

# Wireless Home Network in Smart Home Control by using IBoard & Android design

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**Abstract:** The daily life of the denizens form the manner in everyday life, there are important things smart home. These manners can be used to manner the resident is useful to improve the service for the smart home services that can be used as energy-efficient operation resides in order to reduce the unnecessary and the lighting device using the identified activities based on the activity of their actions. In recognition accuracy possible process automation Smart Home is important to put things in a certain activity, but service needs a lot of challenges in diversity and complexity of the real world because of awareness activities .By using wireless sensor networks and many of the RF technology, the Internet Things (IOT) application got full methods to get development of intelligent control to a home system . This work focuses mainly on the use of fewer devices with high efficiency and competitive price through the use of the IBoard and the XBee with the interface work through the application of Android smart phone .

**Keywords:** ZigBee, Smart Home, Home Automation, Android Smartphone.

## I. INTRODUCTION

In an increasingly automated world, and his ex-gained more attention to home automation the world's families. Many industrial plants .Smart Home is applied in order to provide comfort, energy efficiency and better security. Smart Home System is still rarely used in Indonesia because of the cost and the difficulty of getting the device. The objective of this paper is to offer a Small Smart Home System designed and created by utilizing WLAN network based on Arduino microcontroller. The system is able to monitor and control lights, room temperature , alarms and other household appliances. Results from testing the system show proper control and control monitoring functions can be performed from a device connected to a network that supports HTML5. [1] Smart home must have an ability to separate the distinction between activities conducted by inhabitant and activities conducted by non-inhabitants.[2] Smart Home (SH) promises the potentials for the user to measure home conditions (e.g., humidity, temperature, luminosity, etc.), manipulate home HVAC (heating, ventilation and air conditioning) appliances and control their status with minimum user's intervention.[3] The system consists of three parts include user intelligent control terminal, embedded home gateway and home ZigBee wireless network.[4] A home automation system, which provides two alternative user friendly interfaces, an Android application and a web application, is presented. The system is built to serve multiple users, using up-to-date and emerging technologies, such as Google Cloud Platform, in order to support the communication between the main hardware components of the system.[5] More recently, we have witnessed a new wave of developments in open-source hardware/software, standardization, and commercialization of wireless sensor network technologies. The IEEE 802.15.4 standard specifies the physical and medium access control layers for low data-rate wireless personal area networks9. ZigBee is a low-cost, low power, wireless mesh networking standard built

upon 802.15.410. The 802.15.4 RF transceivers and ZigBee protocol stacks are now available as commercial-off-the-shelf (COTS) modules for rapid prototyping of wireless sensing and actuation systems.

For example, the Digi XBee series OEM modules implement the IEEE 802.15.4 radio and ZigBee networking protocol11 and have become very popular in application system development.[6] Automation and network of families and individuals occupied physical limitations is IBOARD Ethernet shield, and it was the smart micro web server home. Arduino electronics prototyping platform open source based on flexible, easy hardware and software to use. The Arduino micro controller board based on the IBOARD with pins analogy digital I / O. The Arduino Ethernet interface is via the SPI pins. Low voltage - switching Relays were used to integrate devices to show Arduino is switching function. The LM35 temperature and lighting sensors are used to control a smart home environment.

## II. RELATED WORK

Electricity is becoming increasingly important in modern Live. Today is a chain reaction, with serious consequences can be in case of interruption, produced for example, a power outage Impact on the banking system Management, Communication, Transport and security. For sustainable growth must be guaranteed in the future, people need a new type of Power grid . This technology is not only built by the current Architecture platform can handle the bit signal of the modern digital device, but it is also capable of automatic control, monitoring and manage the complexity of the electrical system and the growing demand for electricity.

