**Kevton Introduction:**

The Kevton traffic control adds an intelligent behaviour to the existing timer-based traffic light system using a Radar camera or CORDON multi-target Photo Radar System at every intersection. Each intersection is equipped with a Radar camera that continuously measures the contextual information of the vehicle, including average speed and absolute mean acceleration on a road segment during a specific period. Afterwards, it estimates the local traffic congestion level based on this contextual information. It is a hybrid approach that makes the traffic signal decision based on the timer as well as the local traffic density. Majorly it works on timer-based traffic lights, but it also takes the local traffic congestion in the corresponding road into consideration obtained from the context provider, i.e. Radar camera, here. The leading edge of this system over the existing systems is the rules for the transition of the traffic light. It changes from Red ⇒ Yellow ⇒ Green ⇒ Yellow ⇒ Red mainly on a fixed timer, but until this timer is active, it continuously keeps the context data from the next lanes. So, for example, if the system detects the vehicle density of the current lane is low and current light status is GREEN while there is a lane with HIGH traffic density having current light status RED, then it automatically makes the light status with HIGH traffic density to GREEN and LOW traffic density to RED and reset the timer.

This system is an object-oriented context model which executes on an event-triggered context-aware mechanism. The timer value and the minimum vehicle density value will be predefined in the system, which can be set manually depending upon the observations made from the existing vehicle density. As the timer has an intelligent system to assist it with the vehicle 5 density, so the behaviour of the system varies as per the busy hours and the free hours on the road, which makes it a proper context-based model. Our proposed system does not require any network infrastructure for collecting and processing data, which decreases the expenses effectively. In addition, we propose a new context-aware traffic estimation system, which uses fuzzy logic to estimate traffic state.

**Challenges Kevton addressed:**

1. Developing a context-aware based smart traffic system.
2. upgrading the existing timer-based traffic control system with the addition of radar cameras in order to make the operational behaviour dynamic, depending upon the average traffic density of the corresponding lane.
3. Making the system smarter to address any accidents properly with smarter traffic management in such situations and also enabling it to inform the local authorities about the same.

**Architecture Diagram with context-aware management system:**



The architecture of the context-aware management system for the Smart Traffic Management System is shown above. Various context providers feed information to the Traffic Management Controller. Here the context providers are the Radar Camera which provides the average speed and average acceleration of the vehicles, the Automatic Incident Detection (AID) which informs if an accident took place or not, and the Traditional Timer Based System which provides light status and timer status. This controller then interacts with this data and finds the set of actions to take place in real-time according to the defined context behaviours. Now the action to be taken is finalised. This information is then uploaded to the cloud with the help of gateways. The finalized information is then updated in the Traffic Light System and also notified to the nearest traffic control station with the help of a wireless network (or through Cloud).

**Context acquisition:**

**Radar Camera**: Provides the average speed and average acceleration of the vehicles in the corresponding lane.

**Automatic Incident Detection (AID**): Provides the input if there is an accident in the lane or not

**Time**r: Provides the value of the traffic light timer for the corresponding lane.

The context input obtained from these context providers has then to be derived as per the following procedure:

**Traffic Light**:

L1 → Red

L2 → Yellow

L3 → Green

**Average Speed:**

avg\_speed <= 20.0 → Low

20.0 < avg\_speed <= 50.0 → Medium

avg\_speed > 50.0 → high

**Average acceleration:**

avg\_acc <= 10.0 → Low

10.0 < avg\_acc <= 35.0 → Medium

avg\_acc <= 35.0 → High

**Automatic Incident Detection:**

0 → No accident

1 → accident occurred

Kevton uses fuzzy theory to classify the traffic of that lane into various categories (as mentioned in the later sections). This categorization is done on the basis of the average speed and average acceleration of the traffic in the corresponding lane. The context inputs obtained, make the system to be an event-based model which uses object-oriented context specification.

