security against intrusion as well as automates various home appliances using SMS. The system uses GSM technology thus providing ubiquitous access to the system for security and automated appliance control. Mobile device communicates with the GSM Modem via radio waves. The mode of communication is wireless and mechanism works on the GSM technology. Cell phone has a SIM card and a GSM subscription. This cell phone number is configured on the system. User transmits instructions via SMS and the system takes action against those instructions.

The Home automation control are implemented with several methods by using telephone line, SMS based control, internet of things, voice commands and by wireless protocols. For the ease of user interface the android applications are also developed to access the appliances.

III. PROPOSED SYSTEM

The home appliances like fan and light are controlled manually and automatically based on the intensity of light and temperature in room. In manual control the intensity and the speed can be inputted through capacitive touch panel. Based on the capacitance measured by detecting the touch the control of devices is performed. In the automatic control of the devices there are two parameters considered to do the control of devices. Based on the light intensity and temperature the light can be dimmed and speed of fan can be controlled respectively. The LDR detects the changes in light intensity and the temperature sensor of LM35 is used to measure the temperature changes. Additionally the overload occurred in the device is monitored by the current sensor and the device is turned off automatically by relay. The Pulse Width Modulation [PWM] is used to vary the intensity and speed of the devices. The temperature, Current and the intensity parameters are measured and zigbee communicates over the capacitive touch panel and ARM LPC2148 to invent the control over the devices.

IV. BLOCK DIAGRAM

The proposed system have transmitter and the receiver units in which the transmitter section Fig.1 is the capacitive touch panel interfaced with the ARM LPC2148 and the input to the capacitive touch panel are transmitted to the receiver section by the zigbee transceiver. Based on the input received from the transmitter light intensity and the speed of the fan is adjusted manually. For the automatic control of the devices the light dependent resistor is used to detect the intensity variation and the light can be dimmed, the temperature sensor of LM35 is used to measure the temperature and based on the temperature changes the speed of the fan is varied. The pulse width modulation is used to vary the light intensity and fan speed. The overload occurred can be detected by the current sensor and the device is turned off automatically by relay.

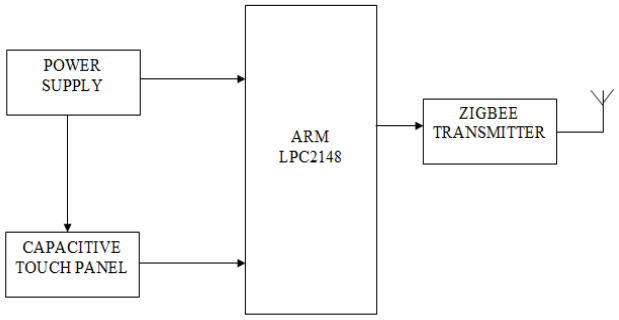

Fig.1 Block Diagram Of Transmitter

The block diagram for the receiver unit is with the interface of sensor units comprises of light dependent resistor and the temperature sensor of LM35 and the current sensor.The zigbee receiver is interfaced with ARM LPC2148 to control the speed of the fan and intensity of the light.
The block diagram for the receiver unit is shown in the Fig.2 as follows

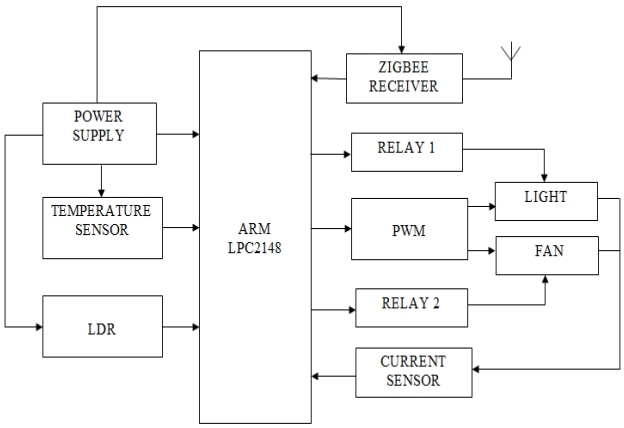

Fig.2 Block Diagram Of Receiver

4.1 Capacitive Touch Panel

Today's more advanced touch pads use capacitive technology, which does not require any actuation force, but instead reacts to the electrical fields that are affected by human fingers. Capacitive interfaces require a gentle touch to activate each button. The system that recognizes the position of a finger due to the sensor feeling changes in the electrostatic capacitance (electrical charge) generated when a finger touches a touch panel screen. Capacitive touch pads also make it possible to produce interfaces with a glass or a polycarbonate surface, which are not only more visually appealing to users, but also more rugged and much easier to clean. Electric fields

generated by the capacitive switch react to the users touch where pressed. The action disrupts the electric field, and the embedded software then controls the appliance based on which keys the user pressed.

Fig.3 Capacitive Touch Panel

4.2 LPC2148 Controller

LPC 2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kb to 512 kb. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 percentages with minimal performance penalty.In-System Programming/In-Application Programming via on-chip boot Loader software. Single flash sector or full chip erase in 400 ms and programming of 256 B in 1 ms. Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.USB 2.0 Full-speed compliant device controller with 2 kb of endpoint RAM.

