



## Internet of things for ubiquitous smart home system

### KEYWORDS

Internet of things, Home automation, Android smart phone, Arduino Uno, Etherent shield, network simulator.

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### ABSTRACT

This paper presents a low cost controlling system using an embedded micro-web server, with IP connectivity for accessing and controlling appliances remotely using android based smart phone applications. The proposed system does not required any PC server and offers a communication protocol to control home environment with more than just switching functionality. To demonstrate the feasibility of this system, devices such as light switches and power plug have been integrated with proposed home control system. Internet of things is nothing but connecting everyday objects like smart phones, Internet TVs, sensors and actuator to internet where the devices are intelligently linked together enabling new forms of communication between things and people.

### I. INTRODUCTION

Internet of things (IOT) is nothing but relating everyday objects like smart phones, Internet TVs, sensors and actuator to internet where the devices are smartly linked together enabling new forms of communication between things and people. IOT has advanced in last couple of years since it has added a new aspect to the world of information and communication technologies [1]. According to [2] the ratio of number of devices associated to the Internet will accumulate from 0.5 million in 2011 to 6 million in 2021, rising at the rate 36% per year. In the year 2011, up to 80% of Machine to Machine (M2M) connections or Device to Device (D2D) are prepared through Internet and it is predicted this ratio will increase up to 93% by the year 2021.

Modern improvements such as Bluetooth present a new kind of wireless systems recognized as mobile ad-hoc networks (MANETs). Ad hoc networks consist of hosts interrelated by routers without a predetermined infrastructure and can be set energetically. Considerable effort has been done in the enlargement of routing protocols in special types of ad hoc networks like MANETs and WSNs. Nodes in mobile ad-hoc network are open to shift and manage themselves in a random fashion. Each user is free to travel about while communication with others. The path between each couple of the users may have several links and the radio between them can be mixed. This allows an involvement of various links to be a component of the identical network.

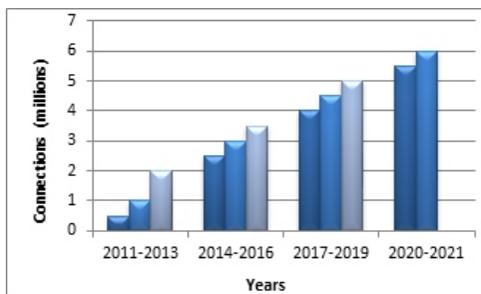


Fig1: Device to Device connections per year

Fig.1 describes, the Device to Device connection are increasing speedily from year 2011 to year 2021. This is nothing but a prediction about increasing connection through internet. By using IOTs, now anyone, from anywhere and anytime (AAA) can connect for any things and this connection will create a vast advanced network of billions of things by IOTs. Internet of things will revolutionize a number of sectors such as transportation, energy, automation, healthcare, services of nano-technologies. IOTs can also be useful for smart home system to afford an intelligent and relieve to improve

quality of life. Number of devices such as lightings, fans, air-conditioner and home security systems can attach to internet so that it can be controlled remotely using smart phone. Not only devices can be controlled, but also monitored for maintaining home environment surroundings. This will reduce the overall cost and also energy saving of system.

In current years, the concentration in ad-hoc networks has grown-up due to the accessibility of wireless communication devices that work in the ISM bands. While making an ad-hoc network in particular we are afraid with the capabilities and margins that the physical layer imposes on the network performance. Ad-hoc is a Latin word, which means "for this or for this only." Mobile ad-hoc network is autonomous system of mobile nodes united by wireless links where each node works as an end system and a router for all other nodes in the network.

### I. RELATED WORK

Smart home can be described as technology to offer comfort, security, convenience and energy efficiency within home environment. By adding intelligence can offer improved quality of life for elderly and disabled people who required a caregiver or assistance. Due to advancement in smart phones and tablets which allows a huge connectivity significant enhance in home automations and smart home systems in latest years, the execution of smart home system are getting more popular and famous.

In recent some years, a choice of wireless technologies can sustain remote data transfer, sensing and control such as Bluetooth, WI-FI, RFID and cellular networks are utilized. The papers have presented on Bluetooth based on home automation system using android smart phones without Internet connectivity. However, due to restricted range of operation, the system is not capable to survive with mobility. Many researchers introduced a Wi-Fi based home control system using PC based web server which controls connected home devices [3]. Parallel designs in paper [4-8] have also presented where a web server, database and a web page have been developed to control the devices with internet. Many disadvantages of these systems, a computer have been utilized which not only increases rate of installation but also energy utilization and enlargement and hosting of web pages also add to the cost.

Proposed system and architecture

#### A. Features of proposed system

Today, as sensing, actuation, communication, and control develop into ever more classy and ubiquitous, there is considerable overlap in these communities, sometimes from a little special outlook. The future Internet, intended as an "INTERNET OF THINGS" is foreseen

to be “a world-wide network of interrelated objects individually addressable, based on ordinary communication protocols” [1]. Recognized by a unique address, any object with computers, sensors, RFID tags or mobile phones will be able to dynamically connect the network, work together and assist efficiently to accomplish singular tasks. Because of different issues of functionality and flexibility in the literature survey, we deliberate and implemented a very low cost, impartial and more flexible home controlling and monitoring system using web services. This system consists of a micro web-server with an arduino Ethernet, hardware interface module and android smart phone application. The system architecture can be modified in different way in order to accommodate various applications with minimum design i.e. each device is added to micro web indicated as new string, that string will automatically created in smart phone application. Hence, the aim of this system is not to include excessive and more composite components such as PC and other hardware components. This system allowed home owners to remotely control connected devices at home using any Wi-Fi network or 3G/4G enabled smart phones which carry JAVA. The smart phone application provides a graphical user interface (GUI) for controlling and accessing the devices at home through server IP.

