A Mini project Report on:

SMART TRAFFIC LIGHT SYSTEM

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INTRODUCTION

Traffic congestion at intersections, especially during peak hours, is a persistent problem in urban areas worldwide. Traditional traffic signals operate on fixed timing cycles, which means they do not adapt to varying traffic densities on different roads. This often leads to inefficient traffic flow, as vehicles on less congested roads might have to wait unnecessarily, while heavily congested roads may not have enough green light time to clear the traffic.

The goal of this project is to develop a smart traffic light control system that adapts dynamically based on real-time traffic density. This system uses IR sensors positioned at a four-way junction to detect the number of vehicles approaching from each direction. By calculating the traffic density, the system can adjust the timing of each traffic light to prioritize roads with higher density, thereby improving traffic flow and reducing congestion. The LPC2138 microcontroller serves as the central processing unit, analyzing data from the IR sensors and managing the light durations.

Such a system has the potential to optimize traffic management, reduce emissions caused by idling vehicles, and minimize delays. Implementing adaptive traffic control systems can also enhance driver satisfaction by reducing wait times and providing a smoother, more efficient driving experience.

LITERATURE REVIEW

Traffic management has been an area of significant research and development, particularly with the rise of urbanization and increasing vehicle populations. Traditional traffic signal systems have employed various methodologies, including fixed-time, actuated, and adaptive control systems, each with its own advantages and limitations.

1. Fixed-Time Systems:
   - Fixed-time traffic signals operate on predetermined timing cycles that do not change regardless of real-time traffic conditions. While simple to implement, these systems often lead to inefficiencies during periods of varying traffic density, causing delays for vehicles on less congested roads.

.2. Role of IR Sensors:
   - Infrared (IR) sensors are increasingly being adopted in smart traffic management due to their effectiveness in detecting vehicle presence without physical road modifications, such as loops. They are non-intrusive, cost-effective, and can cover multiple lanes simultaneously. Research indicates that IR sensors provide reliable data, facilitating accurate vehicle counting and density estimation, which is crucial for adaptive systems.

3. Microcontroller-Based Solutions:
   - The integration of microcontrollers, such as the LPC2138, in traffic control systems allows for enhanced processing capabilities and flexibility in managing sensor data. Microcontrollers can execute complex algorithms that analyze traffic conditions and adjust signal timings in real-time. Previous studies have demonstrated that such systems can respond to traffic fluctuations quickly, leading to improved safety and reduced travel delays.

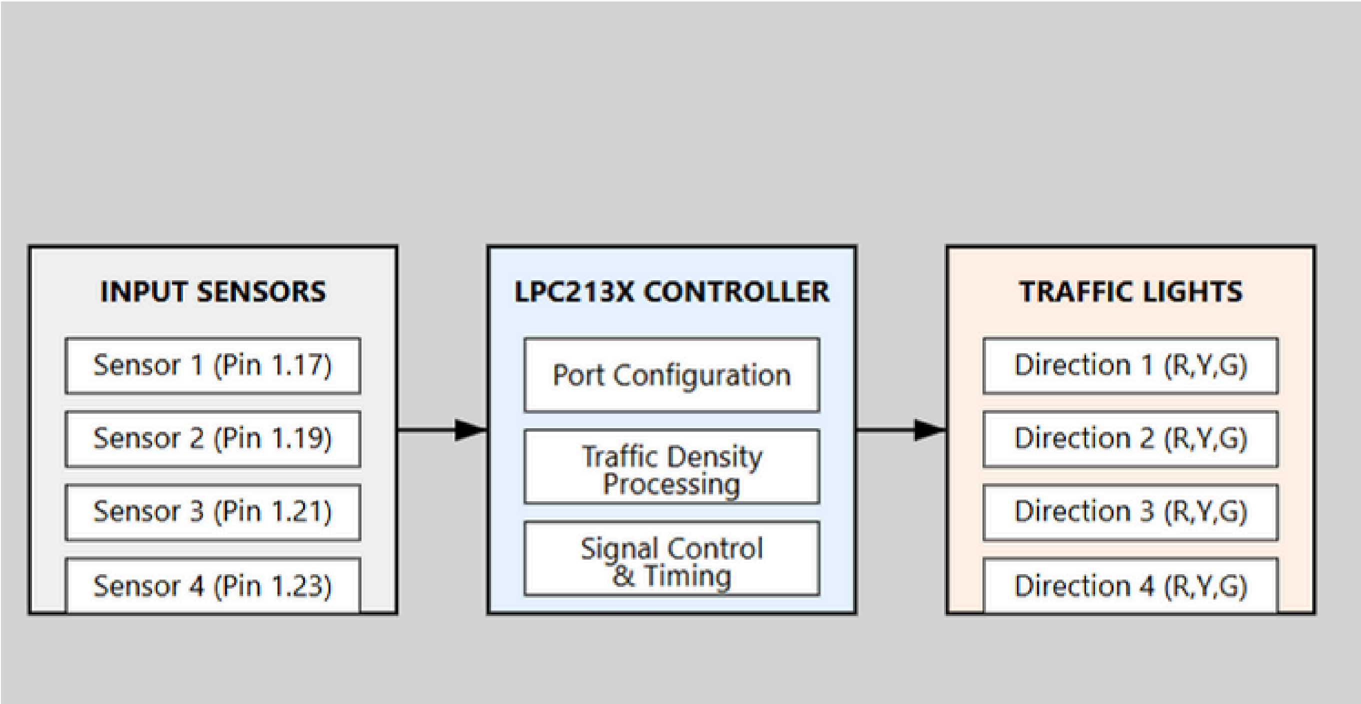
PROBLEM STATEMENT:

