



iJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: VI Month of publication: June 2019

DOI: <http://doi.org/10.22214/ijraset.2019.6365>

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How IOT can be used to solve the Problems of Mumbai City

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Abstract – IOT is the acronym for internet of things. IOT in simple terms is a network of internet connected objects able to collect and exchange data. In this survey paper I have tried to figure out the major problems that people of city of Mumbai are facing and put forth an idea on how IOT can be used to solve these problems. In the beginning of the paper I have explained in short what IOT is and I have given details of the technology that is in use currently and how further advancements can be made to scale up to a larger domain. The examples that are given below are already existing, some of which are in use currently and some can be incorporated in reality with some minor advancements. I have made the use of articles, newspapers, existing research papers, and internet to gather information about research work

Index Terms – Mumbai, IOT, Smarty city.

I. INTRODUCTION

The concept of IOT is quite simple, It means taking all the things in the world and connecting them to the internet. Connecting things to the internet provides many amazing benefits. When a device is connected to the internet, it has the ability to send information or receive information or do both the things. The ability to send information and/or receive information makes devices Smart. When the devices are smart, it is an amazing thing.

In the Internet of things, the devices that are connected to the internet fall under the three categories mentioned below:

Devices that collect information and then send it.

Devices that receive the information then act accordingly.

Devices that can do both.[1]

A. Devices that collect Information and then send it

The devices that are used to collect or gather the information from the surroundings are called as sensors. Sensors could be temperature sensor, motion sensor, moisture sensors, proximity sensors, light sensors and many more. The sensors with the help of a medium allows us to collect information from the environment which allows us to take smarter decisions

The use of IOT can be very beneficial in agriculture.

The Farmers can automatically get the information about the soil moisture through the IOT devices and they will have an idea on when exactly the crops need to be watered. Watering the plants too much is an expensive overuse of irrigation systems and also turns out to be environmentally wasteful. Watering the crops to little can cause loss of crops causing huge financial loss to farmers and the environment. Here the soil moisture sensor can be used to collect data about the moisture content of the soil and thus give an idea to the farm owners on when the crops need to be watered.

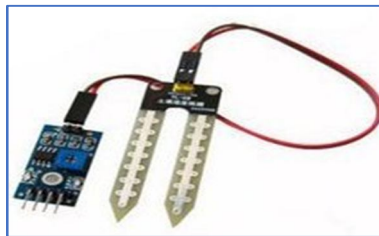


Fig 1: Soil Moisture Sensor

B. Receiving and Acting on Information

We are aware of the devices that act on the information that it receives. The printer prints the document after receiving it through Bluetooth, wifi or in a network. The car receives a signal from the car keys and then the doors open. We have the ability to tell



machines what to do from far away. So we come to know that we have devices that collect information and send the information. We also have devices that receive information and act on the information. This ability gives real power to the Internet Of Things.

C. *Doing Both*

In the farming example given earlier, the sensor can collect information about the soil moisture to tell the farmer how much water the crops need, there can also be a scenario where the farmer is not needed at all. The irrigation system mentioned can also be turned on or off automatically depending on the moisture present in the soil. We can also make further enhancements in this model. If the irrigation system receives information about the weather from its internet connection, we can also come to know when it is going to rain according to the weather forecast and then avoid watering the crops because the crops will be watered by the rains anyways.

Furthermore all this information about the soil moisture, how much the irrigation system is watering the crops, and how well the crops actually grow can be collected and sent to supercomputers that run sophisticated algorithms that can make sense of all this information.

In addition to this other sensors like light, air quality, and temperature, and these algorithms can learn much more. When thousands of farms collect information, algorithms can then be used to give us an insight on how we can make the best crops, to feed the world's population

The above example shows us the use of IOT in general. Specific usage of IOT in terms of solving the problems of the city are given below.

II. PROBLEMS

The major problems that the city faces are as follows:

Traffic Congestion.

Water Management

Waste Management

A. *Traffic Congestion*

The city's vehicular population has grown by leaps and bounds. Over the past five years the number of vehicles has grown from two million to three million. An increase of 50% according to a source. The road length in Mumbai however is around 2000 km and has not changed significantly during the period. Vehicle density has thus increased to approximately 1500 vehicles per km which was 935 between 2011-12 and 2015-16. With the tremendous increase in vehicular population and limited city space, transport experts have demanded betterment of the public transport system and advised citizens to avoid bringing private cars on roads. They fear that the increase in vehicles can lead to more congestion and pollution[2]

In addition to this poor condition of roads and badly planned city layout adds to the traffic congestion.

This is where IOT can prove to be useful in controlling the traffic congestion of the city. Here, the primary idea is about connecting "Things" together so that the city's traffic can get better and effective. For example, by connecting vehicles GPS with traffic cameras, the city's officials (BMC or the traffic police) can have a helpful insight and understanding of how to control and handle traffic efficiently. Also, to make it more productive, a message can be sent to vehicles owners to inform them about the traffic jam present on the route they may be choosing to drive and suggest them to take a different route. The RTO's of Mumbai already have the data of the registered vehicles. SMS alerts, app notifications or email updates can be provided so that the vehicle commuters can avoid the traffic congestion. [3] The result will be a helpful and an efficient traffic experience, a notable reduction in the traffic jam and a secure transportation system

B. *Water Management*

Water management is turning out to be a challenge for the city of Mumbai. The water sources of the city are exposed to plenty of hazards that can contaminate them and make it hazardous for human consumption. Saving water is necessary for a city who has to suffice the needs of around 1.84 crores. Falcon labs a Mumbai based IOT startup has built an ingenious way to track and save water. It makes the use of Data mining technologies and Predictive analytics to detect leaks and track the supply of water. It can also provide information on water consumption patterns in households.[4]

