Intelligent Room Illuminator

Project Report Submitted

to

MANIPAL ACADEMY OF HIGHER EDUCATION

For Partial Fulfillment of the Requirement for the

Award of the Degree

Of

Bachelor of Technology

in

Information Technology

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November 2023

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Abstract

The "**Intelligent Room Illuminator**" project is a comprehensive initiative aimed at revolutionizing room lighting control. This multifaceted project seeks to provide an innovative and energy-efficient solution by utilizing the computational capabilities of the LPC1768 ARM Microcontroller. It aims to minimize energy consumption while ensuring user convenience and comfort. By automatically adapting to changing lighting conditions, the project intends to reduce electricity usage, lower greenhouse gas emissions, and contribute to a more sustainable and environmentally responsible future. The system's versatility allows it to be seamlessly integrated into various environments, enhancing user experiences and promoting energy conservation. This project serves as a testament to the capabilities of advanced microcontroller technology and aims to educate users about the benefits of energy-efficient lighting and environmentally conscious habits. It combines technological advancement, user-centric design, and environmental responsibility to provide a holistic solution for intelligent room illumination.

It marks a paradigm shift in room lighting control, driven by the LPC1768 ARM Microcontroller. Strategically placed infrared sensors (Sensor 1 outside and Sensor 2 inside) ensure precise occupancy detection. Sensor 1, located outside the room, serves to detect individuals as they approach. Sensor 2, placed inside the room, identifies individuals entering the space. This dual-sensor configuration enables precise detection and control of room lighting.

Upon entry, the system activates room lights, focusing on efficient energy management. Its distinctive feature lies in maintaining a real-time visitor count, contributing to energy conservation by deactivating lights upon room vacancy. Upon detecting an individual's entry, the system takes action to activate the room lights. As individuals exit, the system maintains a visitor count and deactivates the lights when the room is empty, contributing to energy conservation and sustainability.

The project's success stems from the synergy of advanced microcontroller capabilities and strategic sensor placement. This implementation sets the stage for future developments in responsive room lighting, emphasizing energy conservation and practical functionality. The scope of the "Intelligent Room Illuminator" project is broad and encompasses various facets, including residential homes, offices, educational institutions, and public spaces. It offers a versatile and adaptable solution that can be implemented in different settings, enhancing user experiences, promoting energy conservation, and ensuring environmentally responsible room illumination.

The "Intelligent Room Illuminator" offers a streamlined yet potent solution, blending cutting-edge technology with environmental mindfulness in diverse settings. This initiative embodies a commitment to sustainable practices, bridging the gap between technological innovation and responsible energy consumption for intelligent room illumination.

Introduction

Visitor counters have evolved significantly in their role of monitoring crowd behavior at various locations. The initial replacement of the tally stick with a mechanical tally counter marked the early stages of this evolution. This transition allowed for more efficient and accurate tracking of visitors. As technology continued to advance, electronic tally counters emerged as the next phase in this evolution. These electronic counters revolutionized the process by incorporating an LCD screen for displaying the count, providing a clearer and more readable output. Moreover, the introduction of a push-button mechanism for tally advancement simplified the operation and enhanced user convenience. This progression showcases a shift from manual to electronic methods, emphasizing increased accuracy, readability, and ease of use in monitoring and managing crowd movements. The evolution of visitor counters reflects the continuous innovation in technology to meet the demands of efficiently tracking and analyzing crowd behavior in various settings.

Description

Counting humans manually has proven to be both unreliable and costly, as it can be tasking for an individual to manually count the number of people entering and leaving[1]. However, an automated crowd limiting system can be helpful to reduce costs and improve reliability, such as a contactless bi-directional visitor counting system[2]. Visitor counting involves tracking the flow of individuals entering and exiting various spaces such as conference rooms, shopping malls, and sports venues. This measurement serves as a vital metric for assessing the foot traffic in these locations. 'With the increase in standard of living, there is a sense of urgency for developing circuits that would ease the complexity of life'[3].

