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INTELLECTUAL PROPERTY TO PAUPERIZE POWER CONSUMPTION OF LED LIGHTING SYSTEM

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ABSTRACT:

With the increase in fashionable world for the market of LED lighting systems, India is facing significant growth in power saving demand and could benefit greatly by using energy efficient lighting systems. The need of the hour for the country is secured, affordable and environmentally sustainable energy to meet the ambitious National Program of "Power to all by 2015". Lighting is the most visible form of electricity consumption and lighting load in our country is very high about 17-18% of total load. By increasing the efficiency of lighting system, there can be significant energy saving and reduction in peak load. There is a scope for reducing about 30 to 35 % of the morning and evening peak demand. Therefore, this work proposes a Domestic and commercial LED Lighting System Considering low power consumption using intellectual property. The proposed system utilizes multi sensors and wireless communication technology in order to control an LED light according to the user's state and the surroundings.

PROPOSED SYSTEM

Our main purpose is to provide the end consumer with an economical fully centralized system in which home appliances are managed by an IEEE 802.15.4-based wireless sensor network. Not only is it necessary to focus on the initial investment, but maintenance and energy consumption costs must also be considered. This paper explains the developed system along with a brief introduction to usual building automation protocols. The proposed LED lighting system reduces total power consumption of the test bed up to 31%. The proposed LED lighting system can autonomously adjust the minimum light intensity value to enhance both energy efficiency and user satisfaction. We designed and implemented the proposed system in the test bed and measured total power consumption to verify the performance . The main objectives of this project are:-

- The new intelligent lighting control system should be designed to maximize the utilization of an LED.
The new intelligent lighting control system should be designed to have the communication capability.
- The new intelligent lighting control system should be designed to control based on the situation awareness.
- The new intelligent lighting control system should be designed to enhance both energy efficiency and user satisfaction.

DESIGN CONSEDERATION

Fig .3.1 Basic transmitter block diagram of the proposed system

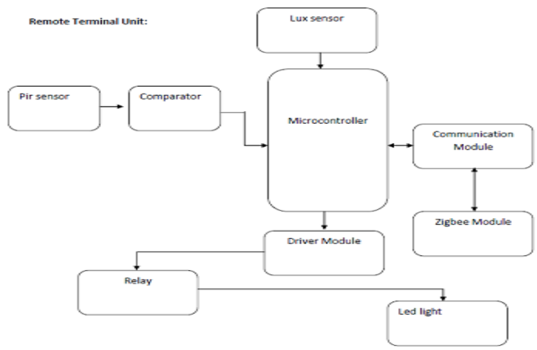

Fig.3.2 Basic receiver block diagram of the proposed system

Above fig.3.2 show the block diagram of intelligent household led lightning system in receiving section the ARM7 LPC2148 Microcontroller perform all input and output controlling operation. The function of PIR sensor trigger the microcontroller when human present. The adaptive middleware platform is composed of the LED control module group, which performs the role of controlling LED, the adaptive middleware group, which can change through the external environment or the remote command of the administrator, and the table group,

Network Module: It is the module related to the Zigbee and RS232 serial for communication with the external control system. This module processes interrupts and message for communications.

Manager Module: It internally processes the control command, which is transferred from the manager of the adaptive middleware group and converts it into a form for communications and control, and has the role of managing the conflict or loss of the transferred messages.

PWM Module: It performs the role of generating and stabilizing the PWM signal for LED control. It also performs the role of generating the signal to control an actual LED based on the data transferred from the adaptive middleware and retrieved from the table group.

(A) Design calculation for PLL (Phase Locked Loop) oscillator

PLL generator allows running ARM at high speed with low speed oscillator connected. Also this minimises EMC emission as frequency is multiplied inside ARM chip. PLL also allows changing frequency dynamically. It may rise calculation power when it needed and lower frequency when power saving is needed. PLL unit itself uses CCO (Current Controlled Oscillator) which operates in the range of 156MHz to 320MHz, so there is additional divider

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which keeps CCO within it's range, while PLL provides desired frequency. Output clock is generated by dividing CCO frequency by 2, 4, 8 or 16. Minimum divider is 2 so output of PLL will always have duty cycle 50% for sure.