One of the major important developments and technologies in the energy system It is the intelligent network must be indented.[7]

The research focuses on more efficient and Appliances effective methods to plan purposes. Main objectives include reducing the Customer's electricity bill and peak average ratio Power distribution system. This is also known as demand Side management from the perspective of the energy system As it is shown in Figure 1, a residential home intelligent system It consists of various household appliances such as washing Machine, dishwasher, heating, and smart meters. The Devices can be divided into three types. Appliances background first category is such such as refrigerators. They are working day adjusted together long and it cannot be controlled. The second category is deliberately Appliances such as televisions. They are controlled by Customers will. For example, I want to see if the client TV, he / she wants to start it, regardless of the monetary costs and Energy efficient. The third category is the predictable budget Devices such as washing machines and dishwashers. This devices can be controlled automatically by the intelligent controller.[8]

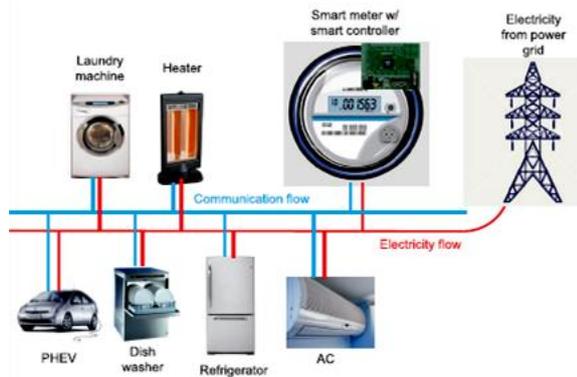


Figure 1. Smart home for a single user

### A. Zigbee Protocol

Zigbee is used one of the more communication standard in Wireless Personal Area Network, which defines the network It provides a framework layer and application layer.

A Zigbee Network of three types of nodes composed:

- Zigbee coordinator: is the root of the network . there are only one coordinator is selected in each network, a personal Identification network (PAN ID) and stores information about the Network as a network administrator and Trust Centre.
- ZigBee Router: can act as an intermediate router forwarding Generates the data of another node or device.

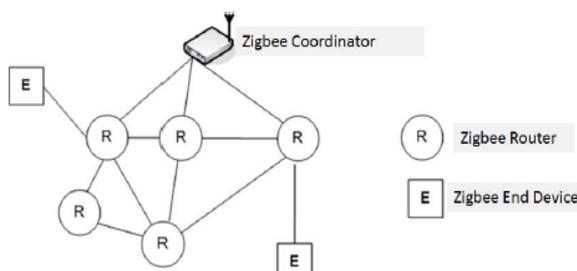


Figure2. Zigbee Mesh network

- ZigBee End Device: can interact only with your direct Father (a router or coordinator) and cannot forward packets Other devices. This type of device can asleep Time, leading to a battery life. The Zigbee standard defines two main typologies:

- *Tree topology*: use a hierarchical organization to construct the network and forward packets from leafs (end devices) to the coordinator.
- *Mesh network*: each device is allowed to contact any other device directly or using *Zigbee Routers* in order to construct a route from one node to another on demand.

In Figure. 2 we can see a typical Zigbee mesh network configuration. As already underlined, in mesh networks *Zigbee Routers* construct a route to the destination on demand conferring a better dynamism to the network; Zigbee specification defines a modified AODV protocol to find the best route. [9]

### B. Service Framework Design

The smart home service framework provides hierarchical integration and management for users based on IOT: on the lower layer has the frame to connect the equipment IOT (wireless sensors, wireless actuators, etc.) And not intelligent device to form the basic sensing network, so that for communication with external devices. Therefore, we have to provide the external system with smart home gateway includes key technologies such as heterogeneous devices integration, play and plug, check the family safe to have and reliable communication with external world by individual smart home gateway. The middle layer has to reliably offer message (data, commands) transmission mechanism. On the top layer, the user can completely dominate the real-time and historical information for the whole family by accessing platform through web, android, etc., which will depend on his my use habit. As shown in the above description, smart home service framework has not only the most basic three features of IOT (total detection, reliable transmission and intelligent processing), but also meets the individual needs of the user. Thus, we propose a service framework oriented which smart home area. Its structure is shown in to figure 3.[10]