The urgency to develop such circuits stems from the desire to enhance efficiency and convenience in managing spaces where people gather. These circuits are anticipated to play a crucial role in optimizing the operation of facilities by providing real-time data on visitor movement. This multifaceted project seeks to provide an innovative and energy-efficient solution by utilizing the computational capabilities of the LPC1768 ARM Microcontroller. It aims to minimize energy consumption while ensuring user convenience and comfort. The system's versatility allows it to be seamlessly integrated into various environments, enhancing user experiences and promoting energy conservation. This project serves as a testament to the capabilities of advanced microcontroller technology and aims to educate users about the benefits of energy-efficient lighting and environmentally conscious habits. It combines technological advancement, user-centric design, and environmental responsibility to provide a holistic solution for intelligent room illumination.

Hardware Used

- The LPC1768, an ARM Cortex-M3 based 32-bit microcontroller by NXP Semiconductors, is engineered for embedded applications necessitating low power consumption and high integration. It operates on Embedded C code, validated on an ALS evaluation board, utilizing a 12-bit internal Analog-to-Digital Converter for voltage-to-Celsius conversion. Its diverse applications span alarm systems, lighting, white goods, and industrial networking, utilizing its SRAM blocks for Ethernet, USB, DMA memory, and general CPU storage.

  Beyond its technical prowess, the LPC1768 is revered for its trifecta of traits: energy efficiency, robust security features, and unwavering reliability. This trifecta has propelled its integration into multifaceted applications, spanning automotive systems, industrial automation, smart homes, connected devices, and beyond.

  Recognized for its energy efficiency, security, and reliability, it serves in automotive systems, industrial automation, smart homes, and connected devices. Equipped with a 100 MHz CPU frequency, 512 kB flash memory, 64 kB data memory, and an array of interfaces including Ethernet MAC, USB Device/Host/OTG, 8-channel DMA controller, 4 UARTs, 2 CAN channels, 3 SSP/SPI, 3 I2C, I2S, 8-channel ADC, and 10-bit DAC, the LPC1768 is extensively applied in robotics, automation, and control systems due to its comprehensive features and performance attributes.

- Infrared (IR) sensors are devices that detect and measure infrared radiation in their surroundings. They operate within the infrared range of the electromagnetic spectrum, typically between 700 nanometers to 1 millimeter. These sensors are widely used in various applications, including proximity and motion detection, temperature measurement, and remote control systems.

  IR sensors function by detecting the IR radiation emitted or reflected by objects in their vicinity. They consist of an emitter that emits infrared light and a receiver that detects this emitted or reflected light. The receiver then translates the received signal into an electrical signal, which is processed to determine the presence, distance, or characteristics of the object.

  Some common types of IR sensors include passive infrared (PIR) sensors used in motion detectors, infrared temperature sensors for non-contact temperature measurement, and IR proximity sensors utilized in obstacle detection in robotics or automatic door systems.

Software Used

- Keil Vision4; Keil MDK serves as a comprehensive software development environment designed for various Arm Cortex M microcontroller devices. It encompasses the Vision IDE, debugger, Arm C/C++ compiler, and essential middleware components. It offers a complete platform for creating, assembling, troubleshooting, and modelling code meant for a range of microcontrollers, including those with ARM architecture. With the help of a user-friendly interface and a suite of tools, developers can create and test embedded systems more quickly and effectively with µVision 4. Its simulator cuts down on development time and expenses by enabling code testing without the need for physical hardware.
  Additionally, the IDE interfaces with different middleware components, which makes it possible to incorporate middleware stacks, other necessary libraries, and RTOS (Real-Time Operating Systems). The process of creating intricate embedded applications is streamlined by this integration.

- Flash Magic 7.20: Flash Magic is a specialized software tool that is widely utilized for programming flash-based microcontrollers, primarily the LPC series of microcontrollers from NXP. With the help of this intuitive PC application, users can quickly and reliably program the flash memory in these microcontrollers, streamlining and speeding up the programming process. Flash Magic is primarily used via ISP (In-System Programming) or UART (Universal Asynchronous Receiver-Transmitter) interfaces to make it easier to transfer firmware and applications onto microcontroller chips. This feature is essential for the effective loading and updating of software onto embedded devices, both in the development and production phases.

