Design of Wireless Framework for Energy Efficient Street Light Automation

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Abstract: The proposed remote-control system can optimize management and efficiency of street lighting systems. Here mainly use ZigBee-based wireless devices to transfer the information from point to point. ZigBee transmitters and receivers are used send the message to the control terminal to check the status of the street lamps. A remote monitoring allows the quick detection of failing devices without needing long searches and wasting personal time and then take appropriate measures to overcome the failure and then all lamps are hierarchically controlled.

Keywords: Control system, Lighting system, Sensors, Wireless networks, ZigBee.

I. INTRODUCTION

 Integration of Digital Addressable Lighting Interface (DALI) devices in wireless sensor networks. Since different manufacturers usually deal with one aspect of building automation - e.g. heating ventilation and air conditioning, lighting control, different kinds of alarms, etc. - final building automation system has different subsystems which are finally taken to an integrated building management system. The cost of this process is consequently increased due to additional hardware investment. 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.

II. LITERATURE REVIEW

Focus on integration of Digital Addressable lighting Interface (DALI) in WSN is used to manage the home appliances[1],OLA algorithm results of integration of wireless sensor and Artificial Intelligence for better energy management in smart home[2], Presented a hierarchical smart sensor system for electricity monitoring, here we go for sensor network to maintain EMM net in tall, building[3],NILM system identifies various loads of home and include electricity demand and remain user of home to save energy[4], Wireless sensor networks (WSNs) will play a key role in the extension of the smart grid towards residential premises, and enable various demand and energy management applications[5], To reduce the long term electricity cost of smart appliances (SAs) with deferrable operation time in smart grid, we propose a novel energy buffering framework to intelligently schedule the distributed energy storage (DES) for the cost reduction of SAs in this paper[6].

III. PROPOSED WORK

Our work focuses on the development of a prototype to be used in a wireless sensor network (WSN) which also integrates DALI protocol. Since DALI is a well-established standard and it has been adopted by major electronic ballasts' suppliers it is very easy to find DALI compliant devices. Despite it is designed for lighting control, DALI has also been adapted to other applications, such as motor or fan controllers, proximity alarms, etc. Adapting the standard to a WSN allows integrating DALI devices as a part of the WSN, expanding the traditional DALI bus and removing wires (DALI devices require a dedicated bus for data transmission), which results in a reduction of installation costs. More No. of slaves added to a single master, make it more control efficient. Gateway enables high level of integration

with multiple industrial networks. A WSN as part of a home automation system is also known as a wireless home automation network , it allows monitoring and control applications for home end user and energy efficiency.

A. Wireless sensor network

Smart environments represent the next evolutionary development step in building, utilities, industrial, home, shipboard, and transportation systems automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The smart environment needs information about its surroundings as well as about its internal workings; this is captured in biological systems by the distinction between exteroceptors and proprioceptors. PDA BSC (Base Station Controller, BST Preprocessing) Wireless Sensor Machine Monitoring Medical Monitoring Wireless Sensor Wireless Data Collection Networks Wireless (Wi-Fi 802.11 2.4GHz BlueTooth Cellular Network, - CDMA, GSM) Printer Wireland (Ethernet WLAN, Optical) Animal Monitoring Vehicle Monitoring Online monitoring Server transmitter Any where, any time to access Notebook Cellular Phone PC Ship Monitoring Wireless Sensor Networks Roving Human monitor Data Distribution Network Management Center (Database large storage, analysis) Data Acquisition Network The challenges in the hierarchy of: detecting the relevant quantities, monitoring and collecting the data, assessing and evaluating the information, formulating meaningful user displays, and performing decision-making and alarm functions are enormous. The information needed by smart environments is provided by Distributed Wireless Sensor Networks, which are responsible for sensing as well as for the first stages of the processing hierarchy
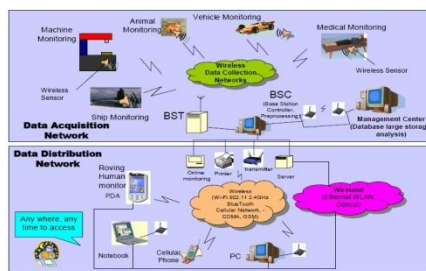

fig 2. Wireless sensor network

B. PIC Microcontroller

All PIC16F87XA devices have a host of features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving operating modes and offer code protection.

•   1,00,000 erase/write cycle Enhanced Flash   program memory typical

•   10,00,000 erase/write cycle Data EEPROM memory typical

•   In-Circuit Serial Programming™ (ICSP™) via two pins

•   Single-supply 5V In-Circuit Serial Programming

•   Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation

•   Programmable code protection

C. ZIGBEE

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network.ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems.

D. Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

E. Current transformer

Current transformer normally known as C.T. is a step up transformer. C.T. has a primary coil of one or more turns of thick wire connected in series with the line whose current is to be measured. Secondary is short by a known resistance. Current step down ratio 20:1 The output voltage between the resistance is proportional to the primary coil current.
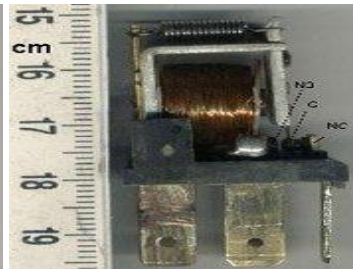

fig 3. Current transformer   fig 4. Zigbee   fig 5. Relay

F.TRIAC

TRIACs belong to the thyristor family and are closely related to Silicon-controlled rectifiers (SCR). Unlike SCRs, which are unidirectional devices ,TRIACs are bidirectional and so current can flow through them in either direction,TRIACs are very convenient switches for AC circuits, also allowing them to control very large power flows with milli ampere-scale gate currents.Low power TRIACs are used in many applications such as light dimmers, speed controls for electric fans and other electric motors, and in the modern computerized control circuits of many household small and major appliances.

G. LDR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.They are also used in some dynamic compressors together with a small incandescent lamp or light emitting diode to control gain reduction and are also used in bed lamps, etc. A photo

resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron conduct electricity, thereby lowering resistance.

IV.   CIRCUIT DIAGRAM AND EXPLANATION
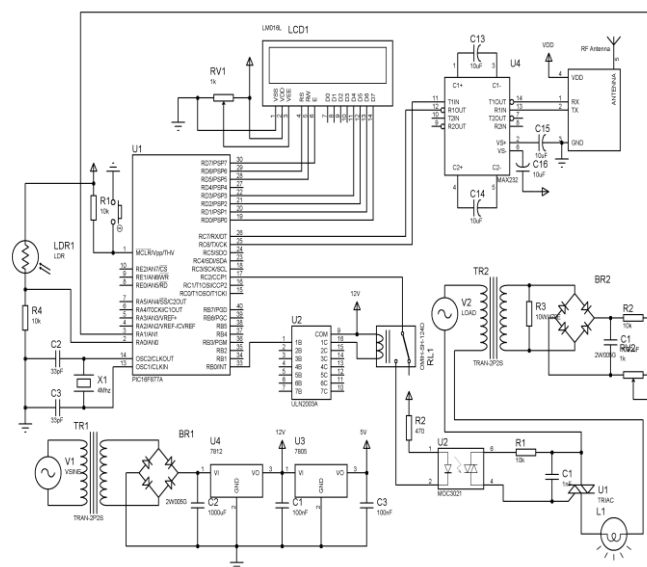
PIC16F877A is a 40 Pin DIP pack IC with 33 I/O pins. Out of which 8 pins can be used either as Digital I/O pins or Analog Input pins. The micro controller is having 5 ports Port A, Port B, Port C, Port D and Port E. Here Port A consists 6Pins and can be used as Analog Pins and Digital Pins, in the same way Port E consists of 3Pins all of them can either be used as Analog Pins or Digital Pins. The Port pins of Port D are connected to LCD pins. RD4 to RD7 as data pins and RD0 to RD2 as control pins. The Pins of Port B are connected to relay drivers, which in turn drives the relays. The Pins 13 and 14 are connected to Oscillators. This Oscillator provides required clock reference for the PIC micro controller. Either Pins 11 and 12 or 31 and 32 can be used as power supply pins. Pins 25 and 26 of Port C are used for serial Port communications; these pins are interfaced with MAX232 for PC based communications. Pins 37, 38, 39 and 40 are used for In-Circuit Debugger Operations, with which the hex code is downloaded to the Chip. Pin 33 is used as external Interrupt Pin. Pin 1 is used as Reset Pin. This Pin is connected to Vcc through a resistor. The LCD we have used in this project is HD1234. This is an alphanumeric type of LCD with 16 pins. Of which Pins 7 to 14 are used as data pins, through which an 8-bit data can be input to the LCD. These Pins are connected to the Port 0 of Micro controller. There are 3 control pins RS (Pin-4), RW (Pin-5) and EN (Pin-6). The RS pin is connected to the 28ᵗʰ Pin of micro controller. The RW pin is usually grounded. The Enable pin is connected to 27ᵗʰ Pin. The LCD has two Rows and 16 Columns. The LCD is powered up with 5V supply connected to Pins 1(Gnd) and 2(Vcc). The Pin 3 is connected to Vcc through a Potentiometer. The potentiometer is used to adjust the contrast level. Here in our project we use the PIC controller in 4-bit mode. Here only 4 data pins are connected and are used as Data Port.

