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Building Automation (IoT) by WSN

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ABSTRACT

The idea for the development of this study is to interconnect smart devices wireless communication systems and applying IOT technologies to smart building automation as introduced. Based on Wireless Sensor Network (WSN), this proposed prototype architecture can be integrated into the system through uniform interface with two technologies viz. ZigBee and Wi-Fi. In this paper the interfacing technology whichis used in between the sensors and server is ZigBee whereas Wi-Fi is used between client and server. WSN will provide a flexible management of sensing nodes according to the user requirement anywhere and anytime using android device in the smart building.

Key Words: *Zigbee, Wi-Fi, IoT, WSN.*

1. Introduction

The goal of this study is to develop building automation system using Wireless Sensor Network (ZigBee) technology on the basis of Internet of Things (IoT). This connection will be, through the use of the exclusive Internet protocol address that permits things for communicating with one another without human intervention. This is an attempt to merge the physical world and information world thus entering in a new era of omnipresence; perhaps we are entering in the era of Internet of Things in which new forms of communication are possible between human and things a [1].

1.1 Wireless Sensor Networks Used

Wireless Sensor Networks are being gradually introduced in various application scenarios. Zig Bee is widely used transceiver standard in wireless sensor networks. WSN provides flexible management of sensing nodes using Zig Bee with its specifications
[2].

2. Background

In recent years, Internet of things (IoT) has advanced and has emerged as a new technology revolution. It is applied in many areas since it is composed of many existing technologies [3].

“It is globally accepted that future internet will not only connect people and data but also all objects”. This means the majority of the traffic will flow between objects as a consequence of building Internet of Things (IoT).

2.2 Previous Research

The perception of Internet of things (IoT) was first suggested by Auto-ID Centre in 1999 as the EPC (Electronic Product Code) system, which set a symbol or guideline for earlier Internet of Things [4].

2.2.1. IoT Business Operation Support Platform:

Qian et al proposed Business Operation Support Platform (BOSP) for IoT management in business.
There are four interfaces in Qian’s design:

a. The Data Interface: it will receive IP packets and forward them to destination
b. The Application Interface: it will provide functions to support application systems
c. The existing abilities entrance: it makes carriers existing abilities work directly
d. The existing BSS/OSS interface: it is used to achieve accounting functions.

2.2.2 The Sensing China:

Chinese Premier WEN Jiabaoin Aug, 2009, introduced a new idea of "sensing China". The internet of things (IOT) which has become the national strategy of China since then. Later on, Secretary of Beijing Municipal Government LIU Qi, introduced the concept of "sensing Beijing" for new industrial motivation of Beijing development. Furthermore, GUO Jinlong, Mayor of Beijing Municipal Government in January 2010, officially remarked that "IOT construction in Beijing should start from the city's security and emergency management applications" [5].

2.2.3 IoT & Environmental Management in South Africa:

In 2012, [6] has identified the Internet of things (IoT)'s potential in the application of environmental management. According to the research following are the sectors in which IoT technology can be beneficial in South Africa's Environmental management [6]:

a. Protection and quality of Environment
b. Management of Natural resource.
c. Management of oceans and coastal climate change mitigation.
d. Management of biodiversity.

2.2.4. Smart Reverse Supply Chain:

The SRSC has the following characteristics:

a. The system can record real-time information by the help of RFID tags.
b. It can enhance the efficiency of the closed-loop management of supply chain. Due to increasingly intelligent network systems, administration will be less dependent on staff.

c. In addition, real-time monitoring will possibly reduce storage cost and enhance transportation process. By the help of such information system the supply chain management will be more visible through IoT implementation.
d. In short, the problems caused by the complexity and randomness of reverse supply chain [7], will effectively be solved by SRSC.

From above discussed research methodologies, it is evident that the Internet of Things (IoT) is the most rapidly growing technology; many countries have been adopting it, among which China is playing a lead role.

3. Proposed Model

The Internet of Things (IoT) has two main wireless technologies. One is Wireless sensor network (WSN) and the second is RFID (Radio Frequency Identification) both have a wide variety of applications and thus provide unlimited future potentials. RFID is used for the detection, presence and location of objects while WSN is used to sense and monitor the objects [8].

Since the internet of things (IoT) is a vast composition of many technologies, we are focusing on controlling and monitoring objects via Wi-Fi with Wireless Sensor Networks kit, android phone and computer or laptop.

Our proposed model includes an android phone as client, computer or laptop as server. The server is connected to WSN kit.

