Implementing An Automatic Efficient Lighting Control And Management System Based On Arm Microcontroller And Wireless Communication




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ABSTRACT:

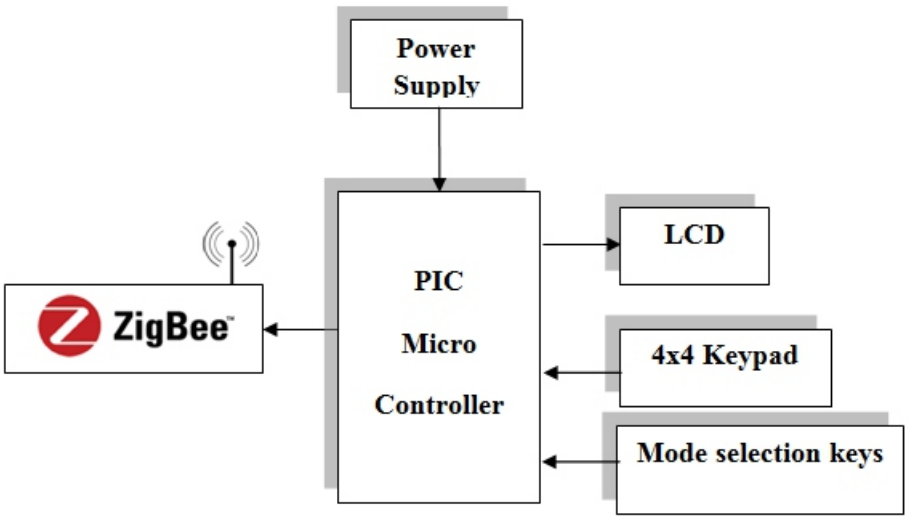
Scientific inventions have made this world worth living. They have provided us with various means of comforts and luxuries. The invention of electricity is one of the greatest of its wonders. Indeed, we cannot even dream of living in absence of electricity in modern times. There is no walk of life in which it is not used these days. Some of the more important of its uses are given below. We now light our lamps with electricity. Switch on the button and there is the daylike light even in the darkest night. Through such a system only they did avoid the power wastage. So we are in need of an effective system for power conservation. LED light source is gradually to the replacement of traditional lighting equipment with high power consumption. Meanwhile, the "next-generation light source" matching intelligent lighting control system is produced. Today several wireless technologies are used for building wireless networks. Among them the 2.4GHz wireless network is most widely deployed and used.

The wide usage of 2.4 GHz wireless communication indicates that this infrastructure can give near real time responses and makes suitable for crucial industrial monitoring systems.ZigBee also helps save time and cost in the installation of office lighting fixtures.

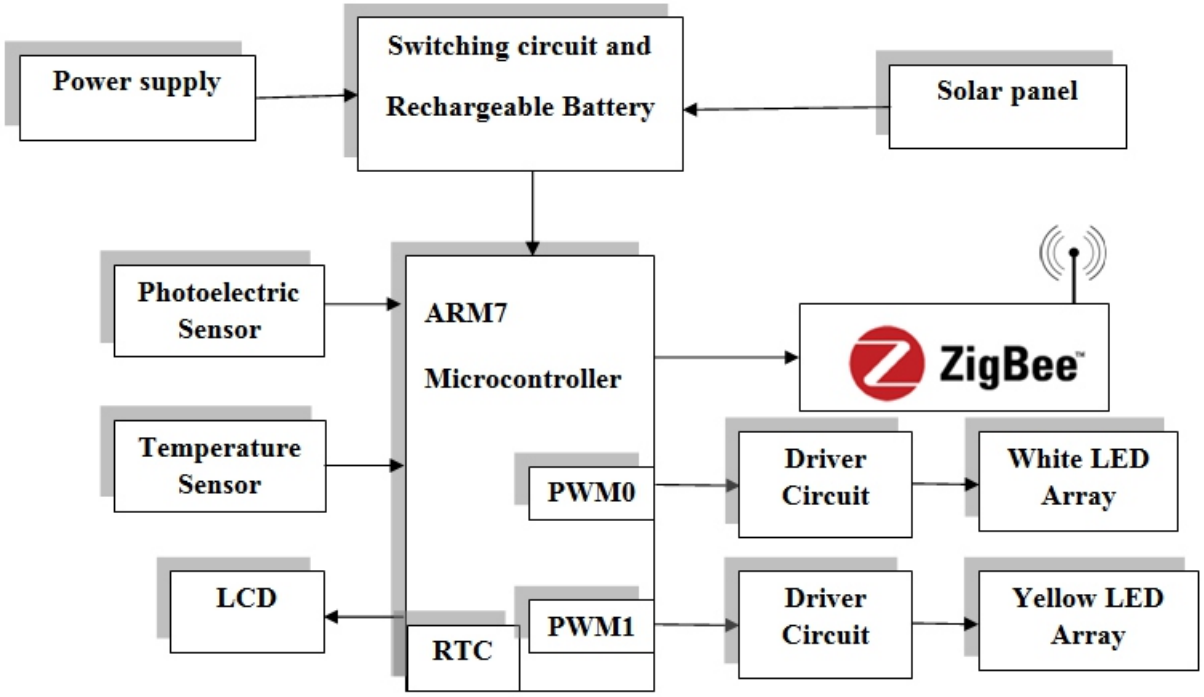
Instead of hiring an electrician to install new electrical wiring and dimmers, ZigBee enabled lights can simply be plugged into any ac outlet and then controlled wirelessly by a ZigBee controller. LED lighting control system based on the Zigbee wireless network is a combination of Zigbee's advantages in wireless network and short-range wireless transmission and LED's characteristic of high lighting efficiency and low power, it is not only security, intelligence, easy to control, but also engineering convenient in wiring and maintaining. It has good applicability in interior illumination and road lighting engineering.

