Implementation of ict for smart city waste management

Business, Management

India is the second highest populated country of the world. It’s having 1. 32 billion people; this is increased by almost 182. 5 million since last decade. This population growth brings too many challenges related to management of environment such as industrialization, changing lifestyle. By introduction of new technologies many problems have been solved as well as many issues are emerged such as waste management. Every city and town are messed up with left garbage in open and it’s become very difficult to manage these garbage, According to the report of world bank, 2012, waste generation rate is about 1. 2 kg/capita/day that is 1. 3 billion tones/year. 10 years ago, this was about 0. 64 kg/capita/day that is 0. 68 billion tones/year. By the year 2025, it will be the 2. 2 billion tones/year.

According to requirement and availability of services, this is also requiring managing of garbage from the industries itself located in the Urban areas. This impact on the environment, air, water, pollution and invites to many disease. so, it become the priority of the authorities to improve their services and to continuously monitor, collect and dispose this garbage cost effectively, and satisfactory manner in terms of environmentally and socially.

Concept of smart city

The smart city concept integrates information and communication technology (ICT), and various physical devices connected to the network (the Internet of things or IoT) to optimize the efficiency of city operations and services and connect to citizens. Smart city technology allows city officials to interact directly with both community and city infrastructure and to monitor what is happening in the city and how the city is evolving

Framework for smart city

Outcome by the Interference of ICT in solid waste management

- Sanitation Scheduling Solution: Efficient use of resources for cleaning
- Sweeper machines: Increase capacity
- Output based Performance tracking: Performance based service
- Waste collection scheduling solution: Efficient collection, reduced littering
- GPS Sensors and devices on waste trucks: Efficient collection, reduced cost
- rucks with Separate containers: Avoid mixing of waste
- Waste Bin Sensors with GPS: Efficient collection, reduced theft
- Advanced Recycling techniques: New revenue streams, reduce impact on environment
- Smart Landfill management: Reduce environmental impact
- Pollution Sensors: Reduce environmental impact
- Advanced Pollution Control Equipment: Reduce environmental impact
- Garbage segregation at source: Efficient waste management
- Sensor based Sorting: Efficient segregation
- Modify Building code to incorporate garbage chute: Sustainable buildings

Architecture of ICT

Human Centered Inclusive Design: User interface and application to be designed in such a way that it is accessible, easier to use and understood by all.

Multichannel Platform: Applications should be accessible to stakeholders over multiple channels like mobile, web, phone, kiosk etc.

Open Standard Based Design: o ensure standardization, inter-operability, flexibility to move for one vendor to another and reduce CO.

Technology & Vendor Agnostic: Solution which is technology and vendor agnostic and helps in achieving cost effectiveness.

Service Oriented Design: ensures technology independent, reusability and interoperability in the long term.

Preparedness for failure: Architecture should be designed to tolerate failure and have recovery tools and/or processes defined

Fit for purpose, Unique and reusable: Each capability should be implemented only once without duplication. Web Services/Interfaces should to expose to ensure reusability/integration.

Integrated Approach: Integrate planning, execution & monitoring of applications & systems to ensure the wheel is not reinvented, solutions are not over-engineered and ownership is clear.

Layers of ICT Architecture

1. Access Layer: Access layer provides multi-channel (Web/Mobile/Phone/Kiosk/Face to Face) access to stakeholders (citizens, businesses & city mgmt.)

2. Security Layer: Security layer comprises of the comprehensive security framework, standards , policies and tools/solutions for Identity management, Infrastructure/ Application/Data/Instrumentation/Physical Security
3. Application & Intelligence: Comprises of applications to enable smart city domains like water, energy, transportation etc. and also core enterprise applications like ERP
4. Data Layer: Data layer provide basic (access/storage/retrieval) data management capability and advanced capabilities like master/meter data management, dash boarding, reporting, data management and analytics
5. IoT /M2M Layer: IoT layer simplifies connectivity, device management, sensors/meter data acquisition/management, and provides capabilities to monitor, manage and control connected sensors/meters and devices
6. Communication Layer: Communication layers provides Wired/Wireless connectivity medium. It includes wired/wireless connectivity medium like GSM/GRPS/3G/Wi- Fi/Proprietary
7. Instrumentation Layer: Instrumentation layer constitutes sensors, meters, devices , controllers, cameras etc.