Figures:

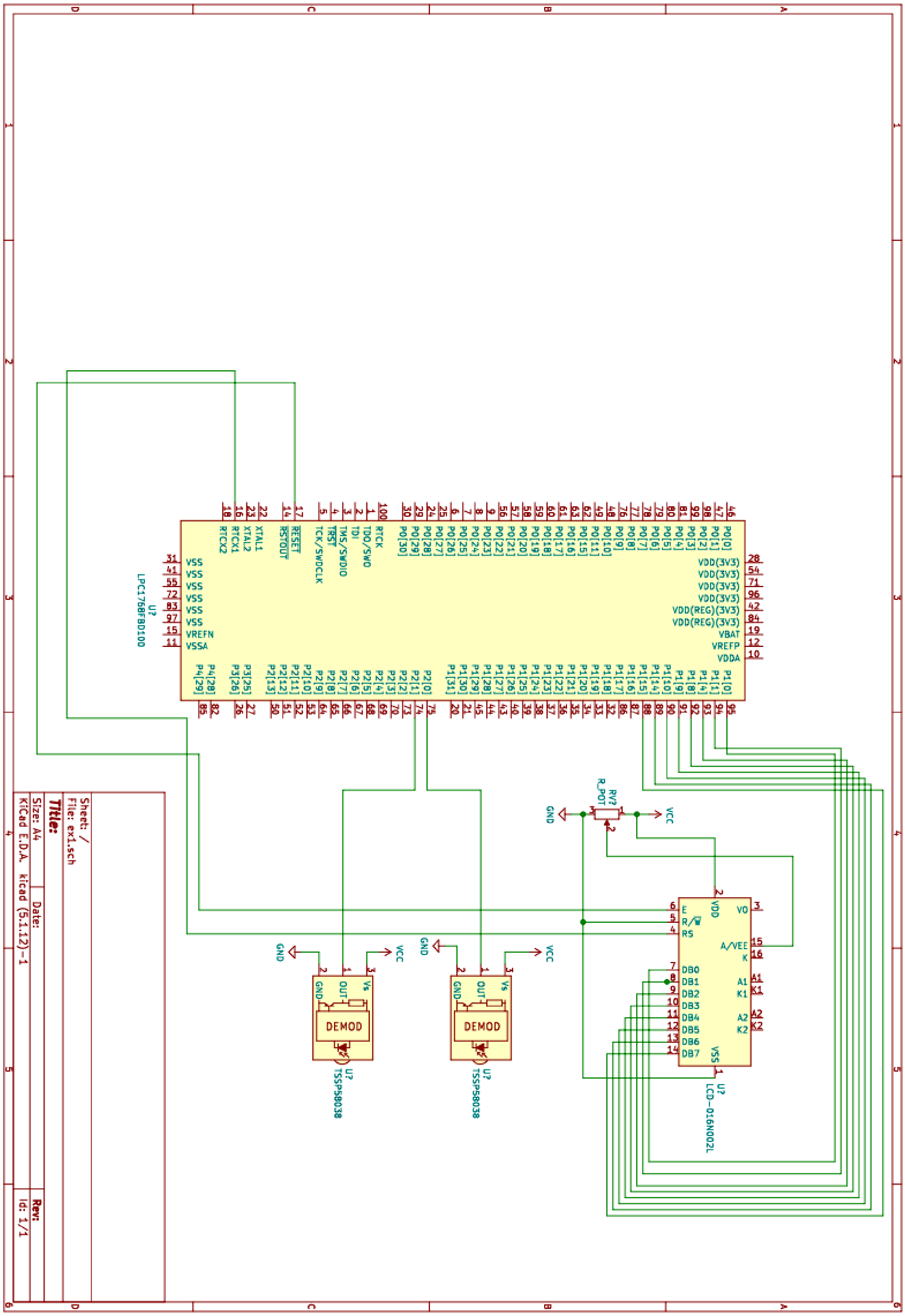

Fig 1.1: Circuit Diagram

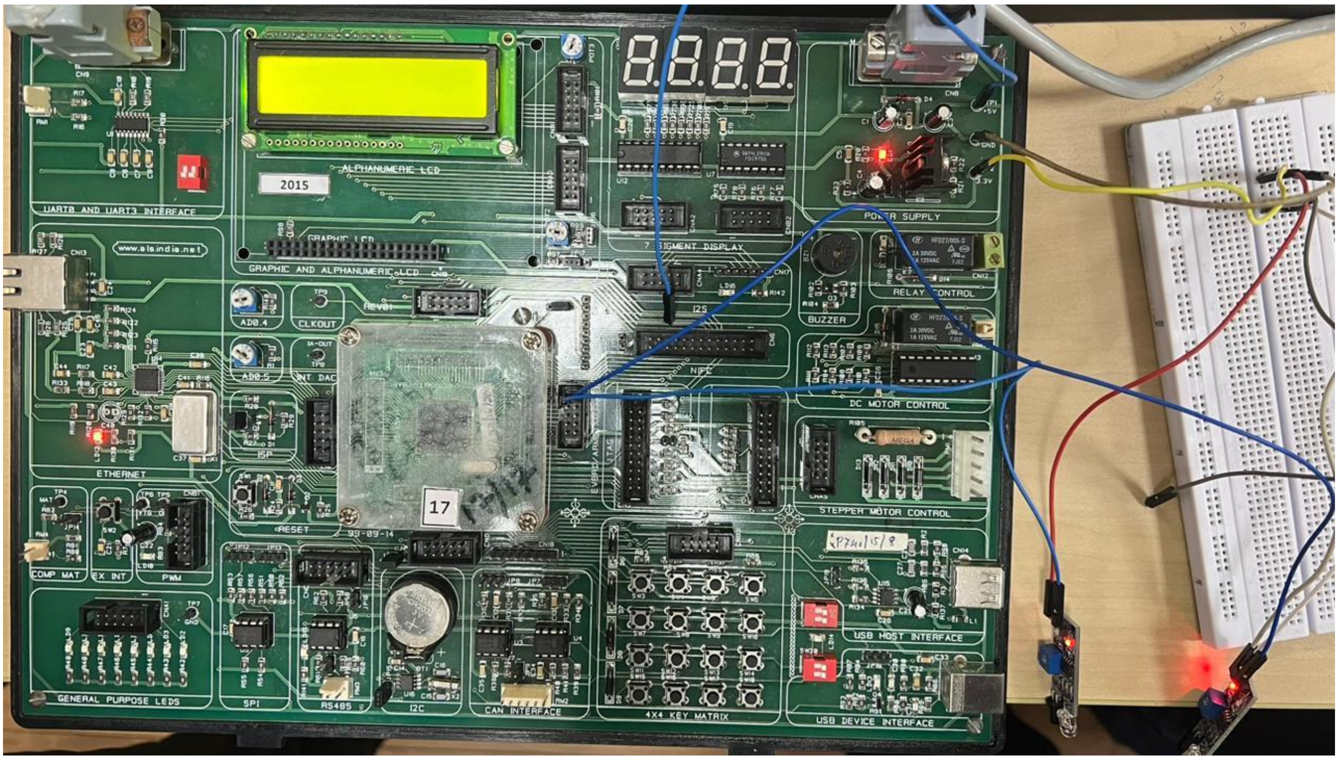

Fig 1.2: Picture of the circuit on the LPC1768 (ARM 32-BIT CortexM3 Microcontroller)