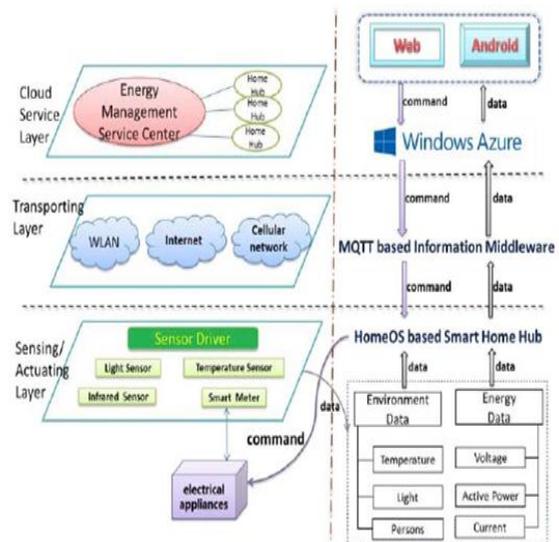


Figure.4 Structure Of Smart Home Service Framework

**C. Smart Home Energy Management System**

To the efforts of the role of support last consumers in smart grid functions, research at the institute for power and applied electrical engineering from Slovak technical university in Bratislava are a smart home energy development system (SHEMS). The conceptual architecture of SHEMS is shown on the following figure. 5.

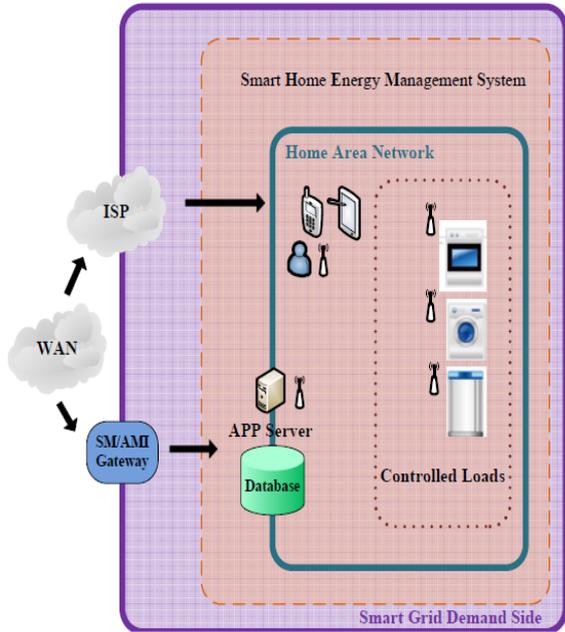


Figure.5 Smart Home Energy Management System

The aim of the research on SHEMS is to provide to the final consumer the data from smart meter throughout the local interface of smart meter (IEC 62056-21 Electricity metering – data Exchange for meter reading, tariff and load control.[11]

Smart Home to help disabled people in their everyday life. In addition to the aspects that form such a space, including the importance of artificial intelligence through the benefits and progress it can make in such a domain. In the near future, we are planning to further develop the prototype and make it much closer to the theoretical system we designed.[12]

A local home service manager and a mobile unit based user interface on the Android mobile equipped with a Google Speech® ASR, that allows speech recognition and exchanges information with the Software “*Portable Interface and Local Service manager*” (PILSM) in order to perform the required tasks. After interpretation of each user request, it is sent through a router over the Ethernet to the Home Controller (Arduino) and this will execute the requested operation through the relay shield module in figure 6. The operation confirmation message provided by the Arduino will be voice synthesized by means of the SVOX® TTS for Android software and it can also be read as text on the Smartphone screen. In this application, the screen virtual buttons and the speech will play a key role in this process.[13] The local control is an Arduino with Ethernet module as mentioned above, that receives the request operation from PILSM through the Web by a

router and controls a relay shield module in order to switch devices off and on; it also collects the indoor and outdoor temperatures, if requested[13]

