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Internet Protocol Address Assignment in Internet of Things for Smart City Development

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Abstract

It has always been interesting to know how to assign Internet Protocol (IP) address to the sensors inherent in Internet of Things (IOT) for smart city. Though there are no such protocols or rules to allocate IP address it is evident that sensors needs IP to connect it to the server or cloud. Nowadays the concept of IPV6 is emerging, feeling that IP address in IPV4 is insufficient for each and every sensors present in the network. This paper aims to eliminate the confusion regarding the number of available addresses and its efficient usage. This research was carried out using a pair of ultrasonic sensors and these sensors were connected to the microcontroller and to the Ethernet port; eventually the sensor was connected to the router and the connection made available over the internet. The IP address is provided by the microcontroller for each sensor just to connect it to the router and to identify this sensor in the internet applications unique identification number can again be assigned; this task is also accomplished by programming or writing some lines of code in the microcontroller. The experiment conducted became successful to assign the IP address to each sensor and later the IP address was allotted a unique ID so that the address does not get mismatched in the internet or network. The findings of the real time experiment shows that for general applications of IOT the addresses provided by IPV4 is sufficient but when the adequate or extremely high number of sensors are connected in a LAN then there might be a problem but the probability of occurrence of this case is very rare.

Keywords: *Internet of Things, Internet Protocol, Local Area Network, Wide Area Network, Framework.*

1. INTRODUCTION

The The Internet of Things (IoT) is all about smart machine-to-machine (M2M) interconnection technology enabled by secure connectivity and appropriate infrastructure, to reliably transform data into useful information for people, businesses, and institutions with appropriate analytics based on the data [1] The appropriate infrastructure could be a hybrid compute and store mechanisms like cloud stack and Big Data technologies. Internet of Things also refers to the rapidly growing network of connected objects that are able to collect and exchange data using embedded sensors [2]. Thermostats, cars, lights, refrigerators, ultrasounds and more appliances can all be connected to the IoT. Smart cities provide a more efficient and higher quality lifestyle for their residents, and the methods they use to reach these goals (Thompson, 2016). Today computers and, therefore, the internet are almost wholly dependent on human beings for information. Nearly all of the roughly 50 petabytes (a petabyte is 1,024 terabytes) of data available on the internet were first

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captured and created by human beings by typing, pressing a record button, taking a digital picture or scanning a bar code [3].

The problem is, people have limited time, attention and accuracy all of which means they are not very good at capturing data about things in the real world. If we had computers that knew everything there was to know about things using data they gathered without any help from us. We would be able to track and count everything and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling and whether they were fresh or past their best [4].

IPv6's huge increase in address space is an important factor in the development of the Internet of Things. According to Leibson, 2015, who identifies himself as "occasional docent at the Computer History Museum," the address space expansion means that we could "assign an IPV6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths." In other words, humans could easily assign an IP address to every "thing" on the planet. An increase in the number of smart nodes, as well as the amount of upstream data the nodes generate, is expected to raise new concerns about data privacy, data sovereignty and security [5-6].

2. METHODOLOGY

The experimental setup as shown in figure 1 was done for assigning IP address to the standalone ultrasonic sensors. This research experiment aimed to develop automatic system to fill and store the water in home using ultrasound technology. The optical fiber has been used for communication between upper and lower tanks. Raspberry-Pi will be used for networking, and controlling the sensors. Trial versions of cloud computing has been taken to store the data in the cloud. The figure below shows the experimental setup of research. Two IP addresses were assigned to the sensors; 192.168.1.102 and 192.168.1.104. The IP was assigned to the sensors by using the router and microcontroller and Ethernet port available in the raspberry pi. Circuit as shown in figure 1 was used for converting the analog sine wave to square wave. This step was essential for easing the ADC and the controller to perform their task efficiently.

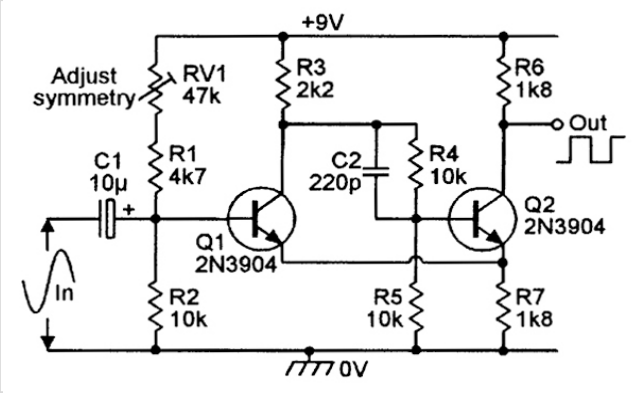

Figure 1. Circuit for converting sine wave to square wave.

The resonating frequencies of the ultrasonic sensors were 41 KHZ. The analog output obtained from the sensors was converted to digital by using the Analog to Digital converter, so that the digital output was easily understandable by the microcontroller. This made the processing of data easy and the communication between these sensors was based on the data.