In addition, the LPC2148 provides 8 kb of on-chip Random Access Memory accessible to USB by Direct Memory Access. One or two 10-bit ADCs provide a total of 6/14 Analog inputs, with conversion times as low as 2.44 ms per channel. Single 10-bit DAC provides variable analog output. Two 32-bit timers/external event counters (with four capture and four compare Channels each), Pulse Width Modulation unit (six outputs) and watchdog .Low power Real-Time Clock with the
Independent power and 32 kHz clock input. The LPC 2148 incorporate a 32 kb, 64 kb, 128 kb, 256 kb and 512 kb flash memory system respectively. This memory may be used for both code and data storage. Programming of the flash memory may be accomplished in several ways. It may be programmed In System via the serial port. The application program may also erase and/or program the flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc. Due to the architectural solution chosen for an on-chip boot loader, flash memory available for user's code on LPC 2148 is 32 kb, 64 kb, 128 kb, 256 kb and 500 kb respectively.

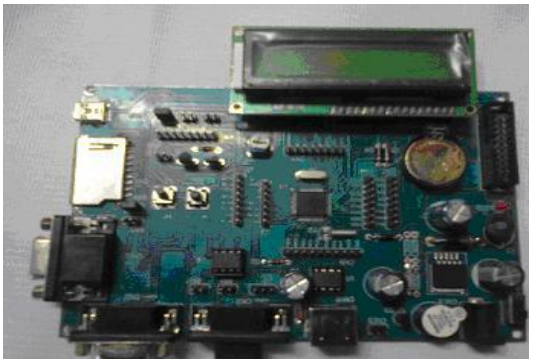

Fig.4 LPC2148 Controller

4.3 Light Dependent Resistor

An LDR is a component that has a resistance that changes with the light intensity that falls upon it. They have a resistance that falls with an increase in the light intensity falling upon the device. Electronic opto sensors are the devices that alter their electrical characteristics, in the presences of visible or invisible light. The best-known devices of this type are the light dependent resistor (LDR), the photo diode and the phototransistors.
Light dependent resistor as the name suggests depends on light for the variation of resistance.

- LDR are made by depositing a film of cadmium sulphide or cadmium selenide on a substrate of ceramic containing no or very few free electrons when not illuminated. The film is deposited in a zig zag fashion in the form of a strip. The longer the strip the more the value of resistance.
- When light falls on the strip, the resistance decreases.

In the absence of light the resistance can be in the order of 10K ohm to 15K ohm and is called the dark resistance.
The below figure shoes that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it is shown in Fig.5

Fig.5 Light Dependent Resistor

The basic construction and symbol for LDR are shown in above figures respectively. The device consists of a pair of metal film contacts. Separated by a snakelike track of cadmium sulphide film, designed to provide the maximum possible contact area with the two metal films. The structure is housed in a clear plastic or resin case, to

provide free access to external light.

4.4 Temperature Sensor

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ºC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 ºC temperature rise in still air. The LM35 series 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. The LM35 does not require any external calibration.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ºC rise/fall in ambient temperature,*i.e.*, its scale factor is 0.01V/ ºC.

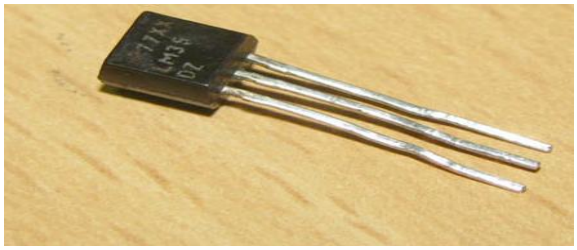

Fig.6 Temperature Sensor of LM35

4.5 Current Sensor

A current sensor is a device that detects electrical current (AC or DC) in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose. The Hall effect is the production of a voltage difference (the Hall voltage) across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. It was discovered by Edwin Hall in 1879. The Hall coefficient is defined as the ratio of the induced electric field to the product of the current density and the applied magnetic field. It is a characteristic of the material from which the conductor is made, since its value depends on the type, number, and properties of the charge carriers that constitute the current.

Fig.7 Current Sensor

4.6 Zigbee

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15.4 standard. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. There have been a multitude of proprietary protocols for control applications, which bottlenecked interfacing. Need for a widely accepted standard for communication between sensors in low data rate wireless networks was felt. As an answer to this dilemma, many companies forged an alliance to create a standard which would be accepted worldwide. It was this ZigBee Alliance that created ZigBee.

Fig.8 Zigbee

V. WORKING MODEL

The system is simulated in proteus for the phase-I. The intensity of the light and the speed of the fan are controlled based on the pulse width modulation. In phase-I of project LPC 2148 ARM based microcontroller is programmed in keil uvision4 compiler. Proteus is used to co-simulate the implementation of the system in ARM LPC2148. Based on the pulse width modulation the light intensity and speed is varied.

