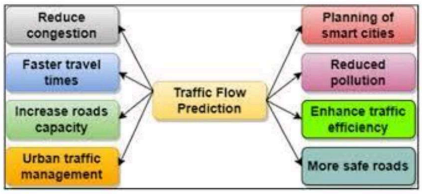
TRAFFIC MANAGEMENT SYSTEM PHASE-2



TRAFFIC PREDICTION

- **Traffic prediction** means forecasting the volume and density of traffic flow, usually for the purpose of managing vehicle movement, reducing congestion, and generating the optimal (least time- or energy-consuming) route.
- Traffic prediction is mainly important for two groups of organizations
- **1.National/local authorities**
- 2. **Logistics companies**

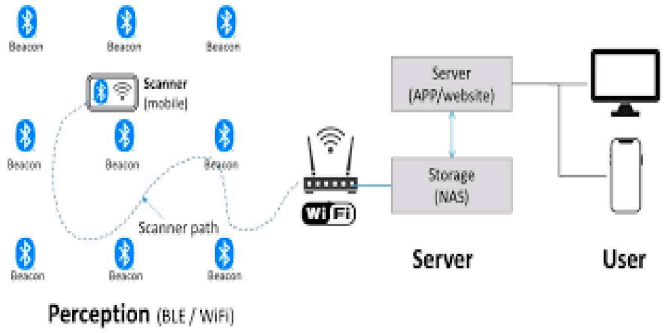
- **1.National/local authorities**. In the last ten to twenty years, many cities adopted intelligent transportation systems (ITS) that support urban transportation network planning and traffic management. These systems use current traffic information as well as generated predictions to improve transport efficiency and safety by informing users of current road conditions and adjusting road infrastructure (e.g., street lights).
- 2. **Logistics companies**. Another area of implementation is the logistics industry. Transportation, delivery, field service, and other businesses have to accurately schedule their operations and create the most efficient routes. Often, it's not only related to current trips, but also to activities in the future. Precise forecasts of road and traffic conditions to avoid congestion are crucial for such companies' planning and performance

COMMUNICATION PROTOCOL USED

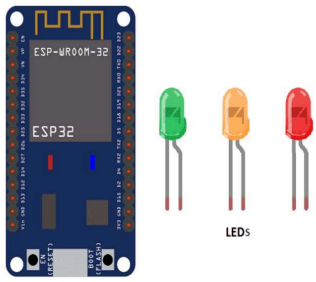
- HTTP(Hyper Text Transfer Protocol)
- MQTT(Message Queuing Telemetry Transport)
- CoAP(Constrained Application Protocol)
- AMQP(Advanced Application Protocol)

CONNECTION USED

- BLE(Bluetooth Low Energy)
- WIFI(Wireless Fidelity)

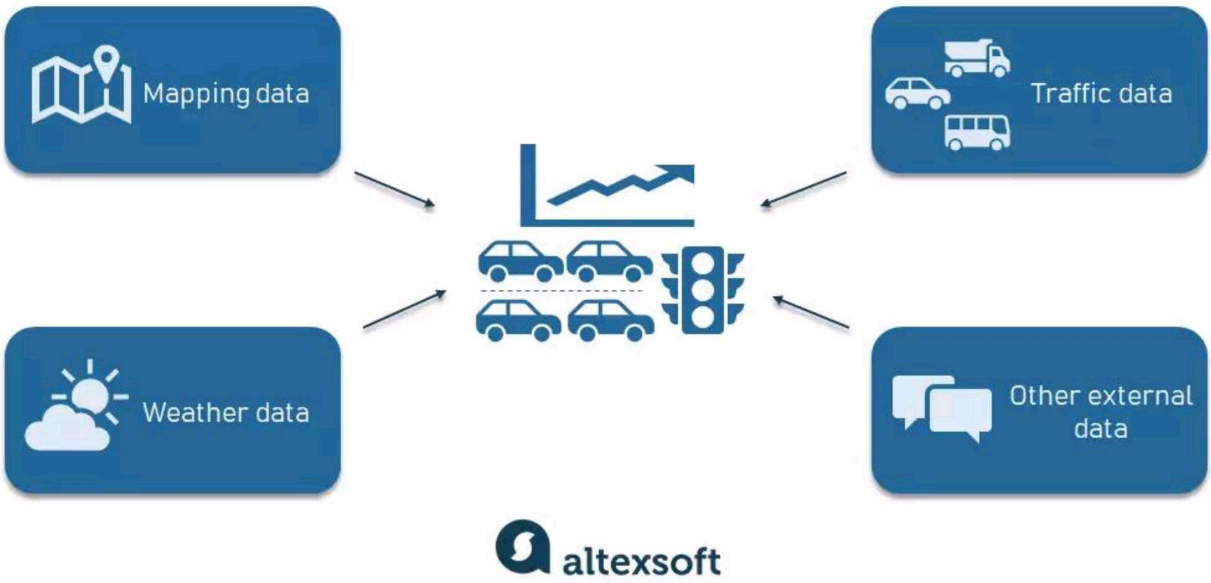


ESP32 MICROCONTROLLERS



- **ESP32** is a series of low-cost, low-power system on a chip microcontrollers with integrated wi-fi and dual-mode bluetooth The ESP32 series employs either a tensilica xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches ,RF balun power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by espressif , a Chinese company based in Shanghai, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

DATA NEEDED FOR TRAFFIC PREDICTION



TRAFFIC INFORMATION

- **Traffic information,** you'll have to collect both historical and current traffic-related information such as the number of vehicles passing at a certain point, their speed, and type (trucks, light vehicles, etc.). Devices used to collect this data are
- loop detectors,
- cameras,
- weigh in motion sensors, and
- radars, or other sensor technologies.
- Fortunately, you don't have to install these devices all over the place on your own. It's easier to get this information from the aforementioned providers that gather data from a system of sensors, diverse third-party sources, or make use of GPS probe data.

