IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 4, April 2021

DOI 10.17148/IJIREEICE.2021.9406

# DESIGN OF WIRELESS GATEWAY FOR DALI BASED SMART CITY AUTOMATION

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**Abstract:** Smart Street light is an automatic system that automates the streets. The main aim is to reduce power consumption when there are not any vehicle movements on the road. The Smart street light are going to be get turned ON when there are vehicles or humans on the road otherwise the lights are going to be OFF. With the advancement of technology, things are becoming simpler and easier for everyone in the world today. As a result of automatic control of street lights the power is saved to an extent. The Smart street light provides a way for saving energy which is achieved by sensing an approaching vehicle using the IR sensors then switching ON a block of street lights ahead of the vehicle. As the vehicle passes by, the trailing lights turn OFF automatically. Thus, we save a lot of energy. So when there are no vehicles or humans on the highway, streets then all the lights that remain OFF are being preferred over the manual system.

**Keywords:** smart city automation, ZIGBEE, MPLAB IDE, DALI.

## INTRODUCTION

In the scope of industrialization, automation could be a step beyond mechanization. Mechanization, use machines to replace human labour, automation greatly decreases the requirement for human sensory and mental requirements also. Street lighting is one of the important parts. The street lights are relatively simple but with the event of urbanization, the number of streets increases rapidly with high traffic density. Several factors need to be considered to design a good street lighting system such as night-time safety for community members and road users, provide public lighting at cost-effectiveness, depletion of crime. The first generation of the original street light is controlled by manual, which has a control switch set in each of the street lights. After that, another method that has been used as the optical control method was done using a high-pressure sodium lamp in their system. Nowadays, it is seen that the method is widely utilized in the country. Street lamps that light up automatically at dusk and turn off automatically in the morning is controlled by setting optical control circuit, change the resistance by light sensitive device.

Due to the technological development nowadays, road lighting are often categorized by the installation area and performance, as an example, lighting for traffic routes, lighting for subsidiary roads, and lighting for the urban center and public amenity areas. The Wireless Sensor Network helps in improving the network sensing for street lighting. The LED is considered a solution to modern street lighting systems due to its behavior and advantages. The street lights system using LED lamps are interfaced with an IR sensor for controlling and managing.

Street lights are the helpful in transportations and avoiding accidents during the night. Despite that, in today's busy life nobody bothers to turn it off/on when not required. The project introduced here gives a answer to the present by eliminating manpower and reducing power consumption. This requires three basic components i.e. LDR, Sensors, and microcontroller. There is no requirement of street lights in daytime therefore the LDR keeps the street light off until the sunshine level is low or the frequency of sunshine is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Thus the street lights do not glow. As soon as the light level goes high or if the 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 electro conduct electricity, thereby lowering resistance now the circuitry goes in on condition

## RELATED WORK

SMART STREET LIGHT CONTROL SYSTEM

To control and maintain complex street lighting system more economically, by using a wireless sensor network (WSN), which is integrated with Digital Addressable Lighting Interface –DALI (two-way communications protocol that is used to provide control over and communication between, the components in a lighting system). The gateway enables a high level of integration with multiple industrial networks. It works on PIR and proximity based human

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sensing and thereby automatically control the brightness of the lights. The main purpose is "automatic control of street lights while human or vehicle passes through it". It can be used to minimize the usage of power in late nights thereby the cost of electricity and also the cost of manpower to manually on-off the street light is reduced. In this project automatic street light control is done by pic microcontroller is used to on-off automatically by uses of LDR (Light dependent Resistor), relay, Opamp and pic16f877a microcontroller without any human interface.

