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PHASE 5

TRAFFIC MANAGEMENT SYSTEMS:

Traffic Management Systems (TMS) provide permanent control across the network, automatically sets routes for trains and logs train movements as well as detects and solves potential conflicts.

Key Benefits:

- Meets a wide variety of transit system types and sizes.
- Flexible train operation management.
- Reduced operator workload.
- Better automatic control and regulation using very sophisticated algorithms.
- Easy to use.
- High availability.
- Low life cycle cost.
- Commercial hardware.
- Easy configuration.

Objective:

This section focuses on the application of TMS and how it can be used to achieve Travel Demand Management (TDM) goals.

Tools for Traffic Management Systems:

- Automatic Incident Detection (AID).
- Ramp signalling/Metering.
- Variable message signs.
- Variable Speed Limits.
- Lane control.
- Adaptive traffic signal control.

	centre	urban	suburban	rural
Automatic incident detection	***	***	**	*
Ramp Signalling/ Measuring	***	***	**	-
Variable Message Signs	***	***	***	*
Variable Speed Limits	***	***	**	*
Lane control	***	***	**	*
Adaptive Traffic Signal Control	***	***	**	*

Case Study - Automatic Traffic Management System:

The key strategic goal of this project is to operate the Petone to Terrace Tunnel State Highway corridor in a way that contributes to an integrated, safe and responsive, and sustainable transport system.

The project will:

- Improve management of general traffic flow, in conjunction with the Naguranga and Petone sections, and traffic signal controls within the Wellington urban network.
- Achieve improved rapid identification of problems on the highway.
- Improve targeted response to, and clearance of incidents.

- Provide early and accurate alerts to drivers of congested or hazardous traffic and road conditions.

- Assist in matching traffic speed to network conditions, to improve safety and optimize flow.
- Provide a sustainable asset and improve the network functionality.

PROGRAM FOR TMS.

```
#include <string>

#include <ctime>

#include <chrono>

#include <thread>

using namespace std;

// Define a class for a Traffic Light

class TrafficLight {

private:

string color;

public:

TrafficLight() {
color = "red"; // set the ini · al color to red

}

string getColor() { return

color;

}


void setColor(string newColor) {

color = newColor;
```

```
 }
 };
 // Define a class for a Traffic Signal
class TrafficSignal {
private:
TrafficLight light;
string name;
int duration;
public:
TrafficSignal(string n, int d) {
name = n;
duration = d;
}
string getName() {
return name;
}
string getStatus() {
return light.getColor();
}
Void setStatus(string newStatus) {
light.setColor(newStatus);
}
```

```
int getDuration() {
return duration;
}

};
// Define a class for a Traffic Junction
class TrafficJunction {
private:
vector<TrafficSignal> signals;
public:
void addSignal(TrafficSignal signal) {
signals.push_back(signal);
}

TrafficSignal getSignal(int index) {
return signals[index];
}
int getSignalCount() {
return signals.size();
}
void run() {
int index = 0;
while (true) {
TrafficSignal signal = getSignal(index);
```

```
string signalName = signal.getName();
int signalDuration = signal.getDuration();
// Set the current signal to green
signal.setStatus("green");
cout << signalName << " is " << signal.getStatus() << endl;

// Wait for the signal duration
this_thread::sleep_for(chrono::seconds(signalDuration));
// Set the current signal to red
signal.setStatus("red");
cout << signalName << " is " << signal.getStatus() << endl;

// Move on to the next signal
index = (index + 1) % getSignalCount();
}
}
};
// Define a main function to test the Traffic Management System
int main() {
// Create a Traffic Junction
TrafficJunction junction;
// Create and add Traffic Signals to the Junction
TrafficSignal signal1("Signal 1", 5);
junction.addSignal(signal1);
TrafficSignal signal2("Signal 2", 5);
```

```
junction.addSignal(signal2);
// Start the Traffic Junction
junction.run();
return 0;
}
```

OUTPUT

INNOVATION OF TMS:

Traffic management is the focus area for most urban dwellers and planners. Congestion is the most important major obstacle that has been seen in many countries including India. Countries to avoid this obstacle means how to manage the traffic smoothly. Traffic congestion mainly focuses on the signals failure, reduced law enforcement and improper traffic management. Existing foundation can't be extended increasingly and subsequently the main choice accessible is to enhance the administration of the traffic. Traffic congestion is not a good sign for our country as well as it creates a negative impact starting from economy to the leaving standard. Consequently the opportunity has already come and gone to viably deal with the traffic congestion. Many methods are designed to manage the traffic and minimize the congestion. Out of all the techniques, infrared sensor, inductive loop detection, video data analysis, wireless sensor network, etc. are used to somewhat solve the congestion in the traffic and to manage the traffic smartly. But in the above said methods having some demerits like much time to take for installation, maintenance cost is very high. Actually, our objective is to develop a new technology or method; that will solve the above problems and produce better result within a stipulated time. To overcome the challenges, a new method arises called as Radio Frequency Identification (RFID).

