SMART CITIES THROUGH IOT AND ANALYSIS INFERENCE

JUSCO

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LPWAN – IOT

➢ low power wide area network (LPWAN) is a wireless communication network for internet of things .

➢ features of LPWAN

  ➢ **Low Power** : The rate of data is usually around a few hundred or less. The rate depends on applications. Owing to the low power consumption, the lifespan of the battery is more than 10 years.

  ➢ **High Penetration** : The penetration power of LPWAN gateways is quite amazing as it can penetrate deep into the ground as well as inside building – thus it is able to connect to sensors anywhere outside,inside or underground.

  ➢ **Low Cost** : Several hundreds and thousands of devices are served by Base Stations – thus requiring less base stations and low infrastructure cost.

  ➢ **High Sensitivity :** Its unique ability of filtering out constant ramp chirp signal while delivering long-distance data helps achieve high-interference immunity.

  ➢ **Long Range :** The range is quite long (5 – 15 Km) depending on the environment – owing to which it provides better coverage both in urban and rural areas.

  ➢ **Low Data Rate :** The data transfer rate is quite low (less than 5000 bits per second). Therefore, only 25 – 256 bytes per message are sent several times a day.
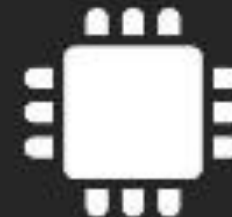
WHY LPWAN /LoRaWAN ?
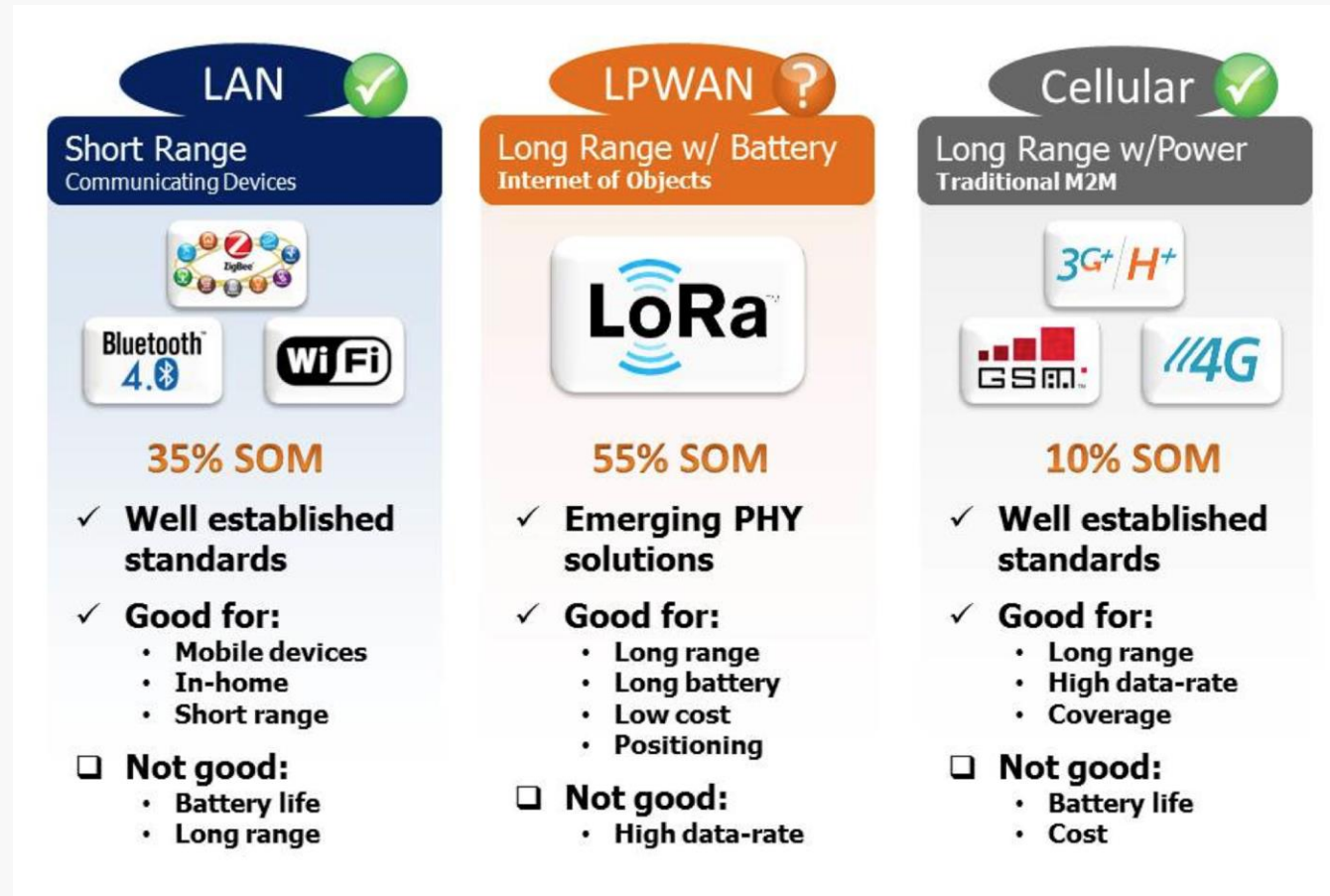
JAMSHEDPUR AS A SMART CITY

FACTORS IN FAVOUR OF JAMSHEDPUR

❑ In a 2013 study of AC Nielsen ORG-Marg, Jamshedpur is named the second-best city in quality of living in India. Primary reasons for this rating were reliable electricity, water supply and sewage systems. In International Global Water Wards 2008, Utilities and Services Company Ltd was ranked the best provider of water in India. In this town build for employees of Tata, the company owned tracts of land that are large enough that they could plan infrastructure.