The wireless sensor network (WSN) is composed of a group of sensing nodes which carry data or information via any wireless network. This wireless network can be ZigBee or Wi-Fi for example.

WSN kit’s main board is connected serially with server and it broadcasts the commands to different wireless sensing nodes wirelessly via ZigBee.

In our model we have used three sensing nodes, namely, temperature sensing node, water level sensing node and light sensing node. Fig. 1 shows design network block diagram.

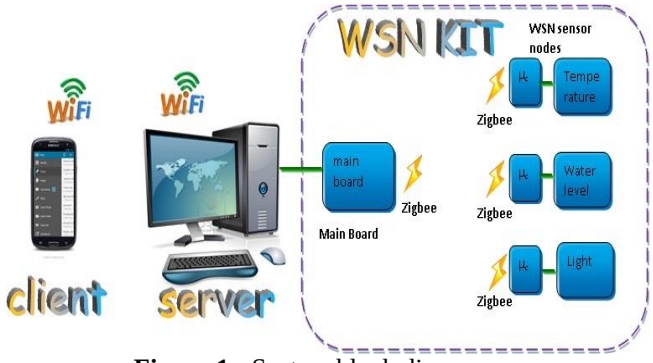

Figure 1: System block diagram

3.1 Justification of Using Wi-Fi as a Wireless Network (Computer and Android)

The wireless medium between the server (computer) and the android phone (client) is Wi-Fi because the user can access information of any object at any time via Wi-Fi from the server, as shown in Figure 2. No matter where he is, how far he is from home or business, if he has an Android set and a connection to the wireless then he can retrieve the information from the server regarding the intact sensing node and he can also change the required temperature or water level as per requirement at any time.

Figure 2: Client and Server

3.2. Justification of Using Android Phone

Android is becoming the standard operating system of IoT because all the devices ranging from every screen variation, mobile chips and all the sensors known to

man haves been tuned to work with Android. Some key advantages of using android are:

a. The user interface of Android is based on direct manipulation, using touch inputs that loosely correspond to real-world actions.
b. It is an easy to carry the device and makes it stress-free to monitor things even remotely.
c. If we just stick to the computer for monitoring purposes, then it would be a limited resource as we cannot carry it everywhere.

According to the previous research analysis it makes clear the vision of how the android phone works better for this nature of interacting services dealing for connection of the virtual world to the physical world. Below is an example of IoT pre-android and android IoT as shown in Fig. 3 [9]:

Figure3: Pre-Android and Android IoT

3.3. Justifications of Using ZigBee

ZigBee over IEEE 802.15.4 defines specifications for low data rate to support low power monitoring and controlling devices. The advantage of using ZigBee over other RF technologies is that it uses very little power[10].

Following are the main reasons, explained by table 1:

a. ZigBee as typical network joining time is 3msec therefore it is perfect for getting real time data of each sensing node as well as it's very easy to add or remove nodes from the network.
b. It is less complex than other wireless networks. Another reason is cost: ZigBee is less costly than Wi-Fi and Bluetooth.

We are using ZigBee in WSN kits because in spite of all these advantages and shorter range, it perfectly satisfies our project's requirements.

Table 1: Comparison between Wireless Technologies

STANDARDS	BLUETOOTH	WI-FI	ZIGBEE
COVERAGE	Low(10m)	Medium(100m)	High(km)
COMPLEXITY	Medium complex	High complex (user increase)	Simple
SECURITY	Less secure	Medium secure	More secure
COST	Less expensive	Highly expensive	Least expensive
TIME FOR NETWORK COMMUNICATION	Low (10 seconds)	Medium (30 seconds)	High (30 mili-seconds)

4. Methodology

A WSN generally consists of a host or "gateway" that communicates with a number of wireless sensors nodes. Wireless sensor node will collect the data then, it will compress it, and transmit to the gateway directly or, if required, use other wireless sensor nodes to forward data to the gateway. Thus the data is input into the system which is ensured by the gateway.

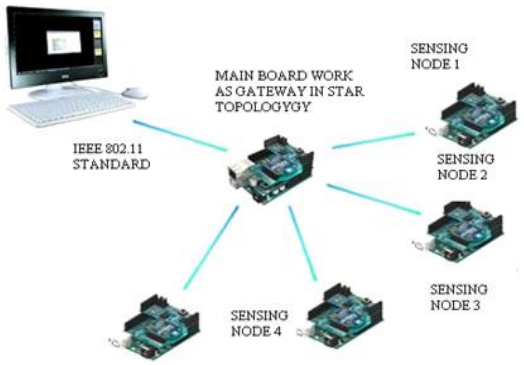

Figure 4: WSN as star network topology

The figure 4 evaluates the best suitable topology for assigning our project goals. In this simplest star topology, the sensor nodes connect directly to the gateways, and gateway autonomously connects to the server. While through server the signal is transmitted to the client as required.

