ENVIRONMENTAL OBSERVATION USING WIRELESS SENSING ELEMENT NETWORKS (WSN) SUPPORTED IOT

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ABSTRACT

In recent years, we have got seen a different era of short vary wireless technologies like Wi-Fi, Bluetooth [7], ZigBee [6], rising before individuals. The project aims at building a system which can be used on universally at any scale to observe the parameters in each setting. Raspberry-pi and sensors collects all the amount of data from setting and now period data is fetched by the net server and shows it. User can access this data from anywhere through internet. Raspberry Pi works as a base station that connects the number of distributed detector nodes via zigbee protocol. Wireless detector Networks (WSN) has been accustomed gather data relating to phenomenon in varied applications like environment observation. Cyber space of Things (IoTs) area unit typically depicted as connecting everyday objects like smart-phones, net TVs, sensors and actuators to cyberspace where the devices area unit intelligently connected on facultative new styles of communication between things and folk, and between things themselves. In wireless detector network system, the detector node sense determination the information from the detector that data collects the highest tags, end tags send its data to the router and router to organizer and supply multi-clients services moreover as data show, the complete data area unit detain base station and thus the keep data will send to the cloud (Ethernet) and thus the patron can visit rock bottom station remotely via (website) computer network. Such detectors are unit temperature, vibration, pressure, moisture, light-weight and pollution.

Index Terms: Raspberry pi; Zigbee; Sensor node; Sensors ***etc.***

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1. INTRODUCTION

The development in wireless sensor networks can be acclimated in ecology and con- trolling assorted ambit in the agronomics field, acclimate base field. The sensor arrangement accouterments platforms are basically low-power anchored systems with some altered sensors such as onboard sensors and analog I/O ports to affix sensors. Like hardware, software should as well be developed, including OS, sensor/hardware drivers, networking protocols and application-specific analysis and processing algorithms. The purpose or cold of ecology ecology is altered in altered situations, but important aims to ecology ecology to acquisition risks to animal and wildlife, ambit to citizenry clearing from top body areas to low body areas and to bind discharge of gases.

Wireless sensor arrangement (WSN) [1] is a low cost, low ability wireless arrangement fabricated up of bags of acute sensor nodes which adviser concrete or ecology conditions, such as temperature, pressure, moisture, etc. at altered breadth or altered location. The Internet of Things (IoT) is an arising key technology for approaching industries, and ecology monitoring. The Internet of Things (IoTs) can be declared as abutting accustomed altar like smart-phones, Internet TVs, sensors and actuators to the Internet area the accessories are intelligently affiliated calm enabling new forms of advice amid things and people, and amid things themselves. Building IoTs has avant-garde decidedly in the endure brace of years back it has added a new ambit to the apple of advice and advice technologies.

2. INTERNET of TINGS (IOT)

The Internet of things (stylized Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.

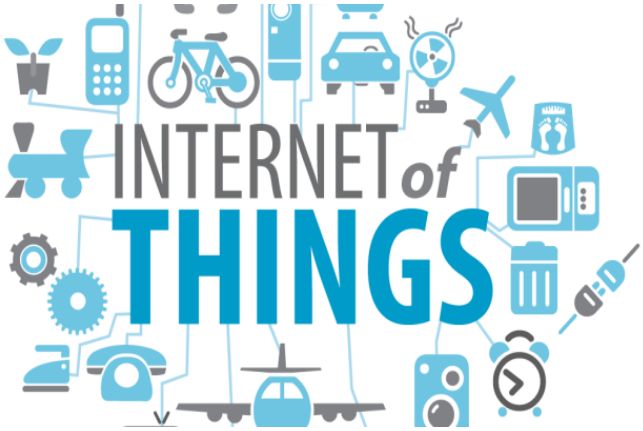


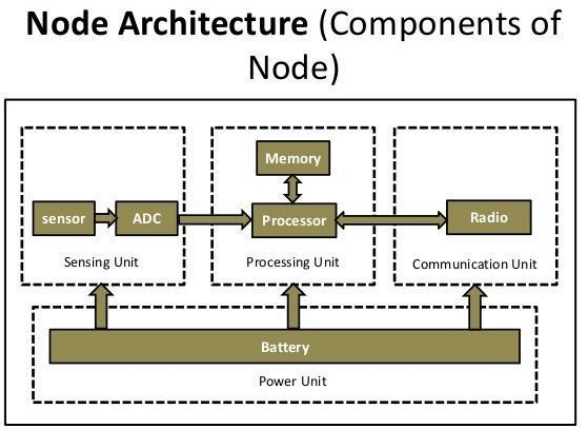
FIG 01: IOT

FIG 02: IOT

In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society. "The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. the vision of the Internet of things has evolved due to a convergence of multiple technologies, including ubiquitous wireless communication, real-time analytics, machine learning, commodity sensors, and embedded systems.