❑ George Mason University professor Alex Tabarrok points out that despite being privately run, water, sewage and electricity provisions in Gurgaon are not efficient. Unlike , private providers of these sources do not own enough land. So, they do not have enough incentives to plan infrastructure that would benefit the whole city. To attract the best employees possible, Tata Steel had to invest in civic infrastructure in Jamshedpur.

❑ By allowing private developers and companies to buy land easily, the government can ensure a better infrastructure. If land acquisition laws were easy throughout the country, we would have seen more cities like Jamshedpur. Tatas founded Jamshedpur in 1908, when it was easier to acquire land. Acquiring land is not easy anymore.

NEWSPAPER CLIPPING

"We will be using LoRAWAN (Lower Power Wide Area Network), new data network technology, to allow connectivity with the Internet without using 3G or WiFi. It is ideal for battery-operated sensors and low-power applications in customised sensors so that real-time information can be sent to the integrated command centre," explained Jusco's senior deputy general manager, corporate relations and corporate communications, A.P. Singh.

The command centre, to come up at Jusco corporate office, will display real-time data of all the basic civic services ie, water, electricity, parking lots and roads, Jusco provides for a population of 8 lakh.

According to a Jusco official in the urban planning department, sensors using LoRAWAN technology would be fitted at the water treatment plant (WTPs) and also at water towers in the first phase. These sensors will not only inform the command centre about a dip in water pressure, indicating leaks, but also alert the centre about water levels at towers to prevent wastage, in addition to monitoring the water quality being supplied.

"Gradually, we will be fitting such sensors with water meters in individual households to detect wastage due to leakage or overflow in the supply line and also monitor the quality of water being supplied," said Singh, adding that sensors would also be fitted at power sub-stations and transformers to detect overloading and prevent outages.
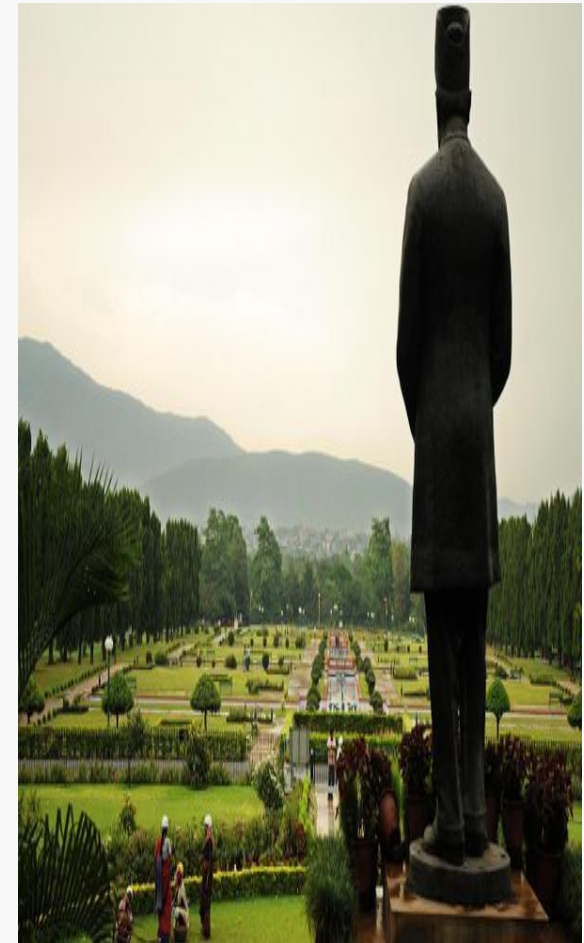
IMPLEMENTATION OF SENSORS

SMART BINS

❑ Protects environmental health and promotes quality of urban environment with the real-time location and monitoring of waste containers

❑ Notifies the fill level of the containers all the time and empties the container only when detected full

❑ Maximizes waste recycling and reuse

❑ Helps in data analytics and planning with centralized data collection

❑ Reduces service cost by 50% by efficient monitoring and management of waste bins

❑ Provides centralized dashboard and command control centre for waste collection and transportation

❑ Helps in real time monitoring of the vehicles to improve the productivity and reduce non-compliance

❑ Helps in efficient usage and route optimization of garbage trucks

❑ Reduces fuel consumption by avoiding unnecessary roundtrip of trucks

❑ Sends SMS to the driver to notify them about when the bin is going to be filled

❑ Offers 24/7 live bin level monitoring

sample data of SMART BIN

Bin Id	Device id	Filled %	Time	Area
1	FE1AE528	87.71 %	06/03/2017 03:46:39 PM	Sai Mandir, CH Area, Sonari
2	0000acfffe3dedf2	79.46 %	09/03/2017 10:20:25 AM	Dindli Enclave, Kadma
3	0000acfffe2f446b	21.05 %	07/03/2017 05:18:09 PM	Professional Flat B Block
4	0000acfffe1ae528	31.05 %	07/03/2017 05:18:09 PM	Kagal nagar
5	0000acfffe495ef6	19.05 %	07/03/2017 05:18:09 PM	West layout H road
6	0000acfffe7dcef6	0.00 %	16/03/2017 10:53:44 PM	professional flats IC road
7	0000acfffe152952	27.81 %	16/03/2017 10:53:44 PM	Sonari-2

