Smart Traffic Management System

INTRODUCTION :

- A Smart Traffic Management System in IoT (Internet of Things) is an advanced infrastructure that leverages interconnected devices, sensors, and data analytics to efficiently manage and optimize traffic flow in urban areas. This system utilizes IoT technology to collect real-time data from various sources, process it, and make informed decisions to improve traffic conditions, enhance safety, and reduce congestion.

- In traditional traffic management systems, traffic lights, signage, and other infrastructure operate on fixed schedules or manual adjustments. IoT-based smart traffic management, on the other hand, leverages advanced technologies to create a dynamic and adaptive traffic control system.

- This data is then used to make informed decisions and dynamically adjust traffic signals, routes, and other aspects of traffic management to improve overall efficiency, reduce congestion, and enhance safety on the roads.

- Smart traffic infrastructure is an essential component of smart city initiatives because traffic congestion is a severe issue that grows along with city development. Smart traffic management includes intelligent transport systems with integrated components like adaptive traffic signal controls, freeway management, emergency management services, and roadside units.

- Such systems collect real-time traffic data and take necessary measures to avoid or minimize any social issue created as part road congestions. For example, access to real- time traffic maps will assist the residents in selecting appropriate route to save time and effort.

PROBLEM STATEMENT :

- In 2014, 54% of the total global population was urban residents. The prediction was a growth of nearly 2% each year until 2020 leading to more pressure on the transportation system of cities. Additionally, the high cost of accommodation in business districts lead to urban employees living far away from their place of work/education and therefore having to commute back and forth between their place of residence and their place of work.

- More vehicles moving need to be accommodated over a fixed number of roads and transportation infrastructure. Often, when dealing with increased traffic, the reaction is just widen the lanes or increase the road levels. However, cities should be making their streets run smarter instead of just making them bigger or building more roads. This leads to the proposed system which will use a micro controller and sensors for tracking the number of vehicles leading to time based monitoring of the system.(Babu, 2016)(Zantout, 2017).

KEY REASONS TO USE A TRAFFIC MANGEMENT SYSTEM :

1) Traffic Flow Optimization
2) Road Safety
3) Reduced Environmental Impact
4) Resource Optimization
5) Public Transportation Efficiency
6) Emergency Response Coordination
7) Enhanced Urban Planning
8) Customer Satisfaction
9) Economic Benefits
10) Adaptability to Urban Growth
11) Alternative Route Suggestions
12) Environmental Impact Reduction.

DESIGN DETAILS

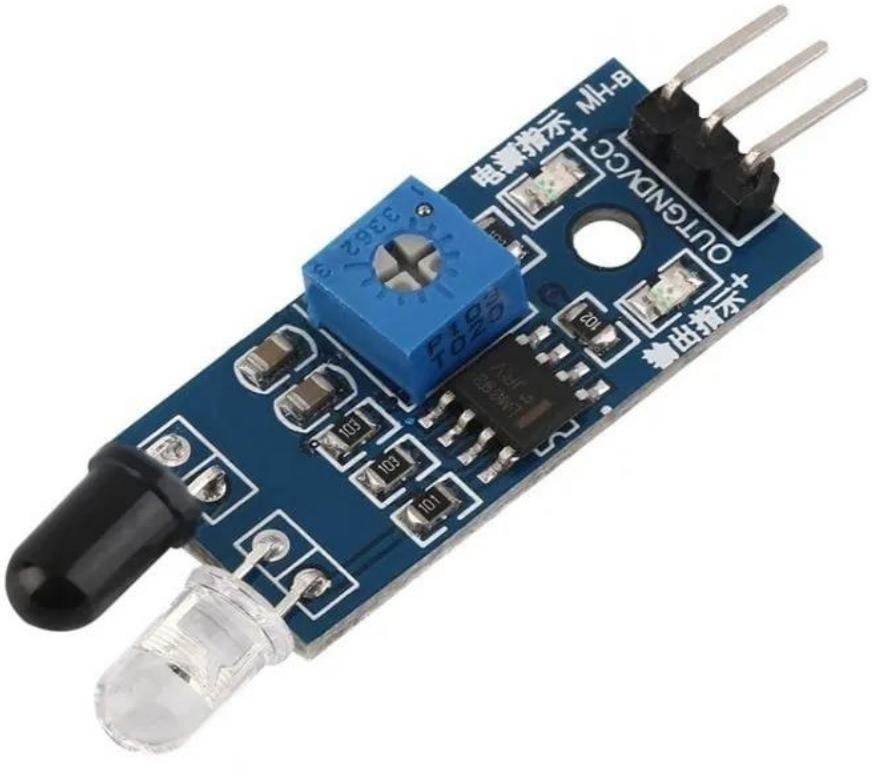
COMPONENTS:

1.) Microcontroller (Arduino Mega 2560:

The Arduino Mega 2560 is a micro- controller board based on the Atmega 2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimile.