PLL Activation and control is done via PLLCON register. PLL multiplier and divider values are controlled by register PLLCFG. These registers are protected from accidental alteration of PLL parameters or deactivation of PLL. Lets see how this is done in practice. Say we have 12MHz crystal connected to LPC2148. Then we can say Osc =12MHz. We want core frequency to be 60MHz then we have to multiply crystal frequency by five:

Cclk=M*Osc=5*12=60MHz;

Second thing is that we have to keep OCC oscillator frequency (Fcco)within its range [156Mhz-320MHz], so wee have to control another constant P:

Fcco = Cclk*2*P;

Fcco = 60MHz*2*2=240MHz;

So we can have P=2 ant this meets CCO requirements (156MHz<240MHz<320MHz).

(B) UART

UART (Universal Asynchronous Receiver Transmitter) are one of the basic interfaces which provide a cost effective simple and reliable communication between one controller to another controller or between a controller and PC.

(C) RS-232 Level Converter

Usually all the digital ICs work on TTL or CMOS voltage levels which cannot be used to communicate over RS-232 protocol. So a voltage or level converter is needed which can convert TTL to RS232 and RS232 to TTL voltage levels. The most commonly used RS-232 level converter is MAX232.

This IC includes charge pump which can generate RS232 voltage levels (-10V and +10V) from 5V power supply. It also includes two receiver and two transmitters and is capable of full-duplex UART/USART communication.

- RS-232 communication enables point-to-point data transfer. It is commonly used in data acquisition applications, for the transfer of data between the microcontroller and a PC.
- The voltage levels of a microcontroller and PC are not directly compatible with those of RS-232, a level transition buffer such as MAX232 be used.

(D) Interfacing UART

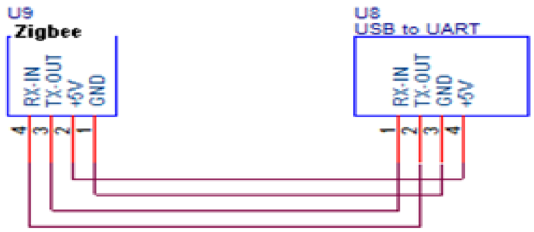


FIG 3.3 USB INTERFACING

FIG 3.3 shows UART itnerfacing with a zigbee. To communicate over UART or USART, we just need three basic signals which are namely, RXD (receive), TXD (transmit), GND (common ground). So to interface UART with LPC2148, we just need the basic signals. Port UART1 TXD PIN connect to PC via max232 and port UART1 RXD connect to zigbee receiver. DALI is based upon the master-slave principle; the master sends messages (frames) to any slave device in the system. Those messages contain an address and a command, thus only the addressed ballast will react to the message. A message sent by the master is called a forward frame; it consists of 19 bits at 1200 bps using a bi-phase encoding (Manchester Differential). The first bit is a start bit, the next 8 bits are the slave address and the next 8 are the command. There last two stop bits are not in Manchester code.

Our approach consists of implementing a DALI master controller using an IEEE 802.15.4-based WSN. Nodes which compose the WSN have a microcontroller unit (MCU) and an IEEE 802.15.4-compliant transceiver. The DALI communication protocol is implemented in the MCU. In our system we have the DALI devices as slaves and the nodes as masters, controlled by the personal area network PAN coordinator attached to a PC host. The coordinator accesses to any DALI device using the node MAC (8 bytes) or network (2 bytes) address instead of the DALI slave address, enhancing the number of connected devices. With this process we also skip the long DALI address allocation process.