Keywords Traffic management :

- RFID
- GSM
- Congestion IOT

Background and Motivation:

Traffic management is the arranging, observing and control or impacting of activity. It expects to: boost the adequacy of the utilization of existing foundation; to guarantee dependable and safe operation of transport; to address ecological objectives; and guarantee reasonable assignment of framework space (street space, rail openings, and so forth.) among contending clients. Traffic monitoring system developed so far are primarily focused on structured traffic that is not the case in a country like ours. Development of overhead structures can't be considered as a viable option since it increases the cost substantially.

Internet of Things (IOT):

In Today's Scenario it is certainty that, number of vehicles is expanding expo-mentally, however infrastructure for transportation isn't adequate to fulfil their necessities. Because of this, valuable time is being lost each day.

What Is IOT?

The gigantic system of gadgets associated with the Internet, including advanced mobile phones and tablets and practically anything with a sensor on it cars, machines in production plants, jet engines, oil drills, wearable devices, and more. These "things" collect and exchange data. All the non-living organs are connected with each other for sharing the information in a global network.

IOT = Physical Object + Controller, Sensor, Actuators + Internet

Applications of IOT

IOT gives the solution easily for the society; and also it is very easy to implement. The most and famous application area where IOT is used.

Environmental monitoring

This utilization of the IOT regularly utilize sensors to aid ecological assurance by observing environment or soil quality and can incorporate zones like checking the development of untamed life and their living spaces.

Infrastructure management

The key application of the IOT is railway tracks, bridges, on-and offshore-windfarms are the checking and controlling operations of urban and rural infrastructure (building, bridges and dam). IOT system can be utilized for checking any events or changes in basic conditions that would negotiation be able to safety and increment risk.

Energy management

Coordination of detecting and activation frameworks, associated with the Internet, is probably going to improve the total energy utilization. This is normal for IOT gadgets to incorporated with all types of energy expending gadgets(switches, electrical plugs, bulbs, TVs, etc.) and have the capacity to speak with the utility supply organization keeping in mind the end goal is to adjust power generation and its use. Such gadgets would likewise offer the open door for clients to remotely control their gadgets, or midway oversee them by means of aloud based interface, and empower advanced capacities like planning (e.g. Remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.).

Industrial Applications

Engineering Applications look at the idea of thing remembering the ultimate objective to constant enhancing to have an average publicizing, for instance, who are most interested to which thing and how this thing can find exhibiting with which minor changes;

Medical and Healthcare

Systems Medicinal services Systems shows signs of improvement understanding state by checking and controlling their

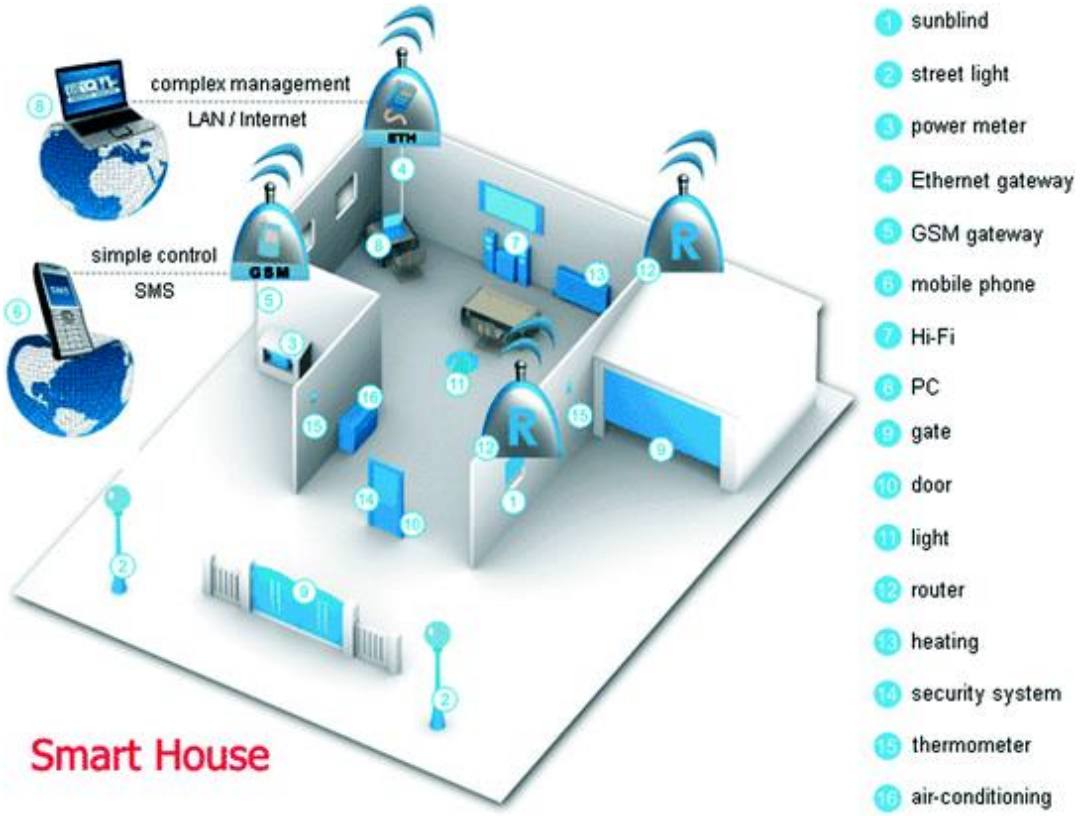
heart rate or pulse or even for their diet.. Smart tablet shows the number of dosages and its ingredient needed for a particular patient.