4.1.WSN kit

For monitoring and recording the physical conditions of the environment and organizing the collected data at a central location, WSN kit comprises of a group of spatially dispersed and dedicated sensors and providing it to server as shows in figure 5.
On-board are 3 nodes for gathering data (related readings) from surroundings:

a. Temperature (with externally connected fan)
b. Light (with externally connected light source)
c. Water-Level (with externally connected pump motor)

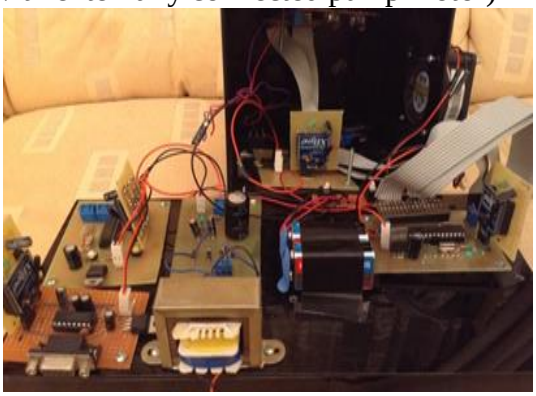

Figure 5: WSN kit

4.2.Eclipse IDE software used as client coding

Eclipse is a Java-based open source platform that lets one quickly set up new Android projects, create an application UI, add components based on the Android Framework API, debug your applications using the Android SDK tools, and even export signed (or unsigned) .apk files in order to distribute your application.Java is for creating complete applications that may run on a single computer or be distributed among servers and clients in a network or build applet for use as part of a web page.

4.3.GUI design of Our Android application

The GUI design of android application is highlighted in figure6 that create an .xml that is further used to create .apk file application for Android phone

which enables us to get the status of temperature, water-level and light power and also controls each of these environmental factors by setting up the desired values through the application on android phone.

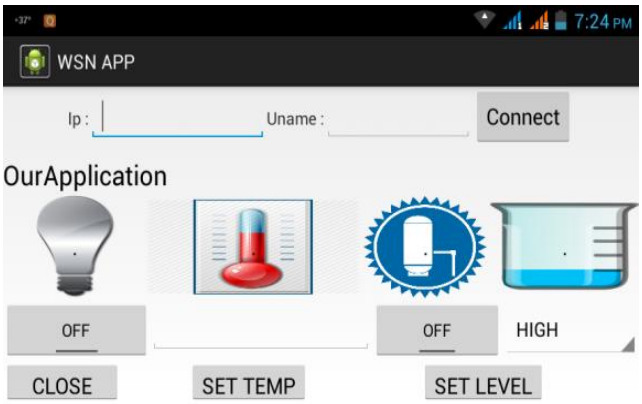

Figure 6: Android device screen view for sensing nodes

4.4.Android development tools (ADT) environment used for android application

Android Development Tools (ADT) is a plug-in for the Eclipse IDE that is designed to gives a powerful, integrated environment in which to build Android application. The Android application used is Eclipse which integrates its AVD Manager virtual device management into the tool as well. The AVD Manager is an easy to connect with user interface to manage your AVD (Android Virtual Device) configurations. The application design by ADT software mentioned an in figure7.

Figure7: Programming on Eclipse IDE with Java

5. Conclusion

This study has shown that how the “Internet of Things (IoT) is an incorporated part of upcoming Internet and could be defined as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘things’ are interconnected in the network”.
In the present paper, IoT basis, ‘things’ are made to become active so that they can interact and communicate among themselves as well as with the environment by “sensed”, and exchanging data and information, while reacting autonomously to the ‘real/physical world’ events. “Interfaces in the form of services facilitate interactions with these ‘smart things’ over the Internet, change their status by taking into account of security and privacy issues by accessed client”.

6. Future Enhancement FU

Advancement rarely comes where it is predictable. However, in the foreseeable future, home industries with all the appliances they contain, including electricity, gas and water meters, street lights, sprinklers, bathroom scales even walls will be connected to the IoT. In the future, several innovations will be added to these appliances such as not heating the house if hot weather is forecast, watering garden automatically only if it doesn't rain, getting assistance immediately on the road, and so on. These improvements will smoothen the abundantly, and add a new dimension of progress to our lives, by utilizing natural resources more resourcefully and creatively.

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