ALGORITHM AND FLOWCHART:

(A) Minimum Light Intensity Control Algorithm

Fig. 4.1 illustrates a flowchart of a minimum light intensity control algorithm that requires a signal of inconvenience and a countdown timer. The signal of inconvenience is received from residents through a switch when they feel the brightness of the lighting with inconvenience. The countdown timer can interrupt the system after a given amount of time has expired. The proposed minimum light intensity control algorithm automatically adjusts *Lmin* based on the signal of inconvenience of users, which are inputted via smart phones. The value of illumination intensity of the lighting that has been felt with inconvenience at the latest is *Lminincon*, whereas the value of illumination intensity that has not been felt with inconvenience for a certain period of time, T at the latest is *Lmincon*. The initial *Lmin0*, and *Lminincon* is set to zero, and the initial *Lmincon* is set to *Lmax*. The procedures are composed of five steps.

Step 1. First, check whether a signal of inconvenience has occurred. If a signal of inconvenience has occurred, then *Lminn* = (*Lmincon*+*Lminn-1*)/2, *Lminincon* = *Lminn-1*, *n* = *n* + 1, and *timer* = T. And then check again whether a signal of inconvenience has occurred

Step 2. Check whether a signal of inconvenience has occurred. If a signal of inconvenience has occurred, then *Lminn* = (*Lmincon*+*Lminn-1*)/2, *Lminincon* = *Lminn-1*, *n* = *n* + 1, and *timer* = T as in Step 1. If a signal of inconvenience has not occurred, then check whether *timer* is equal to zero (i.e. the expiration of a given amount of time, T).

Step 3. Check whether *timer* is equal to zero, if *timer* is equal to zero, then *Lminn* = (*Lminincon*+*Lminn-1*)/2, *Lmincon* = *Lminn-1*, *n* = *n* + 1, and *timer* = T. And then, check whether *Lmincon* minus *Lminincon* is less than 5 or not. If *timer* is not equal to zero, check again whether a signal of inconvenience has occurred.

Step 4-1. After check whether *Lmincon* minus *Lminincon* is less than 5, if *Lmincon* minus *Lminincon* is less than 5, then terminate this flowchart. If *Lmincon* minus *Lminincon* is not less than 5, then perform the process of Step 4-2.

Step 4-2. Check whether a signal of inconvenience has occurred. If a signal of inconvenience has occurred, then *Lminn* = (*Lmincon*+*Lminn-1*)/2, *Lminincon* = *Lminn-1*, *n* = *n* + 1, and *timer* = T. If a signal of inconvenience has not occurred, then perform again from Step 3. It is possible to derive the value of *Lmin*, which can save energy at the maximum without causing inconvenience for users through the proposed algorithm.

