Building a Smart City through an of Internet of Things (IoT)

Nisha Mary Lemos[1] Shruti Narayan Nair[2] Sonali Sanjay Yadav[3] Prof. Dr. Vijaya Rahul Pawar[4]
[1,2,3]Student [4]Assistant Professor
[1,2,3,4]Department of Electronics and Telecommunication Engineering
[1,2,3,4]Bharati Vidyapeeth's College of Engineering for Women, Pune-43

Abstract— India with a population of 1.29 billion people ranks the 2nd in the world after China. Over 30% of this populace lives in urban areas and it is expected that by the year 2030 40.76% of the population will be residing in cities. As a result it becomes increasingly necessary to make cities smarter in order to enable the city inhabitants and the governing system to acquire real time data regarding their surroundings supplied through an IoT to make the necessary decisions and act accordingly so as to have a better standard of living as well as plan for the future. The Internet of Things (IoT) enables a system consisting of a group of heterogeneous sensors which can be seamlessly incorporated into the framework of cities and provide real time monitoring to achieve this goal. Environmental monitoring as well as future planning for the city can be aided by observing the results put forth by the system. This paper focuses on the implementation of five aspects including temperature, pollution and noise monitoring along with traffic light control and street light control. The project aims at reducing pollution levels and creating a better, safer and improved environment for city life.

Key words: Smart Cities, Internet of Things (IoT), Cloud Server, Cloud of Things

I. INTRODUCTION

As humanity makes progress in technology in leaps and bounds, the demands made on the health of the people and the environment are often neglected. We are fraught with air, water, light and noise pollution etc which if not checked urgently will result in grievous problems in the future. All across the globe efforts are being made in order to bring this awareness into the picture in order to conserve our nature and its bounties for the sake of the future generations. The production of electricity contributes largely to the pollution levels and it becomes necessary to save as much electricity as is possible. Our system is aimed at trying to control if not reduce the pollution generated in cities.

India ranking second in the world on account of its population is more prone to generate excess pollution and recent statistics show an alarming growth in the pollution levels throughout the country. According to a survey carried out to rank the most polluted cities in the world, 13 of the 20 most polluted cities are in India with Delhi ranking topmost and closely followed by Patna, Gwalior, Raipur and Ahmadabad. Air pollution in Delhi proving hazardous for human health has often made headlines recently. It becomes urgent to take heed and attend to the environment as such. Air pollution is not the only concern in India. Mumbai is the noisiest city in the world followed by Kolkata in the second place and Delhi ranking fourth. Our culture doesn't help the case either with the tremendous amounts of noise and air pollution caused by firecrackers as well as water and light pollution caused due to the different rituals. As a result it becomes glaringly clear that efficient steps need to be taken immediately in order to reduce the pollution being generated. With these views in mind we propose this system which takes into account air, noise and light pollution as well as strives at reducing the effects of global warming and monitoring these levels continuously. We need to work smart and make our cities smarter. Since a large chunk of the population lives in cities and the contribution of cities to pollution is most significant, for this purpose we suggest building a smart city using an Internet of Things (IoT).

The system will involve sensors for temperature, noise, gas, etc. all these sensors along with a microcontroller will constitute one module. These modules will be placed throughout the city at crossroads and crowded areas. All the modules will be Bluetooth enabled. Each area will have a central controller which will be an Android Application Device. All the Bluetooth modules in the area will be connected to these android controllers and many such controllers will be placed around the city. These controllers will send the data over the internet to a cloud server where the values will be stored. Thresholds will be set for the values coming from the sensors and if the incoming values exceed these, a warning will be given. Along with these parameters we will also try to reduce the consumption of electricity within the city by automatically controlling the street lights as well as the traffic lights. We aim at reducing greenhouse gasses emitted by idling vehicles at the signals by controlling the timers for the traffic lights according to the traffic density in the lanes. Street lights will be automatically turned ON/OFF according to the lighting of the surroundings, thus saving electricity. In such a way it will be possible to achieve at least some of the goals set for a safe and flourishing environment.

