

# Array of Things in Smart Cities

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**Abstract-** Smart City is a new concept that is incipient in this hi-tech world. Cities with not only quick-witted intelligence but also with attractive and comfortable designs are Smart Cities. Convergence of Data and Communiqué to improve the performance, interactivity of services, reducing cost and optimized use of resource is the main goal of developing any Smart City. Array of Things is a new-fangled model supporting the smart cities. It act as a fitness tracker by collecting the various information about the surroundings, infrastructure and on-goings in the city. This paper covers the epitome of Array of Things, how it is implemented and the possible progress in future.

**Keywords:** Array of Things, Internet of Things, Smart City, Sensor, Urban Flooding.

## I. INTRODUCTION

In this twenty first century the world has been turned into a concrete technological mart. Colossal steps have been taken in order to make this world place better by making some “SMART” decisions. At present, technology is not confined in the boundaries of gadgets but now these gadgets are being used to reshape this world. Smart cities are the preminent example now a days. The term smart not only reveals the property to be attractive or upmarket but also now this has changed into quick-witted intelligence.

Smart Cities are also responsible for securing the green score card by creating a balance between technology and environment [1]. Smart City holds several different definitions and terms [2]. Smart Cities can be called as ability to integrate multiple technological solutions in a secure fashion to manage the city’s assets [4]. Using Statistics and communiqué to enrich the quality of performance, interactivity of urban services with reduction in the cost and resource consumption is what smart city follows. Smart city is non-entity but convergence of technology, government and society to enable some characteristics as smart economy, smart supremacy, smart vitality, smart building and smart people. [6]. Cities are changing into Smart cities, Closets are transformed into smart closets, refrigerators, watches, phones etc. these all have become smart in terms of there working and appearance. To develop such smart things and cities, there

must be some synchronization with the technology. Array of Things is the new inventions or milestones in this field.

In order to develop smart cities there is need to have such equipment that will help us to maintain the quick-witted astuteness of the city. As there is no definition to describe a smart city, no end points but only some steps by which a city becomes comfortable, irrepressible and able to respond to new vicissitudes swiftly. Array of Things is a new concept in this approach. It can be called as the fitness tracker for any city. Tracking the various situations and Health of the city makes this concept more valuable for smart cities.

Array of Things is an urban sensing project that is aimed to act as an aptness pursuer for the Chicago. Collecting data of Chicago’s surroundings, frame and the various activities that are taking place, was publicized as a significant step towards creating a smart city. This project is designed to nurture niftier working practices, gestating technology revolution and enhancing the social life in the city.

## II. ARRAY OF THINGS

Array of Things is a cooperative creativity of Argonne National Laboratory and The University of Chicago. Four years ago, Charlie Catlett Senior Computer Scientist at Argonne National Laboratory with his fellow Researchers [7] decided to monitor the air quality of the Chicago city. They implemented their idea with the help of sensors, internet connectivity and power supply and it was a successful idea but due to the improper supply of power and the failure to find the places to put the sensors from where no one could filched them the students bring their sensors back to home and thus, this was not idea was not implemented properly.

After that Catlett along with the some members-Rajesh Sankaran, Pete Beckman from computation Institute Argonne and Douglas Pancoast, Satya Mark Basu from the school of Art of Chicago they all came up with a new notion as Array of Things.

This was firstly implemented in The University of Chicago with 20 sensors nodes collecting data from the campus and using it for various purpose. Later, it was also introduced in North Eastern Illinois University.

Array of Things is serving or acting as a “Fitness Pursuer” in the city of Chicago. It is an inner-city intuiting project, a network of shared and integrated sensors that are set up around the city of Chicago to discern the infrastructure, milieu and commotion for research and public use.

### III. INTERNET OF THINGS AND ARRAY OF THINGS

Internet of Things is a convergence of conventional related devices and smart piece of equipment. It can be called as Web of objects. Different sensors, software’s are linked together and provide privilege to objects that they can exchange their data without human to human or human to machine interaction.