(B) Flowchart

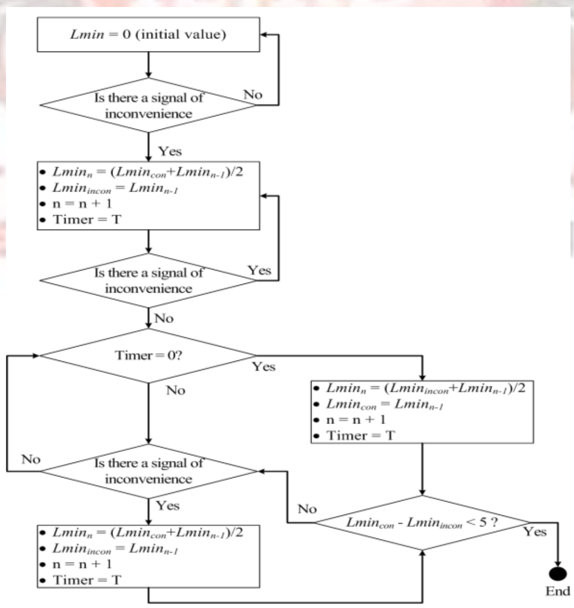


FIG 4.1 FLOW-CHART OF MINIMUM LIGHT INTENSITY CONTROL ALGORITHM

PERFORMANCE ANALYSIS

(A) Keil uVision4 MDK ARM

KeilµVision4 IDE (Integrated Development Environment) is a Windows based front end for the CCompiler and assembler. KeilµVision4 is used for writing embedded C programs. Embedded C is a high level language, which includes many aspects of the ANSI (American National Standard Institute) C programming language. This software is mainly used to activate ARM7 (lpc 2148) microcontroller according to the input received by it. "Embedded C" code is written using this work bench. In this project, coding is written for pir and zigbee with ARM7 board at the transmitter end. As per the code embedded in the controller, the interfaced modules generate appropriate output at the receiving end.

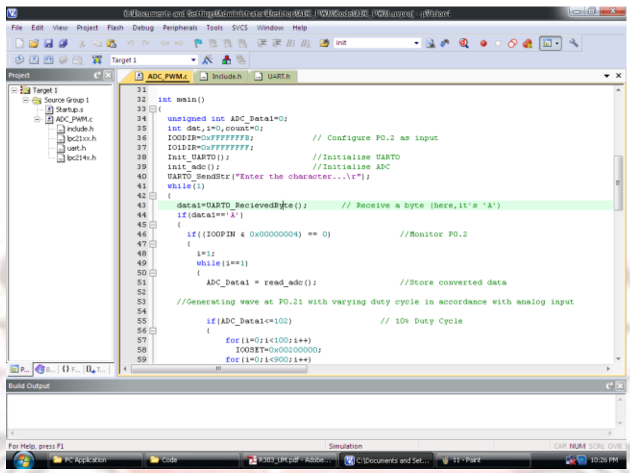


Fig.5.1 . Keil compiler screen shot

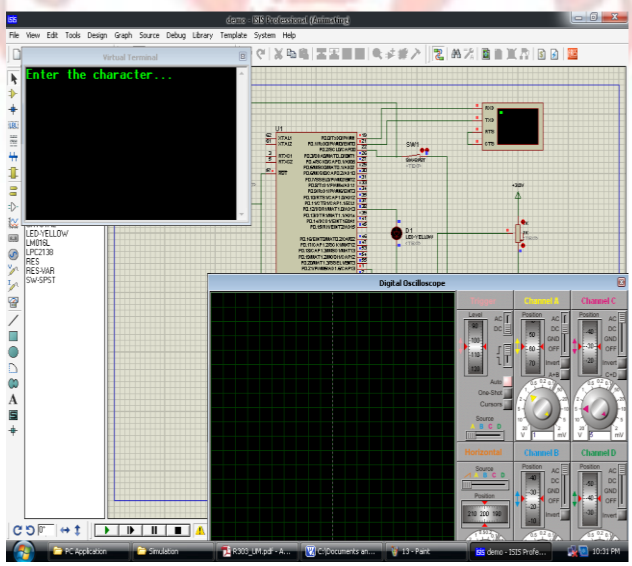


Fig 5.2 . Protius simulation of proposed system

It is the module to possess the core function of the adaptive middleware. Basically, it is mainly used for the manager management, scheduling for managers, and access control of the table used by the managers. It registers and activates the managers upon receiving the control messages from the external management server. It also performs the role of deleting the existing managers in accordance with the commands transferred from the management server. In addition, it performs the role related to authentication for external management server. This group can registers and deletes the managers in the adaptive middleware group in real time. The illumination sensor manager performs the roles of gathering the value of intensity of illumination from the sensor or making the rule table for control upon receiving the data sensed from the sensor module, the neighboring lighting system, or the management server. Developed system can easily be implemented with the existing setup. The complete hardware system consumes very less amount of power. The technology adopted in this project is quite simple, very logical and economical too. Making it more compact and producing it on a large scale, can make this device even more durable and help reduction in the cost. This system is simple and easy to use. It can be installed by anyone for saving energy in home, schools, offices etc. The designed demo hardware has been installed in a room where daylight was not sufficient. The circuit is examining with connected load of 120W (one light and one fan each 60W) in the month of April when the temperature is more than 30C. The test result with the hardware and without the hardware is shown below

