SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF AUTOMOBILE ENGINEERING

19AUE402 – Intelligent Vehicle Technology

IV YEAR / VII SEM

UNIT – 4 Intelligent Transportation Systems

Topic – Traffic Control

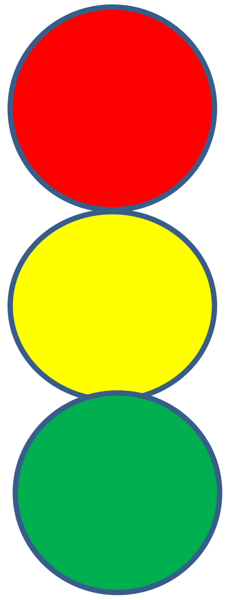
Embedded Systems

Embedded Systems are computing systems with tightly coupled hardware and software integration, which are designed to perform a specific task.

Any device that includes a programmable computer but is not itself a general-purpose computer is an embedded system.

In simple terms, any device using a Microprocessor for control and automation is an Embedded System.

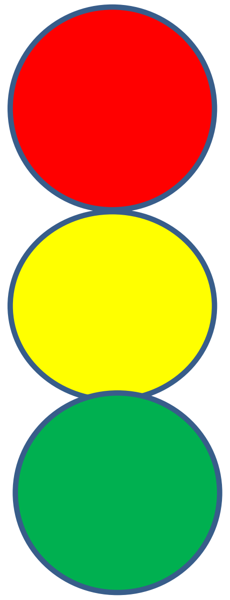
What are Traffic Signals?



Traffic Signals, also known as **traffic lights, traffic lamps, signal lights** are signaling devices positioned at or near road intersections, pedestrian crossings and other locations to control competing flows of traffic.

Traffic lights provide the right way to road users by displaying lights of a standard color (red, yellow/amber, and green) following a universal color code.

Why is traffic light an Embedded System?



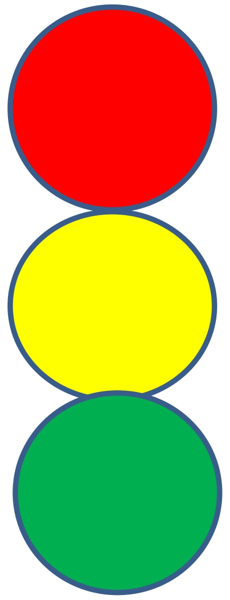
Traffic Lights contain a controller.

The controller is appointed to control the changing of the lights accordingly.

It consists of small no. of integrated chips (IC’s) which are programmed to perform a specific task.

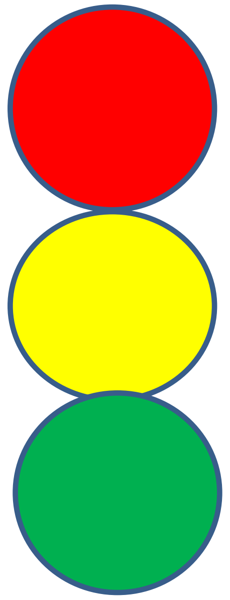
It also contains a timer which helps the controller to indicate to change the light after a specific time interval

