Parking Facility Monitoring System Using IR Sensors

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ABSTRACT

This project focuses on revolutionizing urban parking management with an advanced parking facility tracking system. By utilizing Infrared (IR) sensors strategically placed at entry and exit points, the system offers real-time monitoring of parking occupancy, overcoming limitations seen in traditional sensor-based systems.

The parking facility tracking system promises improvements in urban mobility by optimizing traffic flow within parking facilities and addressing challenges of limited parking in crowded urban areas. It enhances user experience by providing drivers with timely and accurate parking information.

Key components including the LPC-1768 kit, IR sensors, FRC cables, and an LCD display are carefully integrated to ensure system functionality and reliability. Rigorous testing and iterative refinement validate the system's effectiveness across different conditions, aiming to enhance resilience and adaptability over time.

Beyond technology, the project aims to benefit urban communities by setting new standards for parking management and inspiring future developments. Ultimately, it seeks to transform urban spaces into more efficient, sustainable, and liveable environments.

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INTRODUCTION

Smart cities integrate technology into urban infrastructure to improve residents' quality of life and optimize city operations. Parking facility tracking is crucial for addressing urban vehicular congestion by efficiently managing limited parking space amidst increasing vehicle numbers. Traditional parking systems, often manual and disconnected, result in inefficiencies such as traffic gridlocks, pollution, and user frustration due to the lack of real-time occupancy information.

The proposed parking facility tracking system relies on a network of Infrared (IR) sensors, leveraging their precision and responsiveness to detect vehicle movement at parking lot entry and exit points. IR sensors are reliable and cost-effective, accurately determining vehicle presence and transforming static parking facilities into dynamic data-generating hubs. Real-time parking occupancy data from IR sensors is vital for managing traffic flow in urban centres.

Key Objectives of the System:

- Establish a robust IR sensor framework for accurate monitoring of vehicle ingress and egress, providing a live count of parked vehicles.
- Evaluate the precision and reliability of the IR sensor-based parking facility tracking system across various environmental conditions, ensuring adaptability and effectiveness.

Central to this initiative is the embedded technology platform, seamlessly integrating sensor input to bridge the gap between physical parking spaces and digital oversight.

The overarching goals of this project include:

- Enhancing parking space utilization by enabling administrators to monitor and manage parking resources in real time.
- Developing a scalable parking facility tracking model adaptable to various parking lot dimensions and layouts.

Through careful design and execution, the parking facility tracking system aims to revolutionize parking management in urban landscapes, serving as a beacon of innovation and a template for future smart city initiatives. Further sections will explore the methodology, design considerations, and expected impacts of this advanced parking solution.

PROPOSED METHODOLOGY

Our approach aims to enhance existing parking facility tracking systems by prioritizing precision, scalability, and adaptability. We utilize infrared (IR) sensors to create a highly accurate and reliable parking management system.

A. Overview of the Proposed Method

1) **Data Acquisition:** IR sensors are strategically placed at parking lot entry and exit points to detect and count incoming and outgoing vehicles, effectively monitoring parking space occupancy.

2) **Preprocessing and Data Relay:** Raw data from IR sensors undergoes preprocessing to remove noise and false triggers, ensuring accurate vehicle detection.

3) **Data Management:** An intuitive interface displays real-time information on parked vehicles for efficient monitoring and management.

4) **System Adaptability and Calibration:** Calibration procedures ensure the system performs well in diverse parking environments, accounting for variations in vehicle sizes and parking space dimensions.

5) **Feedback and Continuous Improvement:** Feedback mechanisms correct discrepancies in vehicle counts, continually improving system accuracy over time.