The end-to-end solution of Falcon labs consists of sensors, transmitters and actuators. These devices track water data such as water level, water pressure and flow rate. The gathered information is then uploaded on the cloud. The next step is to process the data,

Numerous data points collected and processed daily are analysed to detect consumption patterns and offer information about water usage for the specific area

This processed data can then be utilized in tracking daily, weekly or monthly water consumption. The demand and supply matching can be done, prior leakages can be detected. The data available can be monitored through mobile and web applications of Falcon labs. This system can also do a live tracking of water levels that is present in tanks and reservoirs. Doing this will help us to develop early warning systems to avert emergency situation and crises if any

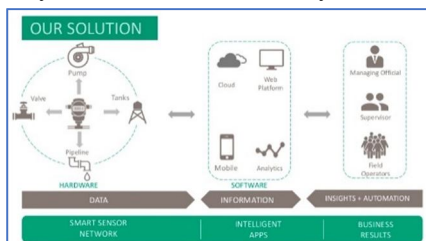


Fig 2: Falcon lab solution

Implementing such kind of methodology in the city can help reduce the city’s water crisis considerably. Systematic and planned effort should be made with the help of IOT to solve the water management problem that the city faces. The municipal corporation and the housing societies should collectively implement this to solve the water crisis of the city.

C. Waste Management

The daily waste generated across Mumbai has increased 105% up to 11,000 tonnes per day (TPD) in 2016 from 5,355 TPD in 1999. [5] Mumbai is also the largest waste generator among 46 cities in India over 17 years, revealed data from EnviStats 2018, a document published by the Central Statistics Office under the Ministry of Statistics and Programme Implementation. With such a huge amount of garbage collected daily and a wide area to be covered Garbage or waste management is turning out to be a problem. The existing method of garbage collection is the garbage truck going around the city twice a day to collect the trash. This method turns out to be inefficient. For eg. A street A is a busy street and we see that the garbage fills up really fast whereas maybe street B even after two days the bin isn't even half full. The garbage truck still has to go to street B to check if the trash can has been filled.

A company named “Technovation”’s has come up with a system that provides a solution to the problem. What the system does is, It gives a real time indicator of the garbage level in a trashcan at any given time. Using that data we can then optimize waste collection routes and ultimately reduce fuel consumption. It allows trash collectors to plan their daily/weekly pick up schedule.[6]



Fig 3: Trashcan’s with distance sensor

The basic working of the model is as follows.

We first need to enter the height of the dustbin. This will help us understand the percentage of the trash in the trashcan and when it needs to be emptied.

There are two criteria’s which needs to be satisfied in order to show that the particular bin needs to be emptied :

- 1) *First Criteria:* The amount of trash in the can, If the bin is half full we don't need to empty it. The threshold is kept to 75%. If the amount of trash if the trashcan goes above 75%, it sends a signal, that the trashcan needs to be emptied.
- 2) *Second Criteria:* The second criteria tracks the duration of the trash in the trashcan and when the trashcan was last emptied.

for eg. If there is just 20% trash in the trashcan and it remains the same for two weeks, then it comes under the second criteria. The reason for this is that even a little amount of trash will start rotting and will emit a bad odour. to avoid this the trashcan need to be emptied after a specific duration. The tolerance level is set for 2 days, so even if a trashcan is less than 75% but it is two days old it then will also need to be emptied.

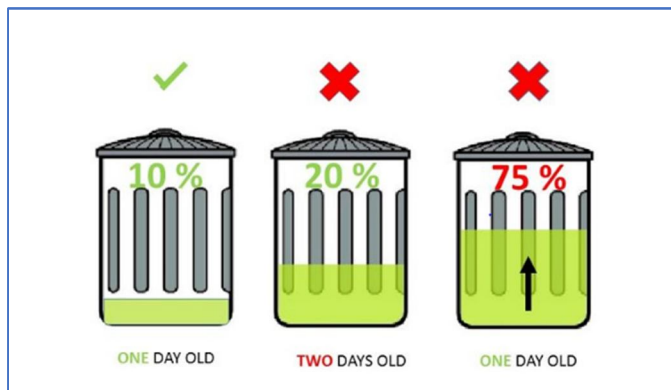


Fig 4: Criteria wise signal sending

The working of the system in terms of technical perspective is as follows:

An ultrasonic sensor also known as a distance sensor will be placed on the interior side of the lid, facing the waste. As trash increases, the distance between the ultrasonic sensor and the trash decreases. The micro-controller then processes the data and through the help of WiFi sends it to an app. The app will visually represent the amount of trash in the bin with a small animation. This process will indicate all the bins which require attention, leading the user to take the most effective route. Implementing this will help the BMC garbage collection trucks to save fuel and effort by avoiding to pick up the trash cans which do not need to be emptied. Cleanliness will also be maintained as trash will be eradicated from time to time. Eradication of trash will also help to reduce the spread of diseases which will lead to a healthier surrounding.

III. CONCLUSION AND LEARNING

From the examples given above we have understood what an IOT is and how it can be used to solve some of the problems that Mumbai faces. Implementing such techniques will turn out to be economically feasible for Mumbai and will also reduce human effort. The examples shown are not a fantasy or science fiction but can be practically implemented. With an annual budget of more than thirty thousand crores, the municipal corporation has the resources to put these ideas into practice. Implementing this will surely make Mumbai cleaner and greener in the near future.

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