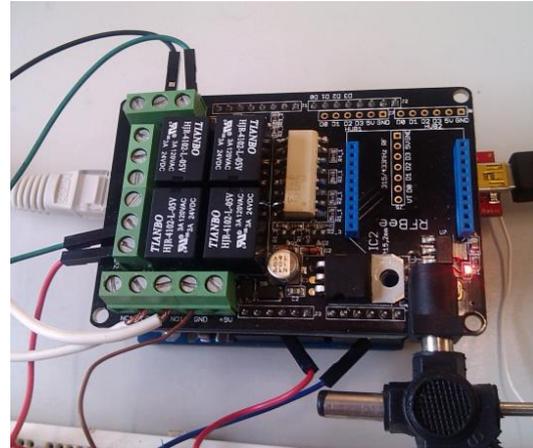


Figure 6 Arduino with Ethernet connection + Relay Seedstudio Module

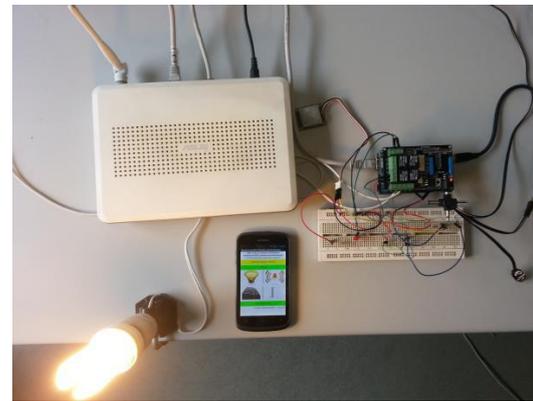


Figure7. PILSM system

In spite of that the PILSM presents advantages over other platforms because it uses Arduino as a controller (cheaper than local servers and notebooks), it does not require a server to manage and store information and it provides a control device environment by speech which increase the usability and the intelligibility of an interface.[13]

An integrated Xbee Arduino and differential evolution localization algorithm for wireless sensor networks localization problem is introduced in this paper. This algorithm is range based and distributed, so it is much suitable for resource constraint wireless sensor network. The multi hop communication for location information is reduced, which increases the lifetime and reliability of wireless sensor networks. The algorithm is simple to implement and uses less control variables. The performance and accuracy can be further improved by reducing RSSI error by proper design and placement of sensor nodes. Further a hybrid algorithm may give better estimate of location information.[14]

**III. DESIGN AND IMPLEMENTATION OF SMART HOME**

Smart home system basically consists of three parts: ZigBee wireless home network, built-in intelligence

Gateway and external network. wireless home network is a wireless LAN that includes multiple nodes and terminals Coordinator node. Depending on the application, ZigBee Terminating node can be divided into three categories: Acquisition nodes, security and control node. House intelligent door entry receives query or control of information from a network via the Web server remotely, the It is processed and transmitted ZigBee coordinator, then The coordinator sends the information from the ZigBee end nodes, according to the direction Information to monitor current and to control Devices and sensor information. Of course, in addition to automatically controlled by the door as intelligent link Environmental information collected by the sensors, users can Control and electrical switchgear on site by smart phone Android application.

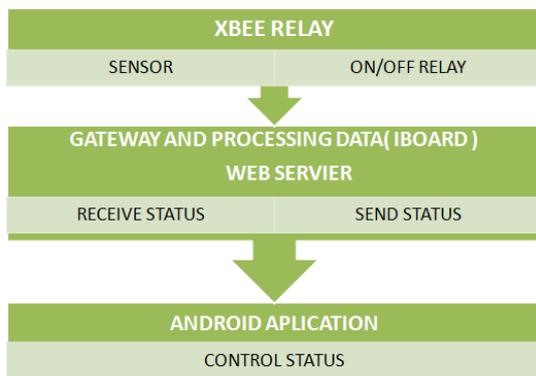


Figure 8. Data flow in smart home design

*A. hardware structure components.*

1. I Board Ex

The IBoard Ex is a unique Arduino board which features a WIZnet Ethernet port with POE, an XBee socket, nRF24L01+ module interface, Micro SD socket and an ATMEGA32U4.

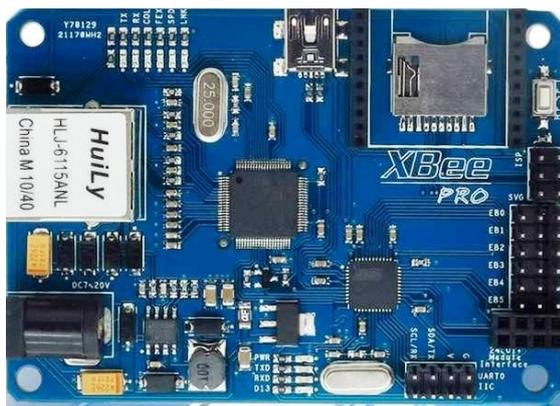


Figure 9. Arduino IBOARD

This board will add wireless XBee control as well as internet connectivity to your projects. And don't need any external programmer, just connect it with PC by a USB cable. It's great for anything from home automation to robot control.[15] IBoard Ex is used the ATmega32U4, and compatible with Arduino Leonardo. Now the SD and Ethernet library is not support well with Arduino Leonardo, so when you use the IBoard Ex with these

libraries, you need to modify something to make the code work. With embedded boot loader, IBoard Ex is easy to use by Arduino IDE through USB, and chooses the selection of the "Board" menu with "Arduino Leonardo". ISP of Atmega32U4 is broke out for download firmware easily.