Source code:

```
#include<LPC17xx.h>
#include <stdlib.h>
#include<stdio.h>
#define RS_CTRL  0x08000000  //P0.27, 1<<27
#define EN_CTRL  0x10000000  //P0.28, 1<<28
#define DT_CTRL  0x07800000  //P0.23 to P0.26 data lines, F<<23

unsigned long int temp1=0, temp2=0,i,j,r,x;
unsigned char flag1 =0, flag2 =0,k;
char msg1[16];
char msg2[16];
int count=0;
int entrf=0, exitf=0;
int exted=0, entred=0;
void lcd_write(void);
void port_write(void);
void delay_lcd(unsigned int);
unsigned long int init_command[] = {0x30,0x30,0x30,0x20,0x28,0x01 ,0x06,0x0c,0x80};
long j1,x1,x2;
 void lcd_write(void)
         {
          temp2 = temp1 & 0xf0;// 4 - Bits to get it to least significant digit place
temp2 = temp2>>4;
port_write();
         if (!((flag1==0)&&((temp1==0x20)||(temp1==0x30)))) //send least significant 4 bits
only when it is data/command other than 0x30/0x20
          {
 temp2 = temp1 & 0x0f;
 temp2 = temp2 ;
 port_write();
          }
         }


void port_write(void)

{

LPC_GPIO0->FIOPIN = temp2<<23; // sending the ascii code
     if (flag1 == 0)
          LPC_GPIO0->FIOCLR = RS_CTRL; // if command
     else
          LPC_GPIO0->FIOSET = RS_CTRL; //if data

LPC_GPIO0->FIOSET = EN_CTRL; //sending a low high edge on enable input
for(r=0;r<25;r++);
```

```
void display()
{
flag1 =0;
for (i=0; i<9;i++)
                {
   temp1 = init_command[i];
       lcd_write();
                }
flag1 =1; //DATA MODE
for(i=0;msg1[i]!='\0';i++){
    temp1=msg1[i];
    lcd_write();
}
flag1=0;
temp1=0xC0;
lcd_write();
flag1=1;
sprintf(msg2,"%d",count);
for(i=0;msg2[i]!='\0';i++){
    temp1=msg2[i];
    lcd_write();
}
}

int main(void)
{
SystemInit();
SystemCoreClockUpdate();
sprintf(msg1,"Headcount is:");
LPC_PINCON->PINSEL3 = 0; //SENSOR
LPC_PINCON->PINSEL0 = 0; //LED
LPC_GPIO1->FIODIR = 0;

//LCD
LPC_PINCON->PINSEL1=0;
LPC_PINCON->PINSEL4=0;
LPC_GPIO0->FIODIR = DT_CTRL | RS_CTRL | EN_CTRL | (0xFF<<4); //0xf<<23 | 1<<27 |
1<<28;
LPC_GPIO2->FIODIR = 0<<12;

display();

while(1){
//LPC_GPIO0->FIOCLR=0xFF<<4;
x1=LPC_GPIO1->FIOPIN&1<<23;
x2=LPC_GPIO1->FIOPIN&1<<24;
```

```
if(x1){

if(x2){
//no entry no exit
entrf=0;
exitf=0;
}
else{
//exit
entrf=0;
if(exitf==1) continue;
exitf=1;
if(entred==1)
{
entred=0;
count++;
LPC_GPIO0->FIOSET=0xF<<8;
display();
}
else{
exted=1;
}
}
}
else{
//entry
if(!x2) continue;
exitf=0;
if(entrf==1) continue;
entrf=1;
if(exted==1){
exted=0;
count--;
if(count<0) count=0;
LPC_GPIO0->FIOSET=0xF<<4;
display();
}
else{
entred=1;
}
}
for(j1=0; j1<100000; j1++);
}
}
```

Conclusion

This system can be used to automate a room. The Entry and exit Visitor Counter with Automatic Room Light Controller is a model that accurately counts the number of visitors in a room and controls the room lights accordingly. When someone enters the room, the counter is incremented by one and the room lights are switched on automatically. When someone leaves, the counter is decremented by one and the lights are switched off only when all people leave the room [4]. People counting is also useful for event management, security, and smart cities applications and many more real-life applications. The LPC1768 Training Kit project was created as a part of our ES LAB PROJECT Vth sem. The objective of building this project was to check the connectivity and effectiveness of the IR sensor with the LPC1768 Training Kit and its connection with the Liquid Crystal Display (LCD) to display the count accurately. In this project we learnt to write an effective code for the LCD configuration of LPC 1768 and understood the functioning and working of both the LCD and the sensor. We got an opportunity to learn the basic concepts of Embedded C programming and voltage manipulating. Developing a working code for the LPC1768 kit made me understand the functioning of the components more effectively.

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[3] Winfred Adjardjah, George Essien, Hilary Ackar-Arthur Design and Construction of a Bidirectional Digital Visitor Counter ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online-www.iiste.org) Vol.7, No.2, 2016

[4] S Deepa, YR Saravanakumar, P Kirubakaran, K Vijaykumar, and M Tharun. Bidirectional visitor counter with automatic room light controller. International Research Journal of Engineering and Technology (IRJET), 8(04):479–481, 2021