To design an effective solution 'SMART TRAFFIC LIGHT SYSTEM' and reduce traffic congestions by dynamically adjusting traffic light timings, particularly at a four-way junction, the system improves traffic flow, reduces congestion, and minimizes wait times.

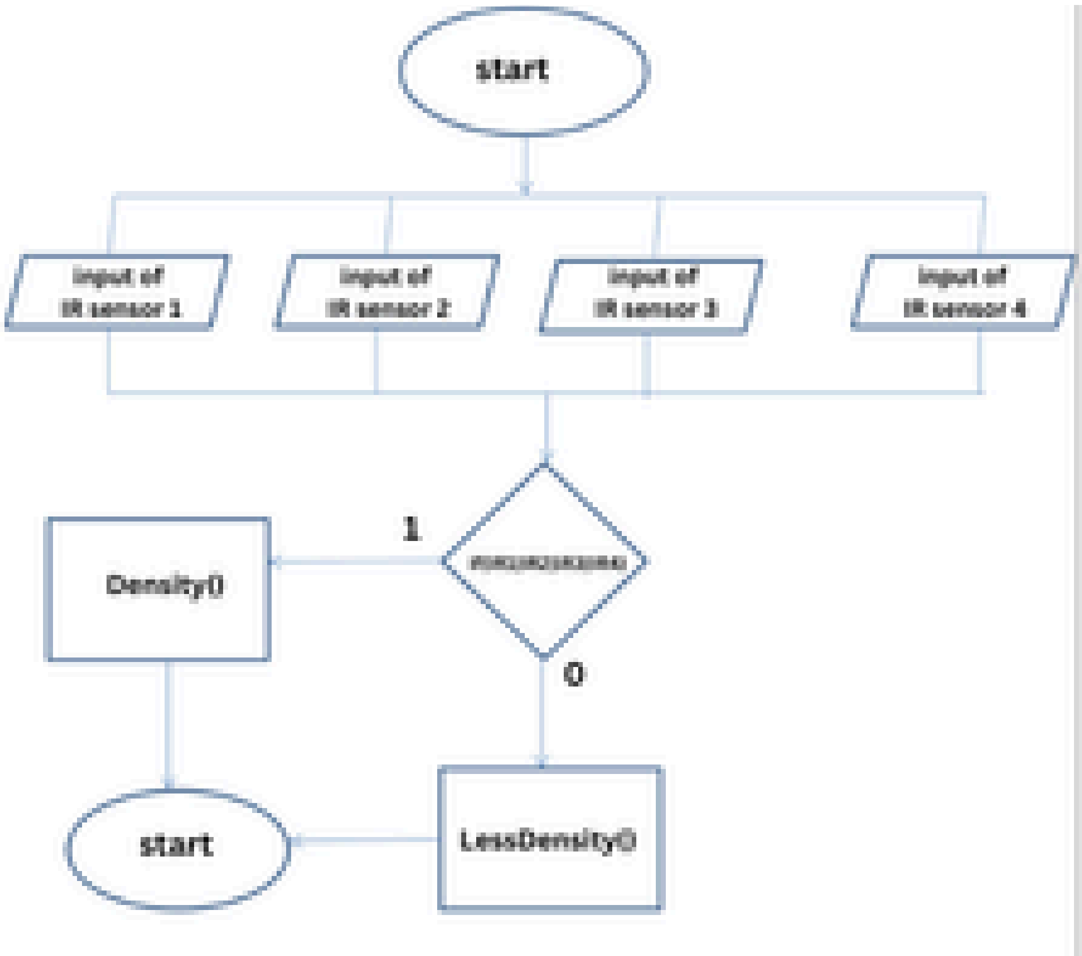
COMPONENTS REQUIRED

1)LPC2138 Microcontroller: For processing sensor data and controlling traffic light timers.
2)IR Sensors: To detect the presence and density of vehicles on each road.
3)Traffic Light LEDs: Red, yellow, and green LEDs to simulate real traffic lights.
4)Timer Module: For controlling timing intervals.
5)Power Supply: To power the components. Connecting Wires and
6) Connecting Wires and Resistors: Basic wiring to connect the sensors, microcontroller, and lights.

BLOCK DIAGRAM:



FLOW CHART



WORKING:

The smart traffic light system operates by continuously monitoring traffic density at a three-way intersection. Here's a step-by-step breakdown of how the system works:

1. Traffic Detection Using IR Sensors:

- IR sensors are installed at strategic points on each approach to the intersection to detect the presence of vehicles. These sensors count the number of vehicles or measure the traffic density by determining the level of infrared light reflected back when a vehicle is present. - The IR sensors are connected to the LPC2138 microcontroller, which receives signals based on the vehicle count or density detected by each sensor.

2. Processing and Decision-Making by the Microcontroller:

- The LPC2138 microcontroller is programmed to interpret signals from the IR sensors and assess traffic density on each road. The microcontroller compares the densities of all three roads to determine which road has the highest density. - Based on this comparison, the microcontroller makes decisions on how to allocate the green light timing. For example: - If one road has significantly higher density, it receives a longer green light duration to allow more vehicles to pass through. - Roads with lower density may receive a shorter green light duration to allow the higher-density road to clear more quickly. - The timing is continuously adjusted based on real-time updates from the sensors.

3. Timer Adjustment for Traffic Lights:

- Once the microcontroller determines the timing allocation for each road, it adjusts the timers for the traffic lights accordingly. The green light duration on the high-density road is extended, while the green lights on other roads are shortened proportionately. - This adjustment cycle repeats as traffic density data updates in real-time, allowing the system to respond dynamically to changing traffic patterns throughout the day.

4. Updating the Traffic Lights:

The microcontroller controls the LEDs representing the traffic lights at the intersection. It sets the green, yellow, and red lights according to the adjusted timings, ensuring that the system functions just like a regular traffic light but with adaptive timing. - This cycle continues indefinitely, with the system making adjustments every few seconds (or based on a specified interval), ensuring optimal traffic flow.

