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Internet of Things for Smart Cities

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Abstract: *The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of a plethora of digital services. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. In this paper we focus specifically to an urban IoT systems that, while still being quite a broad category, are characterized by their specific application domain. Urban IoTs, in fact, are designed to support the Smart City vision, which aims at exploiting the most advanced communication technologies to support added-value services for the administration of the city and for the citizens.*

Key Words: *Smart Cities, Sensor System Integration, Network Architecture,IOT,Microcontrooler*
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I. INTRODUCTION

A. Concepts

Due to the rapid growth of the population density in urban cities, infrastructure and services are required to provide the necessities of the city residents. On this basis, there is a significant increase for digital devices, e.g. sensors, actuators,and smartphones that drive to huge business potentials for the IoT, since all devices can interconnect and communicate with each other on the Internet . The IoT prototype is subject to smart and self-configuring objects that are connected to each other through a global network infrastructure. IoT is mostly considered as real objects, broadly scattered, with low storage capability and processing capacity, with the target of improving reliability, performance and security of the smart city and its infrastructures.

B. Motivations

Smart cities have become smarter than before thanks to the recent developments of digital technologies. A smart city is equipped with different electronic elements employed by several applications, like street cameras for observation systems, sensors for transportation systems, etc. In addition, this can spread the usage of individual mobile devices. Therefore, by considering the heterogeneous environment, different terms, such as features of objects, contributors, motivations and security rules should be investigated. Some of the main aspects of a smart city are shown in Fig. 1.

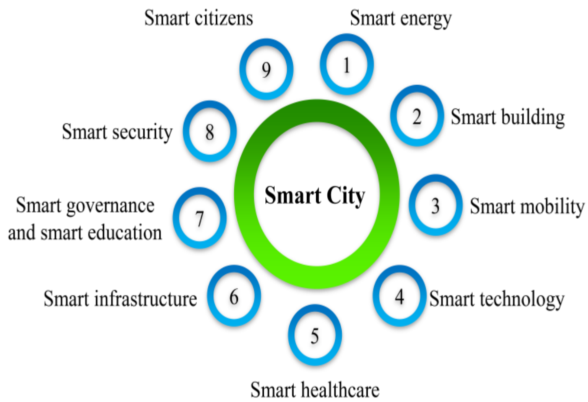

Fig. 1 Main Aspects of Smart City.

Some of the services that might be enabled by an urban IoT paradigm and that are of potential interest in the Smart City context because they can realize the win-win situation of increasing the quality and enhancing the services offered to the citizens while bringing an economical advantage for the city administration in terms of reduction of the operational costs . To better appreciate the level of maturity of the enabling technologies for these services, we report in fig.1 a synoptic view of the services in terms of suggested type(s) of network to be deployed; expected traffic generated by the service; maximum tolerable delay; device powering; and an estimate of the feasibility of each service with currently available technologies. From the figure it clearly emerges that, in general, the practical realization of most of such services is not hindered by technical issues, but rather by the lack of a widely accepted communication and service architecture that can abstract from the specific features of the single technologies and provide harmonized access to the services:

1.Smart lighting

In order to support the 202020 directive, the optimization of the street lighting efficiency is an important feature. In particular, this service can optimize the street lamp intensity according to the time of the day, the weather conditions and the presence of people. In order to properly work, such a service needs to include the street lights into the Smart City infrastructure. It is also possible to exploit the increased number of connected spots to provide WiFi connection to citizens. In addition, a fault detection system will be easily realized on top of the street light controllers.

2. Noise monitoring

Noise can be seen as a form of acoustic pollution as much as carbon oxide (CO) is for air. In that sense, the city authorities have already issued specific laws to reduce the amount of noise in the city centre at specific hours. An urban IoT can offer a noise monitoring service to measure the amount of noise produced at any given hour in the places that adopt the service. Besides building a space-time map of the noise pollution in the area, such a service can also be used to enforce public security, by means of sound detection algorithms that can recognize, for instance, the noise of glass crashes or brawls. This service can hence improve both the quiet of the nights in the city and the confidence of public establishment owners, although the installation of sound detectors or environmental microphones is quite controversial, because of the obvious privacy concerns for this type of monitoring.

