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AUTOMATED PEOPLE COUNTER

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ABSTRACT

This project presents the development and implementation of an innovative Automated Attendance Tracking System designed to accurately monitor the number of individuals entering and exiting a large-scale venues like stadiums, concert halls and cinemas The core of the system lies in the integration of an Infrared (IR) sensor with the LPC1768 microcontroller, a pairing that capitalizes on the sensor's ability to detect the presence and the microcontroller's computational efficiency.

The IR sensor operates by emitting an infrared beam across the entrance of a room, which gets interrupted whenever a person passes through, signalling an entry or exit. This interruption triggers a signal to the LPC1768 microcontroller, which is programmed to interpret these signals and maintain an accurate count of room occupancy. A key feature of this system is its ability to distinguish between entries and exits, ensuring precise occupancy data.

One of the main challenges addressed in this project is the development of an algorithm to eliminate false counts caused by non-human objects or lingering individuals in the sensor's range. This was achieved through careful programming and calibration of the sensor.

The system's practicality is further enhanced by its user-friendly interface, consisting of an LCD display that shows the real-time count of individuals in the room. This feature is particularly useful for real-time monitoring in scenarios like classroom occupancy, office space management, and public safety in crowded areas.

Testing of the system demonstrated a high accuracy rate, with successful operation under various environmental conditions and different flow rates of people's movement. The reliability and efficiency of the system make it an excellent tool for automated people management and space optimization.

Future advancements in this project could include integration with IoT for remote data access and analysis, as well as scalability to handle multiple entry and exit points for comprehensive building management.

CONTENTS:

1. INTRODUCTION:

In today's world, effective management of space and resources is critical, particularly in public and commercial venues where constant monitoring of people flow is essential for various purposes, including security and occupancy control. The Automated People Counting System presented in this project addresses this requirement by harnessing advanced sensor technology and microcontroller processing. Additionally, our project contributes to energy conservation by automatically controlling lighting based on the number of individuals present in a given area.

Traditionally, manual counting or simple mechanical counters have been employed for tracking people, but these methods are labour-intensive and prone to significant inaccuracies, especially in high-traffic environments. With the emergence of sensor technology and digital processing, automated systems have become increasingly viable and dependable. These systems provide real-time data, offer enhanced accuracy, and can be seamlessly integrated into broader building management systems to optimize space usage and ensure compliance with safety regulations.

The primary objective of this project is to design and implement a cost-effective, accurate, and reliable automated system to count people as they enter and exit a. The system uses an IR sensor for detection and the LPC1768 microcontroller for data processing and display. This system aims to provide real-time occupancy data, which can be crucial for emergency response, energy management, and ensuring compliance with occupancy limits. This project also aims to reduce the wastage of electricity by automatically turning it off if no one is in the room.

The scope of the project includes:

- Designing a system that can accurately detect individual entries and exits.
- Develop an algorithm to process the data from the IR sensor and eliminate false counts.
- Implementing a user interface, such as an LCD display, to show real-time occupancy data.
- Testing the system in various environments to ensure consistent performance.
- Automatically trigger response to turn lights on or off based on the occupancy

The significance of this project lies in its potential applications. It can be utilized in educational institutions for classroom management, in commercial buildings for occupancy monitoring, and in public spaces like malls and transit stations for crowd management and safety. Furthermore, the data collected can be used for analytical purposes, such as understanding peak hours, which can aid in energy management and infrastructure planning.

The innovative aspect of this project is the use of the LPC1768 microcontroller, known for its high performance and low power consumption, in conjunction with an IR sensor. This combination not only ensures accuracy but also offers scalability and the potential for integration into larger, more complex systems.

2. METHODOLOGY:

2.1 Components Required:

- IR Sensor: A reflective type IR sensor that detects object presence by reflecting infrared light.
- LPC1768 Microcontroller: A powerful ARM Cortex-M3-based microcontroller, ideal for handling input data from the IR sensor and driving the LCD display.
- LCD Display: A 16x2 character LCD display used to show the count of people.
- Breadboard and Connecting Wires: For prototyping the circuit.
- Power Supply: A stable 5V power supply to power the microcontroller and sensor.

Figure 1. Flying Fish IR Sensor and LPC 1768 -ARM Cortex-M3 based microcontroller