Array of things can be classified as an activity of Internet of Things [5]. It can be categorized as an application of Internet of Things that help us to create a smart environment to live.

### IV. WHAT DATA IS COLLECTED

Array of Things will provide instantaneous and location based data of Chicago. Data about Chicago’s structure, its atmosphere and all the deeds that are going on will help researchers, policy makers of the city to develop on the mend, competent and more civilized city. This will also help in addressing some problems like Urban Flooding.

Urban flooding is nothing but the blizzard of land-dwelling or chattels in a built environment, mainly in the compactly populous regions. As the number of people migrating to cities is increasing day-by-day therefore, the green areas are becoming impervious areas, there is increment in the urban runoff and as the density is increasing people will live on flood plains and low-lying coastal areas, and thus they are in flood prone areas [3].

The concept of Array of Things will help by providing time to time situation of the flood prone areas by using the sensors.

The sensor nodes will be amassing the proportion of different oxides in the air, vibration, sound intensity, surface temperature, and vehicle and everyday traffic etc. This data collected by the sensors will be open for the public freely and some innovative mobile applications will be there to track the air containments, or will navigate the users through the city based on poor quality of air, noise, traffic etc.

Array of Things will not collect any information about any individual, it will only monitor the city’s health. The privacy protection is already build into the design of sensors.

### V. HOW THIS DATA IS USEFUL?

A. This project in Chicago will help in avoiding the various situation, the data collected will detect the urban flooding and will help in reducing the property damage and illness of the citizens.

B. It will also suggest the people of Chicago about the suitable and unsuitable time and routes to walk in the city. It will also maintain the relationship between diseases and urban environment.

C. The citizens will get all the updates of weather and climate. It will be responsible for the block-by-block data in the city.

D. It will reduce the congestion based pollution. All the pedestrian will be updated with the safe and efficient routes.

E. The data collected by the nodes will also help to maintain the relation between the air quality and health. As the students of University of Chicago are studying cardiovascular health and collecting data from the various resident surveys. This data could be integrated with the environmental data through sensor nodes.

Thus, the sensor nodes collecting data from the city’s different situations and environment will help the citizens and will create a livable environment to live.

### VI. HOW THIS DATA IS COLLECTED

The whole process of the project Array of Things is shown in the figure 1. As the node consists of different sensors such as- environmental sensors, air quality sensors, Linux node controller, power controller, light and infrared sensors these all are the constituents of the node which is the main entity of the system.

As per shown in the figure 1, all the data collected by the node will be transmitted to the Argonne Laboratory data Servers and through the different applications, data portals and dashboards later, this data is open and freely available for researchers, residents, engineers, inventors etc. to construct some data analysis tools and applications.

This raw data will also be available to the City of Chicago’s data network and Plenario. Plenario is web-based portal that supports open data sets and their exploration.

Environmental Sensors will be sensing the entities like pressure, humidity, temperature, sound etc. Air quality and Light Sensors are responsible for the light intensity, surface temperature, traffic, proportion of oxides such as carbon monoxide, nitrogen, hydrogen sulphide’s etc.

Linux Node Controller is there for system health management, image processing and controlling communication between devices.

Node Power Manager is to monitor the health of the system and for resilience functions.

The Argonne Laboratory Servers are there to collect all the data and after some processing it is transmitted to the various open data portals such as Plenario and various applications such as air tracking applications.