Block Diagram:

Transmitter Section:



Lighting Section:



Hardware Requirements:

» ARM7, PIC 16F877A Microcontroller unit.
» LCD.
» Zigbee.
» White and Yellow LED Array, Pulse Driver Circuit
» Max 232.
» Temperature Sensor, Photoelectric Sensor.
» 4x4 Matric keypad.
» Swithcs.

Software Requirements:

» Embedded C.
» KeilC Compiler.
» MikroC compiler.

INTRODUCTION:

The LED light control system implimented based on the 2.4GHz zigbee wireless Modules , ARM7 , PIC18F microcontroller and few sensors.This system consists of two parts, respectively for Trasmitter module and a Lighting modules. The major components of Trasmitter module include main control chip PIC18F452 , Zigbee RF transmission system, 4x4 matix keypad, mode selection keys and a LCD screen. 4x4 Matrix keypad will helps us to access the password based authentication. User can send commands to the controller by the mode selsction keys, and the data will be transmitted by the ZigBee modules. Receiving Lighting module consistes of ARM7 Microcontroller, led driving circuits, sensors.

The data will be transformed into the corresponding PWM signal when receiving module receives the orders from the sender, then, the PWM signal is transferred to the LED lighting terminal, which makes lighting terminal produce the presupposed lighting effects.In the proposed system, the user is provided with list of functions. LCD will display the function selection menu. According to the needs of application and demonstration, user may select different function, for that they are provided with keypad. There are Five mode of operation:

1)Normal PWM dimming (Photo electric)

2)Self-Adaptive dimming (Temperature)

3)Timing dimming (RTC)

4)Self-Adaptive dimming (Photo electric and RTC)

5)Automatic Mode (Temperature, Photo electric and RTC)

Through the Zigbee network, the receiver receives the command signal and executes corresponding functions. When the user selects in the selection menu, the receiver will startup ordinary dimming mode. When the coordinator sends illumination level again, the receiver will produce pulse signal with different Duty-cycle to control the luminance of LED lamps, thereby achieve multilevel diming. When the user selects 2 in the selection menu, the receiver will startup self-adaptive dimming (Temperature) mode.

The LCDautomatic displaystemperature. The sensor will send the data to receiver, then, controller will produce PWM signals. When temperature changes, the proportion of light will change, thereby the temperature would be controlled.In this mode, user will feel comfort in sense.

Just like this mode 3: we may set the timing for such a LED control to be On/Off. When the user selects 4 in the selection menu, the receiver will startup self-adaptive dimming (Photo electric) mode. The LCDautomatic displays luminescence of the room. The sensor will send the data to receiver, then, controller will produce PWM signals. When luminescence changes, the proportion of light willchange, thereby the intensity would be kept in constant which is already stored in it. In this mode, user will get power conservation. The system will check for the light availability in the room.

ARM keil IDE and MikroC IDES will be used for implementing the application and building the software. Suitable applications of developed product will be studied and documented.

ARM PROCESSOR:

The ARM core uses RISC architecture. Is a design philosophy aimed at delivering simple but powerful instructions that execute within a single cycle at a high clock speed? The RISC philosophy concentrates on reducing the complexity of instructions performed by the hardware because it is easier to provide greater flexibility and intelligence in software rather than hardware. As, a result RISC design plays greater demands on the compiler. In contrast, the traditional complex instruction set computer (CISC) relies more on the hardware for instruction functionality, AND consequently the CISC instructions are more complicated.