2. XBee Series 2

The XBee Series 2 OEM RF Modules were engineered to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band.[16]



Figure 10. XBee Series 2

3. ZigBee USB Interfacing Board

All title and ZigBee (XBee) USB interfacing board used to interface ZigBee (XBee) wireless module with desktop or laptop computer systems. User can use this interfacing board to connect raw module of ZigBee (XBee) to make communication between pc to pc, pc to mechanical assembly, pc to embedded and microcontroller based circuits. User can also use this board to configure ZigBee (XBee) according to application. As ZigBee (XBee) communicates through serial communication so other end of USB which is connected to pc, treated as com port for serial communication. User can use any type of ZigBee module almost. It is provided with indication LEDs for ease.[17]



Figure11. ZigBee USB Interfacing Board

*B. IMPLEMENTATION SYSTEM*

This section discusses the underlying concepts and a short Description of the developed system presented followed, an explanation of the design of software and hardware

System. This system controls multiple devices in the home including relay switches, lights and curtain blinds Controller. The system works primarily through a wireless network sensor network using the ZigBee protocol. This system can They are classified into four components: control, communication, Sensors and I / O control module is the primary And brain component of a system represent in IBOARD.

The communication module allows communication between devices user interface and the microcontroller. The sensor component consists of relay switches, LDR light sensors and LM 35 heat sensors. The I BOARD also work as web server connect system to the net work through Ethernet by router , which allows a user, control and displays the status and switches in Android application as figure 12.

The X-CTU software is provided by Digi-International available recommended for testing and configuration of the XBee Module. The transmission speed must be set for the Software to communicate with the XBee module. The data can then transmitted and displayed by the XBee module. To enable XBee devices together to interact, the devices must be configured with source and destination directions. The XBee devices can interact with each other when device configuration are the same.

Android application Software used for graphic User Interface (GUI) in the central control panel, in which the Users can choose the conditions for smart home. android platform access by IP address It consists of on / off button for switches and status declaration as well as automatic button for automatic work as figure 13.

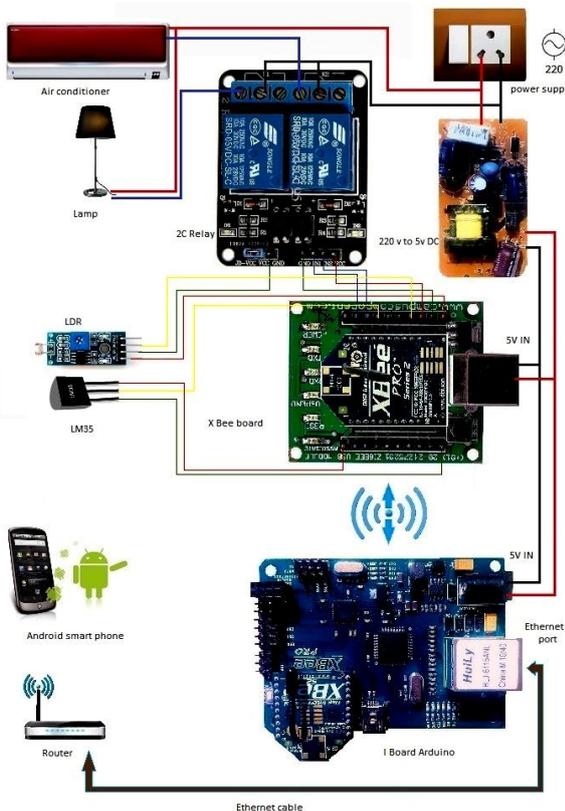


Figure 12. Main block diagram of system

The relay module "ON" function as a regular switch and "OFF" light of a lamp. An infrared detection system consists of infrared sensor as an input while the relay module as Arduino XBee adapters start. The XBee module is a rich RF characteristics for use in a wireless sensor network. The IEEE 802.15.4 protocol significantly reduces the work of programming secure data communication.