Building and Home Automation

In all types of home appliances that have the potential to monitor and remote-control such as, ventilation, security lock lightening, heating, air condition, telephone system, television to make a comfort, secure, with low energy consumption.

Transport Systems

Transportation Systems helps in automatic configuration in traffic lights, smart parking, and traffic camera to detect which road has heavy traffic and offer automatically less crowd road [7–9], or smart camera which fine driver in high-speed. Figure 6shows the smart parking system.



The major goals of the ITS domain is:

- Increase transportation system efficiency
- Mobility Enhancement
- Safety Improvement
- Reduce fuel consumption and environmental cost
- Increase economic productivity
- Create an environment for an ITS market.

Our objective is all the devices are connected and sharing the information smoothly over globally. Many methods are designed to manage the traffic and minimize the congestion. Out of all the techniques infrared sensor, inductive loop detection video data analysis, wireless sensor network, etc. are used to solve the congestion in the traffic and manage the traffic smartly.

Inductive Loop Detection Induction:

Loops are utilized for transmission and gathering of correspondence signals, or for recognition of metal objects in metal detectors or vehicle indicators. Multiple rounds of insulated cable are situated in a low cut out in the street, a lead inside the cable passes through the street-side pull box towards the controller and the electronic element positioned in the controller cabinet [11, 12]. The induction of the wire has changed depending upon the number of objects passes through the loop or stops. Change of induction is directly proportional to frequency. Due to the frequency change a electronic signal is forwarded to the control unit; this signal indicates the presence of the vehicle. Inductive loop detection helps to know the vehicle existence, its movement and also counts the number of vehicles passing through an exact location.

Video Analysis

An intelligent camera which has a unit to process data, different sensors to sense the stimuli and a unit for communication. The traffic always checks using an intelligent camera [11]. The video which is captured by the camera after that compressed to shrink the transmission bandwidth. The summary of video analysis depends on the raw video data and then calculates the traffic statistics. This statistic has the information about vehicles frequency, its average speed and path occupancy. The problems linked with video analysis are—(i) high relatively cost (ii) affect of deep smog or rains (iii) at the evening surveillance requires proper street lighting. An Innovation Model for Smart Traffic Management System.

Infrared Sensors

The main objective of infrared sensor is used to sense or emit the infrared radiation. The sensors [11] are also capable of measuring the heat being emitted by an object and detecting motion; Infrared Radiation. It is used to detect the energy coming from the various types of objects like vehicle, road surface etc. The data can be captured the object by this electronic device is focused on to an infrared reactive objects using an optical method which then converts the energy into an electrical signals. The captured energy of the infrared sensors is determined against infrared sensitive objects with an optical scheme which subsequently transforms the energy into the electric signals. These stimuli are used to check the traffic. It is used for signal management, recognition of pedestrians during crosswalks and commune-cation of traffic information [13]. The major drawback of infrared sensors is that the usefulness of the system can be affected due to fog; also it has a complex installation and maintenance process.

Wireless Sensor Network

By the help of the various technologies related with wireless sensor networks(WSNs) have been used to detect the traffic and avoids road congestion. WSNs are very trendy due to their faster transfer of information, easy installation, less maintenance, compactness and for being cheaper compared to other network options [12,14,15]. There has been significant research on Traffic Management Systems using WSNs to avoid congestion, ensure priority for emergency vehicles and cut the Average Waiting Time (AWT) of vehicles at intersections. In recent decades, researchers have started to monitor real-time traffic using WSNs, RFIDs ,ZigBee, VANETs, Bluetooth devices, cameras and infrared signals.

Proposed Traffic Management System

Introduction and Objective

According to a new concept RFID, any vehicles deployed along with a RFID tag. The tag maintains the entire information about the vehicles. The tag identifying all vehicles exclusively and alerts the driver for getting various traffic messages. Third controller can be fixed with open signalling system. As per the Fig. 7, every signal have knows the data about all the vehicle passes through it. Here, each vehicle considered as an object and when it crosses through a signal, signal can repeatedly keep the data that means count of the vehicles passing by it.