The processing of instructions is broken down into smaller units that can be executed in parallel by pipelines. Ideally the pipeline advances by one step on each cycle for maximum throughput. Instructions can be decoded in one pipeline stage. The processor operates on data held in registers. Separate load and store instructions transfer data between the register bank and external memory. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor. Optimized for cost and power- sensitive applications, the ARM7TDMI solution provides the low power consumption, small size and high performance needed in portable, embedded applications.

PIC MICROCONTROLLER:

PIC microcontrollers (Programmable Interface Controllers), are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and much more. They are found in most electronic devices such as alarm systems, computer control systems, phones, in fact almost any electronic device. Many types of PIC microcontrollers exist, although the best are probably found in the GENIE range of programmable microcontrollers. These are programmed and simulated by Circuit Wizard software.PIC Microcontrollers are relatively cheap and can be bought as pre-built circuits or as kits that can be assembled by the user.

A PIC's instructions vary from about 35 instructions for the low-end PICs to over 80 instructions for the high-end PICs. The instruction set includes instructions to perform a variety of operations on registers directly, the accumulator and a literal constant or the accumulator and a register, as well as for conditional execution, and program branching.

Some operations, such as bit setting and testing, can be performed on any numbered register, but bi-operand arithmetic operations always involve W (the accumulator), writing the result back to either W or the other operand register. To load a constant, it is necessary to load it into W before it can be moved into another register. On the older cores, all register moves needed to pass through W, but this changed on the "high end" cores.

The PIC instruction set is suited to implementation of fast lookup tables in the program space. Such lookups take one instruction and two instruction cycles. Many functions can be modeled in this way. Optimization is facilitated by the relatively large program space of the PIC (e.g. 4096 × 14-bit words on the 16F690) and by the design of the instruction set, which allows for embedded constants. For example, a branch instruction's target may be indexed by W, and execute a "RETLW" which does as it is named - return with literal in W.

Interrupt latency is constant at three instruction cycles. External interrupts have to be synchronized with the four clock instruction cycle, otherwise there can be a one instruction cycle jitter. Internal interrupts are already synchronized. The constant interrupt latency allows PICs to achieve interrupt driven low jitter timing sequences. An example of this is a video sync pulse generator. This is no longer true in the newest PIC models, because they have a synchronous interrupt latency of three or four cycles.

1.Temperature sensor LM35:

The LM35 is an integrated circuit sensor [11] shown in Fig.8 that can be used to measure temperature with an electrical output proportional to the temperature (in oC). It measures temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/oC. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4oC at room temperature and +/- 0.8oC over a range of 0oC to +100oC. Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self heating capability. The sensor self-heating causes less than 40.1 oC temperature rise in still air. The sensor has a sensitivity of 10mV / oC.

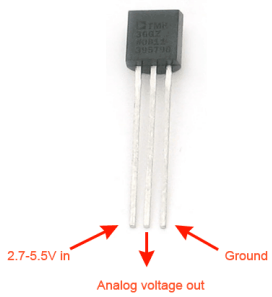


Figure-3: LM35

ZIGBEE:

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.

The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or in the works are:

- Home Automation
- ZigBee Smart Energy
- Commercial Building Automation
- Telecommunication Applications
- Personal, Home, and Hospital Care
- Toys

ZigBee coordinator(ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys.

ZigBee Router (ZR): As well as running an application function a router can act as an intermediate router, passing data from other devices.

ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

Protocols:

The protocols build on recent algorithmic research (Ad-hoc On-demand Distance Vector, neuRFon) to automatically construct a low-speed ad-hoc network of nodes. In most large network instances, the network will be a cluster of clusters. It can also form a mesh or a single cluster. The current profiles derived from the ZigBee protocols support beacon and non-beacon enabled networks.

In non-beacon-enabled networks (those whose beacon order is 15), an unslotted CSMA/CA channel access mechanism is used. In this type of network, ZigBee Routers typically have their receivers continuously active, requiring a more robust power supply.

However, this allows for heterogeneous networks in which some devices receive continuously, while others only transmit when an external stimulus is detected. The typical example of a heterogeneous network is a wireless light switch: the ZigBee node at the lamp may receive constantly, since it is connected to the mains supply, while a battery-powered light switch would remain asleep until the switch is thrown.

The switch then wakes up, sends a command to the lamp, receives an acknowledgment, and returns to sleep. In such a network the lamp node will be at least a ZigBee Router, if not the ZigBee Coordinator; the switch node is typically a ZigBee End Device.

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