Design and Implementation of IOT Gateway

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Abstract: Today's user needs a more fast and mobile way of devices to respond. The necessity of smart devices providing connectivity to the world at each second becomes as mandatory part of our life. Therefore the connectivity of a number of smart and intelligent devices rapidly grows each year. So that according to necessity an autonomous device connection should be required. One of the impressive and powerful solutions is known as the Internet of Things (IoT).The IoT is a network of Man smart physical devices which would be connected to each other that they could interact directly with each other and collect as well as exchange data. In this project, an IoT Gateway system based on ZigBee and Wi-Fi protocols according to the typical IoT application scenarios is presented. Wireless sensor networks (WSN) is a collection of different sensors with different protocols sends data to IoT Gateway which is responsible for the conversion of different protocols in standard format and also do the conversion of internet protocols and finally gave an implementation of prototyping system and system validation.

Keywords: IOT, Gateway, WSN, ZigBee, Wi-fi.

I. INTRODUCTION

The internet is a combination of so many networks which enables devices to communicate globally by using some protocols .in early years Internet is represented by website and electronic mail called as E- mail. These days we are able to see many forms of Internet around us. As a part of our life internet is providing plenty of services and applications. User-friendly and automated mechanism is the main cause behind the digitalization.

The demand of using internet technology is affecting every individual's life , devices become mobile and closer to each other.Today the smart devices making their place in the world and providing end to end connectivity thus each year no of devices increasing rapidly. So it requires devices should communicate automatically. Therefore one of the good solutions would be the internet of things (IOT).This is a network of devices which would interact with the each other by Unique Identifier (ID).

Various applications of Internet of Thing (IOT) technology is affecting the backbone of network development as its one of the emerging and blooming technology.The ideal architecture of IOT combined of three layers first would be sensing layer allows for sensing data and get identified, many sensor devices are connected to this layer ,then second is network layer ,it will connect devices using ZigBee, RFID , Wi-Fi, Ethernet etc and third is application layer in this layer data can be used and communicated by users
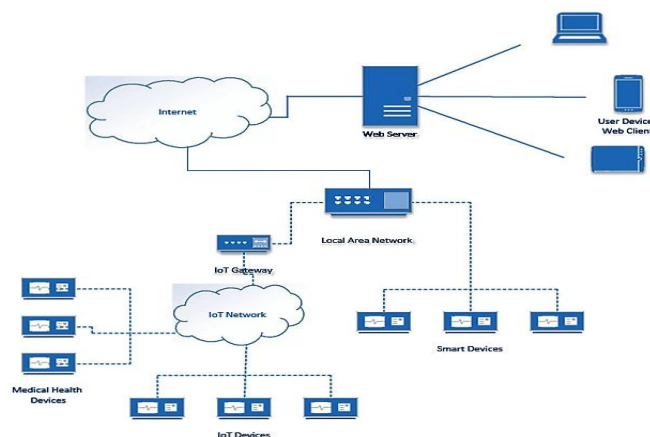

Fig 1-Scenario of IOT application and deployment

Figure 1 shows a typical IOT network in a house. In this many IOT device connected directly to an Internet router or with a gateway which acts as a bridge between designed IOT networks and Internet. IOT devices connect in this fig uploads data receive a request from the server. Users would able to access data from anywhere like web interface, Mobile app, etc

In this project, we proposed an IOT gateway system based on ZigBee and Wi-Fi protocols according to the requirement of IOT from the data transmission between wireless sensor networks and internet, protocol conversion of different sensor network protocols, and finally gives us an implemented prototyping system and its validation.

II. LITERATURE REVIEW

In 1999, Auto-ID Laboratory of MIT introduced a concept known as Internet of Things IOT. As the popularity of IOT is growing up abruptly, It is expected that more and more no. Of devices will be connected to the Internet in upcoming years. In this section, we will take a brief review of some existent Internet of thing (IOT) gateways. As listed below-

Shang Guoqiang, Chen Yamming, zuo Chao, Zhu Yanxu [1] –In this paper, the author has specified a pluggable gateway system which would run on high power also has an external interface for software development.

Qian Z, Ruicong W, Qi C, Yan L, Weijun [2]-In this paper the author specified a gateway for interconnection .different protocols like ZIGBEE, BLUETOOTH etc, but they are not that flexible just due to their customization for different applications.

Jong-Wan,Yong-ki,Choon-Sung, Dong-Rye [3]-In this paper the author specified a gateway system combining the main server and many sensing servers connecting different many networks .due to this hardware cost will increase.

L Wu, Y Xu, C XU, F.Wang [4] - In this paper, the author specified a system which would be the pluggable gateway system.The gateway collects data, capabilities, and information of the heterogeneous network to homogeneous networks. In this, the gateway will run on PC and accommodate higher hardware.

Shan Yin,Yueming Lu,Yonghua Li[5]-In this paper author specified a system based on IOT which will connect all home appliances together and a centralized gateway based on RFID
So that they would communicate properly but linkage policy used here is manual, not feasible

III. METHODOLOGY

A. Hardware

1. To propose an overall architecture for Gateway.
2. To design printed Circuit Board (PCB) Layout for Gateway.
3. Hardware implementation of Microcontroller (ATMega328P), Wi-Fi module (ESP8266) and ZigBee of Gateway on PCB.

B. Software

1. To develop a C code for SPI communication between sensor node and Microcontroller in Arduino IDE.
2. Log the sensor data onto Thing Speak (Open source data platform and API for the Internet of Things)
3. Continuous monitoring of real-time data.