Sai Mandir, CH Area, Sonari — 87.71 %

Dindli Enclave, Kadma — 79.46 %

Professional Flat B Block — 21.05 %
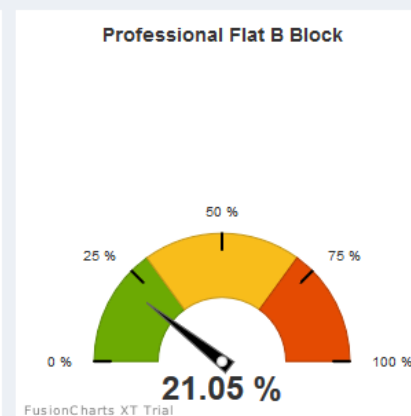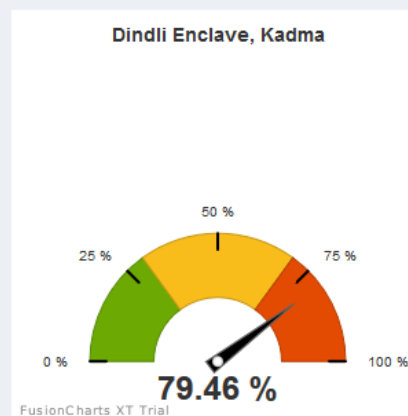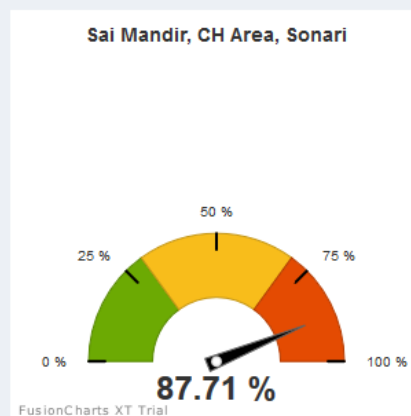
IMPLEMENTATION OF SMART BINS

☐ SEGREGATION OF WASTE AS DRY AND WET WASTE

PROBLEMS

1) inefficiency in disposal of waste materials

2) wrong data given by level sensors when fitted at top of bin as when dumped gave 100 %

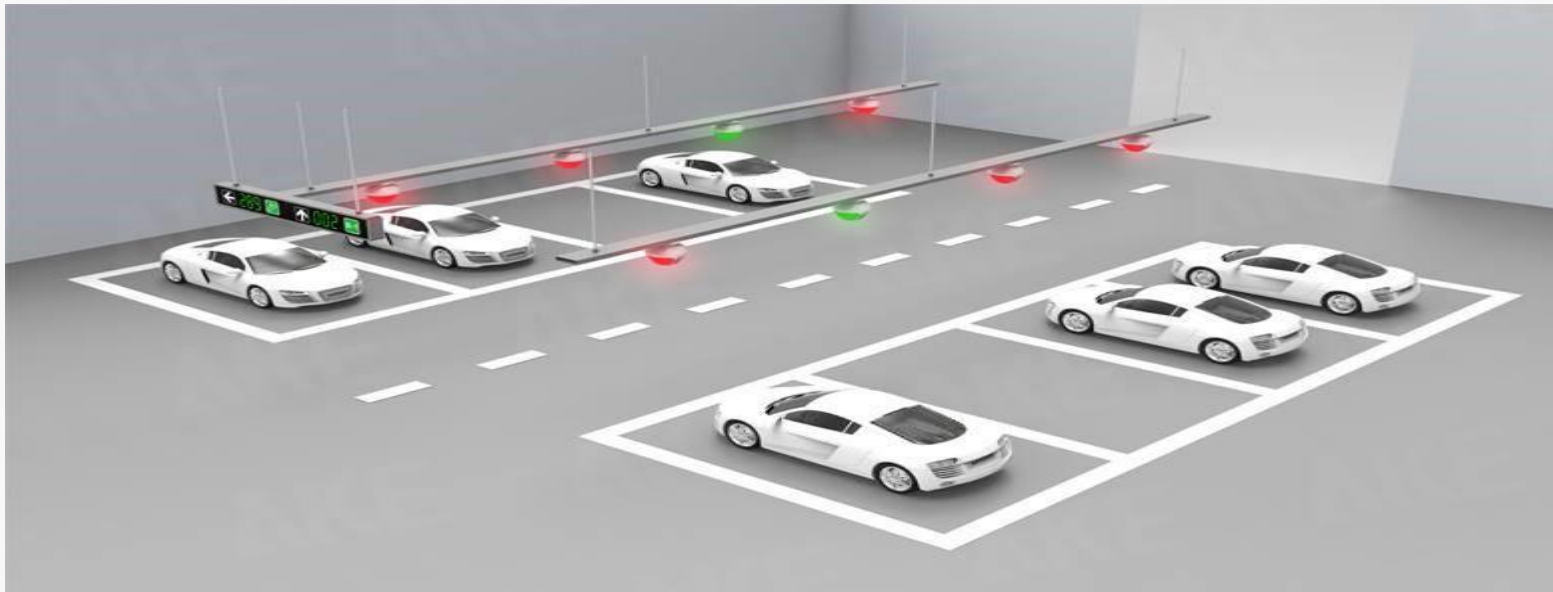full at each stage when a single piece of bin is thrown into it

PROPOSED SOLUTION

1) automatic suction of wet waste   from segregated waste from bins to either near biogas

treatment or landfill for efficient disposal of waste

2) side way open bins and calculation of average of   data feed per hour should be calculated

for correct results in bins . So now if data is consistent for over one hour   then we conclude

data for confident .