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/15-0-15v is used to perform the step down operation where a 230V AC appears as 15V AC across the secondary winding. In the power supply unit, rectification is normally achieved using a solid-state diode. Diode has the property that will let the electron flow easily in one direction at proper biasing condition. As AC is applied to the diode, electrons only flow when the anode and cathode is negative. Reversing the polarity of voltage will not permit electron flow.A commonly used circuit for supplying large amounts of DC power is the bridge rectifier. A bridge rectifier of four diodes (4*IN4007) is used to achieve full wave rectification. Two diodes will conduct during the negative cycle and the other two will conduct during the positive half cycle. The

DC voltage appearing across the output terminals of the bridge rectifier will be somewhat less than 90% of the applied RMS value. Filter circuits, which usually capacitor is acting as a surge arrester always follow the rectifier unit. This capacitor is also called as a decoupling capacitor or a bypassing capacitor, is used not only to 'short' the ripple with frequency of 120Hz to ground but also to leave the frequency of the DC to appear at the output. The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant DC voltage to the device. Power supplies without regulators have an inherent problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region of the desired output. IC7812 and 7805 are used in this project for providing +12v and +5v DC supply.

There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. here in our project the relays are connected to the micro controller through ULN 2003 relay driver IC. The input from the micro controller is 5V and the output from the ULN is 12V this output is used to drive the relay. The output is fed to the coil supply of the relay. The ULN IC has 7 input Pins 1- 7. The output is taken from Pins 9-15. The ULN consists of Darlington arrays. Here in our project the micro controller pins are connected to ULN through Pins

V. RESULT AND DISCUSSION
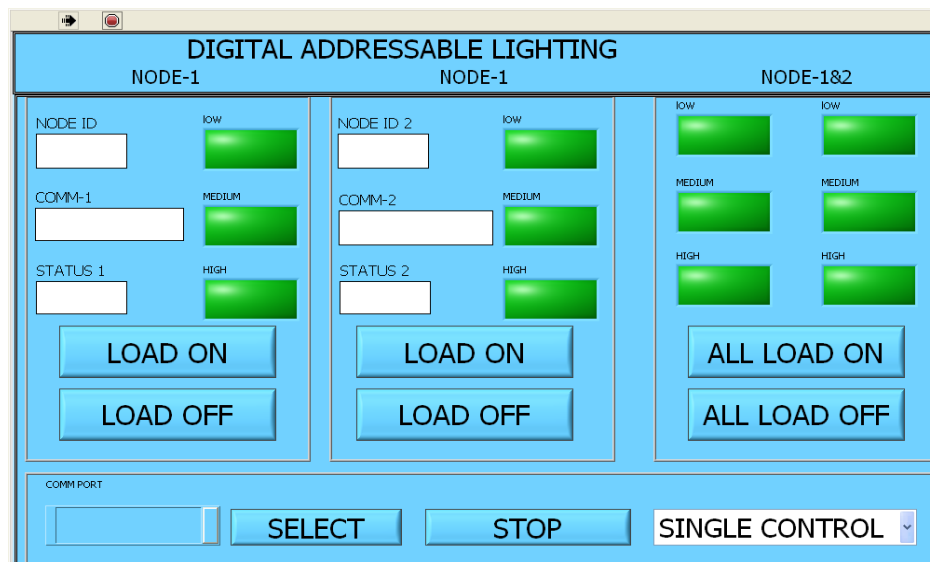
The project "DIGITAL ADDRESSABLE LIGHTING INTERFACE" has been completed successfully and the output results are verified. The results are in line with the expected output. The project has been checked with both software and hardware testing tools. In this work "PIC16F877A, LCD& RELAY" are chosen are proved to be more appropriate for the intended application. The project is having enough avenues for future enhancement. The project is a prototype model that fulfills all the logical requirements. The project with minimal improvements can be directly applicable for real time applications. Thus the project contributes a significant step forward in the field of "EMBEDDED SYSTEM".

VI. SUMMARY AND CONCLUSION

This paper describes a new intelligent street lighting system which integrates new technologies available on the market to 0ffer higher efficiency and considerable savings Another advantage obtained by the control system is the intelligent management of the lamp posts by sending data to a central station by ZigBee wireless communication. The system maintenance can be easily and efficiently planned from the central station, allowing additional savings.. The system is always flexible, extendable, and fully adaptable to user needs. The simplicity of ZigBee, the reliability of electronic components, the feature of the sensor network, the processing speed, the reduced costs, and the ease of installation are

the features that characterize the proposed system, which presents itself as an interesting engineering and commercial solution as the comparison with other technologies demonstrated.

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