DEVELOPMENT OF TMS IN 1:

Introduction:

A huge number of cars drive onto the roads of different cities almost every day. Generally that number exceeds The accommodation capabilities, which results in numerous traffic jams being formed. It is believed that, on an average, drivers around the world spend about

100 hours per year stuck in traffic jams. According to the research conducted by experts from INRIX (The Moscow Times, 2018), among most congested cities in the world, Moscow takes the second place: drivers of the Russian capital spend an average of 91 hours a year in traffic jams, which makes up approximately 26% of their total time on the road. Other Russian cities that have very busy traffic include Novosibirsk (where drivers spend 52 hours a year in traffic jams), St. Petersburg (54 hours),Krasnodar (57 hours), Kansk (64 hours), and Magnitogorsk (73 hours). Londoners spend around 74 hours a year in traffic jams, and drivers in New York have it almost as bad as Moscow drivers, averaging 90 hours a year.

Materials and Methods:

Methods used in this study include analysis of existing approaches to defining the transport system and designing it, as well as analysis of existing cases and practices of creation and implementation of transport managements systems in cities around the world.

The transport system is designed to meet the people's transportation needs of and includes the following components.

- Road and transport complex;
- Road users;
- Environment

The road and transport complex, as the name suggests, includes

street network, which is a system of streets and roads in a unified transport network of the city;

- personal transport;
- public transport;
- other elements of transport infrastructure Ent.

Advanced Traffic Management System (ATMS):

The ATMS uses data collected from sources such as traffic lights and car parks in order to manage traffic. These sources provide updated information about the current status of traffic, which allows the ATMS to actively control traffic and provide guidance to drivers for a safer, faster driving experience. The ATMS includes the following functions: • Redirecting traffic from congested areas by controlling traffic lights, thus reducing traffic jams; • Adjusting toll rates on roads that have them in order to direct people towards using public transport instead of personal vehicles; • Providing traffic participants with relevant information, i.e. available parking spots.

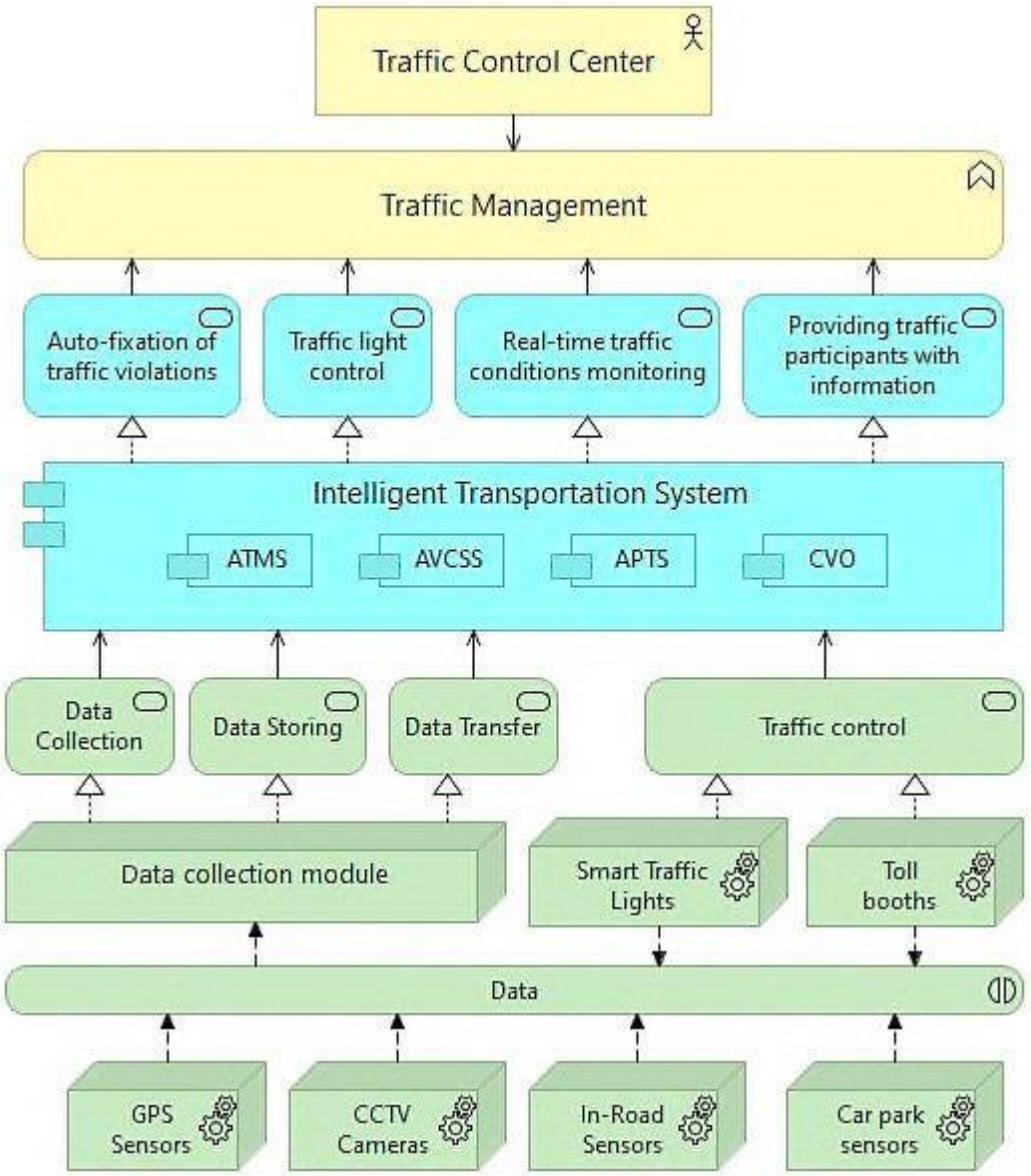
Advanced Public Transportation System (APTS):