SMART PARKING

A. Shows the parking slot availability all the time using the dashboard
B. Reduces searching time for the vacant slot
C. Provides efficient space utilization
D. Reduces supervision cost
E. Mobile app for car parking
F. LoRa WAN Enabled

SAMPLE DATA FOR PARKING IN CITY

Smart Parking

slot 1	slot 2	slot 3	slot 4	slot 5
6.81 feet	6.81 feet	6.81 feet	6.81 feet	6.81 feet
Vacant	Vacant	Vacant	Vacant	Vacant
6/21/2017 9:43:34 AM	6/21/2017 9:43:34 AM	6/21/2017 9:43:34 AM	6/21/2017 9:43:34 AM	6/21/2017 9:43:34 AM
Bank Of Baroda	Bank Of Baroda	Bank Of Baroda	Bank Of Baroda	Bank Of Baroda

ACTUAL DATA IMPLEMENTATION

E8-E1-E1-00-01-00-14-2C	Car Parking		
6/19/2017, 3:00:44 PM	1	0	Car Not Parked
6/19/2017, 3:11:40 PM	4	1	Car parked
00-00-AC-FF-FE-3F-C3-95	Car Parking		
6/19/2017, 12:39:57 PM	1	0	Car Not Parked
6/20/2017, 9:24:13 AM	3	1	Car Parked
E8-E1-E1-00-01-00-17-D5	Car Parking		
6/19/2017, 6:55:31 AM	3850	0	Car Parked

Smart Parking (Bistupur)

E8E1E1000100142C	E8E1E1000100142B
NO VEHICLE	NO VEHICLE
Vacant	Vacant
6/20/2017 12:52:45 PM	6/15/2017 12:01:36 PM

- Data as received from tata communication server for different area parking ID .

CITY SURVIELLANCE

PROPOSAL

- ➢ Placement of a well networked CCTV at most of the parks and museums.
- ➢ Installation of a centralized monitoring system along with the proximity sensor's report to be analyzed on daily basis
- ➢ Implementation of CCTV camera and PR sensors including intruder alarm
- ➢ Placement of CCTV camera to reduce the requirement of security guards
- ➢ Placement of Intrusion detection system with a buzzer to prevent theft

CENTRE COMMAND

- A Centralized dashboard for monitoring

- Water level of all the water tanks and reservoirs

- Water quality of water tanks, flow of water in water treatment plants and water tanks

- Dust bin level in web app/mobile app

- Opening and closing of inlet and outlet valves of water tower

- Data analytics that leads to better planning and efficient resource utilization
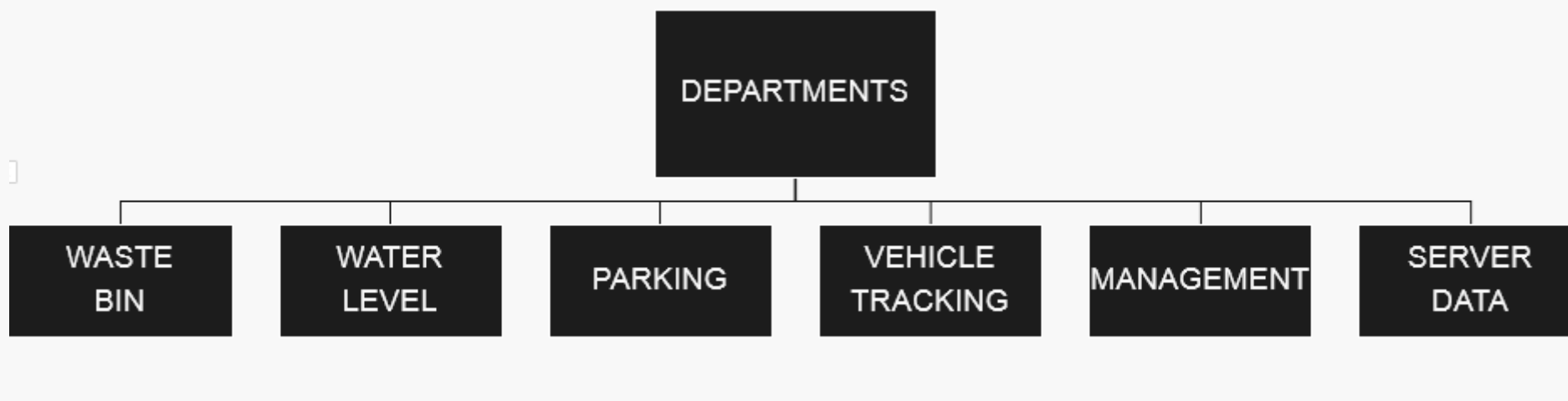
SMART POOL

BENEFITS OF IMPLEMENTATION OF SMART POOL

- ❖ Notifies Chlorine, Ph and temperature level on smart phone and web application 24/7
- ❖ Provides accurate sensors and reliable readings
- ❖ Notifies the quantity of chloride when it is less or excess
- ❖ Ensures easy monitoring of pool from anywhere
- ❖ Prevents diseases due to excess chlorine
- ❖ Reduces service cost and man power for maintenance

SAMPLE DATA OF POND AND POOL

❖ IN POOL CHLORINE LEVEL , PH VALUE AND TEMPERATURE IS NOTED

❖ IN POND DISSOLVED OXYGEN LEVEL , PH VALUE AND TEMPERATURE IS NOTED AND FOUNTAIN IS OPENED AUTOMATED IF DO LEVEL IS NOT

   NORMAL , TO INCREASE AGITATION IN SURFACE WATER .

