

Power Theft Detection through Zigbee

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Abstract: The idea of designing and implementing the power theft detection circuit is born with the observation in our real-life incidents happening around us. This project deals with the detection of illegal usage of electricity and promotes the authorized access of electricity. In this project one keypad is used for entering the correct password. By entering the correct password, the person can utilize the power in an authorized way. If an unauthorized person is trying to short his household wire to the power supply, the 8052-micro controller which is used in this system automatically detects and sends a warning message to authorized person as a beep sound from the buzzer and to the power station through zigbee. So, that the power supply will be disconnected. Here, LCD display board is used to display the message continuously. This will prevent the illegal utilization of electricity. Here, keil tools are used to give instructions to the microcontroller. Flash software is used for displaying the warning message on the monitor at the power station.

I.INTRODUCTION: India, the largest democracy with an estimated population of about 1.01 billion is on a road to rapid growth in economy. Energy, particularly electricity is a key input for accelerating economic growth. The theft of electricity is a criminal offence and power utilities are losing billions of rupees in this account. Power theft is the use of electrical power without any authorization. Power theft includes “Direct hooking from line” or “Bypassing the energy meter” or “inserting any foreign element into energy meter” etc. Power theft occurs when

- An illegal consumer (not a registered customer) steals directly from the distribution lines or from another legal customer.
- A legal customer (registered customer)

steals either bypassing the meter (connecting around the meter to a live cable on the company side of the meter) or tampering with the meter to make it read less or no consumption.

World losses US \$89.3 billion annually to electricity theft. The highest losses were in India (\$16.2 billion), followed by Brazil (\$10.5 billion) and Russia (\$5.1 billion).

II.ZIGBEE: ZIGBEE is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection.

A. **ZIGBEE Network:** ZIGBEE network is comprised of coordinator(C), router(R) and end devices (E). ZIGBEE supports mesh-routing. For detailed information on routing protocol employed in ZIGBEE, one may refer Ad-hoc on-demand Distance Vector Routing protocol (AODV protocol), RFC 3561.

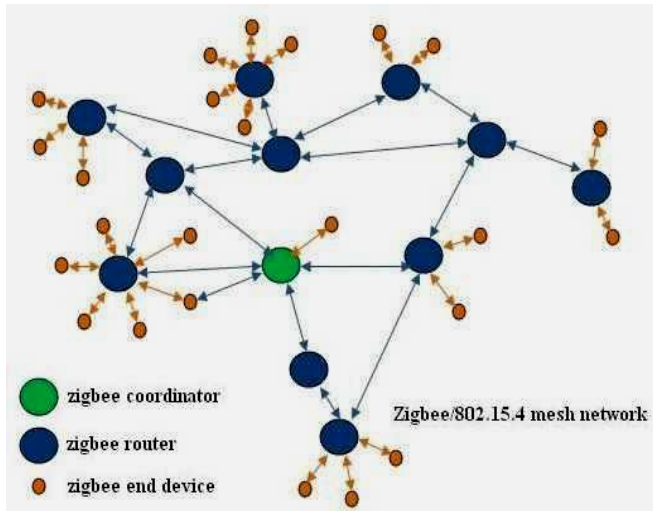


Fig 1: ZIGBEE Network:

a.Coordinator

Always first coordinator need to be installed for establishing ZIGBEE network service, it starts a new PAN (Personal Area Network), once started other ZIGBEE components viz. router(R) and End devices(E) can join the network(PAN). - It is responsible for selecting the channel and PAN ID. - It can assist in routing the data through the mesh network and allows join request from R and E. - It is mains powered (AC) and support child devices. - It will not go to sleep mode.

b.Router:

First router needs to join the network then it can allow other R & E to join the PAN. - It is mains powered (AC) and support child devices. - It will not go to sleep mode.

c.EndDevices

It cannot allow other devices to join the PAN nor can it assist in routing the data through the network. - It is battery powered and do not support any child devices. - This may sleep hence battery consumption can be minimized to great extent. There are two topologies, star and mesh, as mentioned ZIGBEE supports mesh routing. PAN ID is used to communicate between ZIGBEE devices, it is 16-bit number. Coordinator

will have PAN ID set to zero always and all other devices will receive a 16-bit address when they join PAN. There are two main steps in completing ZIGBEE Network Installation. Forming the network by Coordinator and joining the network by Routers and End devices.