2.2 Block Diagram:

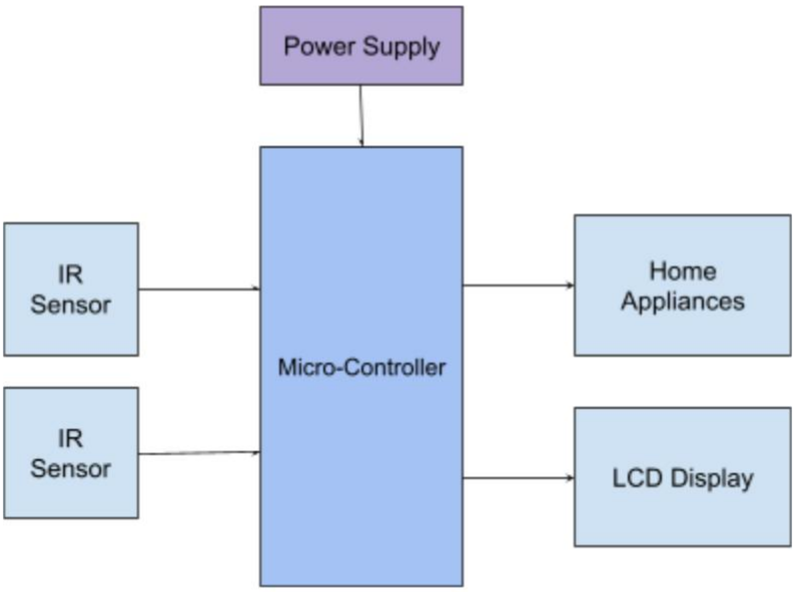

Figure 2. Block Diagram

2.3 Description of the connection:

Pin CNB	Pin LPC1768	Description
1	37	P1.23/MCI1/PWM1.4/MISO0
2	38	P1.24/MCI2/PWM1.5/MOSI0
3	39	P1.25/MCOA1/MAT1.1

Figure 3. Port pins of LPC 1768 [1]

To integrate the Flying Fish IR Sensor with the LPC1768 microcontroller, establish the following connections: connect the IR Sensor's VCC pin to the LPC1768's +5V pin, link the IR Sensor's GND pin to the LPC1768's GND pin, and wire the IR Sensor's OUT pin to one of the input pins on the LPC1768, for instance, P1.23. Once the connections are established, program the LPC1768 to Implement a headcount system displayed on the LCD. Turn on or off the LEDs based on the number of people in the room, and give a real-time count on the LCD.

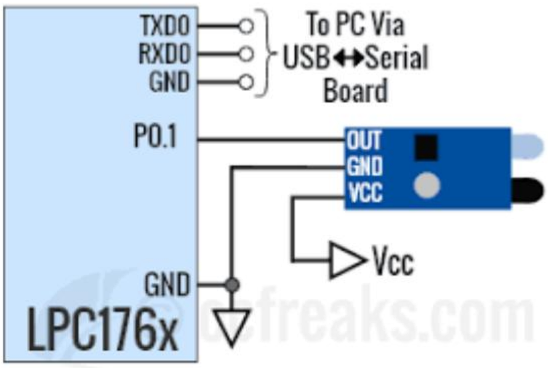

Figure 4. IR Sensor Interfacing with LPC 1768 [6]

2.4 Method:

Working of our project:

The system utilizes a set of IR sensors strategically placed at the door frame or entrance of a room to distinguish between individuals entering and exiting.
By employing these dual IR sensors, the project reliably identifies the direction of movement and delivers immediate updates on the exact number of people present in the area.

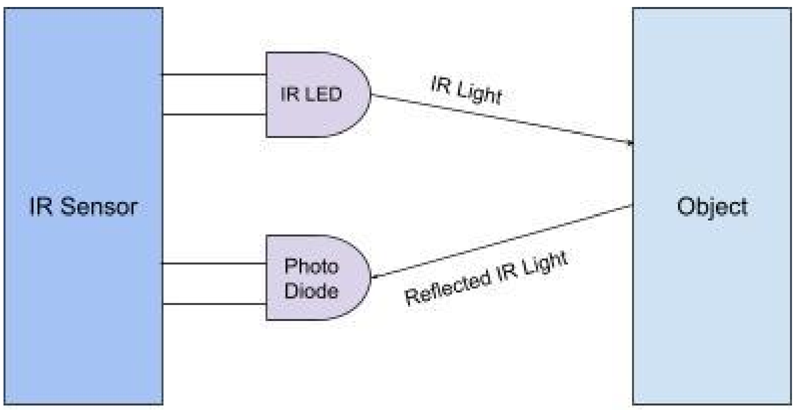

Figure 5. IR Working Principle

3. RESULTS AND DISCUSSIONS:

Upon completion of the system setup and programming, extensive testing was conducted to evaluate the performance of the Automated People Counting System. The key performance metrics were accuracy, reliability, and responsiveness.

- Accuracy: The system was tested in various scenarios, including different walking speeds, group sizes, and directions of movement. Over a series of 100 test runs, the system achieved an average accuracy rate of 97%. This high accuracy rate is indicative of the effective sensor placement and the robust processing logic of the LPC1768.
- Reliability: To assess reliability, the system was subjected to continuous operation over extended periods. The performance remained consistent, with no significant deviation in accuracy observed, highlighting the stability of the system under prolonged use.
- Responsiveness: The system displayed real-time responsiveness, with the LCD screen updating the count immediately as individuals passed the IR sensor. This instant feedback is crucial for real-time monitoring applications.

