ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 19, April 2016

IoT Based WSN With Device Control

K.Selvam
Electronics and Communication Engineering Department
SRM University
Chennai, India
mr_selvam2020@yahoo.co.in

KavithaSudha AP
Electronics and Communication Engineering Department
SRM University
Chennai, India
rkavithasudha@gmail.com

Abstract— **Wireless Sensor Network (WSN) is an interconnection of sensor nodes and built from a few to several hundreds or even thousands. These sensors are spatially distributed to monitor physical or environmental conditions, such as light, sound, pressure.etc and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The Internet Of Things (IoT) is an smart technology for Machine-to-Machine(M2M) communication which implies the network of physical objects such as devices, vehicles, buildings and other items embedded with electronics, software, sensors and network connectivity to enable these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.**

Keywords—wsn; IoT; Device Control ; environment monitoring

NOMENCLATURE

WSN – Wireless Sensor Network
IoT – Internet Of Thing
ADC – Analog to Digital Converter
RF – Radio Frequency
PIR – Passive Infra Red
IDE – Integrated Development Environment
CPU – Central Processing Unit
LDR – Light Dependent Resistor

I. INTRODUCTION

With the advancement of sensor technology, the sensor not only senses the physical quantity, it can also send its own data as well as pass the data from neighbor sensor to the remote location. This advanced sensors interconnection creates one more milestone of sensor technology called WSN. The widespread sensor deployment in WSN will be used in various applications such as smart agriculture harvesting, intelligent lighting system. Similarly the faster development of internet and various smart devices introduces the interconnection of various smart devices. This trend can manage enabling or disabling the various smart devices and so called as IoT. IoT is involved in various applications such as smart grid, smart transportation. The integration of WSN, IoT and additional computing techniques provides new economic opportunity for word wide profitability, now the WSN can be turn into the internet which is interoperable, open, ubiquitous and multipurpose infrastructure with the aid of Intelligent Built on Network (IBoN) architecture.

II. EASE OF USE

A. *Limitaions of existing WSN*

Legacy WSNs are characterized by high heterogeneity because there are many different proprietary and non-proprietary solutions. This wide range of technologies has delayed new deployments and integration with existing sensor networks. There must be some limitations in scalability and number of devices to be used.

B. *IBoN Architecture*

IBoN is a deployment of WSN from different infrastructures into the cloud computing using IoT. In this architecture, each infrastructure contains number of WSN slave units and one WSN master unit. WSN master act as a server which collects the environmental data from WSN slave units and transfer these data to IoT server on cloud. Each infrastructure is owned by one user. User can get and view their infrastructure related data through internet access. WSN master also can controls the devices involved in the infrastructure.

III. PROPOSED SYSTEM ARCHITECTURE

A. *FEATURES OF THE PROPOSED SYSTEM*

The system monitoring the environment status such as light level, temperature, humidity and other features are:

- Overcome the wide range of proprietary and closed standards
- IP-based sensor networks using the emerging standard 6LoWPAN/IPv6
- With IoT the Machine-to-Machine (M2M) communication also can be enabled
- Good flexibility in Addition or deletion of WSN infrastructure

B. *PROPOSED ARCHITECTURE COMPONENTS*

This architecture contains three components

1. WSN Master: Collecting the environmental data, processing these data. Based on the processing result it sends the control data to control unit. It also transfers

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the environmental data to the IoT server with IP protocol using router.

2. WSN Slaves: Sense the environmental data and send the data to WSN master using RF protocol using RF transceiver. This slave unit also forwards the data from neighbor slave unit if its accessing distance to WSN master is not reachable.
3. Control Unit: It's a load management unit to ON or OFF the electronically controllable device such that lighting system, AC, etc. Its activity is based on the control data received from WSN master with RF protocol using RF transceiver.