3. WIRELESS SENSOR NODE (WSN)

The figure 4 shows design of sensor node. The main components of a sensor node are a microcontroller, transceiver, external memory, power source and one or more sensors. The controller performs tasks, processes data and controls the functionality of other components in the sensor node.



While the most common controller is a microcontroller, other alternatives that can be used as a controller are: a general-purpose desktop microprocessor, digital signal processors, FPGAs and ASICs. A microcontroller is often used in many embedded systems such as sensor nodes because of its low cost, flexibility to connect to other devices, ease of programming, and low power consumption. Transceiver Sensor nodes often make use of ISM band, which gives free radio, spectrum allocation and global availability. The possible choices of wireless transmission media are radio frequency (RF), optical communication (laser) and infrared. Radio frequency-based communication is the most relevant that fits most of the WSN applications. WSNs tend to use license-free communication frequencies: 173, 433, 868, and 915 MHz; and 2.4 GHz. The functionality of both transmitter and receiver are combined into a single device known as a transceiver.

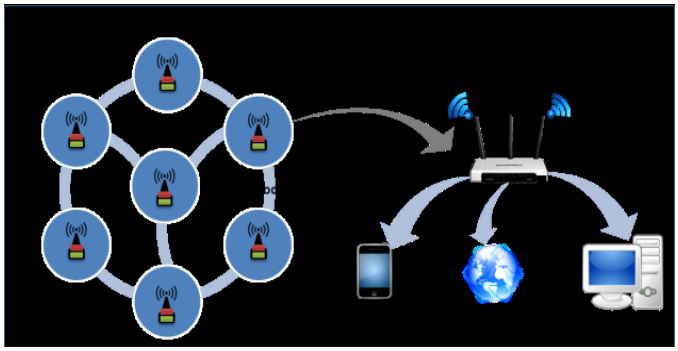


Fig-3: Architecture of WSN

From an energy perspective, the most relevant kinds of memory are the on-chip memory of a microcontroller and Flash memory—off-chip RAM is rarely, if ever, used. Flash memories are used due to their cost and storage capacity. Memory requirements are very much application dependent. A wireless sensor node is a popular solution when it is difficult or impossible to run a mains supply to the sensor node. A wireless sensor node is a popular solution when it is difficult or impossible to run a mains supply to the sensor node. However, since the wireless sensor node is often placed in a hard-to-reach location, changing the battery regularly can be costly and inconvenient. An important aspect in the development of a wireless sensor node is ensuring that there is always adequate energy available to power the system. The sensor node consumes power for sensing, communicating and data processing. More energy is required for data communication than any other process.

4. OVERALL ARCHITECTURE

4.1 Raspberry PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. The raspberry pi is the cheapest ARM11 powered Linux operating system single board computer board. This board runs an ARM11 microcontroller @1GHz and comes with a 1GB of RAM memory [16,17], as this model has better specifications as compared to other raspberry pi models such as raspberry pi B and B+ model [4].