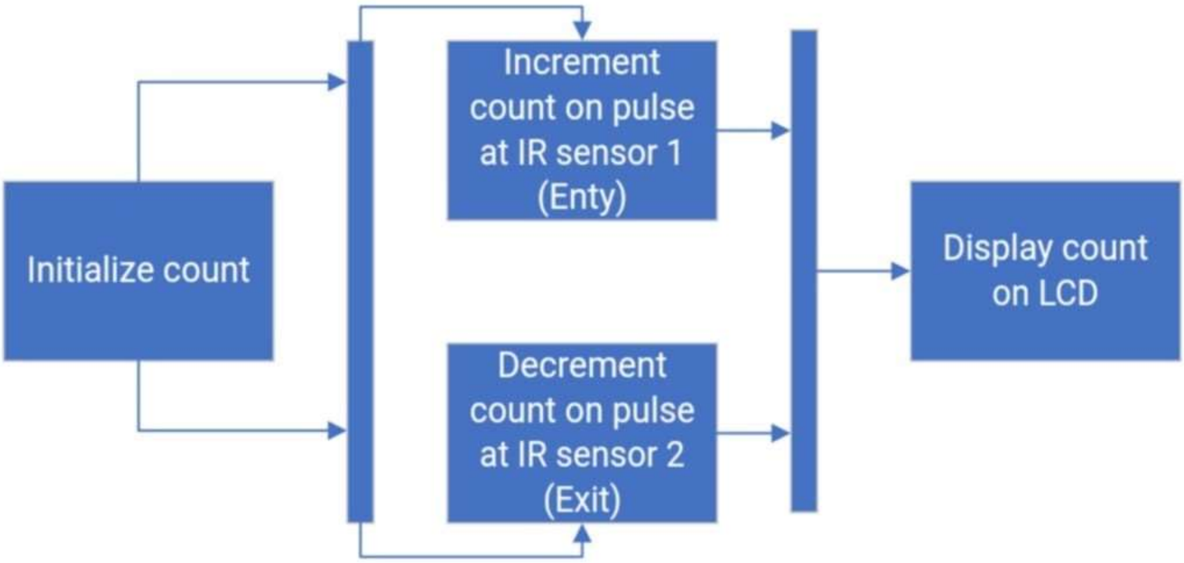
B. Comparison with Surveyed Methods

Our methodology excels by implementing efficient wireless data transmission, a feature not commonly found in existing literature. This integration simplifies system complexity, reduces costs, and enables real-time updates to administrators based on direct sensor data. The modularity of IR sensors ensures scalability, allowing easy expansion or reduction based on parking lot size.

C. Implementing the Proposed Methodology

Implementation involves meticulous testing to validate IR sensor accuracy and communication effectiveness under various conditions. Initial data collection establishes baseline accuracy, followed by iterative calibrations to refine system performance. Continuous feedback-driven refinement enhances reliability and precision. The methodology offers a flexible, scalable parking facility tracking solution adaptable to different parking lot sizes and layouts.

D. Block Diagram



COMPONENTS USED

The implementation of our parking facility tracking system relies on a carefully chosen set of components to ensure efficiency and functionality. The LPC-1768 kit serves as the central processing unit, providing the necessary computational power and interface capabilities. In tandem with this, infrared (IR) sensors are employed at key entry and exit points to accurately detect and monitor vehicle movements.

The connectivity backbone is established using FRC cables, ensuring robust and reliable communication between the IR sensors and the central processing unit. Additionally, an LCD display is integrated into the system to provide real-time information, enhancing the user interface, and facilitating seamless interaction with the parking facility tracking solution. This combination of the LPC-1768 kit, IR sensors, FRC cables, and an LCD display forms a cohesive and effective ensemble of components, contributing to the overall success of our proposed methodology.

Description of Connections:

For IR Sensor 1:

- Output pin is connected to P2.10, Pin 5 of CNB.
- Ground is connected to Pin 10 of connector B (CNB).
- VCC is connected to the common VCC of the KIT.

For IR Sensor 2:

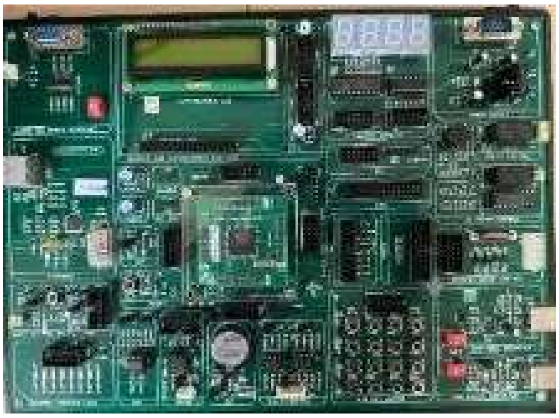
- Output pin is connected to P2.11, Pin 6 of CNB.
- Ground is connected to Pin 10 of connector B (CNB).
- VCC is connected to the common VCC of the KIT.