Beldhi Club - Swimming Pool Monitoring
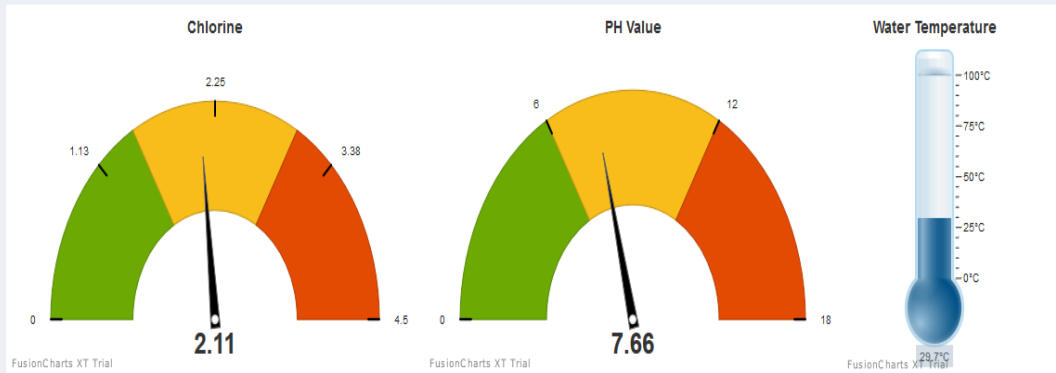
Data recorded at Time : 03-March-2017 03:57:PM

ⓘ Chlorine level : Normal

Cl Value : 2.11ppm

Ph Value is : 7.66

Temperature is : 29.7 C

Jubilee Lake Pond Monitoring
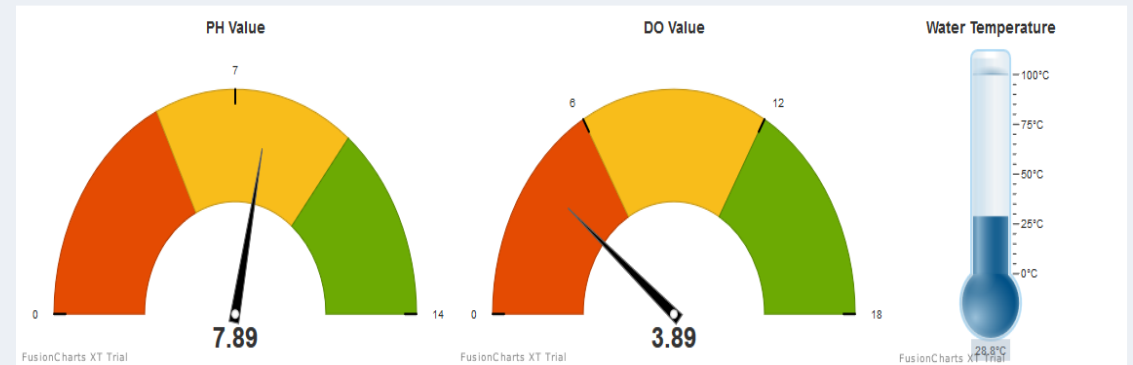
Data recorded at Time : 03-March-2017 03:57:PM

ⓘ Dissolved Oxygen(DO) level : Normal

Ph Value is : 7.89

DO Value is : 3.89

Temperature is : 28.83

SMART STREET LIGHT

Illustration of energy saving by using light sensors and auto timers

Legend:
- Turn ON = Sunset + 5 min
- Dimming 90% = 11:00 pm
- Dimming 80% = 12:00 pm
- Dimming 70% = 01:00 am
- Dimming 60% = 02:00 am
- Turn off = Sunrise – 5 min
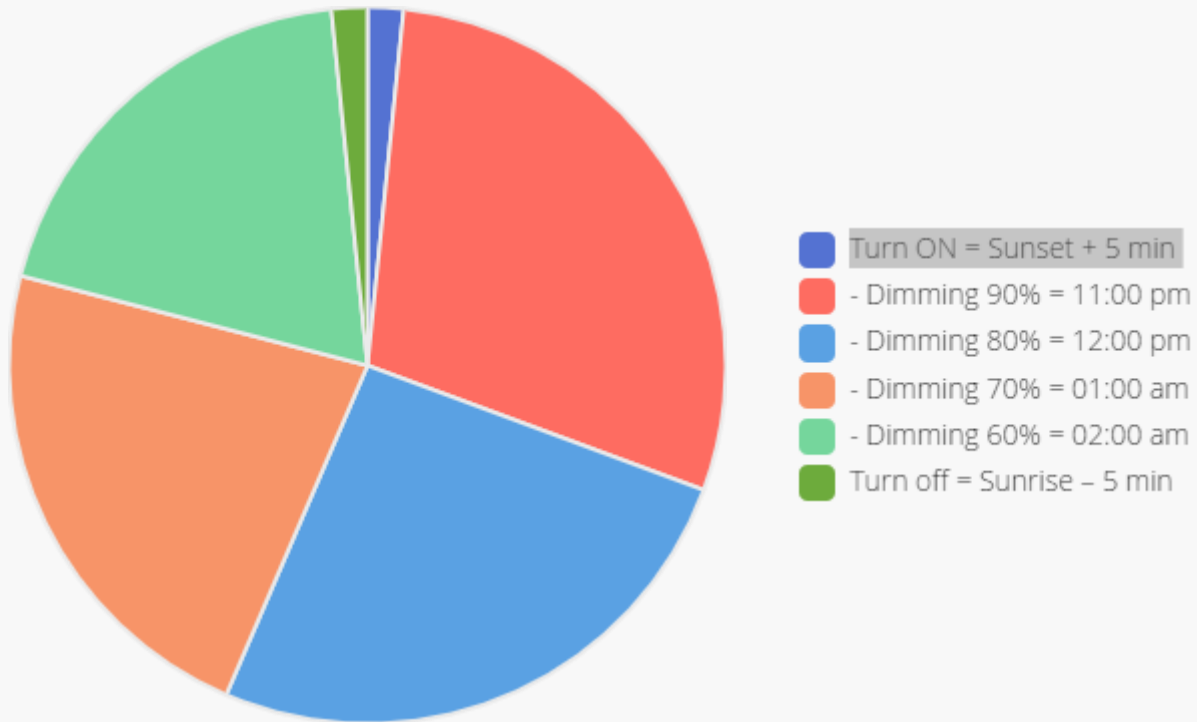
❖ Ensures remote monitoring and control of street light unit