**Block Diagram:**

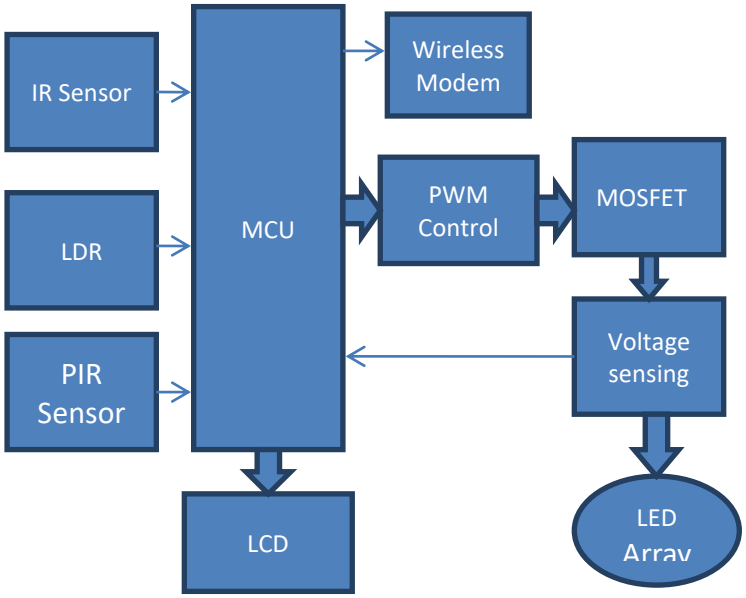


**Fig 1:** smart street light control system

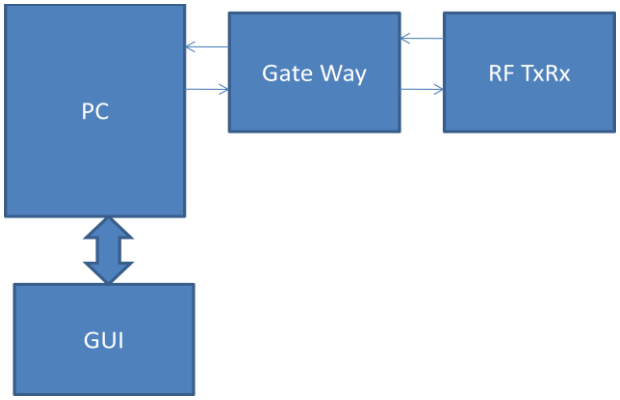


**Fig 2:** DALI server

## HARDWARE REQUIREMENT

**A) LDR:**

**Fig 3:** LDR

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A light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

It is used to measure light intensity. To control gain reduction it is used in dynamic compressors along with a small incandescent lamp or light emitting.

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

**B) PIR SENSOR:**

**Fig 4:** PIR sensor

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually, this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

Infrared radiation enters through the front of the sensor, known as the 'sensor face'.

**C) LCD DISPLAY:**


**Fig 5:** LCD Display

LCD (liquid crystal display) is the technology used for displays in notebooks and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. An LCD is made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time (for example your mouse will appear to move more smoothly across the screen).

**D) IR SENSOR:**

**Fig 6:** IR sensor

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It detects infrared radiation to sense a particular phase in the environment. Generally, thermal radiation is emitted by all the objects in the infrared spectrum. The infrared sensor detects this type of radiation which is not visible to the human eye.

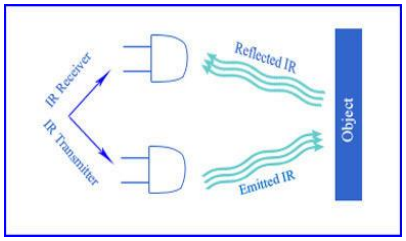


**Fig 6:** IR working

When the IR receiver is subjected to infrared light, a voltage difference is produced across the leads.

It uses a comparator for providing the required logic level for microcontroller. It is highly reliable for detecting an obstacle.

**E) ZIGBEE TX RX:**

**Fig 7:** ZIGBEE TX RX

The XBee RF module is the product based on ZigBee protocol. So it also uses IEEE 802.15.4 standards. It can support a wireless sensor network that requires low-cost and low-power. The XBee RF module can be configured with the Application Transparent mode or Application Programming Interface mode but in this implementation, only the AT mode is used. So in the next chapters, this thesis concentrates on the AT commands. /2/, /5/, /13/ A key component of the ZigBee protocol is the ability to support mesh networking. In a mesh network, nodes are interconnected with other nodes so that multiple pathways connect to each node. In this project, three XBee RF modules were used to build a small mesh network. In this wireless network, all of them could communicate with each other with suitable configuration.

**F) MOSFET:**

**Fig 8:** MOSFET

The functionality of MOSFET depends on the electrical variations happening in the channel width along with the flow of carriers (either holes or electrons). The charge carriers enter into the channel through the source terminal and exit via the drain.