3. Traffic Signal System

Nowadays congestion in traffic is a serious issue. The traffic congestion can also be caused by large Red light delays, etc. The delay of respective light is hard coded in the traffic light and it is not dependent on traffic. Therefore for simulating and optimizing traffic control to better accommodate this increasing demand is arises. In this paper the optimization of traffic light controller in a City using microcontroller is done. The system tries to reduce possibilities of traffic jams, caused by traffic lights, to an extent. The microcontroller used in the system is PIC. The system contains IR transmitter and IR receiver which are mounted on the either sides of roads respectively. The IR system gets activated whenever any vehicle passes on road between IR transmitter and IR receiver. Microcontroller controls the IR system and counts number of vehicles passing on road. Microcontroller also store vehicles count in its memory. Based on different vehicles count, the microcontroller takes decision and updates the traffic light delays as a result. The traffic light is situated at a certain distance from the IR system. Thus based on vehicle count, microcontroller defines different ranges for traffic light delays and updates those accordingly. The system records vehicle count in its memory at user predefined recording interval on real time basis. This recorded vehicle count data can be used in future to analyze traffic condition at respective traffic lights connected to the system. For appropriate analysis, the recorded data can be down-loaded to the computer through communication between microcontroller and the computer. Thus administrator on a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent. In future this system can be used to inform people about different places traffic condition.

II.IMPLEMENTATION

1.Smart Lightning

The Smart street light control system adopts a dynamic control methodology. According to the proposed plan, initially when it becomes dark, all the street lights automatically glow .

The existing work is done using HID lamps. Currently, the HID is used for urban street light based on principle of gas discharge, thus the intensity is not controlled by any voltage reduction method as the discharge path is broken. HID lampsare a type of electrical gas discharge lamp which produces light by means of an electric arc between tungsten electrodes housed inside a translucent or transparent fused quartz or fused alumina arc tube. This tube is filled with both gas and metal salts. The gas facilitates the arc's initial strike. Once the arc is started, it heats and evaporates the metal salts forming plasma, which greatly increases the intensity of light produced by the arc and reduces its power consumption. High-intensity discharge lamps are a type of arc lamp.

Proposed System

Since the HID lamps are not cost effective and not reliable, smart street light system has overcome by replacing the HID lamps with LED. Due to automation, power consumption and cost effectiveness in the present field of electronics and electrical related technologies, industry of street lighting systems are growing rapidly and going to complex with rapid growth of industry and cities. To control and maintain complex street lighting system more economically, various street light control systems are developed. These systems are developed to control and reduce energy consumption of a town's public lighting system using different technologies which uses IR motion sensors to detect the vehicle movement after which the street light begins to glow. As the vehicle moves, the street light that was glowing switches off and the following lights begins to glow.

a) Arduino Uno R3

Arduino Uno R3 specifications are ATmega328 microcontroller, operating voltage at 5v, input voltage 7 to 12v, input voltage limit up to 20v, digital I/O pins 14, analog pins 6, DC current 40mA, flash memory 32KB including 0.5KB used by boot loader. SRAM of 2KB, EEPROM of 1KB and clock speed of 16 MHz some of the Features of Arduino UNO are power: can be USB connection or external power supply, with 7 to 12 volts recommended. The Arduino UNO provides power pins for other devices, the variants are 5v 3.3v and vin IOREF pin for optional power. Arduino Uno is a 2KB of SRAM and 1KB of EEPROM (Electrically Erasable Programmable Read Only Memory). There are various input and output pins where 14 of them are digital pins with serial transfer and external interrupts and PWM (Pulse Width Modulation) pins and 6 analog pins. Arduino differs from all the preceding boards which does not use the FTDI USB-to-serial driver chip.

b) Infrared sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor.The emitter is simply an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode. The resistances and these output voltages, change in proportion to the magnitude of the IR light received. Smart Streetlight using IR sensors.

2.Noise Moinitoring

The schematic of the proposed architecture is given in Figure 2. Based on the nature of operation, the data collection step can be divided into two - fixed infrastructure and mobile infrastructure. The mobile infrastructure can include sensors mounted on vehicles, mobile phones and other hand held devices. Due to the nature of collection, the data collection cannot be continuous and the hardware should be capable of higher processing, networking, geographical location and hold its own power supply. They are useful in people centric approaches where the citizens will contribute to city council's policy making. They enrich data collected by fixed infrastructure by filling gaps in spatial data and help citizens in filing noise complaints where fixed infrastructure facilities are not available. They play a major role in measurement of entertainment noise. Apart from not providing continuous measurement, they also lack calibration and comparison of data due to variable hardware employed. Fixed infrastructure in this context is a realization of WSNs in urban monitoring. The proposed architecture is twotiered including high communication, low processing power backbone node and a low communication, high processing power sensing node. The schematic is shown in Figure 3. Node B in Figure 3 is the low power high communication range node. Any number of clusters can be formed away from the base station. These nodes should be capable of mesh networking. With a higher communication range they are the best candidates to form backbone infrastructure. The commercial sound level meter with analog output can be easily interfaced into the analog to digital converter (A/D) on the sensor board. Apart from sensing the data using a sound level meter, they route the data from other nodes to the base station with other environmental parameters. Nodes 1, 2 and 3 in Figure 3 indicate other high powered low communication range nodes which forms the branches and leaves of the network. They have the ability to interface different sensors, aggregate data and other data processing operations. They do not communicate with base station directly but instead route the data to base via the backbone nodes B. The data from the fixed infrastructure and mobile infrastructure are time stamped and stored in a server. The data is then visualized using geospatial maps or on hand held devices as shown in Figure 2.