- **Additional data on road conditions.** There are external data sources that can provide important information that impacts traffic. Think social media posts about sports events in the area, local news about civil protests, or even police scanners about crime scenes, accidents, or road blockages.

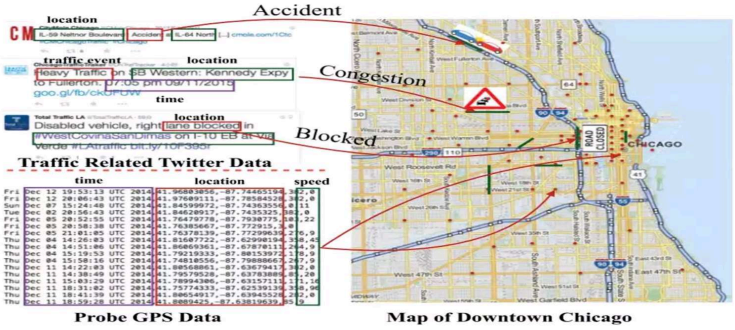
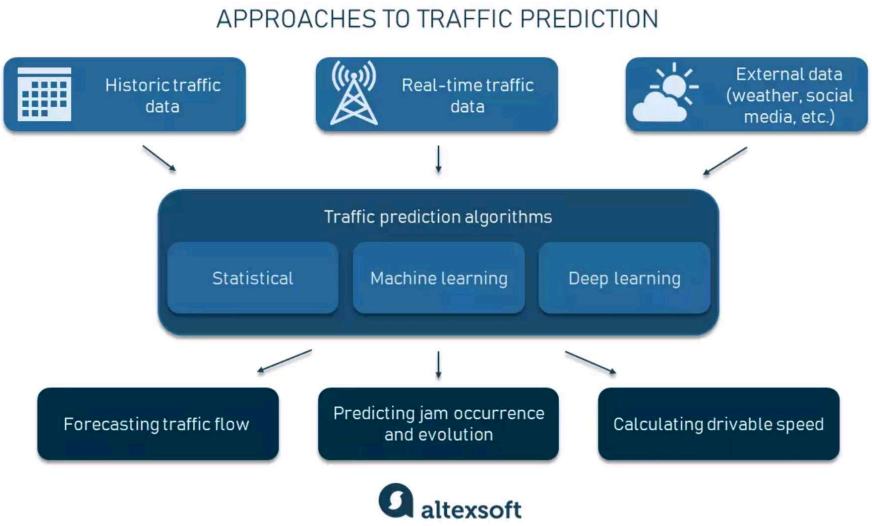


Fig. 1. Illustration of probe GPS data and social media data for traffic monitoring.

Algorithms for generating traffic predictions



STATISTICAL APPROACH

- Statistical methods allow you to identify traffic patterns at a different scale: during the day, on different days of the week, seasonal, etc. They are usually easier, faster, and cheaper to implement than machine learning ones. However, they are less accurate since they can't process as much multivariate data
- Specifically, **auto-regressive integrated moving average** (ARIMA) models have been actively used to predict traffic since the 1970s as they are easy to implement and show higher accuracy compared to other statistical methods. It's a classical statistical approach to analyzing past events and predicting future ones. It observes data that is collected from a series of regular time intervals and assumes that past patterns will repeat in the future

MACHINE LEARNING APPROACH

- Machine learning allows you to create predictive models that consider large masses of heterogeneous data from different sources. Numerous studies have been conducted on the application of ML algorithms to forecast road traffic. Here are some successful examples.
- There are several types of machine learning algorithms that can be used for traffic prediction, including regression, time-series analysis, and artificial neural networks. Regression models use historical traffic data to predict future traffic conditions based on past trends.

MACHINE LEARNING ALGORITHM FOR TRAFFIC PREDICTION

- One of the key advantages of machine learning for traffic prediction is its ability to handle large and complex datasets. For example, traffic data may include information on traffic flow, vehicle speed, and traffic density, as well as other factors such as weather conditions, road conditions, and time of day. Machine learning algorithms can process this data and identify the most important factors that influence traffic patterns, making them ideal for traffic prediction.
- Another advantage of machine learning for traffic prediction is its ability to adapt to changing conditions. Traditional traffic prediction methods are often limited in their ability to handle changes in traffic patterns, but machine learning algorithms can automatically adjust to these changes and continue to make accurate predictions

SENSORS USED IN TRAFFIC MANAGEMENT

Category	Sensor Type	Application and Use
Intrusive	Pneumatic road tube.	Used for keeping track of the number of vehicles, vehicle classification and vehicle count.
	Inductive Loop Detector (ILD).	Used for detection vehicle's movement, presence, count and occupancy. The signals generated are recorded in a device at the roadside.
	Magnetic sensors.	Used for detection of presence of vehicle, identifying stopped and moving vehicles.
	Piezoelectric.	Classification of vehicles, count vehicles and measuring vehicle's weight and speed.
Non-intrusive	Video cameras.	Detection of vehicles across several lanes and can classify vehicles by their length and report vehicle presence, flow rate, occupancy, and speed for each class.
	Radar sensors.	Vehicular volume and speed measurement, detection of direction of motion of vehicle and used by applications for managing traffic lights.
	Infrared.	Application for speed measurement, vehicle length, volume, and lane occupancy.
	Ultrasonic.	Tracking the number of vehicles, vehicle's presence, and occupancy.
	Acoustic array sensors	Used in the development of applications for measuring vehicle's passage, presence, and speed.

OVERVIEW OF TRAFFIC PREDICTION