

Monitor and Control using Virtual Switch Technology

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Abstract— This paper presents a way of replacing mechanical switches by Virtual Switch technology. It mainly aims in designing a virtual switchboard with the help of Laser and LDR which can be used as a replacement of the mechanical switches. Mechanical switches produces sparks and after some span of time they get damaged. As the mechanical switches have limited use they need to be replaced and a better option is using Virtual Switches. We have created an assembly of Virtual Switches which can be used to monitor and control various electrical appliances at home and industrial parameters in industries. Microcontroller used is atmega 16 and Zigbee is used for wireless communication.

Keywords— control, monitor, virtual switch, zigbee.

I. INTRODUCTION

Automation has revolutionized human life at great extent. Automation is the use of control system and information technologies to provide comfort to the human beings.[1]The need for more and more comfort has brought many developments in the existing technologies. Monitoring and controlling electrical devices is becoming an extremely important factor in the development of even-more powerful embedded market. Speech input can be used to automate electrical devices but it has many complexities. The main difficulty is speech recognition. If the voice signal stored in the database of the speech controlled system does not match with the user's voice signal then the system fails. Hence due to its limited reliability, robustness, and flexibility speech signal proves to be unsuitable for certain tasks and environments. The another system is SMS controlled but it fully depends on mobile network, if there is no network then the system fails to work [2]. Considering the disadvantages of the above systems we decided to create an assembly of Virtual Switches to monitor and control various electrical appliances at home and industrial parameters in industries. Virtual Switch technology is one such technology that has greater importance due to its user-friendly nature and low cost

Due to the development in wireless technology, there are several wireless connection available such as GSM, WIFI, ZIGBEE, and Bluetooth. Each one of them has their own unique specifications and applications[3]. Out of which we are using Zigbee wireless communication protocol for operating electrical appliances. Zigbee is a short range wireless communication protocol which has low power, low data rate and, low cost.[4]. The heart of our system is AVR architecture based ATMEL corporation's ATMEGA 16. It is used for controlling our entire system. This is one of the leading and the most widely used devices in the field of embedded systems and control industry. For powering up the whole system we are using transformer based regulated supplies. A single transformer of 12 volt 1 amps or a regulator powers up the whole circuit further we have derived +5 volts for our controller from a second dc to dc converter based on 7805 regulator.

II. SYSTEM OVERVIEW

The proposed system consists of two units first one is the Virtual Switch Unit and the second one is the Control Unit. The Virtual Switch Unit is an assembly of Laser and LDR. The Control Unit consist of electrical devices and various industrial parameters to be controlled and monitored. The system consist of two microcontrollers, the controller in the Virtual Switch Unit is interfaced to Zigbee transmitter and the controller in the Control Unit is interfaced with Zigbee receiver and electrical appliances to be controlled. So there are two controllers one in the Virtual Switch unit and the other one in the Control unit. The Virtual Switchboard, takes the input from the user and provides the same to the microcontroller. Microcontroller will send the information to Zigbee receiver using Zigbee transmitter. The microcontrollers in both the units are connected through zigbee wireless communication protocol.

III. HARDWARE DESIGN

The system consists of following blocks:

LASER: LASER stands for Light Amplification by Stimulated Emission of Radiation. It emits a coherent beam of light.

LDR: LDR stands for Light Dependent Resistor. It is sensitive to light. Voltage is developed across LDR in presence of light. LDRs or Light Dependent Resistors are very useful especially in the sensor circuits. The resistance of an LDR is very high but when the light falls on them, the resistance drops drastically and voltage difference is produced.

So using LASER and LDR pair different voltage combinations can be produced. Laser and LDR are interfaced together to form a matrix of Virtual Switchboard. We have used six Lasers and six LDRs to form 3*3 matrixes of Virtual Switches. Across the LDR we have connected a resistance in series hence when at a point finger is touched the corresponding resistance of the resistor varies and it creates particular voltage difference. This event is registered as a touch. The fig 1 shows the block diagram of Virtual Switch Unit.