C. Introduction to IOT gateway

In an industry so many actuators and sensors are communicating in IOT technology .machineries may have multiple sensors tracking its health and parameters. Each and every sensor must be connected to the microcontroller and the microcontroller takes raw data from every sensor. The collection of the sensor, microcontroller, radio, power is called sensor node. It is a self-derived unit that takes data generated by sensors. As the Sensor node is not having processing storage, Memory, power, so it would use a radio communication network which would be low powered and sends data to the central unit.
The central unit which is acting as a receiver of many incoming raw datasets generated by the sensor node unit is called an IoT gateway

D. Roles of IOT gateway

1. Normalize and Transform data –As data collected by many sensors should be in many different formats. Some kind of nodes uses priority-based protocols or some based on JSON or CSV. Gateway always takes heterogeneous datasets from different kind of sensor nodes and conversion has been done to a standard format by Gateway itself.

2. Transformation of Protocol –As the by itself e sensor node won't be able to use Wi-Fi or Ethernet, they usually use low power communication networks. A gateway could able to handle or supports so many protocols so that it would be able to accept raw data sent by the sensor node unit. Gateway uses many protocols for the processed data communication, which would be connected to the process running in the cloud and gateway. The protocols are CoAp, REST, STOMP .even SMS and MDTT.

3. The role of the gateway as an edge device - As the sensor nodes could make output connections to the internet and cloud, we can't access directly. Thus, gateways play the both role of firewall and that of the router to secure WSN and internal network.
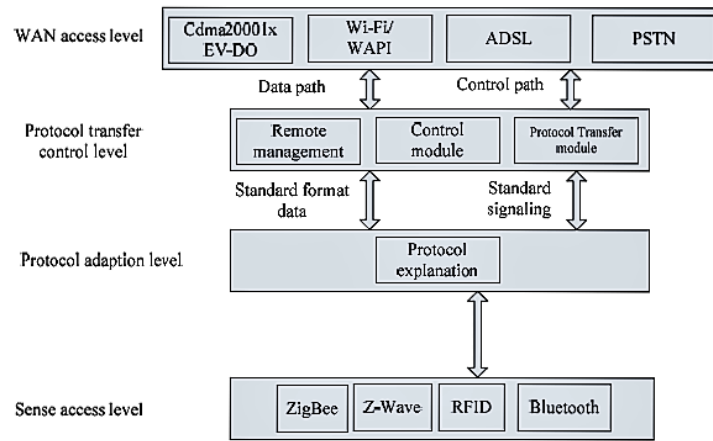
Fig 2- IOT Gateway Architecture.

E.   WSN interface

Interfacing Zigbee based WSN, a ZigBee coordinator is required. It will provide the serial interface so that it would be able to communicate with the module.The software which is running on an IOT gateway must have to be interfaced with ZigBee unit by using ZigBee API format.

F.   IOT communication

As WSN will allow API packets to be sent and received.That packet should go through processing in order to access the internet. Processing will involve encapsulation of data and translation of addresses, to form a packet and unpack the internet packets so as to get a WSN packet.

G.   SYSTEM ARCHITECTURE

The IOT Gateway is made up of several parts as-
1. The microprocessor
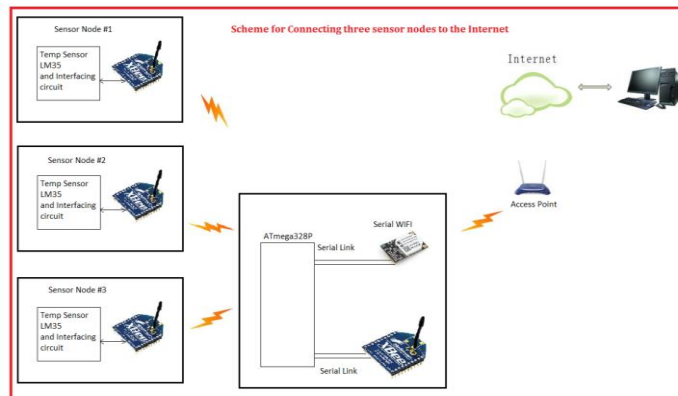2. The radio transceiver
3. WIFI
4. USB

Fig 3- Whole processing of gateway and WSN

Above figure, no.3 shows overall system hardware of the project .includes microprocessor of ATMega 328P, is dedicated to controlling the operation of entire data acquisition .system is used to collect data from different sensors, process them and sent it to open source data platform.In this system, the Zigbee (series 2) would be the radio transceiver responsible for data transmission with many other nodes.WIFI unit will function as its own with lower cost and less space requirement.ESP 8266EX gives a stand alone WIFI network solution.

CONCLUSION

With the advancements in technology, it is expected that the availability of internet is everywhere and online at all time. Low-cost smart sensor node development enabled things to be connected easily and corresponding information can be accessible globally. With the features of scalability, fault tolerance and effective power consumption of nodes and transceiver "Internet of Things" have facilitated ubiquity computational ability to internet work heterogeneous smart devices easily and facilitate the availability of data anywhere. An efficient method for internetworking of WSN and the internet is given. The key idea of proposed method is to provide a low-cost solution and flexible connection mechanisms for integrating Internet of things with home automation systems.

The advantages of the developed system are to have greater control over the routing of packets (security and customization) and ability to adapt to other wireless sensor networks.

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