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**G) PIC microcontroller:**

**Fig 9:** PIC microcontroller

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller,] and is currently expanded as Programmable Intelligent Computer. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

## METHODOLOGY

- The system involves a micro controller, that monitors the ambient light
- Based on ambient illumination, the light intensity is controlled through PWM
- Late nights, the illumination is reduced to conserve energy
- If people movement is detected by PIR sensor, illumination increased for the time
- Fault detection and notification system is integrated
- Server system monitors and controls all the operations

## SOFTWARE DESCRIPTION

**A) MPLAB IDE**:

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows, is easy to use, and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

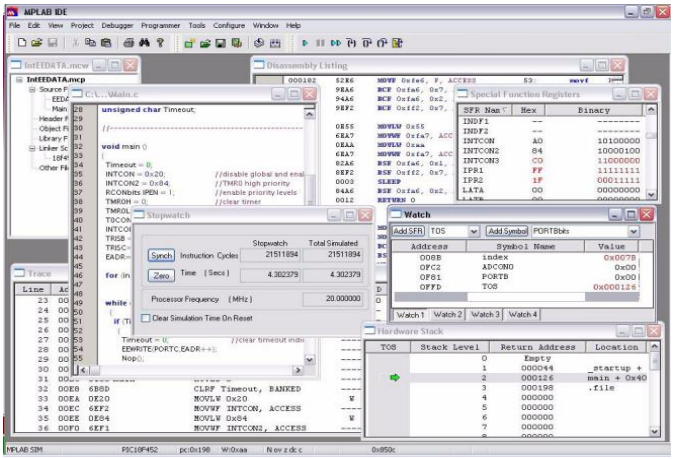

**Fig 10:** MPLAB Tool

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**B) MPLAB IDE features include:**

- Flexible Customizable Programmer's Text Editor:

Fully integrated debugging with right mouse click menus for breakpoints, trace, and editor functions.

- Tabbed editor option or separate source windows.
- Recordable macros.
- Context sensitive color highlighting for assembly, C, and BASIC code readability.
- Mouse over variable to instantly evaluate the contents of variables and registers
- Set breakpoints and tracepoints directly in the editor to instantly make changes and evaluate their effects
- Graphical project manager
- Version control support for MS Source Safe, CVS, PVCS, Subversion.

**C) COMPONENTS:**

- Programmer's text editor
- MPLAB SIM, high speed software simulator for PIC and dsPIC devices with peripheral stimulation, complex stimulus injection, and register logging.
- Full featured debugger
- MPASM™ and MP LINK for PIC MCUs and dsPIC DSC devices
- HI-TECH C PRO for PIC10/12/16 MCU Families running in lite mode
- CCS PCB C Compiler
- Lab center Electronic's Proteus VSM spice simulator
- Many Powerful Plug-Ins including

○ AN851 Boot loader programmer
○ AN901 BLDC Motor Control Interface
○ AN908 ACIM Tuning Interface
○ KeeLoq support

**D) SIMPLE, POWERFUL SOURCE LEVEL DEBUGGING:**

- Auto alignment of breakpoints after source code modification
- Mouse-over variable inspection
- Drag and drop variables to watch windows
- Watch variables, structures, and arrays
- Mixed source code/disassembly view
- Stack symbolic return label display
- Automatic single-step "animate" feature
- Pass counts and break on PIC18F, PIC24, and dsPIC file register R/W for MPLAB ICD 2
- Step-Out-Of function
- Custom hotkeys
- Powerful simulator stimulus generator
- Trace to source correlation to compare real time data collected with original source code and comments

**E) BUILT-IN SUPPORT FOR HARDWARE AND ADD-ON COMPONENTS:**

- MPLAB C Compilers (free student editions available for download)
- MPLAB REAL ICE™ in-circuit emulator
- MPLAB ICD 2 and MPLAB ICD 3 in-circuit debuggers and engineering programmers for selected Flash devices
- PICkit 2 and PICkit 3 Debug Express economy debug/programmers
- PICSTART Plus development programmer
- MPLAB PM3 device programmer
- Third-Party tools, including HI-TECH, IAR, Byte Craft, B. Knudsen, CCS, Micrium, microEngineering Labs, Lab center, MATLAB, Segger

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- A host of low-cost starter boards, demonstration and evaluation kits