❖ Ensures remote monitoring & control of energy load consumption

❖ Helps in dimming of illumination during off peak hours

❖ Achieves up to 85% energy savings by dimming and smart scheduling

❖ Ensures the provision of right amount of light whenever needed

SMART ENERGY METER

BENEFITS OF IMPLEMENTATION

- Helps in remote monitoring of energy meter
- Reduces cost of man power for reading meters
- Retrofitting of communication modem
- Retrofitting of load disconnecting unit along with energy meter
- Disconnects power supply remotely if bills are not paid
- Ensures remote monitoring of water meter
- Reduces cost of man power for reading meters
- Disconnects water supply remotely if bills are not paid

VEHICLE TRACKING SYSTEM

IDEA

- Tracks 24X7 location information
- Optimizes Routes
- Alerts and nonfictions via SMS
- Monitors vehicle's speed
- Increases productivity
- Reduces operation costs
- Saves money on fuel
- Controls work hours
- Betters customer service
- Reduces insurance costs
- Increases security
- Improves dispatching

DEPLOYMENT OF VTS IN CITY

PROBLEMS

- ❖ High running costs by those who speed and waste fuel
- ❖ Recovery if occurrence of thefts.
- ❖ Detailed information on the whereabouts of vehicles at all times and to keep an eye on employee activities.
- ❖ Heavy phone bills by customers
- ❖ Heavy amount of paperwork

PROPOSED SOLUTION

- ✓ Focussing upon those drivers it is possible to not only reduce fuel and maintenance bills, but to also reduce insurance premiums.
- ✓ Some insurance companies will give recovery if thefts do occur.
- ✓ Productivity of workers can be increased by being able to keep track of lunch hours, exposing unauthorised stops and breaks and by evaluating the overtime requests of workers.
- ✓ Vehicle tracking systems will vastly reduce your phone bills as it is no longer a necessity to constantly call employees to find their location.
- ✓ Increase the accuracy of your records.

WATER TOWER MANAGEMENT

IMPLEMENTATION

- ➢ Ensures live monitoring of water level in water tanks
- ➢ Automatically turns on and turns off the valves coming from water treatment plant to water tower
- ➢ Sets time automatically for opening and closing the outlet valves going to consumer houses
- ➢ Monitors water quality including chlorine, turbidity, PH level and conductivity
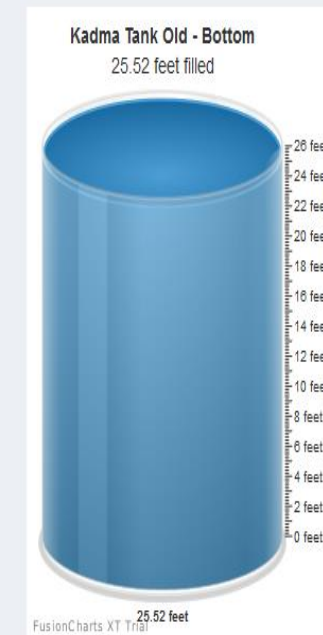- ➢ Makes water tower WI-FI enabled
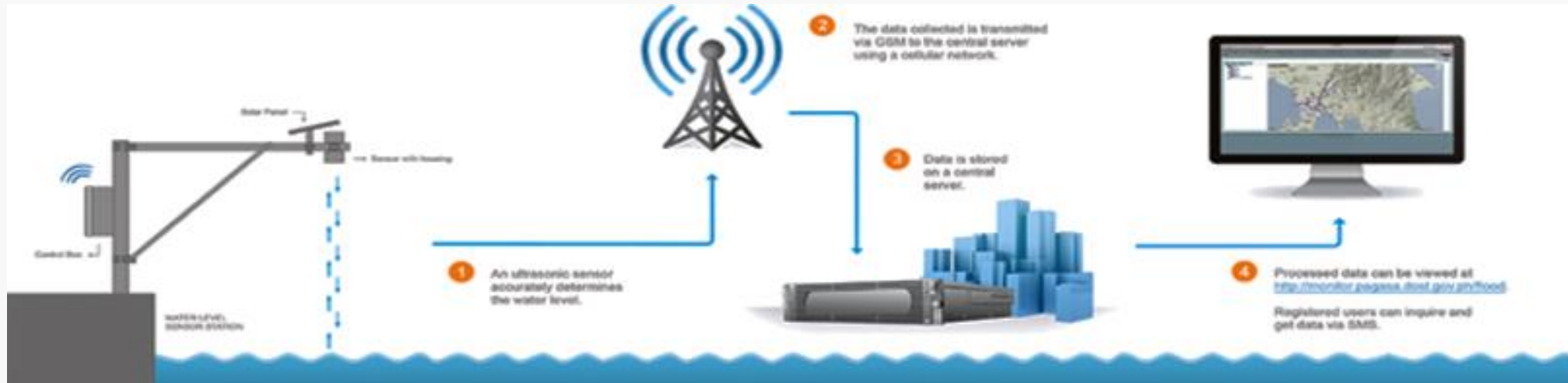
SAMPLE OF CITY IMPLEMENTATION OF WATER MANAGEMENT