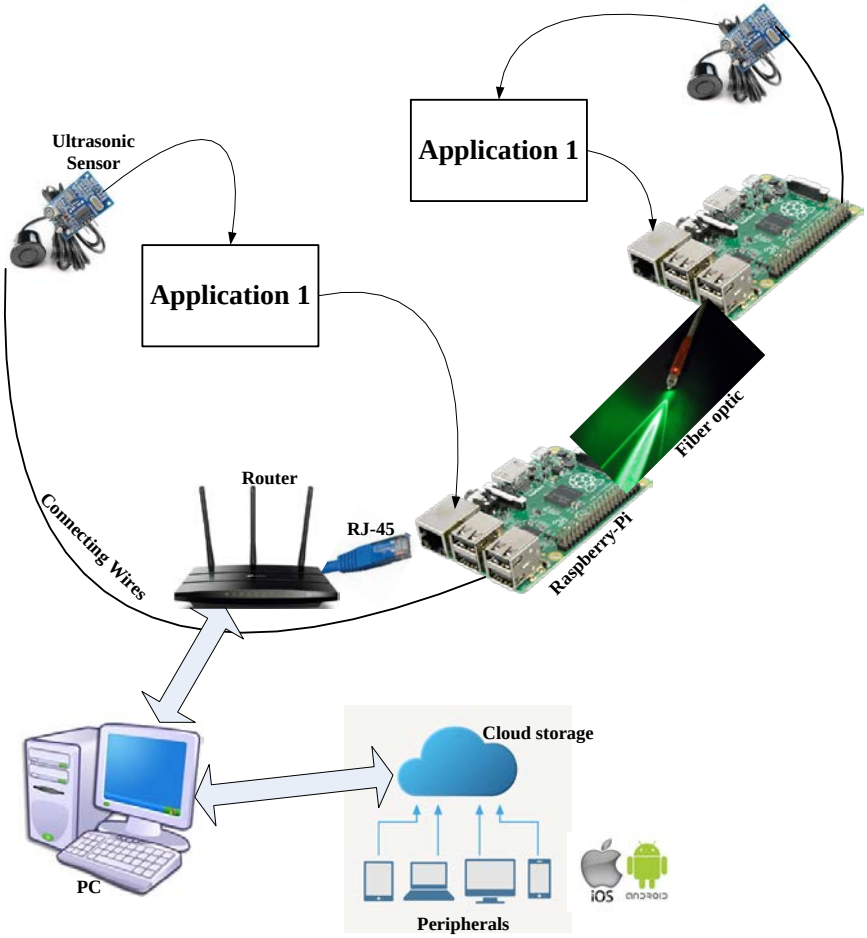

Figure 2. Experimental setup for IP assignment and communication of sensors.

IP address: 192.168.1.102


```
from ultraSonic import *
host='192.168.1.102'; #put ip of client here
port=12345;
```

Figure 3. IP assignment to master.

IP address: 192.168.1.104


```
from ultraSonic import *
host='192.168.1.104'; #put ip of server here
port=12345;
```

Figure 4. IP assignment to master.

In the slave side we can write following couple of code to assign IP address in the microcontroller (Figure 3) and similarly, in the Master side we can write the following couple of code to assign IP address in the microcontroller (Figure 4).

The IP address in both the master and slave differs but the port for both of them should be identical. This protocol should be followed for non-erroneous communication. The IP address assigned to the module is just limited to the single system. From then the system is understood by the unique ID provided in the system which is transmitted to the network and the database is designed being based on the individual identification number.

3. RESULT

Being based on the experiment, it has been found that IP address can be assigned to the objects / sensors so that IOT can be pronounced and the benefits of network computing can be reaped out. This in turn helps a lot in development of smart city. The total numbers of IP address available are identical to the number of sensors that is to be interfaced with the system. The following table illustrates the number of sensors that can be interfaced in IPV4 system.

Table 1. The number of sensors that can be interfaced within a system

S.N	IP class	Available address	Number of sensors
1	C	$2^8 - 2 = 126\ addresses$	126
2	B	$2^{16} - 2 = 65534\ addresses$	65534
3	A	$2^{24} - 2 = 16777214\ addresses$	16777214

4. LIMITATIONS AND FUTURE ENHANCEMENT

The experiment conducted for this research was not exhaustive. However, maximum possibility of assigning the IP addresses has been done to ensure efficient communication between the sensors. It had not been feasible to interface huge number of sensors for the deployment of IOT; it is therefore this study is just based on interfacing two sensors for demonstrating how IOT works and more specifically focused on assigning the IP address to the sensor. The experiment had been constrained to local area network to fulfill the only address assignment purpose to the sensors. This study can be carried out in the internet based environment for enhanced view of IOT and get some meaningful insights in developing smart city.

4. CONCLUSION

It is always interesting to assign IP address to any objects underlying in the nature but assigning the address in the digital system requires a prior knowledge of networking. Being based on the concepts of IPV4 protocol 16842874 numbers of sensors can be interfaced in a single system for implementing IOT. These relations are vital for implementing smart city. Being based on any system architecture the IP address can be assigned, the Ethernet protocol should also be followed by the microcontroller to assigning IP address to the object. IPV4 caters to interfacing a very large number of sensors within a single system. It is therefore the buzz of saying without the deployment of IPV6, IOT cannot be implemented is worthless. It’s not only IP address but unique

identification number should also be associated with the object for several security issues to unauthorized hacking of the system. In a nutshell the address assigned to the sensors play an important role for making them work in efficient manner. The efficient workings of the sensors contribute to deployment of IOT. The essence of IOT is it helps in automatizing any system and develop smart city which improves the lifestyles of the residents.

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