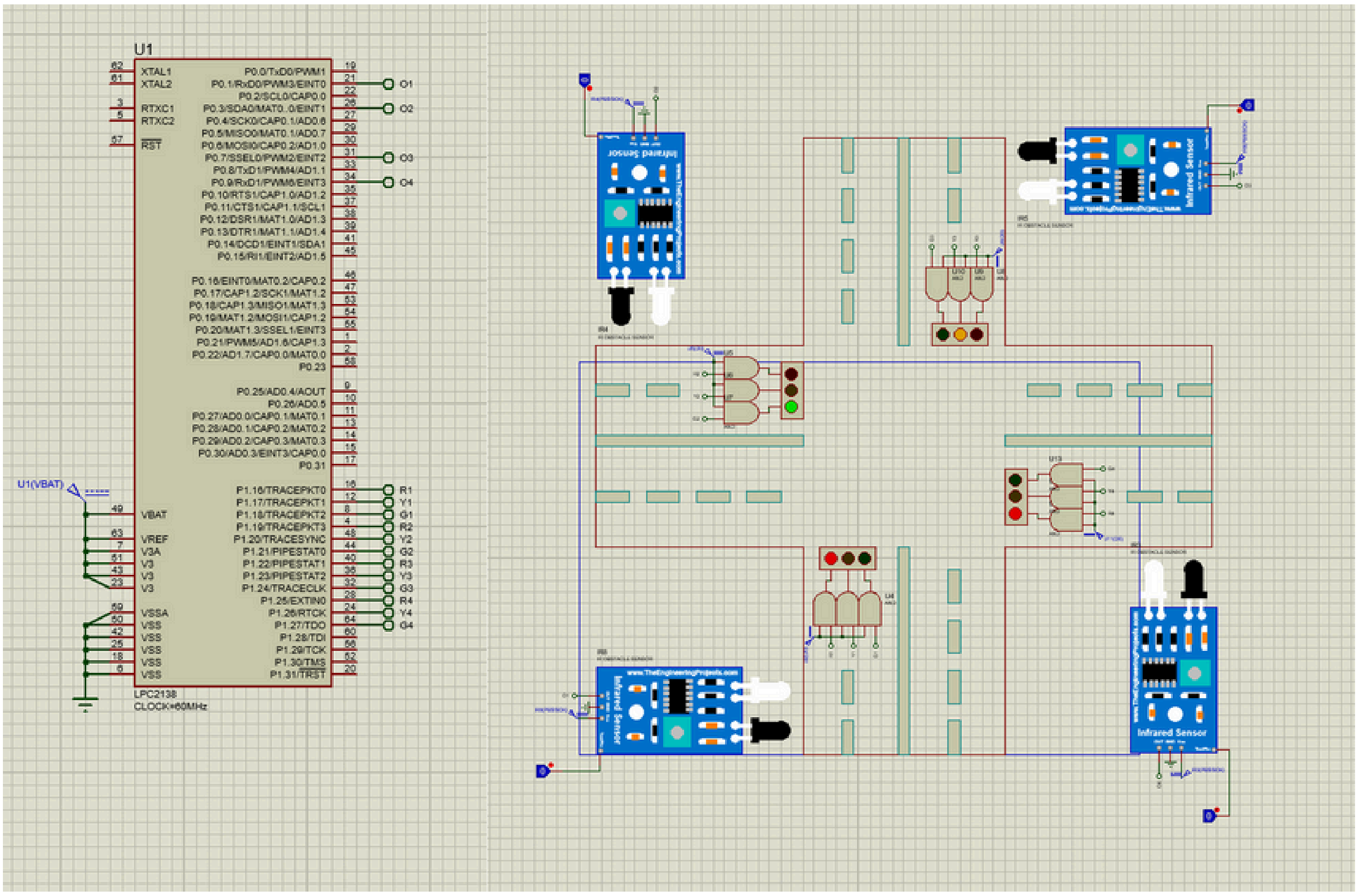
Source Code:

```
#include <LPC213X.H>
static int flg=0;
void Delay(int n)
{
 T0TCR = (1<<1);
 T0MR0 = n;
 T0MCR = (3<<0);
 T0TCR = (1<<0);
 T0PR = 0x270F;
 while(!(T0IR & (1<<0)));
 T0IR = (1<<0);
}

void isr_ext0()__irq
{

 IOPIN1=(1<<18)|(1<<20)|(1<<22)|(1<<25);
 Delay(6000);
 flg=1;
 EXTINT = (1<<0);
 VICVectAddr=0x00;
}
void isr_ext1()__irq
{

 IOPIN1=(1<<16)|(1<<21)|(1<<23)|(1<<25);
 Delay(6000);
 flg=2;
 EXTINT = (1<<1);
 VICVectAddr=0x00;
}
void isr_ext2()__irq
{
 IOPIN1=(1<<16)|(1<<19)|(1<<24)|(1<<26);
 Delay(6000);
 flg=3;
```

```
EXTINT = (1<<2);
 VICVectAddr=0x00;
}
void isr_ext3()__irq
{
 IOPIN1=(1<<17)|(1<<19)|(1<<22)|(1<<27);
 Delay(6000);
 flg=4;
 EXTINT = (1<<3);
 VICVectAddr=0x00;
}
void intr_init()
{
 PINSEL0=0X000CC0CC;
 VICIntSelect=0x00;
 VICVectAddr0=(unsigned)isr_ext0;
 VICVectCntl0=(1<<5)|(14<<0);
 VICVectAddr1=(unsigned)isr_ext1;
 VICVectCntl1=(1<<5)|(15<<0);
 VICVectAddr2=(unsigned)isr_ext2;
 VICVectCntl2=(1<<5)|(16<<0);
 VICVectAddr3=(unsigned)isr_ext3;