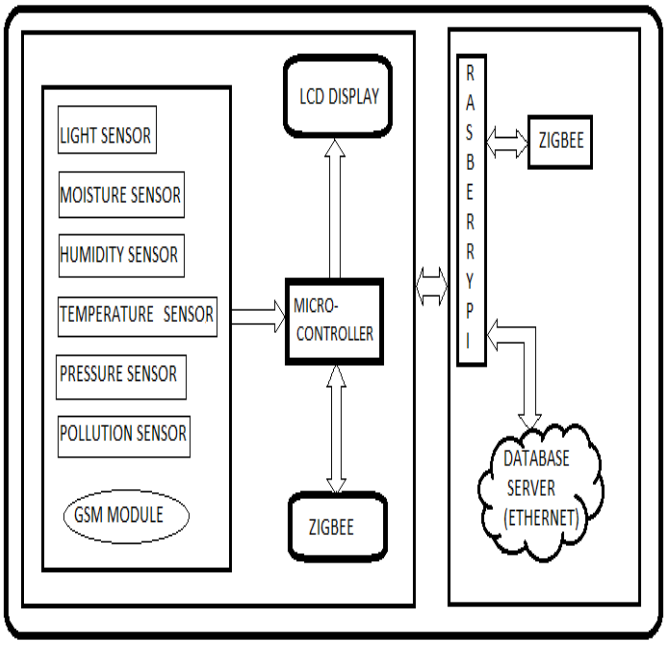


Fig-4: The overall system architecture

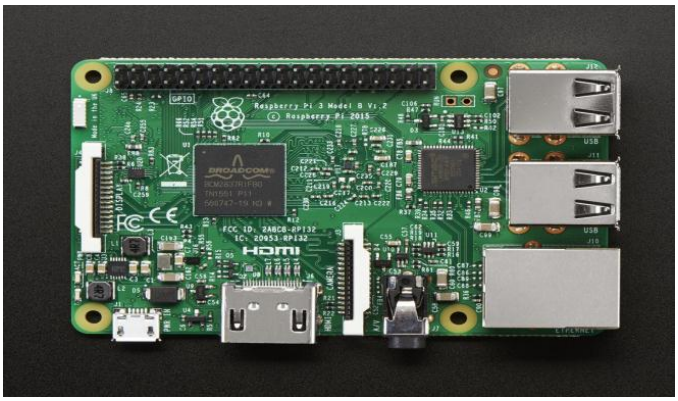


Fig-4.1: Raspberry Pi

It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. It supports 32GB external SD or micro SD card, the device consists a 4USB ports.

4.2 Arduino

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog

inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila. Arduino Mega, etc. I used Arduino Uno in this development. Arduino is based on ATmega328. The package contains a 16 MHz ceramic resonator, a USB connection, a power jack and ICSP header and a reset button. Instead of using the FTDI USB-to-serial driver chip our Arduino features the Atmega16U2 chip programmed as a USB-to-serial converter.

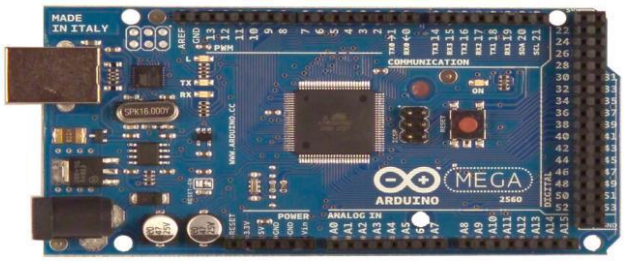


Fig-4.2: Arduino Mega

4.3 XBee Module

Zigbee is a high-level communication protocols used to create wireless networks. Transmission distances to 10–100 meters depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network topology. The Zigbee transmission data rate is 250 Kbit/s [6]. Zigbee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. For the wireless communication between sensor nodes and the gateway node ZigBee RF modules were used. All the ZigBee devices are based on ZigBee standard which has adopted IEEE 802.15.4 for its physical layer and MAC protocols.

Fig-4.3.1: XBee Module

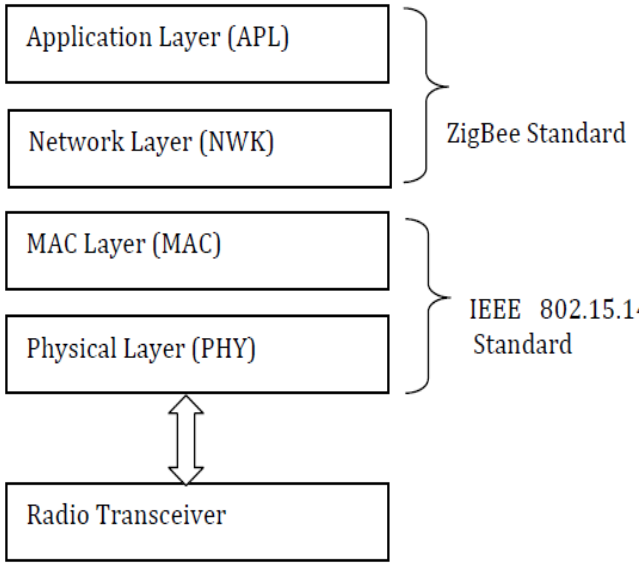


Fig-4.3.2: ZigBee Protocol Stack

The wireless devices based on this standard operate in 868 MHz, 915 MHz and 2.4 GHz frequency bands having a maximum data rate 250Kbps. ZigBee protocol layers are based on OSI model. When the pan is to use ZigBee, it is necessary to mention IEEE 802.15.4 standard. One of the finest characteristics about this standard is it allows user to use PHY and MAC layer defined by IEEE 802.15.4 and lets user to define the upper layers of the OSI model. Similarly, ZigBee also use the MAC and PHY layer of IEEE 802.15.14 standard.