- Gives live updates of water level of each tank
- Ensures live quality monitoring of water tanks and water reservoir
- Detects Motor's fault by checking motor vibration, motor winding temperature
- Minimizes manual intervention due to automated valve control
- Provides data analytics to lead better planning
- Saves water and electricity by 30 %
- Reduces maintenance and labor cost
- Ensures live monitoring of flow of water in water treatment plant
- Auto chemical (chlorine) doping in water treatment plant

Water Tower Level Monitoring

Water Tank No	Device id	Filled in ft	Time	Area
1	FE101E39	25.52 feet	21/06/2017 03:22:49 PM	Kadma Water Tank Bottom

Kadma Tank Old - Bottom
25.52 feet filled

26 feet
24 feet
22 feet
20 feet
18 feet
16 feet
14 feet
12 feet
10 feet
8 feet
6 feet
4 feet
2 feet
0 feet

25.52 feet
FusionCharts XT Trial

View Details   View Graph

MANHOLE LEVEL MONITORING MANAGEMENT

Manhole Level Monitoring Management

View On Map

Area	Junction of New TC,Road No 2	JNAC Office, Ramdasbhatt Campus	Road No 14, Near Profesional Flat C	Flower Shop, Chaganlal Jewellers	back of 140/a uliyan flat,kadma
filled in ft	5.92 ft	7.54 ft	5.36 ft	7.53 ft	0.00 ft
Updated time	03/03/2017 09:46:38 AM	06/03/2017 03:46:39 PM	06/03/2017 11:27:10 AM	04/03/2017 02:18:22 PM	NA
Device id	0000acfffe34c2d8	0000acfffe1ae528	0000acfffe371395	0000acfffe61ddf2	0000acfffe2ab395
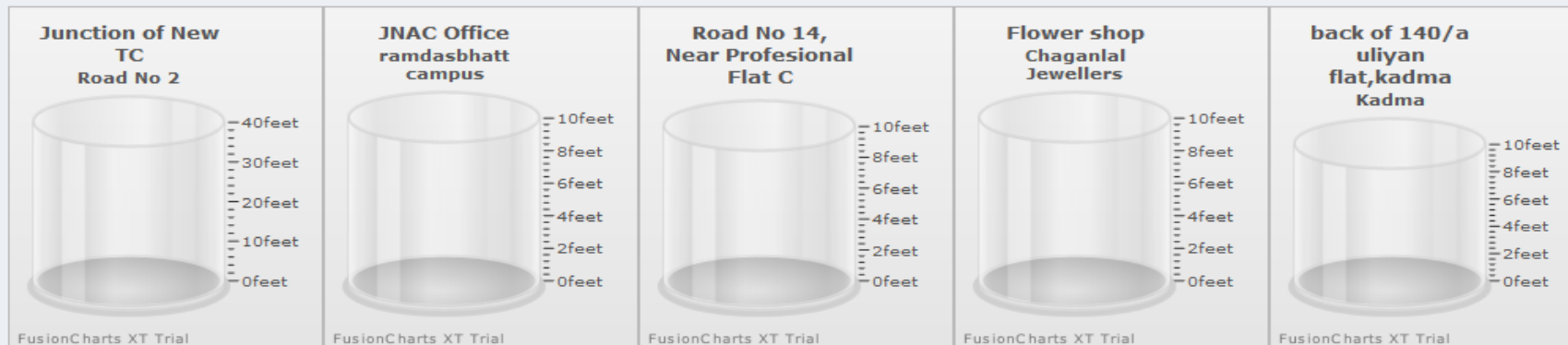
ACTUAL DATA RECEIVED IN LEVEL SENSORS

sample real data of water tank level monitoring

00-00-AC-FF-FE-10-1E-39	Water tank level monitoring		
6/19/2017, 2:27:45 PM	548	TANK:53	ht in inches
6/19/2017, 5:16:53 PM	553	TANK:176	ht in inches
00-00-AC-FF-FE-4D-0E-AE	Manhole Level Monitoring		
6/19/2017, 1:16:33 PM	12	PIPE:36	ht in inches
6/19/2017, 1:17:07 PM	13	PIPE:62	ht in inches
00-00-AC-FF-FE-7F-A5-28	Level Sensor		
6/19/2017, 7:39:02 PM	667	LEN:8131	ht in cm
6/19/2017, 7:38:57 PM	666	LEN:7779	ht in cm
00-00-AC-FF-FE-00-90-41	Level Sensor		
6/19/2017, 9:49:27 PM	1909	LEN:467	ht in cm
6/19/2017, 9:46:24 PM	1880	LEN:971	ht in cm

WORK FORCE TRACKING

IDEA / PROPOSAL

- ❖ LoRa WAN and GPS antennas ensures receiving and transmitting accurate position of worker

- ❖ Alerts and provides info via SMS/email

- ❖ Ensures real time location and tracking of workers through smart wearable devices

- ❖ Leads to better planning and efficient resource utilization by Data analytics