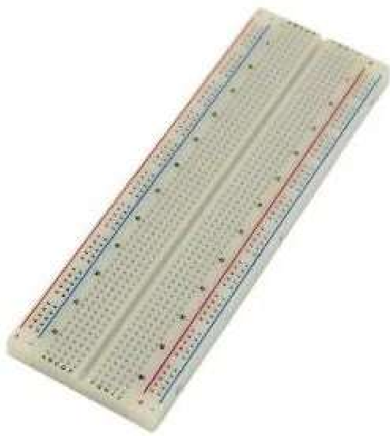
For LCD:

- Output lines P0.23 to P0.26 are connected to pins 1 to 4 of CND.
- Register Select (RS) is connected to P0.27, Pin 5 of CND.
- Enable input is connected to P0.28, Pin 6 of CND.

Other General Components:

- Breadboard to supply power to the two sensors.
- Male to female jumper cable.
- Female to female jumper cable.





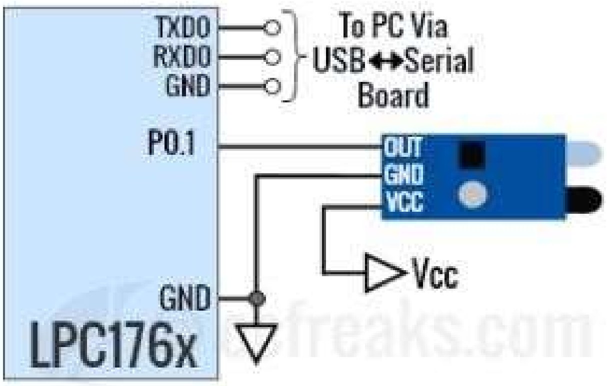
These meticulous connections establish the necessary linkages between the LPC-1768 kit, Infrared sensors, and the LCD display, ensuring seamless communication and integration of components within the parking facility tracking system.

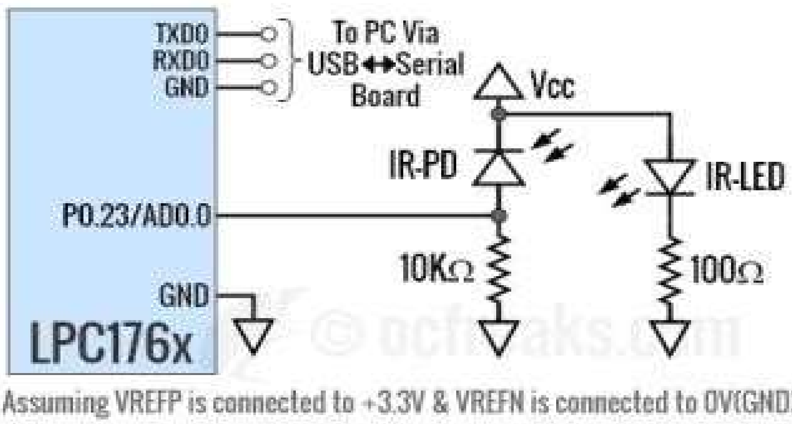
RESULTS & RELAVANCE OF WORK

After reviewing current literature on advanced parking management technologies, it becomes clear that precision, scalability, and adaptability are essential attributes needed in diverse environmental conditions. While existing parking facility tracking solutions introduce innovative features, they often face challenges in high-demand situations or varied environmental contexts. Our proposed smart parking system methodology distinguishes itself by seamlessly integrating reliable IR sensors.

This approach is designed to enhance parking accuracy and address operational inflexibility common in sensor-based systems. The potential applications of our parking facility tracking system are significant, promising improvements in traffic flow management, space utilization, and user experience in urban settings. By providing real-time parking data to administrators, the system is poised to streamline the efficient allocation of parking resources.