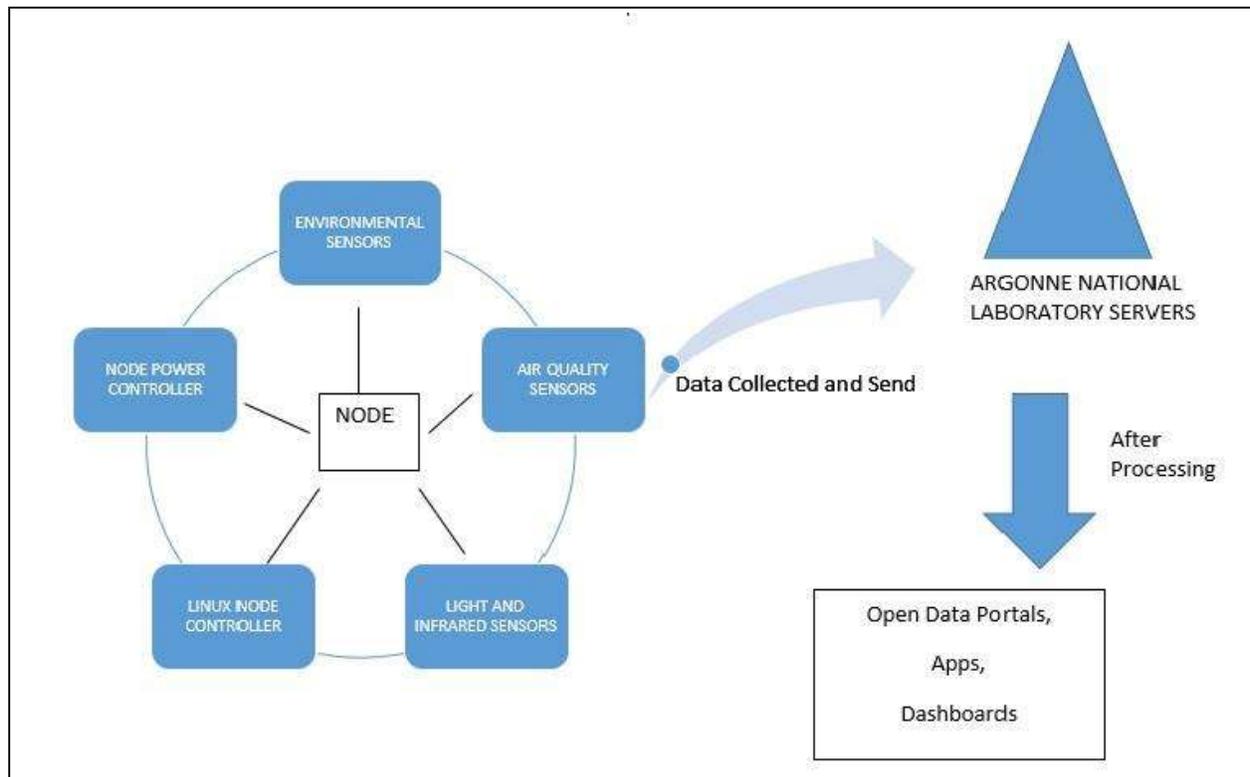


Fig. 1. Architecture of Array of Things.

## VII. MAJOR SPOTLIGHT OF ARRAY OF THINGS

A. *Security and Privacy*: As the data collected by the nodes is freely and openly available therefore, there is need of security and privacy.

In order to maintain the security and privacy there is an external security committee that is chaired by Von Welch and Kevin Moran. Von is the director of Indiana University's Center for Cybersecurity and Kevin is working as the chief technology officer of Chicago.

This committee is also responsible to provide the data on request at anytime from anywhere. The data will always be available after the approval of the security and privacy committee. And there are some terms or policies that will be distributed prior to the installation of the nodes.

B. *Position of Nodes*: There are certain departments that are made to determine the best locations for the nodes. As nodes are the basic entity of the Array of Things therefore they require some more attention or monitoring.

Department of Transportation, Information and Technology, Neighbors, Community members all are responsible for this task in this project.

## VII. CONCLUSION

This project will act as a nervous system for any city and it could make cities a better place to live. As the number of sensors will increase in the city to monitor its health the purveyors investing in this project will also increase. In future, the sensors could also be use in avoiding situations such urban precipitation, standing water, wind etc. This project has an optimistic future in the era of smart cities.

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