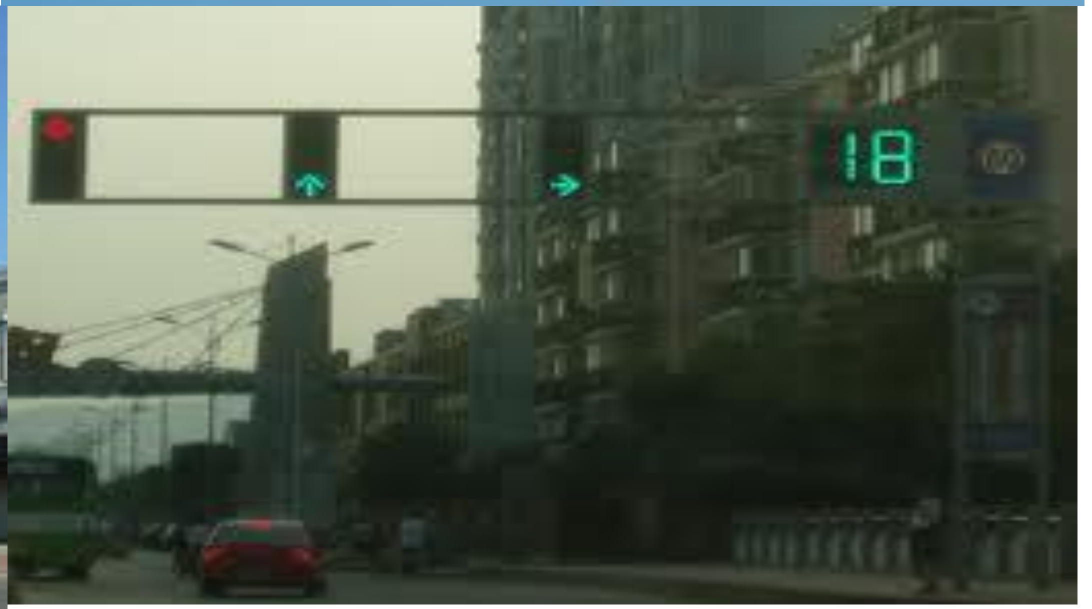
History



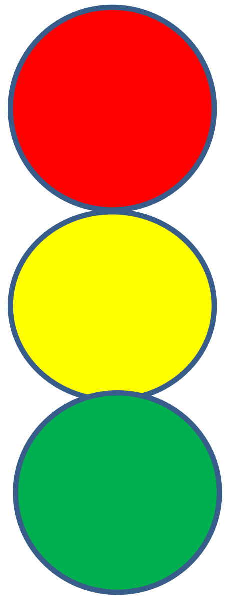
- Traffic lights were first installed in 1868 in London, United Kingdom by J. P. Knight and are now used in almost every city of the world.
- The modern electric traffic light is an American invention. As early as 1912 in Salt Lake City, Utah, policeman Lester Wire invented the first red-green (twin colour) electric traffic lights.
- The first four-way, three-color traffic light was created by police officer William Potts in Detroit, Michigan in 1920.

Types of Traffic Signals





Types



Single aspects -

The simplest traffic light comprises either a single or a pair of colored aspects that warns any user the way of a possible conflict or danger.

Dual aspects –

These are often seen at railway crossings and at intersections of streets. They flash yellow when cross traffic is not expected, and turn red to stop traffic when cross traffic occurs.

Three or more aspects –

The standard is the red light above the green, with yellow between. When sideways, the arrangement depends on the rule of the road. In right-lane countries, the green light is on the right, and in left-lane countries, the left.

Working of Traffic Signals

A traffic signal is typically controlled by a controller inside a cabinet mounted on a concrete pad.

Components of a cabinet

The cabinet typically contains

A power Panel, to distribute electrical power in the cabinet;

A Detector Interface Panel, to connect to loop detectors;

Detector Amplifiers;

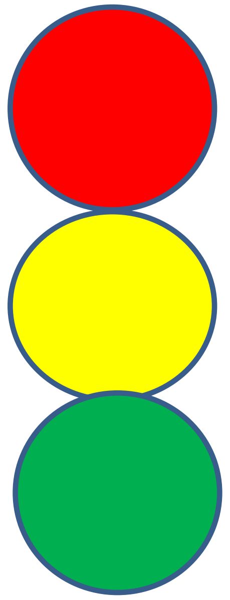
The Controller itself, which sets standards for connectors & interval limits;

A Conflict Monitor Unit;

Flash transfer relays;

A Police Panel, to allow the police to disable the signal; and other components.

How Controllers avoid disaster is case of Failure in the system?

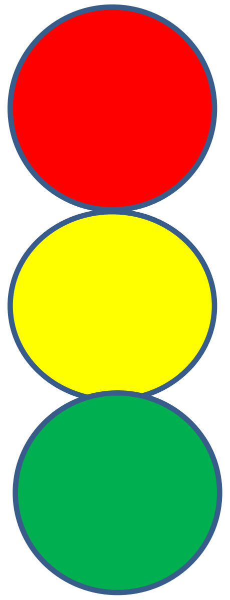


Controllers are required to have an independent *conflict monitor unit* (CMU), which ensures fail-safe operation.

The CMU monitors the outputs of the controller, and if a fault is detected, the CMU uses the flash transfer relays to put the intersection to *FLASH*, with all red lights flashing.