2).IR SENSOR :

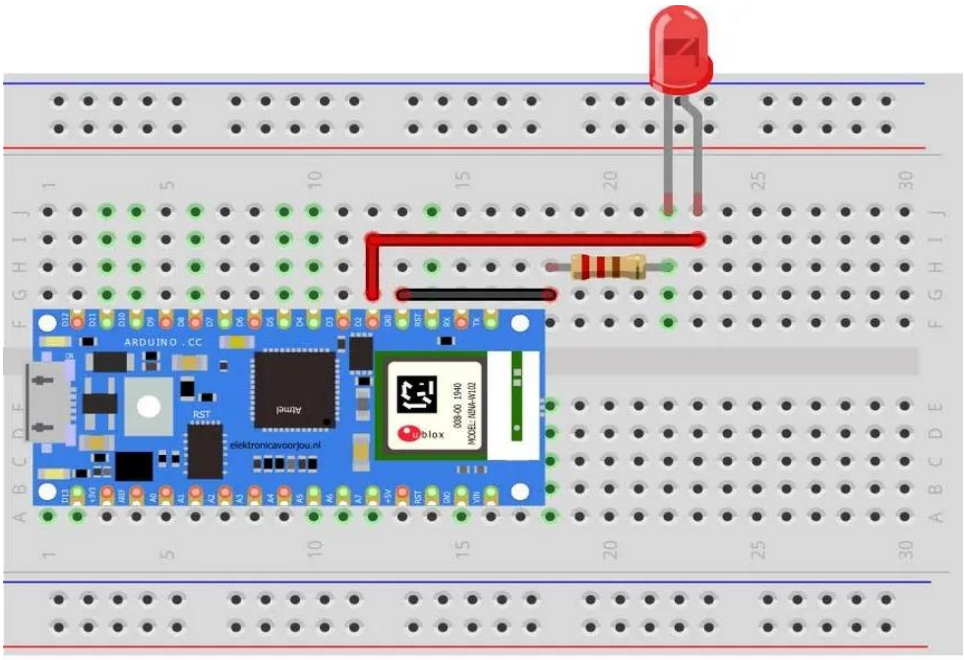


IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

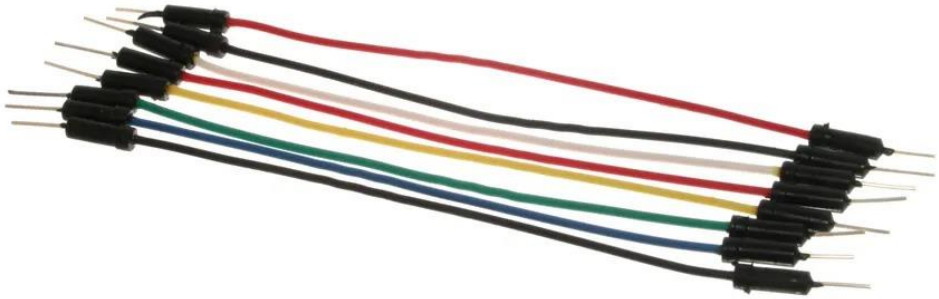
3) LED for traffic light :

LEDS are used for the purpose of signaling according to the traffic condition.



4) Jumping Wires :

A jump wire (also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.



Working of smart traffic system in IOT

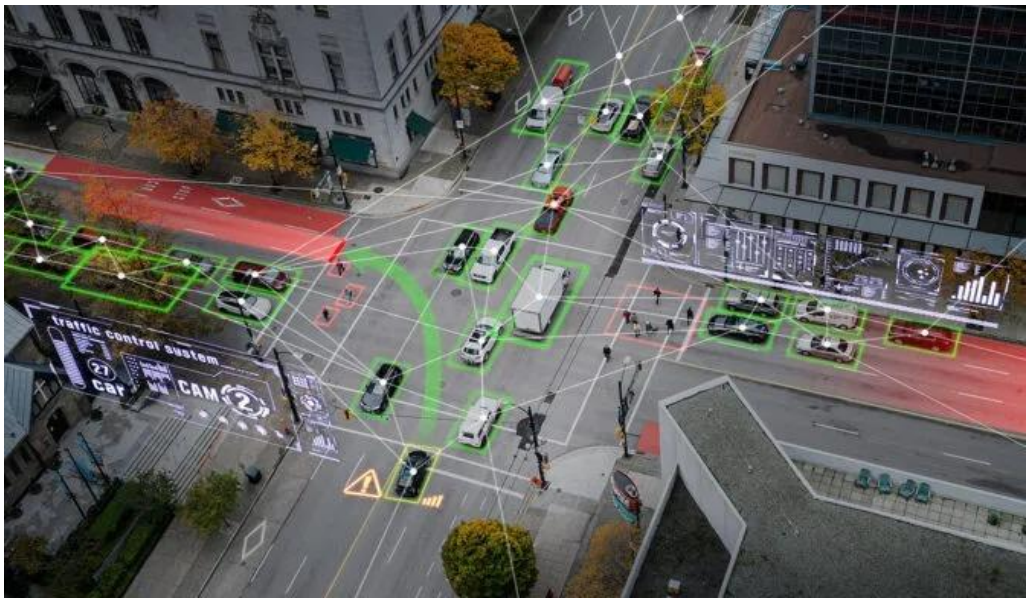
Arduino Integrated Development Environment (IDE):-