5. SENSORS AND Its CHARACTERISTICS

5.1 MQ2 Sensor

Fig-5.1.1: Mq2 arduino gas sensor

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air.

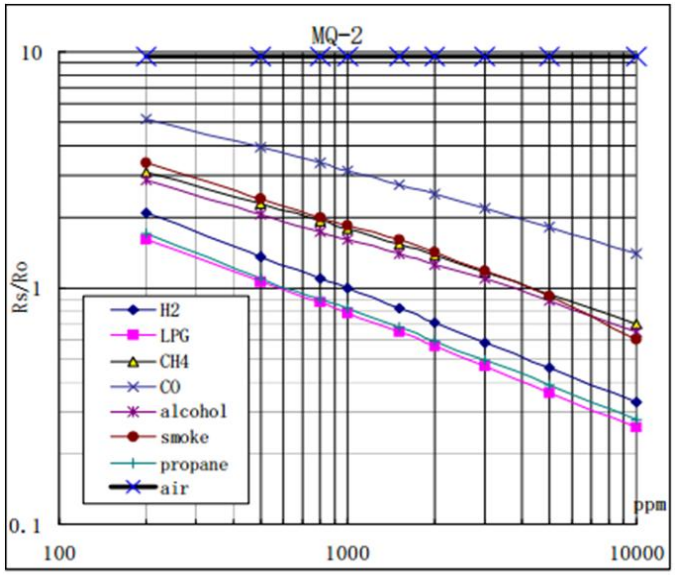
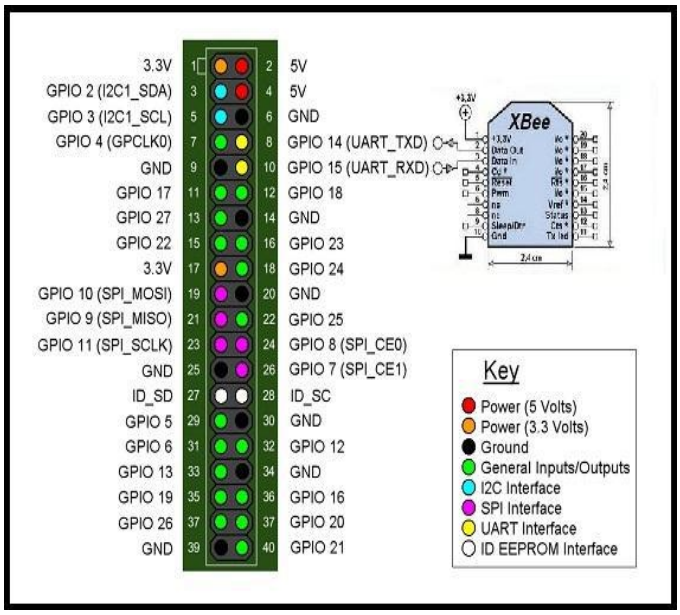


Fig-5.1.2: Sensitivity Characteristics

When the target combustible gas exists, the sensor's conductivity is higher along with the gas concentration rising. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.Fig-5.1.2 shows the typical sensitivity characteristics of Fig.2 shows the typical temperature and humidity the MQ-2, ordinate means resistance ratio of the sensor characteristics. Ordinate means resistance ratio (Rs/Ro), abscissa is concentration of gases. Rs means of the sensor (Rs/Ro), Rs means resistance of sensor resistance in different gases, Ro means resistance of in 1000ppm Butane under different term. and humidity. sensor in 1000ppm Hydrogen. All test is under standard Ro means resistance of the sensor in environment of test conditions.

6. INTERFACING BETWEEN RASPBERRY PI AND XBEE

XBee module is configured as coordinator on the raspberry pi. Raspberry pi can be connected to XBee module directly through USB cable and by UART serial communication interface [3]. The base station also acts as a gateway in this application.