**DALI CODE:**

```
#include <16F877a.h>
#device adc=10
#fuses XT,NOWDT,NOPROTECT,NOLVP
#use delay(clock=4000000)
#use rs232(baud=9600, xmit=PIN_C6, rcv=PIN_C7)

#include <lcd.c>

#define buz PIN_B7

long int lux,cur;

void readlight()
{
set_adc_channel(0);
delay_ms(100);
lux=read_adc();
lcd_send_byte(0,0xC0);
printf(lcd_putc,"%3ld",lux);
}

void readcurrent()
{
set_adc_channel(1);
delay_ms(100);
cur=read_adc();
lcd_send_byte(0,0xC5);
printf(lcd_putc,"%3ld",cur);
}

void main()
{
SET_TRIS_B(0x0F);
port_b_pullups(true);
lcd_init();

 /* ADC CONFIGURATION*/
 setup_adc_ports(ALL_ANALOG);
 setup_adc(ADC_CLOCK_INTERNAL);

output_low(buz);

lcd_send_byte(0,0x80);
lcd_putc("ENERGY EFF LIGHT");
delay_ms(2000);
lcd_send_byte(0,0x80);
lcd_putc("LUX CURR FAULT  ");

 while(1)
  {

   readlight();

   if(lux<500)
   {
                output_high(PIN_C0);
                output_high(PIN_C1);
                output_high(PIN_C2);
   }
   else
   {
      output_low(PIN_C0);
                output_low(PIN_C1);
                output_low(PIN_C2);
                delay_ms(500);
                readcurrent();
                if(cur<20)
```

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```
                {
                lcd_send_byte(0,0xCA);
        printf(lcd_putc,"YES");
        printf("FAULT DETECTED \r\n");
        output_high(buz);
        }
        else
        {
        lcd_send_byte(0,0xCA);
        printf(lcd_putc,"NO ");
        output_low(buz);
        }
   }

  delay_ms(1000);

   }     //WHILE LOOP ENDS HERE
}     //MAIN LOOP ENDS HERE
```

## RESULT


**Fig 11.a:** Without fault (with human presence)


**Fig 11.b:** Without Fault( without human presence)

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**Fig 12.a:** With Fault (with human presence)


**Fig 12.b:** With fault ( without human presence)

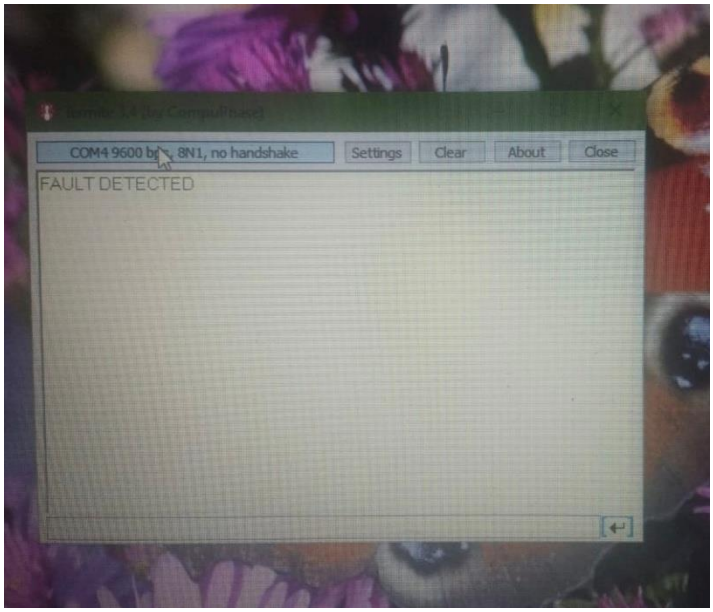


**Fig 13:** Fault Output

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## PROJECT KIT

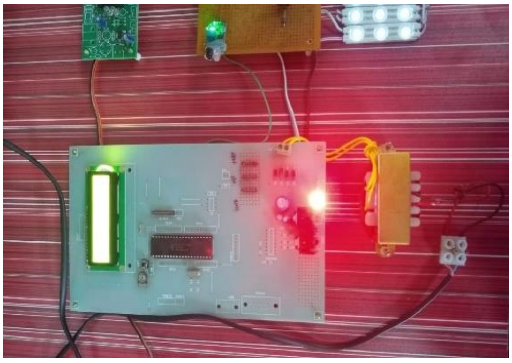

**Fig 14.a** Kit ON mode

**Fig 14.b** Kit OFF mode

## FUTURE SCOPE

- Can be connected to IoT to reach global coverage.
- AI systems can be integrated for improved efficiency.

## CONCLUSION

The DALI (Digital Addressable Lighting Interface) protocol is used for digital fluorescent ballast that outperforms its predecessors with respect to flexibility and functionality. With the help DALI lighting control system the illuminance of light can be adjusted whether human or vehicle passes through it, thereby saving money in energy and maintenance costs. From this project fault can be easily detected. A DALI lighting control system can also be beneficial to designers when trying to meet the requirements of code or recommended practices. It covers the equipment required to make a DALI system work, and using a DALI system how DALI can help meet code and recommended practices and concludes with use of DALI in street light helps to save electricity and maintenance cost.

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