 VICVectCntl3=(1<<5)|(17<<0);
 VICIntEnable=(0x0F<<14);
 VPBDIV=0x00;
 EXTMODE=(0xF<<0);
 EXTPOLAR=(0xF<<0);
}
void initial()
{
 IOPIN1=(1<<18)|(1<<20)|(1<<22)|(1<<25);
 Delay(3000);
 IOPIN1=(1<<16)|(1<<21)|(1<<23)|(1<<25);
 Delay(3000);
 IOPIN1=(1<<16)|(1<<19)|(1<<24)|(1<<26);
 Delay(3000);
 IOPIN1=(1<<17)|(1<<19)|(1<<22)|(1<<27);
 Delay(3000);
}
```

```
int main()
{
 intr_init();
 IODIR1 = ((0XFFF)<<16);
 while(1)
 {
 if(flg==1)
 {
 IOPIN1=(1<<16)|(1<<21)|(1<<23)|(1<<25);
 Delay(3000);
 IOPIN1=(1<<16)|(1<<19)|(1<<24)|(1<<26);
 Delay(3000);
 IOPIN1=(1<<17)|(1<<19)|(1<<22)|(1<<27);
 Delay(3000);
 }
 else if(flg==2)
 {
 IOPIN1=(1<<16)|(1<<19)|(1<<24)|(1<<26);
 Delay(3000);
 IOPIN1=(1<<17)|(1<<19)|(1<<22)|(1<<27);
 Delay(3000);
 IOPIN1=(1<<18)|(1<<20)|(1<<22)|(1<<25);
 Delay(3000);
 }
 else if(flg==3)
 {
 IOPIN1=(1<<17)|(1<<19)|(1<<22)|(1<<27);
 Delay(3000);
 IOPIN1=(1<<18)|(1<<20)|(1<<22)|(1<<25);
 Delay(3000);
 IOPIN1=(1<<16)|(1<<21)|(1<<23)|(1<<25);
 Delay(3000);
 }
 else
 {
 flg=0;
 initial();
 }
 }
}
```