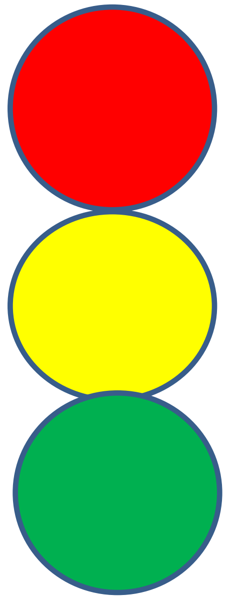
Rather than displaying a potentially hazardous combination of signals.

Changing of Indication in a traffic light



Traffic lights must be instructed when to change phase and they are usually coordinated so that the phase changes occur in some relationship to other nearby signals or to the press of a pedestrian button or to the action of a timer etc.

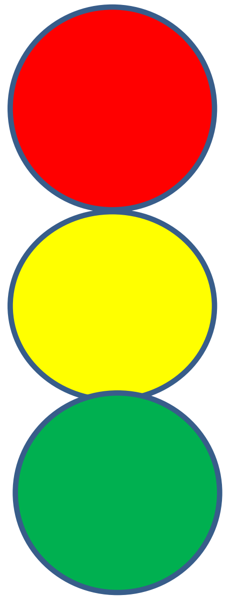
Fixed time control



In general, electro-mechanical signal controllers use dial timers that have fixed, signalized intersection time plans. Cycle lengths of signalized intersections are determined by small gears that are located within dial timers. Cycle gears, as they are commonly known as, range from 35 seconds to 120 seconds.

If a cycle gear in a dial timer results in a failure, it can be replaced with another cycle gear that would be appropriate to use.

Dynamic Control

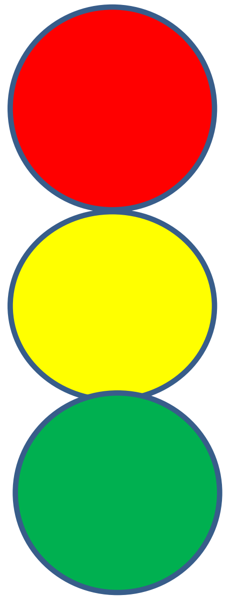


Dynamic, or actuated, signals are programmed to adjust their timing and phasing to meet changing traffic conditions.

The system adjusts signal phasing and timing to minimize the delay of people going through the intersection.

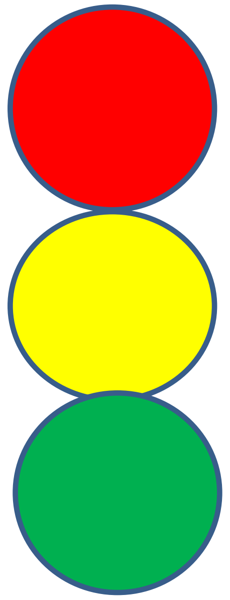
The controller uses input from *detectors*, which are sensors that inform the controller processor whether vehicles or other road users are present, to adjust signal timing and phasing within the limits set by the controllers programming.

Why the need of Intelligent Traffic Control Systems?



- A development of an intelligent traffic signal control (ITSC) system needed because present traffic light controllers are based on old microcontroller such as AT89C51 which has very less internal memory and no in-built ADC.
- These systems have limitation because they will use the predefined program that does not have the flexibility of modification on real time application.
- The present traffic system have fixed time interval for green and red signal which does not provide the flexibility to the system.

How will the ITCS help?



Intelligent Traffic Signal Control System Using Embedded System.

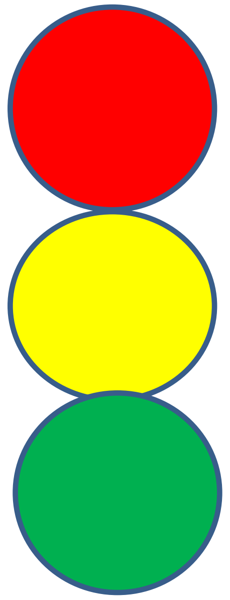
The ITSC system consist of high-performance, low power (AVR_32 microcontroller) with 32k bytes of in-system programmable flash memory and in-built 8-channel, 10-bit Analog to Digital Converter which is required to process the input from sensor network.