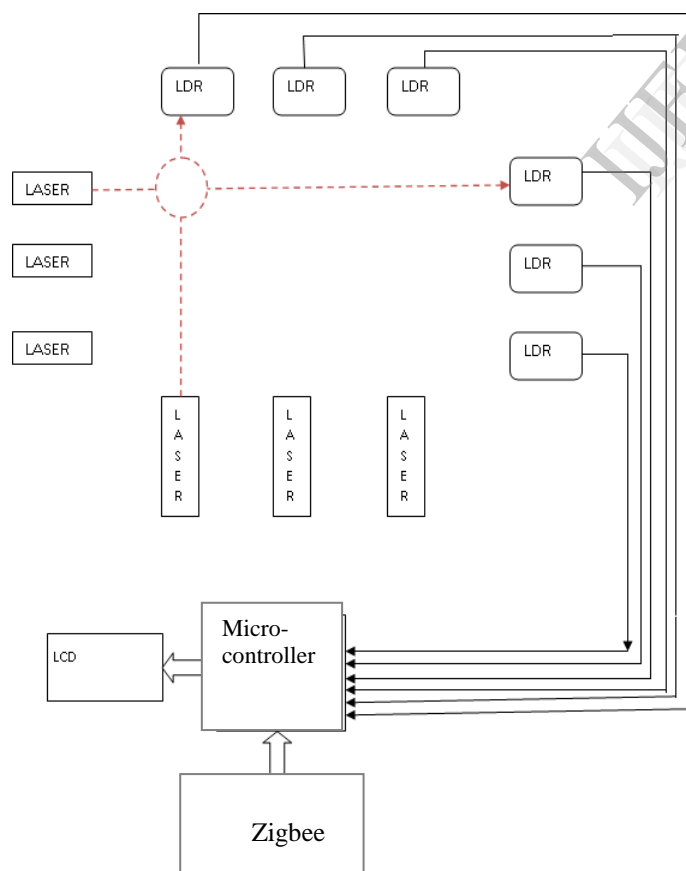


Fig 1. Block diagram of Virtual Switch Unit

MICRO-CONTROLLER: The microcontroller used is AVR (Atmega16). The Atmega16 is a low-power CMOS (Complementary MOSFET), 8-bit controller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1MIPS, 1MHZ allowing the system designed to optimize power consumption vs. designer speed.

So in order to establish a master control a complete master board comprising ATMEGA 16 is designed. It has high performance and requires low power. It will control all actions required for measuring and controlling purposes.

FEATURES OF ATMEGA 16:

- It is an 8-bit processor ,i.e., the CPU can work on only 8 bits of data at a time
- It has
 - ✓ 1K bytes of SRAM
 - ✓ 512 bytes of EEPROM
 - ✓ Two 8 bit timers/counters
 - ✓ One 16 bit timer/counter
 - ✓ Four I/O ports, each 8 bits wide
 - ✓ 5 V Operating voltage from 0 to 40 MHz
 - ✓ 16 K bytes of on-chip Flash program memory with ISP (In-System Programming)
 - ✓ SPI (Serial Peripheral Interface) and programmable serial UART
 - ✓ Four 8-bit I/O ports with three high-current Port 1 pins (16 mA each)
 - ✓ Programmable Watchdog timer (WDT)
 - ✓ On chip analog comparator
 - ✓ External and internal interrupt sources
 - ✓ Power-on reset and programmable Brown-out detection
 - ✓ Internal calibrated RC oscillator
 - ✓ TTL- and CMOS-compatible logic levels
 - ✓ Low power modes
 - ✓ PDIP40 and TQFP44 packages

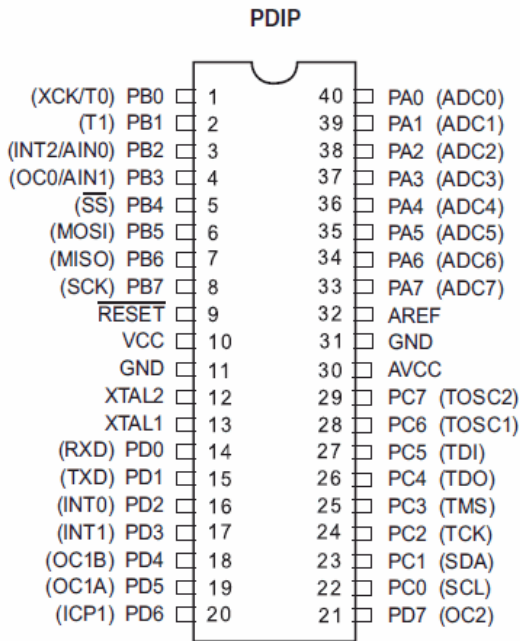


Fig 2.Pin diagram of atmega16

ZIGBEE: It provides wireless platform .It is based on an IEEE 802.15 standard. It is a low powered technology. Its distance of operation is much more than Bluetooth and Wi-Fi .It has data rate of 250 kbit/s .The zigbee module is simpler and less expensive than other modules for wireless communication.

SENSORS: It performs sensing action .For example we are using humidity sensor and temperature sensor. If in case the temperature in the house or in the industry rises then the temperature sensor will detect the surrounding temperature and give it to the microcontroller In case of Fire in the house the temperature will automatically rise, in order to detect this a temperature sensor is being used which will detect the temperature of the surrounding and give it to the microcontroller. An ATmega16 AVR microcontroller is used to carry out all the monitoring and controlling action. It has an in-built analog to digital converter; hence an external ADC is not required for converting the analog temperature into digital value. We are using low cost temperature sensor LM35 for sensing the ambient temperature. The temperature can be sensed using the sensor IC and will be displayed on LCD. The temperature is compared with the desired temperature as set by the user and the necessary controlling action will be carried out.