The main purpose of the APTS is to provide people with necessary information about buses, i.e., seat availability, location, and estimated time of arrival. The system also can be used to optimize the flow of transportation routes, for example, by delaying buses running ahead of schedule. The APTS consists of the following modules that allow it to manage public transport in the most effective way:

- Real time passenger information systems;
- Automatic vehicle location systems;
- Bus arrival notification systems;
- Systems providing priority to buses at intersections

Commercial Vehicle Operation (CVO):

The CVO combines the functions of the previous components to manage commercial vehicles, such as buses, ambulances, trucks, and taxis. CVO methods include automatic vehicle monitoring, which allows to track performance and driving behaviour. This is important since bad behaviour on the road can result in accidents and other potentially dangerous situations.



Traffic management system architecture

Development of TMS in 2:

Overview

Various traffic related organizations, institutions and even individuals have been discussing the recent traffic congestion problems of Dar es Salaam. Some notable studies have recently been sponsored by TANROADS1 and JICA2, to include the current study. Some of the major issues identified by the past studies are:

- Concentration of the business/commercial/industrial areas in a limited area: the current CBD and rapid expansion of residential areas in the suburban areas;
- Mixture of variety of traffics of different demand/characteristics: international, regional and local travel demand; and
- Deterioration of the urban public transport services

Traffic Regulations

In the field of road traffic control and management, the primary policy objective is to develop appropriate institutional and organizational arrangement towards further efficient road use. One of the required actions is to enhance capacity of the relevant organizations in order to coordinate the traffic control devices and traffic management tools that are under jurisdiction of different organizations. Development of a good road traffic legal structure is another necessary action to achieve such requirement. There are two pillars of legal structures among other related laws and acts dealing with traffic control, management and safety: Road Traffic Act of 1973 as amended, and the Road Act, 2007. The former mainly deals with road traffic related regulations and the latter deals with road management from road administrative point of view as the name implies. The Road Traffic Act contains major regulatory tools for the purpose of ordinary traffic control and management as well as tools for traffic safety. It deals with the power of the Ministry and police for traffic operations and management including setting of traffic signals and signs, traffic markings, restriction of traffic on roads, making regulations of temporary speed restrictions, closure of roads, restriction of use of one-way traffic, setting aside parts of a road as special parking areas and so on. On the other hand, Roads Act is the tool for the road authority to regulate traffic in case of construction works, maintenance works, and for preserving road structures.

- Organization/Budget/Manpower
- Various stakeholders are involved in the sector, details of each being presented in subsequent sections.

Ministry of Infrastructure Development

This Ministry has a wide range of responsibilities related to the transport and infrastructure development policy in Tanzania. Traffic control and safety programming are two of the important responsibilities, among others. In the Ministry, there is one organization in charge of traffic management and safety: Road Safety Unit, which makes plans for the traffic management and road safety. A review3 of the 2007/08 government budget for transport infrastructure, undertaken during June 2007, concluded "…required funding is about US$ 166 million (210 billion Tsh.) assuming that the whole road network of 78,892 km in maintainable conditions, 65% of which is for trunk and regional roads while 35% is for district, feeder and urban roads. Budgetary allocations for road maintenance funding have been constantly below 40% of the requirements up to 2006/07." The financial sources of road maintenance come from the road funds managed by the Roads Fund Board, which is to advise the Minister on new sources of road tolls for ensuring an adequate and stable flow of funds. The Road Tolls (Amendment) No. 2 Act 1988 gives the road funds as the following sources:

All moneys collected as roads tolls imposed on diesel and petrol;

- Transit fees;
- Heavy vehicle licensing;
- Vehicle overloading fees; and
- Other sources determined by the Parliament. The fuel levy accounts for over 95% of the funds. Implications based on the 2007/08 budget framework are Less than half of the required maintenance funds have been awarded up to the 2006/07.

- The additional increase is likely to contribute significantly toward better conditions of roads;
- Backlog maintenance requires about US$ 600 million to rehabilitate roads to bring the network to maintainable level;
- Absorption capacity is low. Though more funding is required in order to improve road maintenance, this must be accompanied by improvements in the capacity of implementation agencies and construction industries.

The road network under LGAs is about 50,000 km (mainly rural, district, feeder and urban roads) but receives 30% of the share, in comparison to TANROADS, which has about 28,000 km (mainly trunk and regional roads) receives about 70% of the share. This creates the imbalance of maintenance level between them. However, it is expected to see better management of traffic in the near future with the increase of allocated budget for road maintenance, which includes expenditures for traffic control and management facilities. The capacity increase of implementation agencies and local governments should be enhanced as well.