TABLE 5.1: POWER CONSUMPTION OF THE PROPOSED SYSTEM

Components	*Average Current (mA)*	*Operation Voltage (V)*	*Average Power Consumption (W)*
Microcontroller	123	5	0.615
PIR Sensor	35	5	0.17
Light Sensor	0.5	3.6	0.002
zigbee module	10	5	0.05
relay module	0.6	3	0.003
Power Consumption by the model			0.845

1) Total load connect to the system for 14 days,

1 led strip having 14 led, power consumption of each led 1w/h.

Total no led (14) x power consumption (1w/h) = 42W/h.

Without system average led run 6hr/day

Total power consumption without system for 14days= (6hr/day X 14day) X 42W

Total power consumption without system for 14days= 84hr X 42W= 3528W.

Total power consumption without system for 14days= 3.528KW

Total power consumption with system for 14 days Using system average led run 4hr/day

Total power consumption with system for 14days= (4hr/day X 14day) X 42

Total power consumption without system for 14days= 56hr X 42W= 2352W

Total power consumption without system for 14days= 2.352KW

Total power saving = (total power consumption without system) – (total power consumption with system).

Total power saving = (3.528kw) – (2.352kw).

Total power saving = 1.176Kw ………(1)

2) Using Load = Fan (60w) light(20w) connect system for 14 days

Without system average run 6hr/day

Total power consumption without system for 14days= (6hr/day X 14day) X 80W

Total power consumption without system for 14days= 84hr X 80W= 6720W.

Total power consumption without system for 14days= 6.270KW

Total power consumption with system for 14 days Using system average led run 4hr/day

Total power consumption with system for 14days= (4hr/day X 14day) X 80w

Total power consumption without system for 14days= 56hr X 80W= 4480W

Total power consumption without system for 14days= 4.480KW

Total power saving = (total power consumption without system) – (total power consumption with system).

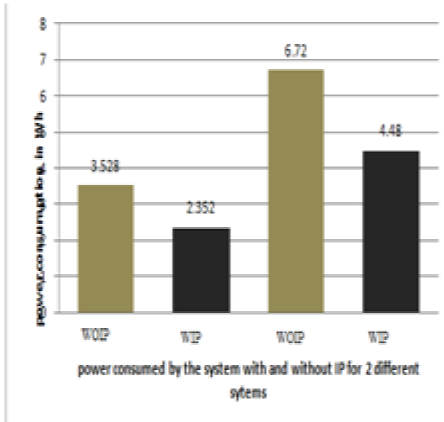
Total power saving = (6.2708kw) – (4.480kw).

Total power saving = 1.79kw ……………… (2)

Using result (1) and (2) total power saving approximately 31%

RESULT :

When we enter in system, bulbs get on automatically and when there is no human bulbs automatically get turn off. We have given program for check frequency for human in the system; time for check frequency can be changed by changing value of time delay in the program. Also we check the lightning system through remote control and server control. It is running successfully.



CONCLUSIONS AND FUTURE WORKS :

Saving energy has become one of the most important issues these days. A light accounts for approximately 20 percent of the world's total energy consumption; thus, a lot of studies and development related to energy saving of a light have been done by various researchers all over the world. However, since there are no products considering both energy efficiency and user satisfaction, the existing systems cannot be successfully applied to home and office buildings. Therefore, we propose an intelligent household LED lighting system considering energy efficiency and user satisfaction. The proposed system utilizes multi sensors and wireless intensity value to enhance both energy efficiency and user satisfaction. We designed and implemented the proposed system in the test bed and measured total power consumption. The proposed lighting system reduces total power consumption of the test bed up to 31%

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