The speed variation of fan with ninety percentage of duty cycle is shown in the Fig.9

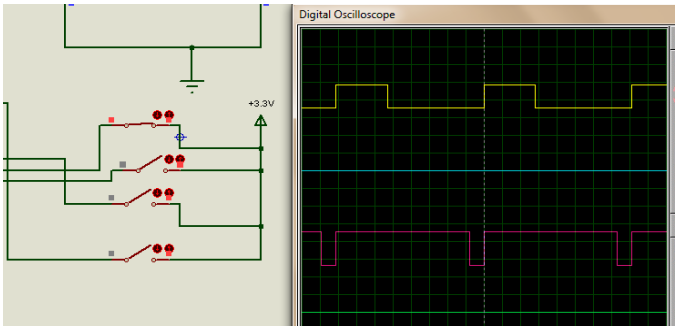

Fig.9 Speed Variation Of Fan With Ninety Percentage Of Duty Cycle

The light intensity variation with the 45% of duty cycle is shown in the Fig.10

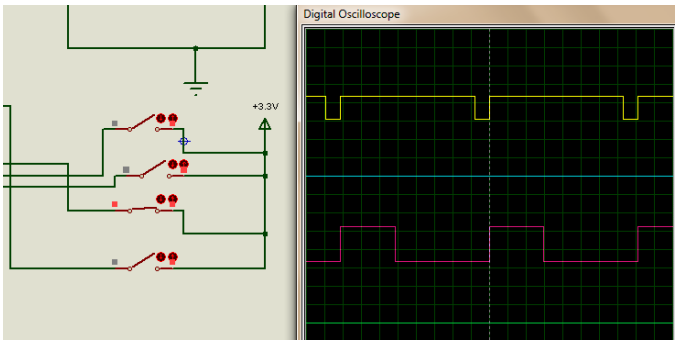

Fig.10 Intensity variation Of Light With Forty Five Percentage Of Duty Cycle

The automatic control depends on the temperature and the intensity. According to the temperature changes the speed of the varied and it is shown in the Fig.11 with the pulse width modulation output.

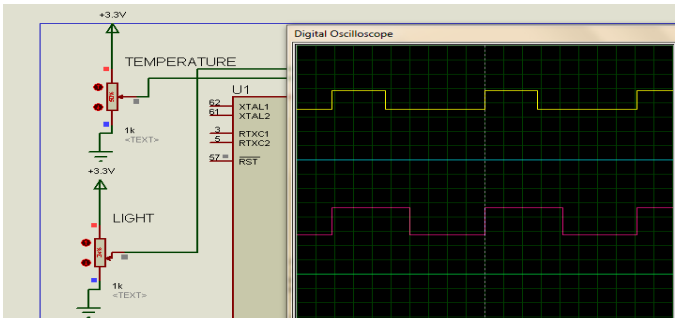

Fig.11 Speed Adjustment Of Fan According To Temperature

The light can be dimmed automatically based on the intensity changes detected by the LDR and the output is shown in the Fig.12 as follows

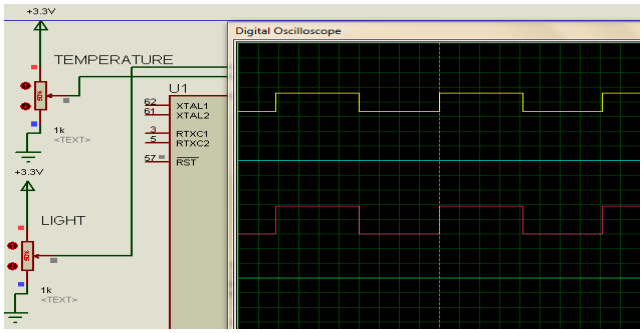

Fig.12 Dimming Of Light According To Intensity

The overload occurred is measured by the current sensor and the device can be turned off automatically. The current measured in the device is shown in the Fig.13

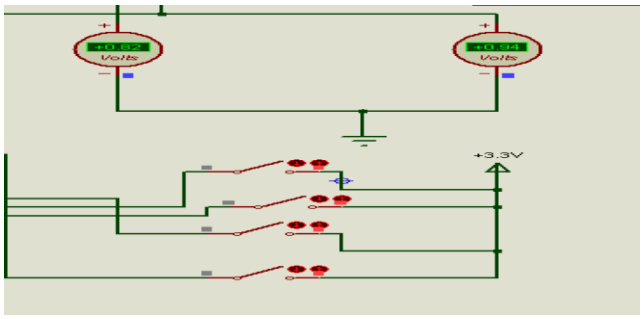

Fig.13 Current Consumed By Devices

VI. CONCLUSION

This paper describes the control of the home appliances like fan and light through input from the capacitive touch panel. The access to the home appliance can be controlled manually and automatically. The system integration is based on wireless control. The automatic control of the device is based on the temperature and intensity changes. Additionally the overload in the device can be detected and the device can be turned off automatically. The user can able to adjust the speed of fan and light variant according to their wish. The system of device control and monitoring provides the ease of user interface to access the appliances and it replaces many of the existing system to turn on and off the appliances and mechanical switches are replaced.

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