- Dar es Salaam City Council and Municipalities
- Dar es Salaam City Council (DCC) has five departments: namely, Finance, Personnel and Administration Dept., Works, Fire and Rescue Service Dept., Waste Management Dept., Urban
- Planning, Environment and Transportation Dept., and Health Service Dep
- SUMATRA
- The mission of SUMATRA is to promote, facilitate and ensure availability of efficient, safe, fair, reliable and environmentally friendly transportation services in the surface and maritime transport sub-sectors.

The SUMATRA Act 2001 sets out the several roles of the Authority. The basis of roles are to seek economic efficiency by effective competition while protecting interests of the consumers, financial viability of suppliers and availability of regulated services to all consumers including low income, rural and disadvantaged consumers.

Among role and functions of the Authority, activities related road transport are licensing to any motor vehicles with carrying capacity of seven persons and above (i.e. bus services). Licensing is expected to ensure that:

Legitimate buses are in service;

- Well maintained vehicles are is use;
- Loading and unloading should be efficiently conducted at designated bus stop without hindrance to other traffic;
- Driving manner of buses, especially Dala Dala, should follow established rules of the road; and
- Buses should be of recent vintage and maintained in a clean condition. However, in spite of regulation of the Authority, actual number of buses operating on the roads in Dar es Salaam is estimated to be approximately 6,000 whereas the licensed buses number about 4,500. Dala buses stop any locations where it is necessary to catch passengers. They drive on the sidewalks when traffic is congested and they stop even on the exclusive left-turning lane at the intersection. Most buses are second-hand and are likely to break down at any moment, which might cause interruption to ordinary traffic on roads. SUMATRA has been aware of the deficiencies caused by Dala Dala bus operation. However, due to lack of staff, actual enforcement in the field is lacking.

Operational Procedures

According to the past study named the Study of Traffic Management on Trunk Roads in Dar Es Salaam Region 4 , it was found out in terms of road and operation conditions that;

- The trunk road network is a radial arterial road network originating from the central business district. The proper management and maintenance of the network is vital for economic growth of Dar es Salaam.
- Sections of this trunk road network, which consists predominantly of one lane per direction, are highly congested and low operation speed prevail during peak times i.e. 20 to 30 km/h. These operating speeds generally equate to Level of Service D (or less) according to the US Highway Capacity Manual.

Traffic Control at Intersections

Severe congestion prevails at many intersections on the trunk road network during morning and evening peak periods due to problems related to intersection traffic control. Some traffic signals are not working or working only during a certain period because of no maintenance, some are not properly controlled and some are completely obsolete having been installed long time ago. The signals in Dar es Salaam are not programmed to respond to demand;

In stead, operated by fixed cycle time. Although the demand exceeds the capacity of a certain approach, the allocated green time remains same and thus creating congestion on the relevant approach(es).

Intersections without traffic signals were initially so designed that drivers could find an interval to manage to go through when a traffic volume was low. The current situation in the city does not allow vehicles in the minor approach to find a proper interval at the

non-signalized intersection. As a result minor road traffic forces into any available intervals, although it seems not safe to enter, thus blocking traffic flow on the main roadway. Finally, all traffic at that particular intersection comes to standstill and creates traffic jam on all the legs of the intersection. The solution practiced now is the police officers, who give more green time for congested leg of the intersection. There are several roundabout intersections in CBD area of the city. The roundabout intersection has the merit of providing continuous circulation of traffic and safe movement of traffic. However, traffic on every leg of the roundabout has to stop or slow down before entering the roundabout, which causes accumulation of queues when the traffic volume is high. Currently due to a large amount of traffic in the downtown Dar es Salaam, every roundabout is a bottleneck of traffic in the city.

Traffic Signs and Markings

The behaviour of road users depends on the roadway design features, traffic flow characteristics, traffic stream composition and traffic control elements. The general rules and legislation, which contains sufficient amount of information to regulate, warn and guide the traffic, determines desired efficiency and safety of road users. Traffic control devices, such as signs, signals, and markings, regulate, warn and guide the traffic. Thus, traffic control devices form an important part of the road transport infrastructure. For effective and efficient functioning of traffic control devices, it is important to ensure that the devices used are uniform. To ensure uniformity, there is need for the recognition of legislation, regulation and a manual for traffic control devices as guiding tools for authorities in charge and road users as well. The devices should also be compatible with regional and international standards. The recognition and realization of above deficiency necessitates the Manual for Uniform Traffic Control Devices to be used within Tanzania. The Manual is approved by the Minister responsible for roads in accordance with Traffic

Control Devices Regulations, 2006 under the Road Act No. 30, and is recognized as the national standard for Traffic Control Devices on all public roads. The dissemination of these standards have begun Figure. The traffic control devices are classified into the following classes and sub-classes according to the regulations:

Geometric Design of Roads and Streets

The most influential elements of planning and design of roads related to traffic control and management would be the number of lanes in a corridor. The number of lanes and configuration of roads govern the actual capability of roads to handle demands. The

estimated traffic volume of a specific road in the target year determines the number of lanes. Currently most arterial roads in Dar es Salaam are at most two lanes for each direction and majority are two lanes for both directions with a nominal lane width of 3.0 – 3.5 meters and a shoulder with which is usually undefined. The maximum capacity of this type of roads under ideal conditions is 2,000 to 2,500 pcu/lane/h without interruption and with full shoulder. The actual capacity of traffic volume depends on vehicle mix, roadside friction, lane width and alignment of roads. If traffic control and other interruptions exist, the maximum capacity of interrupted flow would drop to 600 to 800 hourly vehicles/lane or less. The average hourly demand on these roadways is likely to be 1,500 – 2,000 vehicles (being predominantly automobiles during morning and evening peak periods); volume considerably exceeds available capacity resulting in a substandard level of service. The basic framework of existing road network was built based on the number of traffic, which was far less than the present value. Additional stretches were constructed and widening of some sections were made. However, these improvements are far behind the ever-growing population and traffic demand increase during 30-year periods. There are some sections where the capacity of roads during peak hour periods seems less than the demand though the signal control or priority control is properly done. These are:

- Ali Hassan Mwinyi Road (from Ocean Road intersection to Kinondoni Road), which include the Selander Bridge;
- New Bagamoyo Road (from Rashidi Kawawa Road to Sam Nujoma Road), which is two-lane, two-way road;
- Uhuru Street, which is two-lane, two-way road;
- Morogoro Road (from Rashidi Kawawa to Bibititi Mohamed Road);
- Nyerere Road (from Chang Ombe Road to CBD); and

- Kilwa Road near Bandari Road (Kilwa Road is currently under construction).

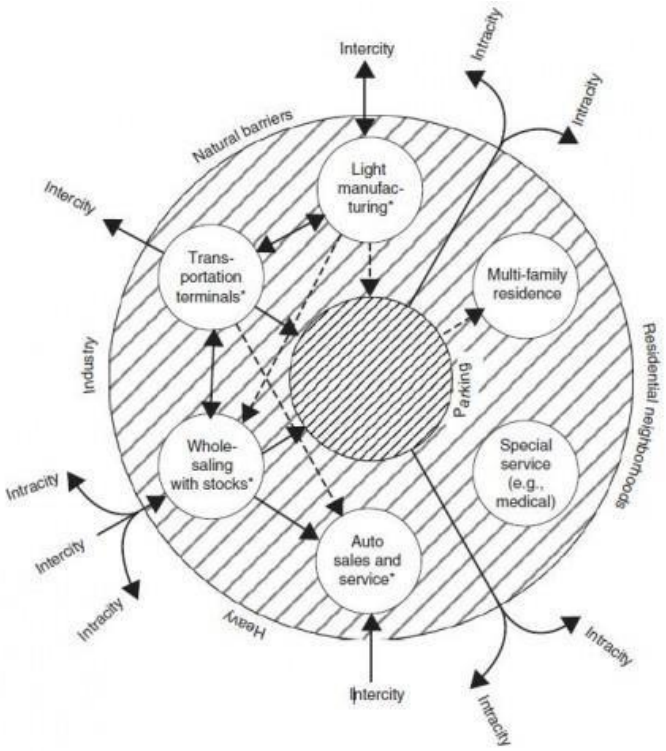
Some arterial roads in Dar es Salaam urban area are usually multi-lane highway equipped with median, sidewalks, right-turning lane and properly working signals, all of which ensure the smooth flow of traffic. Concentration of traffic to these specific arterial roads happens due to lack of intensive highway network and lack of road hierarchy. There are virtually few alternative routes to avoid traffic congestion on a specific route. Road conditions of secondary roads and local roads, which are normally two-lane two-way roads, are extremely bad. The existing road capacity in Dar es Salaam as a road network is poorly managed and this contribute to congestion substantially. As mentioned earlier, mal-functioning traffic signals, poor setting of signal timing, and no coordination of signals along the arterial highways worsen this condition. Other factors influence the capacity of roads. They are:

- Poor road environment; this includes narrow shoulder where break down vehicles can park in case of emergency, poor sight distance due to obstruction in the right of way and vendors alongside of roads.
- Lack of parking facilities especially in CBD.
- Inadequate or lack of bus stops and bus facilities, which give a chance for Dala Dala buses stop on the carriageway. This brings all traffic behind stopping and making long queue. Many main roads do not have properly designed bus bays, where buses stop to pick up and drop passengers without interrupting vehicles on the travel lane.
- Intersection designs do not consider high volume of a specific turning movement. In such intersections, the number of turning lanes may be more than one.