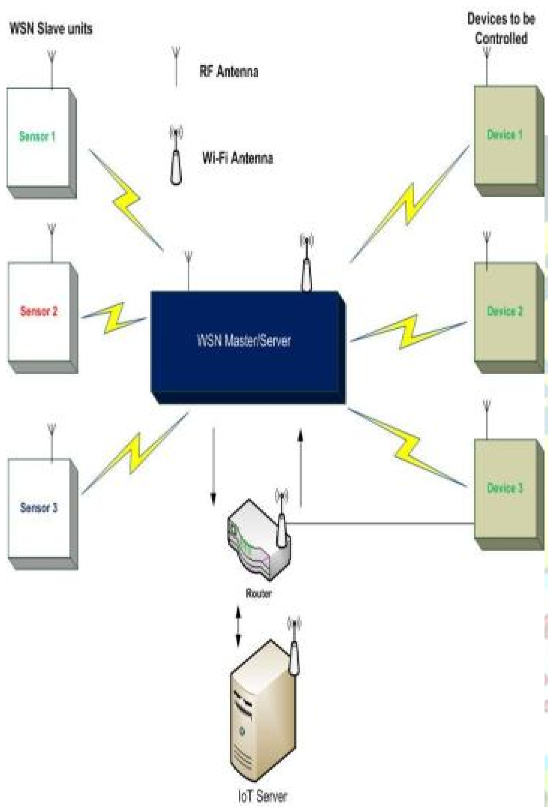

Figure1: IBoN Architectural Components

Finally, the router and IoT server are end components which is accessible by user to view their data using their credentials.

IV. SYSTEM IMPLEMENTATION

A. *System Hardwares*

In system organization each component contains one or more hardware units and their base execution unit is microcontroller. Below section describes about hardware unit in each component

WSN master is constructed with

a. LPC2148 – 32bit microcontroller,
b. RFM75 – RF transceiver
c. ESP8266 –Wi-Fi Transceiver
d. 41fWDsh14LL_SX425 - PIR sensor

LPC 2148 is an ARM7TDMI-S based microcontroller in a tiny LQFP64 package which provides the memory feature of 512 kB of on-chip flash memory and 40 kB of on-chip static RAM.Its128-bit wide interface/accelerator enables high-speed 60 MHz operation.

RFM75 is a small size, low-power; low cost high-speed and high stability FSK/GFSK transceiver module specifically operating in the world wide ISM frequency band at 2400 - 2483.5 MHz, its maximum air data rate can be up to 2Mbps.

ESP8266 is an inexpensive, low power Wi-Fi module which allows the connection to a Wi-Fi network and makes simple TCP/IP connections using Hayes-style commands.

41fWDsh1-4LL_SX425 is low cost PIR sensor to detect the movements in the environment for the range of 7-8 feet radius

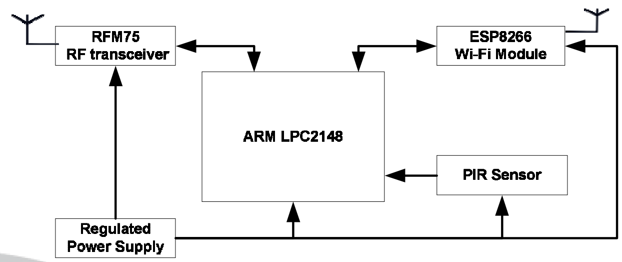

Figure2: WSN Master Block Diagram

WSN Slave contains

a. PIC 16F866
b. RFM75 – RF transceiver
c. Sensors – LDR or LM35

PIC16F866 is a high performance risk cpu based 8 bit microcontroller which provide the memory feature of 8192 words of on-chip flash memory, 368 bytes SRAM and 256 bytes of EEPROM. Its operating speed is DC – 20 MHz oscillator/clock input.

LDR is a light level sensor which is made up of two CDS photoconductive cells with spectral response similar to that of human eye. The cell resistance falls with increasing light intensity.

LM35 series are precision integrated-circuit centigrade temperature sensors devices with an output voltage linearly-proportional to the Centigrade temperature.

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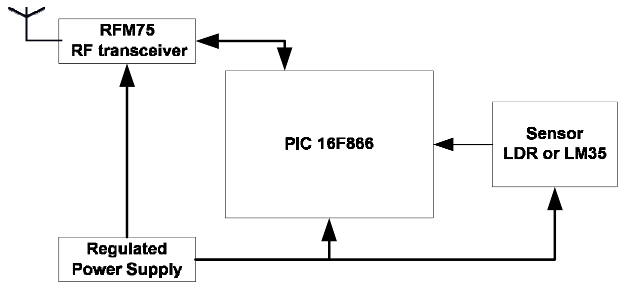