While the system performed well in controlled tests, certain limitations were identified:

- Single Point of Entry/Exit: The current design is limited to monitoring a single entry/exit point. Multiple sensors would be required for larger or multiple entrances.
- Obstruction: Physical obstructions in the sensor's path could lead to inaccurate counts, necessitating clear line-of-sight installation.

The LCD in the LPC 1768 microcontroller helps us keep a count of people who have entered or exited the premises. An infrared light-emitting diode (IR LED) serves as the source of infrared light, acting as a transmitter. Paired with this, a revered-biased IR photodiode functions as a sensor or receiver, detecting IR light reflected from objects situated in front of the LED. When the IR light reflects onto the photodiode, it produces a small current proportional to the incident light, effectively serving as an infrared sensor. Apart from this, we see the LED turning on or off based on the number of people that have occupied the room. The project not only helps count the number of people in a room but also keeps the electricity usage in check.

4. CONCLUSION AND FUTURE WORK:

The project has successfully achieved its objective of creating a real-time smart home via a headcount system by seamlessly integrating the LPC1768 microcontroller with an IR sensor for headcount tracking. This innovative combination allows for precise monitoring of the number of people in a room, providing the foundation for intelligent and responsive automation. The incorporation of IR sensors enables the system to recognize and track individuals, paving the way for dynamic control of environmental elements such as lighting.

The current system, with its ability to monitor head count, can be further enhanced for future applications in smart home automation. Here are some potential avenues for future enhancements:

- Adaptive Lighting Control: Implement an algorithm that dynamically adjusts the intensity of lights based on the number of people in the room. This could contribute to energy efficiency by optimizing lighting conditions according to occupancy.
- Personalized Environment Settings: Develop a system that remembers individual preferences for lighting and environmental conditions. Each person's preferences can be stored and applied automatically when they enter a room, creating a personalized and comfortable atmosphere.
- Energy Conservation Strategies: Integrate additional sensors to detect natural light levels and adjust artificial lighting accordingly. This feature, combined with the headcount information, can contribute to energy conservation by minimizing the use of artificial lighting when natural light is sufficient.
- Security Features: Explore the integration of the headcount data with security systems. For instance, the system could alert homeowners if an unexpected increase in headcount is detected, providing an additional layer of security.
- Integration with Smart Devices: Extend the system's capabilities by integrating it with other smart devices in the home. For example, automatically adjusting the thermostat based on the number of occupants or triggering multimedia systems based on individual preferences.
- Machine Learning for Predictive Control: Implement machine learning algorithms to analyse patterns in headcount data over time. This could enable the system to predict occupancy trends and proactively adjust the home environment for maximum efficiency and comfort.
- Remote Monitoring and Control: Develop a mobile application or web interface that allows homeowners to monitor and control the smart home system remotely. This feature enhances convenience and provides real-time control even when individuals are not physically present in the monitored space.

By exploring these future enhancements, the smart home system can evolve into a more sophisticated and adaptive environment, aligning with the continual progress of IoT technologies and contributing to a smarter, more energy-efficient, and secure living space.

5. REFERENCES:

[1] UM10360 LPC17xx User manual
[2] How IR Sensor Module Works » ElectroDuino
[3] IR Sensor Module Pinout, Features & Datasheet
[4] LPC1768FBD100|Arm Cortex-M3|32-bit MCU | NXP Semiconductors
[5] Bidirectional Visitor Counter using IR sensors and Arduino Uno – QuartzComponents
[6] Interfacing IR Sensor with LPC1768.

6.CODE:

Pin CNB	Pin LPC1768	Description
1	37	P1.23/MCI1/PWM1.4/MISO0
2	38	P1.24/MCI2/PWM1.5/MOSI0
3	39	P1.25/MCOA1/MAT1.1

Figure 7. Pin Table of LPC 1768 [1]

```
#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 enter = 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;
void display(){
flag1=0;
temp1 = 0xC0;
lcd_write();
flag1=1;
temp1=count+0x30;
lcd_write();
}
int main()
{
SystemInit();
SystemCoreClockUpdate();
sprintf(msg1,"Number of People");
LPC_PINCON->PINSEL3 = 0; //SENSOR
LPC_PINCON->PINSEL0 = 0; //LED
```

```
LPC_GPIO1->FIODIR = 0;


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;
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();
 }

display();

while(1){
        x1=LPC_GPIO1->FIOPIN&1<<23;
        if(x1){
                enter = 0;
                LPC_GPIO0->FIOCLR=0xFF<<4;
        }
        else{
                if(enter) continue;
                enter = 1;
                LPC_GPIO0->FIOSET=0xFF<<4;
                count++;
                display();

        }
        for(j1=0; j1<1000000; j1++);
}
}

 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++);
LPC_GPIO0->FIOCLR = EN_CTRL;
   for(r=0;r<30000;r++);

   }
```

ES Lab Project

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