**Entities and Attributes:**

Signal Light:

Light\_color : range {“RED”, “YELLOW”, “GREEN”}

Light\_timer : range [0, 60]

**Crossing**:

Crossing\_ID : range {Ci; i = 1 to n, n = number of crossing}

Lane\_ID : range { Ri; i = 1 to 4}

Avg\_speed : range { 0, 70}

Avg\_acc : range { 0, 50}

Time : range {0:0:0, 23:59:59}

Current\_Light\_Status : range { Li; i = 1 to 4}

**Class-Based Representation of the various entities and their attributes:**

Class Light

{

Light\_Color string;

Timer string

}

Class Crossing

{

Crossing\_Id string;

Lane\_Id string;

Average\_Speed float;

Average\_Acceleration float;

Time string;

Current\_Light\_Status string;

Automatic\_Incident\_Detection boolean

}

The above-mentioned context input, consumers and the object-oriented specification work on the following context behaviours:

1. At a particular crossing, if the traffic light status of one lane is green, then make the corresponding remaining traffic light status as red.
2. When the traffic light timer expires, change the current traffic light status, i.e. change one colour to Green->Red and another to Red->Green
3. If traffic density in the lane is LOW and current light status is GREEN and the respective timer is not expired, then change the current light status to RED, and make the lane with HIGH traffic status as GREEN and reset the timer.
4. If traffic density in all the lanes is approximately similar or in the moderate limit, then traffic lights status changes based on the traffic light timer
5. If an accident takes place on one particular road, then people are informed that an accident took place in that particular road by blinking the yellow traffic light until the current timer expires indicating people to go slow until the issue is resolved and inform nearby traffic control stations using the GPS module

**Base on Kevton work**:

The context providers such as Radar Camera or CORDON multi-target Photo Radar System, Automatic Incident Detection (AID), Timer provides real-time data such as the average speed of the vehicles, average acceleration of the vehicles, if an accident took place, current light status and timer value, etc at every intersection. The data we obtained from these providers is primary data. We further classify this and refine this data into a proper dataset. We classify average speed into three types as “Slow”, “Medium” and “Fast”. Similarly, we classify average acceleration into three types as “Low”, “Medium”, and “High”. Now based on the fuzzy rule, we further derive traffic congestion levels at each intersection. This fuzzy rule depends on average speed and average acceleration at the intersection.

Fuzzy Rule:

| s/no | Speed | acceleration | Traffic congestion |
| --- | --- | --- | --- |
| 1 | slow | low | medium |
| 2 | slow | medium | medium |
| 3 | slow | high | high |
| 4 | medium | low | low |
| 5 | medium | medium | low |
| 6 | medium | high | medium |
| 7 | fast | low | free |
| 8 | fast | medium | free |
| 9 | fast | high | low |

Based on the above fuzzy rule, we will derive the traffic congestion level at each intersection in real-time. So now our approach is a hybrid approach that makes the traffic signal decision based on the timer and the local traffic density.



In this approach, as per the existing model, at a particular crossing, if the traffic light status of one lane is green, then the corresponding remaining traffic light status should be red. And when the traffic light timer expires, change the current traffic light status, i.e. change one light status to Green ⇒ Yellow ⇒ Red and another to Red ⇒ Yellow ⇒ Green anticlockwise. In this approach, if traffic density in the lane is LOW and current light status is GREEN for at least 10 seconds and the respective timer is not expired, while there is a lane with HIGH traffic density having current light status RED for at least 10 seconds and the respective timer is not expired; then change the light status with HIGH traffic density to GREEN and LOW traffic density to RED and reset the timer.

Also, if traffic density in all the lanes is approximately similar or in the moderate limit, then traffic lights status changes based on the traffic light timer, not on the congestion level. And if an accident takes place on one particular road, then people are informed that an accident took place in that particular road by blinking the yellow traffic light until the current timer expires indicating people to go slow until the issue is resolved and inform nearby traffic control stations. We have also incorporated Uncertainty Handling and Conflicting situations and tried to resolve them. Here we are checking the validity of each context input, also checking if all the lights at a particular crossing are of different colours and if context providers are working properly or not (checking for the continuous period). We also check signal timer operation i.e. if max 3 lanes at any particular crossing have the same timer value and if there are any errors we inform nearby traffic control stations. We also have incorporated detection of malpractice of citizens driving in the wrong lane and then notifying the nearby authority.