- ❖ Helps improve work force efficiency

- ❖ Helps reduce the supervision cost by 30%

SAMPLE DATA OF WORK FORCE TRACKING

ANALYSIS

Percentage of female school-aged
population enrolled in school

Series1 Series2 Series3
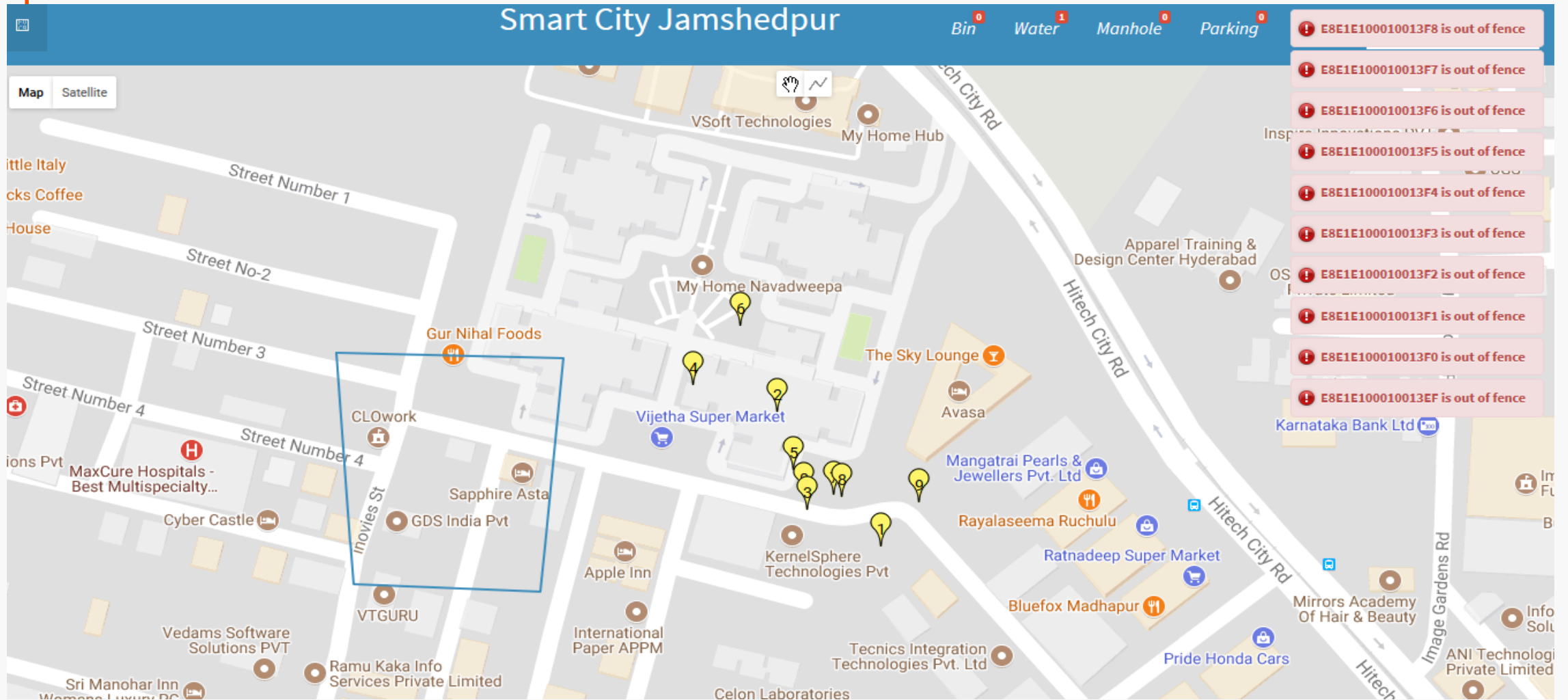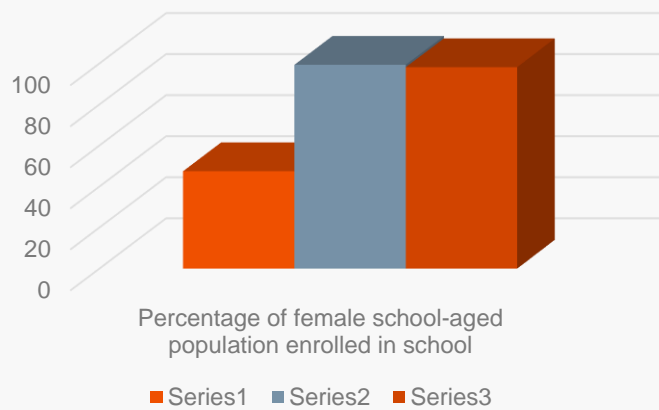
Total residential electrical energy use
per capita (kWh/ year) kWh/yr/capita

1 2 3

Energy (electricity) consumption of public buildings per year (kWh/m²)
Series1 Series2 Series3
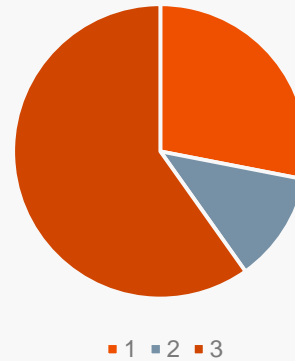
Series 1- pune 2-Jamshedpur 3-london

Total electrical energy use per capita (kWh/year)

■ Series3 ■ Series2 ■ Series1

O_3 (ozone) concentration

■ Series1 ■ Series2 ■ Series3

Average life expectancy

■ Series1 ■ Series2 ■ Series3

Percentage of city population living in slums

■ Series1 ■ Series2 ■ Series3

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Percentage of city population with regular solid waste collection (residential)

■ Series1 ■ Series2 ■ Series3

Number of cell phone connections per 100 000 population

64485.67   78526   139170.98

0%   20%   40%   60%   80%   100%

■ Series1 ■ Series2 ■ Series3

■ Series1 ■ Series2 ■ Series3

12.53

7.74

1.49

Transportation fatalities per 100 000 population

■ Series1 ■ Series2 ■ Series3

318.67

194

221.18

Total water consumption per capita (litres/day)