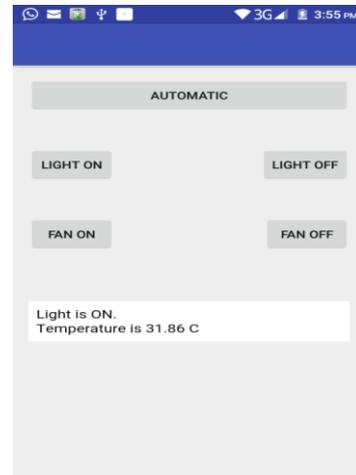


Figure 13. smart home android application

### C. Software Process Design of SYSTEM

All end nodes in the wireless network of the family can divided into two parts: plant operation and Communication network. Compared to the coordinator node, XBee -Relay communication function is easier That it does not have the routing function. In the system, Acquisition node gathers regularly at home Environmental data and node coordinates will be sent, and At the same time query information sent him to the monitor Network which are received and processed. flow chart Node acquisition shown in figure 14,15.

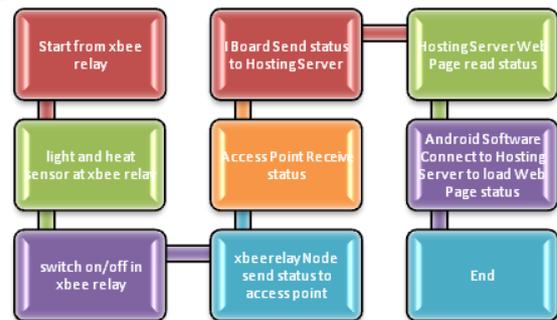


Figure 14. Flow chart for smart switch node sends status to android software

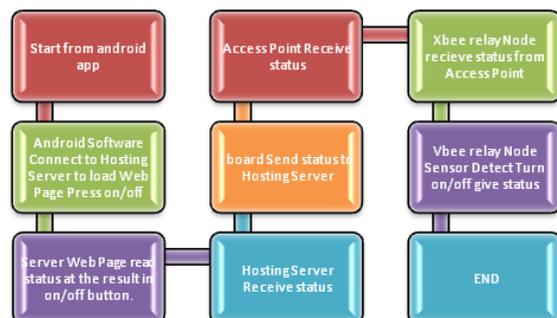


Figure 15. Flow chart for Android software send status to smart switch node

#### IV. THE RESULTS SYSTEM TEST

The XBee network is not widely used in the communication range, in this study, however, it was clearly shows that this right network for home automation mainly due to its low data rate. Therefore existing wired home automation systems can be replaced by longer it will cost wireless home automation systems. The underlying concept and development of the home XBee automation network were herein. The complete system development was as shown detailed schematically. The interaction between android application and microcontroller(arduino I BOARD) devices with XBee and the sensitivity of the sensors are used in this study it was also examined. The sensors were home automation be sensitive and therefore proves effective. some important point got after implementation:

- (1) Convert the protocol. The gateway supports TCP / IP, Wifi, Zigbee, The difference Protocol will be transformed into the gateway.
- (2) Data collection. Sensor specifications and electrical you can buy through the ZigBee network.
- (3) The remote control. The gateway controls the actions of the An apparatus according to the strategy automatically, and also You can run the command ITE and send system status to android app
- (4) Web Services. The gateway supports access to xbee network by SOAP protocol via Internet link

#### V. CONCLUSION

This paper presents a method for the design will be presented and the simulation of a model of information management capable of Smart Home perform the functions of the system according to the needs of the user, Type devices and information flow. In particular, a model is defined to establish the most appropriate rules, to manage each to make the system function and services for end users. the case Study focuses on the use I BOARD as a main control and web Sevier ,as well as the use of ZigBee transceiver. The main advantages of the proposed model: flexibility, Modularity and scalability, adaptability to different SHS Architectures and ecosystems and highly Customizing Features and services to meet a wide range of users. Future work will consider the implementation of an intelligent House prototype system, the test is the most common Functions in different contexts and review Advantages with regard to the effects achieved in the environment, Services, operational costs and user contentment.