LCD: LCD stands for Liquid Crystal Display it will show level of various parameters. LCD is used to display the data. LCD we have used is 16x2 i.e. 16 characters in 1 line, total 2lines are there. We could have used a better resolution LCD but due to limitation of money and for project requirement 16x2 LCD is sufficient. This LCD has 8-bit parallel interface. It is possible to use all 8 bits plus 3 control signals or 4 bits plus the control signals. It requires +5V to operate It is connected to port 2 of microcontroller. It acts as an output to

microcontroller. It uses ASCII values to display the characters

RELAY CIRCUITRY: A Relay is an electrically connected and mechanically isolated switch .It is used for On-Off of different control actions. Relays are used as electromechanical switch. . As we are using relays which turn on at the zero crossing of the ac mains cycle, it reduces the startup surges and increases the life cycle of contacts and devices. [5]

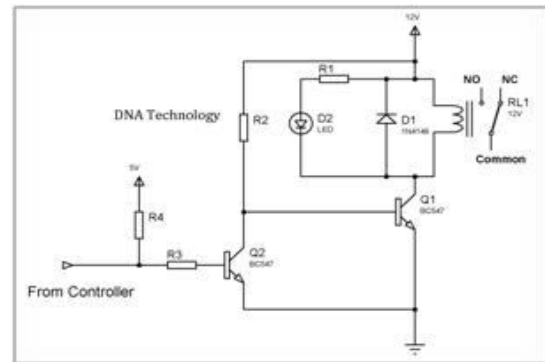


Fig 3. Relay driver circuit

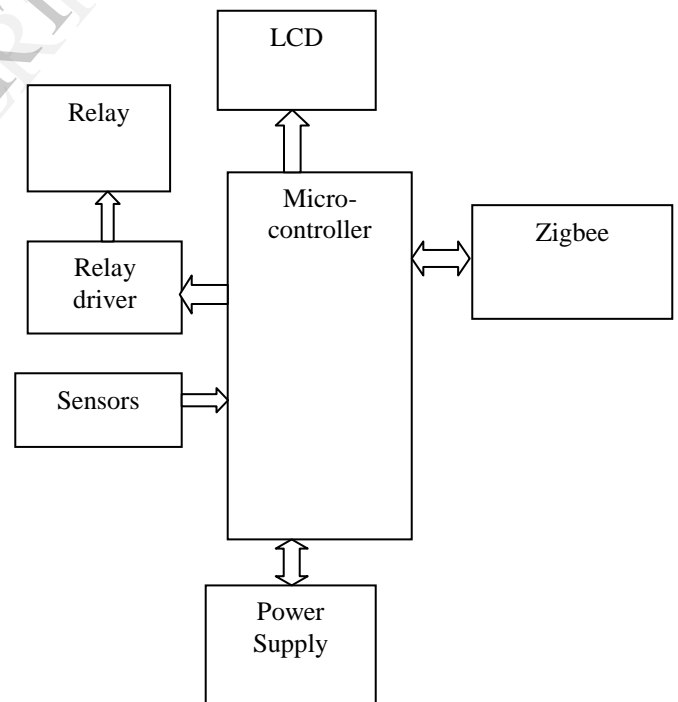


Fig 4: Block Diagram of Control Unit.

IV. WORKING:

LASERs and LDRs are interfaced together to form a matrix. In this project we develop a 3*3 matrix format. Each cell of matrix provides different voltage combinations. When a finger is placed on one cell/switch it is registered as touch event and corresponding voltage is generated and provided to microcontroller. This is analog output which is needed to be digital for that purpose we require ADC. To minimize cost, AVR microcontroller (ATMEGA-16) is used that has in-built ADC.

At workplace we have interfaced sensor circuitry that senses any environmental parameter change and informs it to controller through microcontroller. On LCD display we get to know the status of parameters and as per the requirement specified in the code, microcontroller controls the parameters. LASER-LDR assembly can be carried at any place as the components are few and not bulky while sensor and control circuitry is placed at the workplace. These Virtual switch assembly and master assembly are linked through wireless bus ZIGBEE through both microcontrollers.

V. FEATURES

1. Physical switch replaced by virtual switches: The key feature of this project is that we have replaced physical switches by virtual switches. Due to this the disadvantages of mechanical switches are overcome. Mechanical switches after some span gets damaged and needs to be replaced this are avoided by using virtual switches

2. Wireless monitoring of devices from distance: The role of ZIGBEE is another important feature. Due to wireless monitoring the circuit complexity is reduced to great extent. The virtual switching technology enhances the security capability

3. Virtual Switches based user-friendly interfacing.

4. Low power consumption.

5. Controls high and low voltage devices.

6. Long life.

7. Low cost.

VI. APPLICATIONS

1. In industrial environment where combustibles are used.
2. For house hold automations.
3. In corporate sectors.

VII. RESULT & CONCLUSION

Our paper which represents a way of replacing mechanical switches by Virtual Switch is a low cost and user-friendly technology. Our prototype is working fine..

Finally the conclusion is that our prototype ATMEGA16 based home automation system is working as per design lines and each of the function described in each section is working up to our satisfaction, further this project can be easily modified as per requirement.

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