Need for a Set-up

The blooming and distribution of smart city duties can be ticklish, especially when there are no particular standard to be follow at the blooming stge. The necessity of the set-up is for better understanding or to make ease of blooming and distribution process. Before implementation of frame work the required components are:

Physical Infrastructure: Components/ Hardware are required that is, Bins, rucks, Pipes, Dumps, Features, Recycling, Processing, Bins Location, Bins types.

IoT Technology: IoT technology require RFID, NSF, Sensors, WSN, Actuators, GPS, Cameras.

Software Analytics: It require GIS, DSS, Scheduling, Routing.

OUTLINE (DESIGN) AND EXECUTION

This deals with the precise explanation of the suggested set-up, its characteristics and performance. We made use of documents explanation to keep record of our development set up periodically. The main objective of this research is a blooming set up for the city duties. So that this can be adopted by any of metropolis. This is dynamic set-up; this is already mentioned at the starting of this thesis. So then this set-up can be easily apply to any of the metropolis.

Smart metropolis duties and proof of concept

For our proof of concept metropolis duty, we chose waste management; this is a duty that is needed all over. There should be strict laws for dumping garbage areas. People should not allow dumping their garbage except the dumping garbage area if one area is full to capacity then required to find another one.

Design set-up and architecture (structure)

System overview

This system consists of four major components:-

- Existent world
- Sense smart city core (SSC)
- A simulation system

A management system

Existent world:- The existent world illustrates the metropolis reprocess-bins with sensors. It also illustrates every other operation on the reprocess-bins. eg:- Garbage collection vans.

SSC:- This is a system that stores the data from the existent world and provide interface in real time and non-real time.

Simulator:- Simulator comprises of the existent world sensors (reprocess garbage bins, their specifications, route grid, route mesh, conveyance for the garbage collection. It is a model of SSC core system. Like route selection according to the data that is provided by sensors. This system helps in to change or correction in existent system.

Next section describe the each module of the system in detail.

Management system: management system handles all the control of the service and use the SSC for its proper functioning. The functions are defined as follows:

- Interface for users: Uses of graphs and maps for checking the real time status of the system
- A triggering system for taking actions when required

- A layout for monitoring the system and for controlling the settings

Management system is fully dependent system because it requires them to access the real time data. It collects the waste by the collection trucks by sensing data from the sensors bins. Management system also provides some administrative functions for example addition of new sensors for recycling of stations, management of sensors, managing the general settings, so these settings can be considered for waste collection. A function named as triggering system can also be used as an alternative for scheduling the waste management. So the system can define the eligibility for the waste collection at the time when required such as when bin is full. We define 3 parameters for checking the eligibility:

- Complete eligible: this is the condition when immediate needs for the waste collection
- Partial eligible: this is the condition which to be also considered for waste collection but not on urgent basis
- Not-eligible: this is the condition when there is no need of waste collection for a particular place.

We can also define these criteria on percentage of waste level

- 91-100% : Define as Complete eligible
- 65-90% : Define as Partial eligible
- 0-64% : Not Eligible

Result

For verification of the idea, we consider waste reuse administration framework in the city. Our framework giving information from receptacle or

holders furnished with sensors situated at different areas of the city to control the status of the canister or compartment in deference to amount of waste it contains and level waste in containers or holders. Introduce the sensor on the highest point of the canisters or compartments. The continuous information is put away and made realistic through open defined interface for the city and uncommon organizations. The data is utilized to give esteem additional administration, which wants to benefit the nationals and the city and additionally squander administration frameworks.