#### REFERENCES

- [1] Andi Adriansyah, Akhmad Wahyu Dani "Design of Small Smart Home System Based on Arduino"2014 Electrical Power, Electronics, Communications, Controls, and Informatics Seminar (EECCIS)
- [2] Mirza Adipradhana[, I.G.B. Baskara Nugraha Suhono Harso Supangkat "Intervention of Non-Inhabitant Activities Detection in Smart Home Environment" ICT for Smart Society (ICISS), 2013 International Conference on Date of Conference: 13-14 June 2013
- [3] Moataz Soliman1, Tobi Abiodun1, Tarek Hamouda1, Jiehan Zhou1,2, Chung-Horng Lung1 "Smart Home: Integrating Internet of Things with Web Services and Cloud Computing"2013 IEEE International Conference on Cloud Computing Technology and Science
- [4] Shuyan Zhang, Pingping Xiao, Juan Zhu, Chao Wang and Xiaoguang Li "Design of Smart Home Control System Based on Cortex-A8 and ZigBee"Software Engineering and Service Science (ICSESS), 2014 5th IEEE International Conference

- [5] Ilker Korkmaz ft, Senem Kumova Metin, Alper Gurek, Caner Gur, Cagri Gurakin, Mustafa Akdeniz "A cloud based and Android supported scalable home automation system"Computers and Electrical Engineering 43 (2015) 112–128
- [6] Sheikh Ferdoush, Xinrong Li "Wireless Sensor Network System Design using Raspberry Pi and Arduino for Environmental Monitoring Applications" The 9th International Conference on Future Networks and Communications (FNC-2014)
- [7] Minh-Triet Nguyen, Lap-Luat Nguyen, Tuan-Duc Nguyen "A Practical Implementation of Wireless Sensor Network based Smart Home System for Smart GridIntegration"2015 International Conference on Advanced Technologies for Communications (ATC)
- [8] Christopher Osiegbu, Seifemichael B. Amsalu, Fatemeh Afghah, Daniel Limbrick and Abdullah Homaifar "Design and Implementation of an Autonomous Wireless Sensor-based Smart Home" Computer Communication and Networks (ICCCN), 2015 24th International Conference
- [9] Luigi Coppolino, Valerio D'Alessandro, Salvatore D'Antonio, Leonid Lev and Luigi Romano "My Smart Home is Under Attack"2015 IEEE 18th International Conference on Computational Science and Engineering
- [10] Xue Li,Lanshun Nie, Shuo Chen,Dechen Zhan, Xiaofei Xu "An IoT Service Framework For Smart Home: Case Study On HEM"2015 IEEE International Conference on Mobile Services
- [11] Martin Liska, Marian Ivanic, Vladimir Volcko, Peter Janiga "Research on Smart Home Energy Management System"Electric Power Engineering (EPE), 2015 16th International Scientific Conference
- [12] Ali HUSSEIN, Mehdi ADDA, Mirna ATIEH , Walid FAHS "Smart Home Design for Disabled People based on Neural Networks" The 5th International Conference on Emerging Ubiquitous Systems and Pervasive Networks(EUSPN-2014)
- [13] Pedro Miguel Rodrigues , Diamantino Rui Freitas , Joaquim Gabriel "Portable Interface and Local Service Manager"Proceedings of the 5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (DSAI 2013)
- [14] Harikrishnan R "An Integrated Xbee arduino And Differential Evolution Approach for Localization in Wireless Sensor Networks"International Conference on Intelligent Computing, Communication & Convergence(ICCC-2014) Conference Organized by Interscience Institute of Management and Technology, Bhubaneswar, Odisha, India
- [15] IBoard Ex data sheet, www.iteadstudio.com , Tech Support: support@iteadstudio.com
- [16] XBee™ Series 2 OEM RF Modules, 355 South 520 West, Suite 180 Lindon, UT 84042 Phone: (801) 765-9885 Fax: (801)765-9895rfrxperts@maxstream.net www.MaxStream.net (live chat support)
- [17] ZigBee USB Interfacing Board, Akruti Chambers,Office No. 308, 3rd Floor, Near Laxminarayan Theater, Swargate, Pune- 411037 Mobile : +91 9767444555 Landline : +91 20 24275291sales@campuscomponent.com www.campuscomponent.com"

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