As we prepare for deployment, our system undergoes rigorous empirical testing and iterative refinement to ensure resilience in real-world conditions and embody a model of continuous advancement. This commitment extends beyond innovation; it aims to deliver tangible, adaptable, and user-friendly parking facility tracking solutions that align with the dynamic needs of modern cities. The implications of this work are set to establish a new benchmark for future developments in parking management systems, impacting how urban spaces are managed.





WORKING 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, threshold = 15, empty = 1, full = 0;

unsigned long int init_command[] = {0x30, 0x30, 0x30, 0x20, 0x28, 0x01, 0x06, 0x0c,
0x80};

void EINT0_IRQHandler(void);  // Interrupt handler for Entry (P2.10)
void EINT1_IRQHandler(void);  // Interrupt handler for Exit (P2.11)

void lcd_write(void);
void port_write(void);
void delay_lcd(unsigned int);

void lcd_write(void){
   temp2 = temp1 & 0xf0;  // Extract the 4 significant bits to get least significant digit place
   temp2 = temp2 >> 4;
   port_write(); // Send least significant 4 bits only when it is data other than 0x30/0x20

   if (!((flag1 == 0) && ((temp1 == 0x20) || (temp1 == 0x30)))) {
      temp2 = temp1 & 0x0f;
      temp2 = temp2;
      port_write();}

}

void port_write(void){
   LPC_GPIO0->FIOPIN = temp2 << 23;  // Send the ASCII code

   if (flag1 == 0)
      LPC_GPIO0->FIOCLR = RS_CTRL;  // Command mode
   else
      LPC_GPIO0->FIOSET = RS_CTRL;  // Data mode
```

```
    LPC_GPIO0->FIOSET = EN_CTRL;  // Send a low-to-high edge on the enable input
    for (r = 0; r < 25; r++);
    LPC_GPIO0->FIOCLR = EN_CTRL;
    for (r = 0; r < 30000; r++);
}

void display(){
    flag1 = 0;  // Initialization commands for the LCD

    for (i = 0; i < 9; i++){
        temp1 = init_command[i];
        lcd_write();
    }
    flag1 = 1;  // Data mode

    for (i = 0; msg1[i] != '\0'; i++){   // Display the first message
        temp1 = msg1[i];
        lcd_write();
    }

    if (!full) {     // If not full, display the car count
        flag1 = 0;
        temp1 = 0xC0;  // Move the cursor to the second line
        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, "Car count is:");

    LPC_PINCON->PINSEL1 = 0;   // Configure pin functions
    LPC_PINCON->PINSEL4 |= (1 << 20 | 1 << 22);  // Configure pins for EINT0 and EINT1

    // Configure pins for LCD control and data lines
    LPC_GPIO0->FIODIR = DT_CTRL | RS_CTRL | EN_CTRL | (0xFF << 4);
    LPC_GPIO1->FIODIR = 0;  // LCD
    LPC_GPIO2->FIODIR = 0;
```

```
    display();
    // Configure external interrupts EINT0 and EINT1
    LPC_SC->EXTMODE = 1 << 0 | 1 << 1;  // EINT0 and EINT1 are initiated as edge-
sensitive
    LPC_SC->EXTPOLAR = 0;             // EINT0 and EINT1 are falling edge-sensitive
    NVIC_EnableIRQ(EINT0_IRQn);  // Enable interrupt for Entry
    NVIC_EnableIRQ(EINT1_IRQn);  // Enable interrupt for Exit

    while (1);
}

void EINT0_IRQHandler(void){
    LPC_SC->EXTINT = 1 << 0;  // Clear the interrupt

    // Increment count if not full
    if (!full){
        count++;}

    // Update flags
    if (count > 0 && empty){
        empty = 0;}

    // Display 'Full' if count exceeds the threshold
    if (count >= threshold){
        sprintf(msg1, "Full");
        full = 1;}

    // Update the LCD display
    display();
}

void EINT1_IRQHandler(void){
    LPC_SC->EXTINT = 1 << 1;   // Clear the interrupt

    // Decrement count if not empty
    if (!empty){
        count--;}

    // Update flags
    if (count < threshold && full){
        sprintf(msg1, "Car count is:");
        full = 0;}

    // Update the LCD display
    display();}
```

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