The data collected or detected by sensor node sends to the base station and inserts the data received from sensor nodes into database of raspberry pi. Raspberry pi acts as a base station which connects to sensor nodes by zigbee communication protocol and clients by external network (internet etc.). Python is a widely used general-purpose, high-level programming language, its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. For wireless communication and multi-hop networking protocol, we used XBee series module S2 from Digi international. Multiple users can access the raspberry pi through Ethernet or Wi-Fi connection within local area network or from anywhere on the internet [11]

7. RESULTS

In wireless sensor network, there are three types of devices: coordinator, router and end tags shows in figure 8. Open source data platform for the Internet of Things provides access to a broad range of embedded devices and web services.

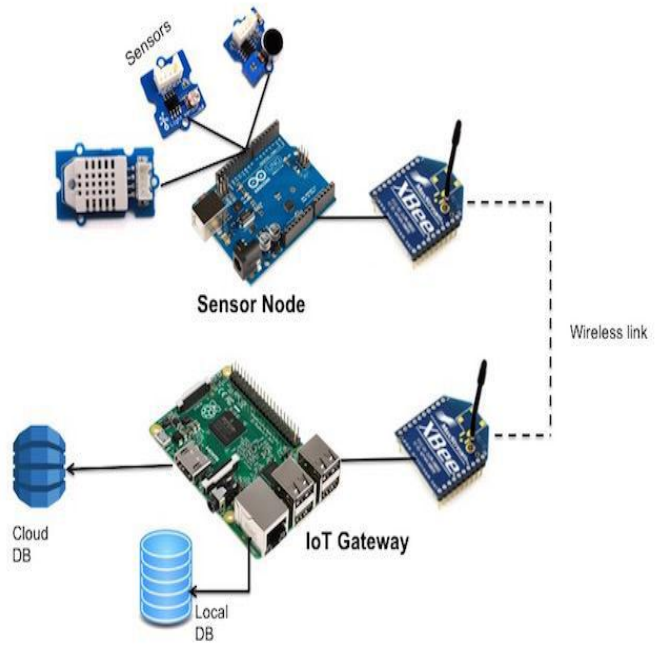


Fig-7.1: Overall system design

So, here one XBee is configured as a coordinator, which is connected with the raspberry pi using UART protocol shows in figure 9,10. Here sensor node is configured as router (R1and R2) and end tag(E52), it will send its real-time data to the nearest router. There is only one coordinator in the network, which communicates with the base station (raspberry pi).

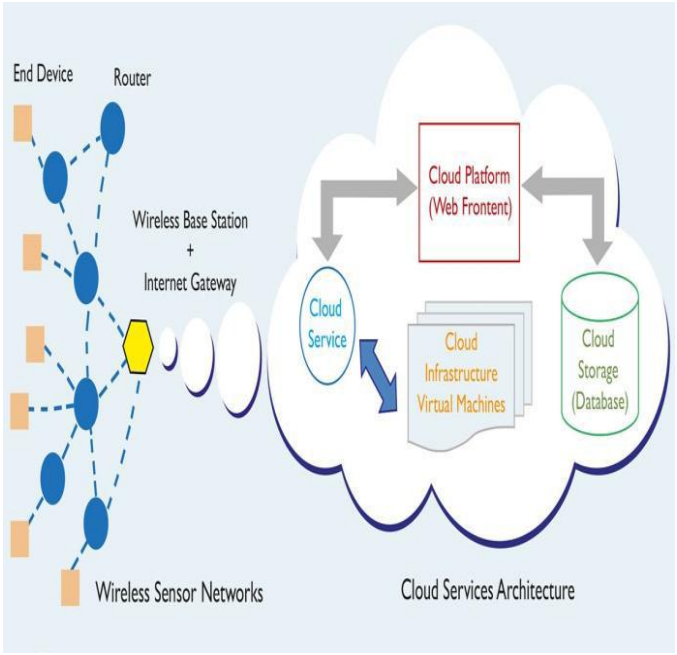


Fig-7.5 WSN integrated with cloud of IOT

8. CONCLUSIONS

Comparing with collection and forwarding information or data of traditional base station (gateway), this system has low-cost, low power consumption, and easy to maintain. This paper designs a wireless sensor network system using Raspberry Pi as a base station, XBee as a networking protocol, sensor node as combination of sensors, controller and zigbee. Hence, we can create sensor-logging application, location-tracking applications, and a social network of things with status updates, so that you could have your location parameter control itself based on your current location. One major advantage of the system lies in the integration of the gateway node of wireless sensor network, database server, and web server into one single compact, low-power, credit-card-sized computer Raspberry Pi, which can be easily configured to run without monitor, keyboard, and mouse. Such a system is very useful in many environmental monitoring and data collection.

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