II. PAST WORK

Jiong Jin, Jayavardhana Gubbi, SlavenMarusic and Marimuthu[1], "An Information Framework for Creating a Smart City through Internet of Things" examines that how Smart city using IoT, which is motivating and strongly demanded from city councils as they seek to ensure the provision of essential services and quality of life for city inhabitants. As technology has advanced, the proper business model of smart city is believed to be equally important in order to push the development forward. In this, it identifies the key IoT building blocks of smart cities, as well as provides the approaches and resolutions to meet their respective communications, computing, and computation requirements".

Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelist and Michele Zorzi[2] "Internet of Things for Smart Cities" surveyed that technologies have reached a level of maturity that allows for the practical realization of IoT solutions and services, starting from field trials that will hopefully help clear the uncertainty that still prevents a massive adoption of the IoT paradigm. The enabling technologies, furthermore, have reached a level of maturity that allows for the practical realization of IoT solutions and

services, starting from field trials that which will help to clear the uncertainty that still prevents a massive adoption of the IoT paradigm.

AnujTiwari, Dr. Kamal Jain [3] "GIS Steering Smart Future for Smart Indian Cities" examines how GIS can improve collaboration in decision making among the three basic components of proposed '3-piller smart city model' and needed in order to create an innovative, prosperous, civic and sustainable Smart Cities. Currently, GIS technology is converging with several other technologies to provide new levels of accessibility and functionality. The current study presents two smart city projects that justify the potential of sustainable development in India. This paper helps to understand the use of GIS and its integration with various approaches to formulate, simulate, a smart city.

Sejal S. Bhagat, Palak S. Shah& Manoj L. [4] "Smart Cities In Context To Urban Development" surveyed that for better connectivity and better access to public information, we can manage cities more effectively, anticipate and solve problems more cost effectively. The enormous challenges facing cities, the size of the opportunity afforded by the focus being given, worldwide, to addressing those challenges by transforming city infrastructures and city systems, and the key actions needed to seize those opportunities.

Riccardo Petrolo, Valeria Loscri, Nathalie [5], "Towards a Smart City based on Cloud of Things" This paper gives details about Cloud computing a valid bridge of the IoT, Internet of people through the Internet of Services. In this paper we presented several IoT platforms that can be efficiently considered in the context of Smart City, but in order to bridge the gap between the different IoT platforms it is necessary to consider a convergence of these platforms and ecosystems. In this paper we envisaged in the Cloud computing a valid bridge of the IoT, Internet of people through the Internet of Services. . The Virtualized Unified Access Interfaces (VUAIs) implements a meta-architecture and migration layer,

III. PROPOSED SYSTEM DESIGN

A. Hardware:

1) Microcontroller:

The microcontroller being used in the system is an ARM based AVR microcontroller- ATMEGA32 which operates on an 8 MHz crystal. It is a 40 pin IC consisting of 5 ports and 32 programmable input/output lines. The microcontroller has an 8-channel, 10-bit ADC and 3 on chip timers. It also consists of 1024 bytes of EEPROM and 2K bytes of internal SRAM.

The various sensors are attached directly to the ADC port of the microcontroller. The ADC converts the analog values from the sensors to digital. The microcontroller then converts these values to ASCII and then forwards them to the next port where the Bluetooth controller is attached.

2) Bluetooth module:

The HC-05 Bluetooth module is used here for communication between the hardware section (microcontroller and sensors) and the android application device. It is a serial port Bluetooth module with an enhanced data rate of 3Mbps modulation complete with a 2.4GHz radio transceiver and baseband which supports a baud rate of 9600. It forwards the ASCII values from the microcontroller to the android application device continuously.

3) Sensors:

- Temperature: A thermistor is used for the purpose of measuring ambient temperature within the city at all times.
- Gas: MQ 5- This sensor is used to detect gasses including H2, LPG, CH4, CO and Alcohol. It has a high sensitivity and a quick response time. A potentiometer can be used to adjust the sensitivity of the device.
- Noise: A mic is used to monitor noise levels
- Light: A simple light diode can be used here.

B. Softwares:

- mikroC PRO for AVR: used for coding the microcontroller in embedded C.
- AVRFLASH: used to burn the program onto the microcontroller.
- NetBeans IDE 7.1: to create the GUI, registration and user login forms for the server.
- Android (Eclipse):design of the APK to be run on the Android application device.
- MySQL: to create the user database.
- Express PCB: to design the PCB layout.