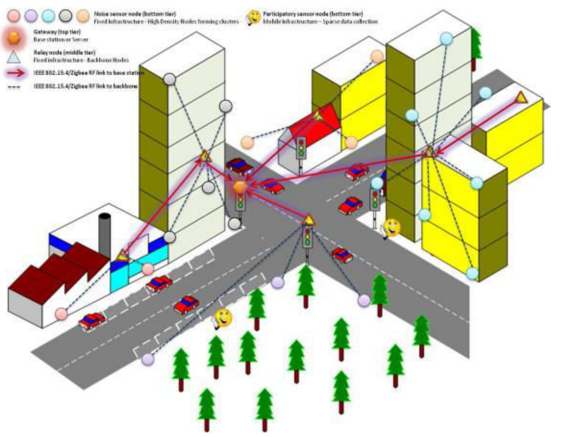

Fig. 2: Architecture of the proposed scheme.

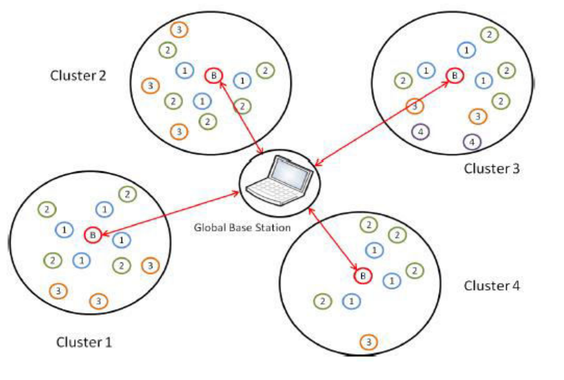

Fig. 3: Block diagram of the proposed scheme.

3.Traffic Signal System

Traffic research has the goal to optimize traffic flow of people and goods. As the number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future. However, some limitations to the usage of intelligent traffic control exist. Avoiding traffic jams for example is thought to be beneficial to both environment and economy, but improved traffic-flow may also lead to an increase in demand. There are several models for traffic simulation. In our research we focus on optimization of traffic light controller in a city using IR sensor and developed visual monitoring using PIC microcontroller. Traffic light optimization is a complex problem. Even for single junctions there might be no obvious optimal solution. With multiple junctions, the problem becomes even more complex, as the state of one light influences the flow of traffic towards many other lights. Another complication is the fact that flow of traffic constantly changes, depending on the time of day, the day of the week, and the time of year. Roadwork and accidents further influence complexity and performance. In this paper, we propose two approaches, the first approach - to take data/input/image from object/ subject / vehicle and in the second approach - to process the input data by Computer and Microcontroller and finally display it on the traffic light signal to control the closed loop system.

Block Diagram

IR transmitter and receiver will be placed on either side of the road at some distance from the traffic signal.IR Rays passes between the transmitter and receiver continuously. Whenever a vehicle passes between the transmitter and receiver, it blocks the IR rays to pass from transmitter to receiver. So whenever a vehicle blocks the IR rays, the IR sensor consider it as count and it also increments the count value for each vehicle entry. The IR sensor senses the density of the traffic for a regular interval of time in this manner and sends the information to the PIC. The count in the traffic signal can be adjusted by the controller based on the density of traffic received from IR sensor. Then the count is displayed in the seven segment display and decremented till zero and this above procedure continues for regular intervals of time.

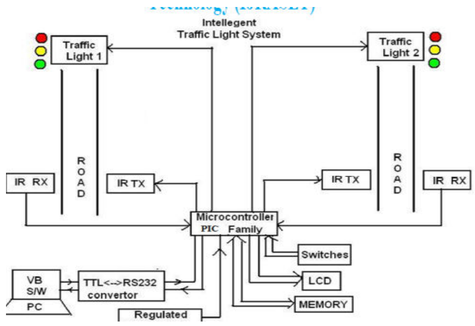

Fig 4. Block diagram of the System

III CONCLUSIONS

In this paper we analyzed the solutions currently available for the implementation of urban IoTs. The discussed technologies are close to being standardized, and industry players are already active in the production of devices that take advantage of these technologies to enable the applications of interest.In fact, while the range of design options for IoT systems is rather wide,the set of open and standardized protocols is significantly smaller. 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 will hopefully help clear the uncertainty that still prevents a massive adoption of the IoT paradigm.

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