### B. Internet of things(IOTs)

The Internet of Things (IOT) is regarded as a tools and financial wave in the worldwide information industry after the Internet. The IOT is a smart network which links all things to the Internet for the reason of exchanging information and communicating through the information sensing devices in accordance with established protocols. It achieves the target of intellectual identifying, locating, tracking, monitoring, and organizing things [10]. It is an expansion and growth of Internet-based network, which expands the communication from human to human and things to things. In the IOT paradigm, various things surrounding us will be associated into the networks in one form or another. RF identification (RFID), sensor technology, and other smart technologies will be rooted into a variety of applications.

How do you direct an experiment and test setup for a system like this in the physical world? You want to have the wireless nodes stretch out over a huge area so that not all are in get in touch with each other, which requires using complete buildings or campuses as the “lab”. Setting up and maintaining such a network is a considerable amount of effort, with labor expenses swiftly dwarfing the cost of the nodes themselves. Having tiny nodes attached to furniture, ceilings, and walls all over an office building is not necessarily popular with co-workers and other development groups, and level to accidents concerning cleaning or moves of other equipment or furniture.

IoT systems are working in a noisy, unfriendly, and difficult real-world environment. Thus, testing for toughness, fault tolerance, and consistency in the presence of network connection difficulties and individual nodes deafening is a compulsory part of building IoT systems. This can be very tough to do in the real world, since controlling the environment and radio network connectivity is precisely challenging, and constantly repeating tests is very challenging.

### C. Description of proposed architecture

In this part, we represent a projected architecture with low cost home controlling as well as supervising system. Three parts of proposed architecture are: Home surroundings, Home access and remote environment, refer fig. 2.

Firstly home surroundings consist of hardware interface module and home gateway. The hardware interface module contains two basic components Arduino Uno and Arduino Ethernet shield. These two components are used to control the loads such as fan, lights and doors etc.

The key work of Home gateway is to sustain data translation services

between internets. Arduino Ethernet is the key component of Home gateway that supports web-server. In the direction of command and direct system components that permit hardware interface module is main tasks of Home gateway.

The system can access from mobile application installed on cell phones and authorization is granted by remote environment using wireless network connectivity such as network of 3G/4G or Wi-Fi. We have developed an android application to control the relay loads using internet. The smart phone can monitor and control all the home appliances from anywhere anytime and anyone. Remote environment provides user to access uniquely devices connected to load.

Hardware module is openly interfaced with actuators and sensors through wires. Hardware interface module has potential to direct power board system such as bulbs, power plug, lights, fans and HFAC (high temperature, freshening and air conditioning) system and protection system such as entrance and exit lock.

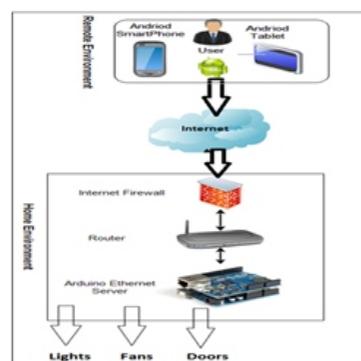


Fig2: Overview of system architecture

### D. System implementation

Basically this system consists of some chief elements: Handset with android application, a web-server and interface system for hardware connections. In this section we illustrate system implementation in details.

The software development system for smart home is come apart into two divisions: application based on server software and application of microcontroller software. The application based on server software is working on Arduino Uno and Ethernet shield. We can handle Ethernet shield for both purpose client as well as server. To converse among remote client and home gateway relationship have been implemented on arduino Uno. The library is utilize to take delivery of data on arduino Uno and generate output message is <Ethernet.h> in JAVA notation. The home entrance is linked with internet in excess of TCP/IP. While the base of Ethernet shield is before now TCP/IP stacks, to focus on execution of software and to join it with remote client. The static IP address is used to originate Local Area Network through Ethernet unit. We have used a static connection rather than Dynamic Host Configuration Protocol to optimize the connection process.

## III. HARDWARE IMPLEMENTATION

A low cost hardware component is used to setup the test bench. The overall implantation diagram is illustrated in Fig3.

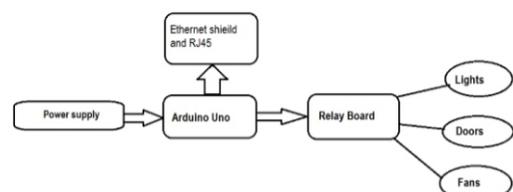


Fig3. Hardware architecture and implementation

The arduino Uno and Ethernet shield are used to implement micro web server for home gateway. Home gateway connects through internet. Arduino Uno is an open source microcontroller that uses ATMEGA 328, an Atmel AVR processor which can be programmed by computer in C language via USB port. Arduino Uno has on board 5 analog pins and 13 digital pins for input and output operations, supporting I2C and SPI which can be used to interface with other devices. To connect Local proxy and Home gateway Ethernet module acts as a bridge. A light switch is integrated with arduino using relay to demonstrate switching capability.

#### IV. CONCLUSION

In this first study step to incorporate WSNs into the Internet of Things, we have considered selected application scenarios presenting a smart home system with high diversity in terms of monitored subjects and environments. By taking into account their main characteristics, we have analyzed three integration approaches and verified that they were inappropriate in their current state to allow sensor nodes joining on demand and dynamically the Internet of Things. We plan to examine existing approaches and discover suitable modifications for resource constrained sensor platforms to tackle these challenges.

This system can be further extended for multiple applications as follows Support to satellite simulation Error model intelligent vehicle tracking. And many more similar applications thus, this system can prove to be very helpful in future.

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