C. Operation:

The logic of the entire system is described here: The Android application device needs to initially connect to all the Bluetooth modules in the vicinity. Each module is allotted a specific Bluetooth id and is paired to the Android Application Device. Via the application, one can check the status of all the sensors as well as the traffic and the street lights. The threshold values for the temperature and noise sensors can be set at the server or the android application device. If the input values are above these threshold values, the controller will be notified. The light sensors are used for streetlight control and turn the lights ON/OFF according to the ambient lighting. For traffic light control, four IR pairs are placed, one at each lane leading towards to crossroad. As a vehicle crosses a pair, one count is registered. According to the count of the vehicles in the lane, the time allotted to each lane is decided. Initially each lane is given 30 seconds of green each. But as the count of vehicles in any one lane increases more than the others, the time of the other lanes is reduced according to the vehicles in each of them and the remaining surplus time is added to the time of the crowded lane. As a result a smart control plan of traffic can be achieved. All the live data received from the sensors is sent to the cloud server via the Internet. In such a way the entire city can be monitored through a mesh created by an Internet of Things.

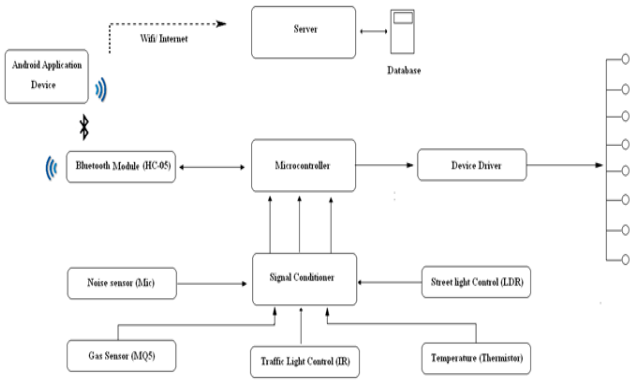

Fig. 1: Operation

IV. FUTURE SCOPE

The system has a vast scope for future expansion including the addition of more parameters to be monitored and controlled. We can include structural health monitoring, waste management, [2] humidity monitoring etc. We can also include various services such for the public to give the control of the city into the hands of the public. In this paper we have considered the IoT platforms as a viable solution to make cities smarter. The different IoT platforms, the various IoT clouds and the several IoT applications and services have resulted in different and heterogeneous IoT ecosystems that introduce a significant degree of fragmentation. In this paper we presented several IoT platforms that can be efficiently considered in the context of Smart City. In this paper we have seen in the Cloud computing a valid bridge of the IoT, Internet of people through the Internet of Services. Several challenges related to the Cloud of Things in smart cities, from technical and privacy view arise: Big Data. The overall IoT data produced by things is growing up fast, becoming really big data. Privacy and Security issues exist for a long time in the computing literature, and many law acts have been published to protect users [6].

More recently, IoT activities are gathering momentum around the world. A city wide smart city tested development is now complete in Spain (Santander) that is laying out a tested for research and service provision. China has established an IoT Center in Shanghai to study technologies and industry standards. A group of 60 telecom operators (key drivers of the technology) have initiated "Sensing China" project. The end goal of smart city IoT platform is to have plug-and- play smart objects that can be deployed in any environment with an interoperable backbone allowing them to blend with other smart objects around them. In order to realize this goal, there are many technological hurdles including architecture, energy ef-ciency, security and privacy, QoS, Cloud computing, data analytics, and GIS-based interpretation. Due to the scale of activities, participation of large companies and the Government will play a pivotal role in the success of this emerging technology.[1].

V. CONCLUSION AND DISCUSSIONS

In this paper, we analyzed the solutions of the increasing pollution and the increasing strength of people in urban cities. The IoT has the potential to add a new dimension to this process by making communications with and among smart objects, thus leading to the vision of ''anytime, anywhere, any media, anything" communications. One vision of the future is that IoT becomes a utility with increased used in sensing, actuation, communications, control, and in creating knowledge from huge amounts of data. The Internet of Things continues to affirm its important position in the context of Information and Communication Technologies and the development of society. The concepts and basic foundations have been elaborated and reached maturity, further efforts are necessary for unleashing the full potential and federating systems and Factors. Smart city concept has a great potential which improves the quality of life by use of Internet of Things paradigm. Deployment of Wireless Sensor Networks would provide huge amount of data on one hand but could add massive and unstructured data management and analysis challenges.

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