CIRCUIT SIMULATION



CALCULATIONS:

C-Clk=60MHz

P-Clk=1/4*C-Clk=1/4*60=15MHz

Delay=NOC*1/P-Clk

Initial Delay:-(2secs)(for less density)

2secs=NOC*1/15MHz

NOC=3000x10^4

PR=9999 , MR0=3000

Additional delay(4 secs)(for more density):

PR=9999 , MR0=6000

APPLICATIONS :

- Urban traffic management systems.
- Emergency vehicle prioritization at intersections.
- Real-time traffic data collection for analytics.
- Adaptive traffic management in high-density areas.
- Real-Time Traffic Alerts by sending notifications to drivers about traffic conditions and light changes through mobile apps or navigation systems.
- Adaptive Traffic Signals for Bicycles by Adjusting timings to accommodate cyclists, ensuring safer crossings and smoother integration with vehicle traffic.
- Integration with Public Transportation by synchronizing traffic lights with bus and tram schedules to prioritize public transport, reducing delays and improving service efficiency.
- Traffic Flow Prediction by Utilizing historical data and real-time inputs to predict traffic patterns, allowing for proactive adjustments.

ADVANTAGES/DISADVANTAGES

Advantages:

- Reduces congestion by adjusting timings based on real-time traffic.
- Minimizes idle time, potentially reducing emissions at intersections.
- Improves traffic flow efficiency, especially during peak hours.

Disadvantages:

- Dependent on sensor accuracy; false readings could disrupt timing.
- May be costly to implement on a larger scale.
- Requires consistent maintenance and calibration.

REFRENCES :

LPC2138 Data Sheet:

https://www.nxp.com/docs/en/data-sheet/LPC2131_32_34_36_38.pdf

Characteristics of IR Sensors:

https://robu.in/ir-sensor-working/