The ITSC system will able to deal two basic problem of traditional traffic light system:

i) Detection of traffic volume.

ii) Emergence vehicle detection such as ambulance, police etc. by using wireless sensor network embedded at the signal intersection.

How will the ITCS help? (Continued)



Thus, it can give more time to an intersection approach that is experiencing heavy traffic, or shorten or even skip a phase that has little or no traffic waiting for a green light.

These type of dynamic control traffic systems are called Intelligent Traffic Control Systems (ITCS).

ITCS have been implemented in USA, Europe, etc & have helped to eradicate traffic jams & disastrous traffic situations.

The Types of Detectors used in ITCS

In-pavement detectors :

These detectors are buried in or under the roadway.

Inductive Detector loops are the most common type.

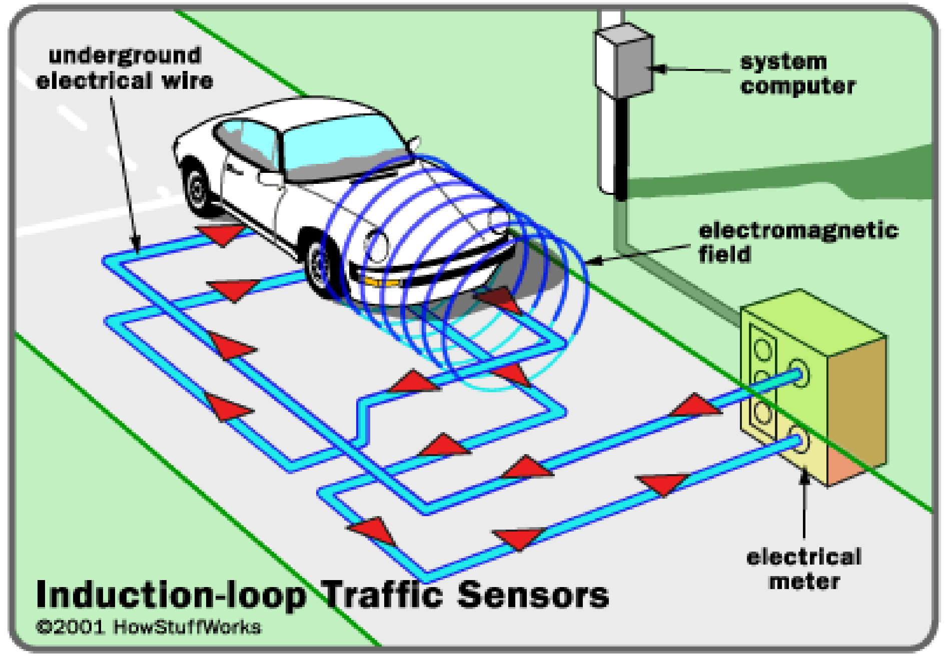
They are sensors buried in the road to detect the presence of traffic waiting at the light, and thus can reduce the time when a green signal is given to an empty road.

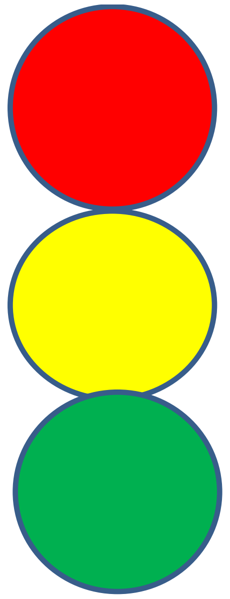
A timer is frequently used as a default during times of very low traffic density and as a backup in case the sensors fail.

The sensor loops typically work in the same fashion as metal detectors.

Consequently small vehicles and bicycles or vehicles with low metal content may fail to be detected causing them to wait indefinitely.

Detectors (Continued)





Non-intrusive detectors :

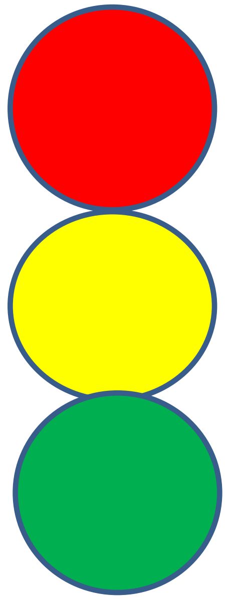
It is sometimes more advantageous and cost effective to install over-roadway sensors than cutting the road and embedding inductive loops. These technologies include video image processors, sensors that use EM waves, or acoustic sensors to detect the presence of vehicles at the intersection waiting for right of way.