B.Forming the ZIGBEE Network

- Coordinator searches for suitable RF channel which is usable and not interfering with Wireless LAN frequencies in use. This is because WLAN also operates in the same 2.4GHz bands. This is done on all the 16 channels. It is also referred as energy scan.
- Coordinator starts the network by assigning a PAN ID to the network. Assignment is done in two ways. Manual (pre-configured) and dynamic (obtained by checking other PAN IDs of networks already in the operation nearby so that PAN ID does not conflict with other networks). Here Coordinator also assigns network address to itself i.e. 0x0000.

- Now coordinator completes its configuration and is ready to accept network joining request queries from routers and end devices who wish to join the PAN. In addition to above, Coordinator(C) sends broadcast beacon request frame on remaining quiet channel. This is also referred as beacon scan or PAN scan. By this Coordinator receives PAN ID of routers(R) and end devices (E) present nearby. It also comes to know whether R/E allow join or not. Now R/E can join by sending association request to C. C will respond with association response.

III. MICROCONTROLLER: The AT89S52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using ATMEL'S high density nonvolatile memory technology and is compatible with the industry standard 80C51 and 80C52 instruction set and pin out. AT89S52 microcontroller IC is as shown in fig. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on

a monolithic chip, the Atmel AT89S52 is a powerful microcomputer, which provides a highly flexible and cost effective solution to many embedded control applications.

A. Microcontroller IC: The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, six-vector two-level interrupt architecture, Full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.



Fig 2: Microcontroller AT89S52

IV. LCD DISPLAY: Liquid Crystal Display (LCD) is a very useful medium of communication in a variety of applications, especially in consumer goods such as washing machines, microwave appliances, and VCRs, to name a few. The number of lines displayed and the number of characters displayed per line characterize LCDs into 16x2, 40x2, and 40x4 dimensions. An LCD requires a controller to control various features of its display.

An LCD with a controller is referred to as an LCD module. The following section describes one such LCD module. 16x2 LCD has 2 horizontal line which comprising a space of 16 characters. It has two type of register inbuilt that is Command register and Data Register. Command register is used to insert a special

command into the LCD. While Data register is used to insert a data into the LCD. Command is a special set of data, which is used to give the internal command to LCD like Clear screen, move to line 1 character1, setting up the cursor etc. LCD's operate as a light "valve", blocking light or allowing it to pass through. To display letters and numbers, we must send ASCII codes for the letters A-Z. An image in an LCD is formed by applying an electric field to alter the chemical properties of each LCC (Liquid Crystal Cell) in the display in order to change a pixel's light absorption.

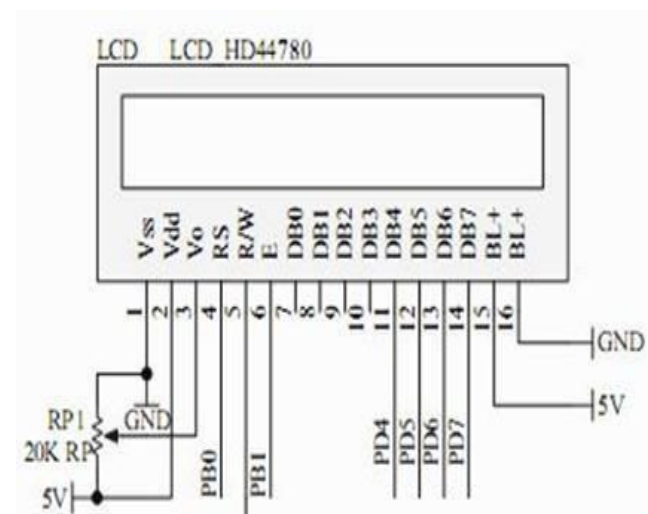


Fig 3: LCD Display

V. MAX232: The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5V.

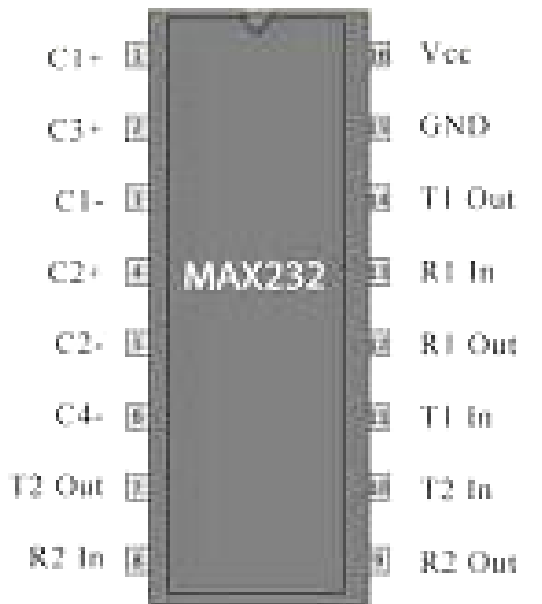


Fig 4: Pin Diagram of MAX232

When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15 V, and changes TTL Logic 1 to between -3 to -15 V, and vice versa for converting from RS232 to TTL. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ± 30 -V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels.