One-way Streets

Configuration of city streets determines the use of automobiles in the road network. Some streets can handle large volumes of traffic, whereas some streets mainly cater for access purpose including moving pedestrians, loading and unloading of cargos, parking or street trading. Such street type must be considered in the CBD area redevelopment. Currently, it can be possible to differentiate two types of roads and usage in Dar es Salaam city area (also refer Chapter 2 this volume for a discussion of road functional classification):

- Main facilities - Bibiti Mohammed, Morogoro, Uhuru/Railway, Samora, Sokoine, Kivukoni Front, Azikiwe, Ohio and Ocean Roads
- Supporting facilities - Libya, Kisutu, Jamhuri, India, Indra Gandhi, Zanaki, Garden and Ghana. Although main roads exist for circulation purpose, narrow roads and streets dominate the CBD and similar areas because they were planned during the colonial period, when the traffic volume was far smaller than at present.
- The narrowness of the roads necessitated the city government to plan and provide one-way streets. Current one-way system in CBD Dar es Salaam.



The purpose of one-way system was to create more space for traffic of a specific direction thus ensuring smooth traffic flow, instead of simply providing two-lane two-way street. Nevertheless, illegal parking vehicles occupy such space thus hindering effective use of space and smooth flow of traffic. This is because signs are not clearly shown, there is no edge and lane markings indicating traffic lanes of two lanes on such road as Samora Avenue, and there is no stop line at the intersection indicating where to stop at the intersection. Another type of one-lane, one-way street is to create more spaces for loading and unloading of cargos or parking spaces without interrupting traffic flow, such as India Street. There are no evident through streets in the city with exception of multilane streets such as Bibititi Mohammed Road and Maktaba Street, which could handle a large volume of traffic. Unless the priority signs are posted at each intersection of through streets, all vehicles stop or slow down at every intersection to avoid collision. Slow down and stops obviously interrupt smooth traffic flow. Samora Avenue, again, is currently operated as two-lane one-way street to handle a large volume of

vehicles but the parking spaces along the street spoil the nature of through street.

Traffic Demand Management

One of the policy instruments of traffic control and management is traffic demand management (TDM). The purpose of TDM is to reduce automobile use so that any type of transportation mode can effectively use the present supply of road facilities. Although more than 90% of passenger movements in Dar es Salaam depend on the public transport system, which consists mainly of Dala Dala bus services, conceivable TDM measures includes;

• Encourage more use of mass transportation system through the service of, such as,

a) Bus Rapid Transit, with new articulated bus fleets of higher capacity, reliable services and safe transportation to attract more people to use bus transportation,

b) Trunk bus service on non-busway roads, and typically operating in mixed traffic, which supplements and complements BRT services.

c) Zone bus service, which serves in a specific zone,

d) Bus service for handicapped people,

e) Shuttle bus service between high activity precincts/developments,

f) Circulatory bus service within the CBD, thus promoting public transportation use in the high activity core area, and,

g) Park and ride facilities, which encourages modal shift from automobile use to mass public transportation (BRT)

• Encourage use of bicycles and pedestrian traffic by:

a) Pedestrian mall in commercial and business districts,

b) Pedestrian zone in CBD,

c) Bike lanes to encourage use of non-motorized transportation modes.

d) High density development in an urban area.

• Control car ownership by,

a) Car sharing; this reduces the number of registered automobiles,

b) Automobile tax increase, which slows down the increase rate of car ownership,

c) Strict regulation of automobile storage especially in CBD area.

• Restrain automobile use and promoting effective use of automobiles by,

a) One-way system to maintain smooth traffic flow,

b) Traffic control zone, which allows only accepted vehicles,

c) Road pricing to limit the number of vehicles, such as allowing only high occupancy vehicles,

d) Parking management (regulation),

e) Car-pooling; this aims to reduce commuting traffic during peak periods,

f) Limitation of vehicles entering into CBD by providing detours.

CONCLUSION

The improvement of town traffic condition is largely dependent on the modern ways of traffic management and control. Advanced traffic signal controllers and control system contribute to the improvement of the urban traffic problem. The intelligent of traffic signal controller that is introduced in this project with powerful functions and hardware interface. Good quality social benefit has been made through the application of the intelligent traffic controller in practice, and the application result shows that the intelligent traffic signal controller will improve.

Traffic signals mainly operate in three modes, which are Fixed-time mode, Semi-time mode and Actuated mode. For this project, the actuated mode was chosen. Under this mode, there are detections for all approaches. The traffic signal is set to provide the green light "on-demand" or only in the presence of vehicles. If the road have pedestrians crossing, the pedestrian must push button in order to cross either the major or minor streets.

This project has two major phases. The first stage is to design a program, which consists of reading, research, planning and designing a program. The simulation is needed to get a waveform and the output of this simulation must be a same value or data with the waveform. After that, continue with the hardware implementation using the gate logic and the interface light is using led. The blinking is depending on the state machine transition. As a conclusion, the controller can control the traffic movement and detect a busy and non-busy road. The overall of this project is ok but certain condition the traffic signals is not function properly. The critical problem is about the timing. The output of the timing always changing, certain time the timing is ok and certain time is not. The environment and equipment's are used can effects the output.