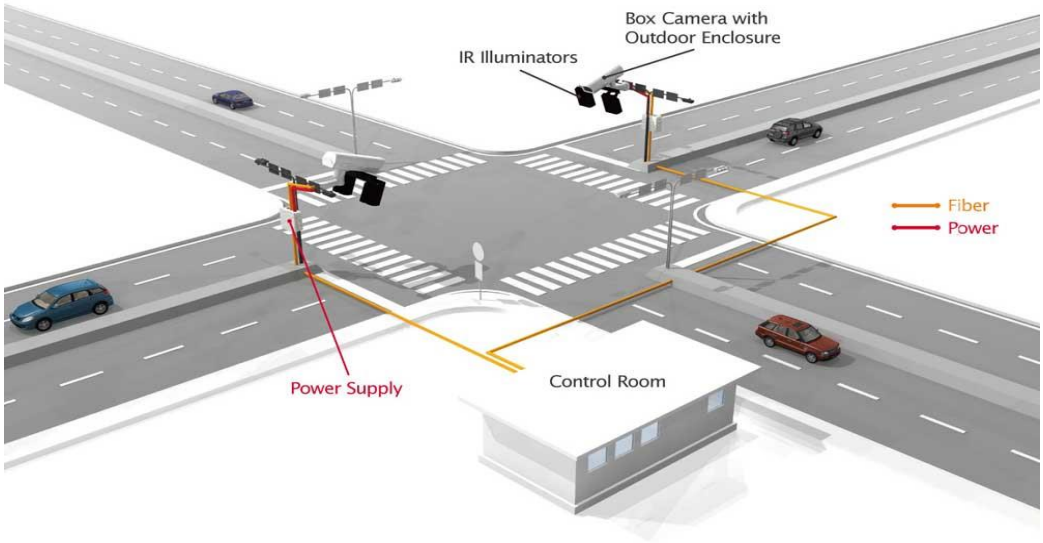
- The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

- The Arduino Integrated Development Environment (IDE) is a cross platform application (for Windows, mac OS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring.

- The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code

only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution.





EXAMPLE PROGRAM :

```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <unistd.h>

// Define constants for traffic signals
#define RED 0
#define GREEN 1

// Function to control traffic lights
void controlTrafficLights(int intersection) {
    if (intersection == 1) {
        // Control traffic lights for intersection 1
        // Implement logic to switch lights from RED to GREEN and vice versa
    } else if (intersection == 2) {
        // Control traffic lights for intersection 2
        // Implement logic to switch lights from RED to GREEN and vice versa
    }
    // Add more intersections as needed
}

// Function to collect data from sensors
```

```
void readSensors() {
   // Implement code to read sensor data (e.g., vehicle presence, traffic density)
}

// Main function
int main() {
   // Initialize IoT modules and sensors

   while (true) {
      // Read sensor data
      readSensors();

      // Analyze sensor data to make traffic decisions

      // Implement logic to control traffic lights based on sensor data
      controlTrafficLights(1); // Intersection 1
      controlTrafficLights(2); // Intersection 2

      // Sleep for a specific interval before the next iteration
      usleep(500000); // Sleep for 0.5 seconds
   }

   // Clean up and exit
   return 0;}
```

CONCLUSION :

Smart Traffic Management System has been developed by using multiple features of hardware components in IoT. Traffic optimization is achieved using IoT platform for efficient utilizing allocating varying time to all traffic signal according to available vehicles count in road path. Smart Traffic Management System is implemented to deal efficiently with problem of congestion and perform re-routing at intersections on a road.

This research presents an effective solution for rapid growth of traffic flow particularly in big cities which is increasing day by day and traditional systems have some limitations as they fail to manage current traffic effectively. Keeping in view the state of the art approach for traffic management systems, a smart traffic management system is proposed to control road traffic situations more efficiently and effectively. It changes the signal timing intelligently according to traffic density on the particular roadside and regulates traffic flow by communicating with local server more effectively than ever before.

The decentralized approach makes it optimized and effective as the system works even if a local server or centralized server has crashed. The system also provides useful information to higher authorities that can be used in road planning which helps in optimal usage of resources.