A. FEATURES

- Input voltage levels are compatible with standard CMOS levels
- Output voltage levels are compatible with EIA/TIA-232-E levels
- Single Supply voltage :5V
- Low input current : 0.1 μ A at TA=25°C
- Output current :24mA
- Latching current not less than 450mA at TA=25°C
- The transmitter outputs and receiver inputs are protected to ± 15 kV Air ESD.

VI. BLOCK DIAGRAM: The Block Diagram consists of a ZIGBEE module, Microcontroller, LCD Display, Buzzer, LED, Keypad, House wires.

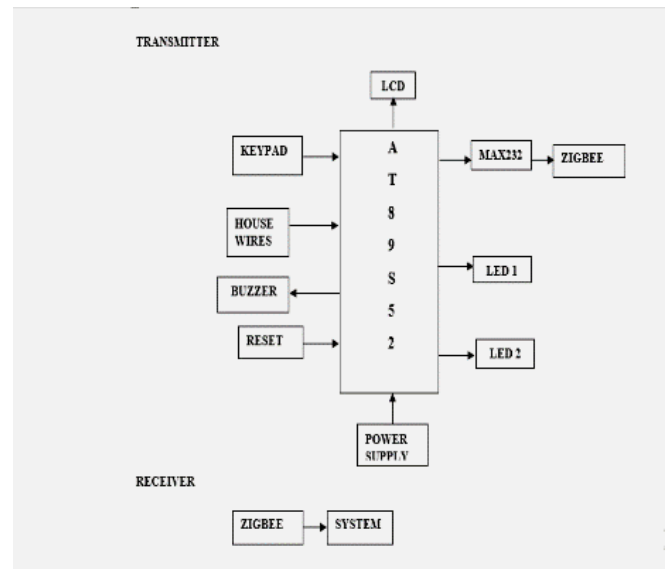


Fig 5: Block Diagram

Here, microcontroller is the heart of the system. It requires 5V DC supply which will be obtained by using power supply section. The information will be given to microcontroller by using MAX232 which is used to convert RS232 logic levels to TTL logic levels. Messaging will be done by using ZIGBEE and the data will be displayed in LCD. The Buzzer, LED's, Keypad and ZIGBEE are connected to the microcontroller which is at the transmitter side. At receiver end ZIGBEE is connected to the system through the USB connector.

VI. SOFTWARE DETAILS:

A. Keil Compiler

Keil is a cross compiler. Keil Software provides you with software development tools for the 8051 family of microcontrollers. With these tools, you can generate embedded applications for the multitude of 8051 derivatives. Keil provides following tools for 8051 development

1. C51 Optimizing C Cross Compiler,
2. A51 Macro Assembler,
3. 8051 Utilities (linker, object file converter, library manager),
4. Source-Level Debugger/Simulator,
5. μ Vision for Windows Integrated Development Environment.

The keil 8051 tool kit includes three main tools, assembler, compiler and linker.

An assembler is used to assemble your 8051 assembly program.

A compiler is used to compile your C source code into an object file.

A linker is used to create an absolute object module suitable for your in-circuit emulator 8051 project development cycle: - these are the steps to develop 8051 project using keil

- Create source files in C or assembly.
- Compile or assemble source files.
- Correct errors in source files.
- Link object files from compiler and assembler.
- Test linked application

A.Software dumping procedure

• The assembly language Instructions typed in dos editor or notepad with an extension of .ASM compile the above file with 8052 cross assembler.

• The assembler converts the .ASM file into .HEX file (Contains all opcodes).

• Copy the converted Hex file into internal flash Rom of Micro Controller with the help of Universal Programmer or Micro Controller Programmer.

VIII.CONCLUSION: We developed efficient and reliable hardware equipment which detects illegal usage of power and promotes authorized accessing of power. This system uses ZIGBEE and microcontroller. ZIGBEE is used to send warning through wireless communication. The project **“POWER THEFT DETECTION THROUGH ZIGBEE”** has been successfully tested.

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