These over-roadway sensors are more favorable than in-roadway sensors because they are immune to the natural degradation associated with paved right-of-way

Detectors (Continued)

Non-motorized user detection :

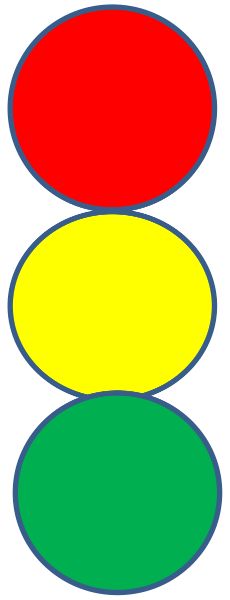
Some traffic lights at pedestrian crossings, especially those away from junctions, include a button which must be pressed in order to activate the timing system.



This is generally accompanied by a large display reading "wait", which lights up when the button is pressed, and off when the lights enter the red phase.

Often, other displays, such as countdowns or the green & red pedestrian lights are included in this panel.

Other types of control

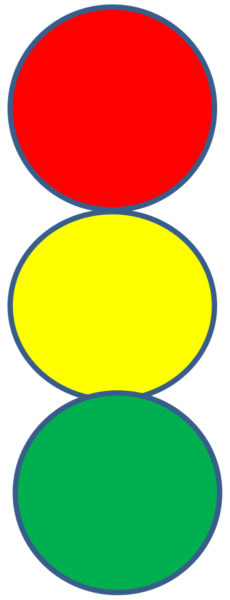


Failures: If power is still available, a flashing amber light is used to warn of an intersection. In some countries including Australia, the road rules outline procedures such as giving way to the right.

Part-time operation: Some traffic lights will not operate at night or when traffic is very light. Some may only operate at particular set times (e.g. during working hours of a major factory) or only during special events such as sports or exhibitions.

Railroad preemption: Traffic signals are activated to coincide with the approach of a train, often where the intersection is near a rail crossing.

Controls (Continued)

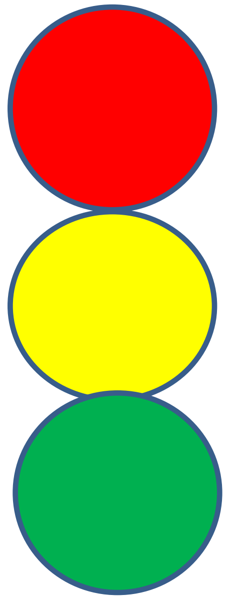


Bus and Transport Priority: Traffic signals are activated to coincide with the arrival of a bus or tram along a busway, bus lane or tramway.

Emergency Vehicles: Some lights outside of fire or rescue stations have no green, as they may turn only amber and then red when fire trucks, ambulances, or other emergency vehicles of the like are exiting the station en route to an emergency

Benefits

ITCS when compared with the Fixed Mode Traffic Light Controller, are:-



More **efficient**

Less **waiting time**

Efficient operation during emergency mode

Designed system has **simple architecture**

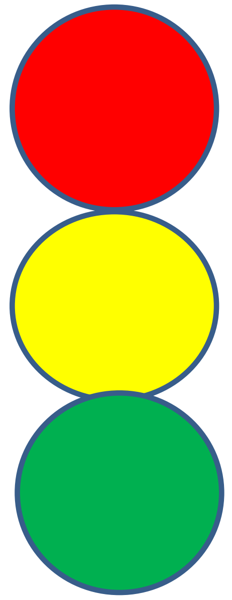
Fast response time

User friendliness

Scope for **further expansion**

Increasing the traffic handling capacity of roads

Benefits



Reduce collisions, both vehicular and pedestrian.

Encourages travel within the **speed limit** to meet green lights.

Reduce unnecessary stopping and starting of traffic - this in turn reduces **fuel consumption, air pollution, noise and vehicle wear and tear.**

Reduce driver frustration and 'road rage'.

Thank You