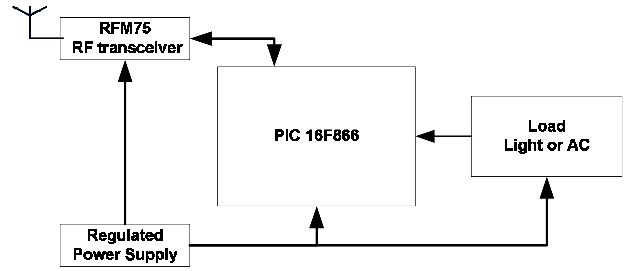

Figure4: Device Control Unit

Figure3: WSN Slave Block Diagram

Device Control unit

a. PIC 16F866
b. RFM75 – RF transceiver
c. Loads – Lighting system or Temperature processing system (Light or AC)

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Note: The detailed information about each device is available at corresponding manufacturer data sheet. onyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

B. System Softwares tools set

List of tools used by the system for its software development is:

Keil µ Vision: This is LPC2148 software development tool which is used to develop the WSN master software functionalities. This tool is an IDE which combines project management, source code editing, compile C code, assemble assembly source files, link and locate object modules and libraries, create HEX files formatted application program, flash the created application program into target and debug target program.

PCWHD: This C-Aware IDE is highly optimized and feature-rich ANSI C compiler for Microchip PIC® MCUs. Our C-Aware IDE provides embedded developers with a suite of tools and an intelligent code optimizing Microchip PIC® C compiler that frees developers to concentrate on design functionality instead of having to become an MCU architecture expert. C-Aware allows developers to manage every aspect of their embedded software development, from design through device programming and debugging. C-Aware is the ideal environment to develop C program code with integrated built-in functions, performance analyzation and statistics, and debugging compiled code in real-time while running on Microchip PIC® MCU devices.

Proteus: This is Virtual System Modeling and circuit simulation application. The suite combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs. Proteus also has the ability to simulate the interaction between software running on a microcontroller and any analog or digital electronics connected to it. It simulates Input / Output ports, interrupts, timers, USARTs and all other peripherals present on each supported processor.

C. System Softwares Design

System software is designed as a three component and each component has its own software units.
The communication of sequence is as below

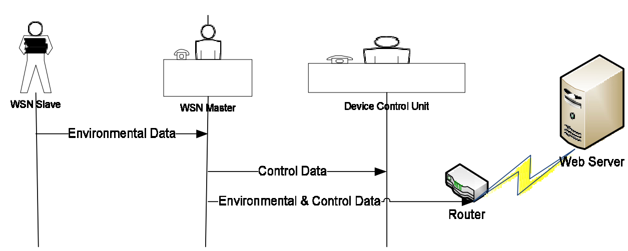

Figure5: Component Level Sequence Diagram

De-Packetizing the data derived with RF protocol stack for data aggregation and resend
Transmit the packetized data to the WSN master.
In this sensor node will collect the physical phenomenon from environment, aggregate all the sensed data and also transfer the collected data to the WSN Master. The sensor nodes follows common routing algorithm for the data aggregation process.

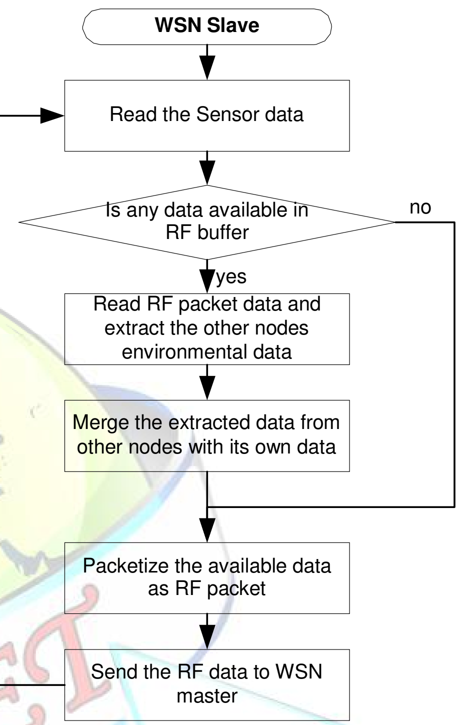

Figure6: WSN Slave Unit

WSN Master:
This component will take care about
De-packetizing the RF data packet and extract the environmental data
Processing environmental data and creates the control data with the help of available threshold value.
Packetize the control data using RF protocol stack
Merge the environmental data and control data as web data
Packetize the web data using IP protocol stack
Transmit the control data to Device Control unit
Transmit the web data to web server through router

Device Control Unit:
This component will handle
De-packetizing the RF data packet and extract the control data

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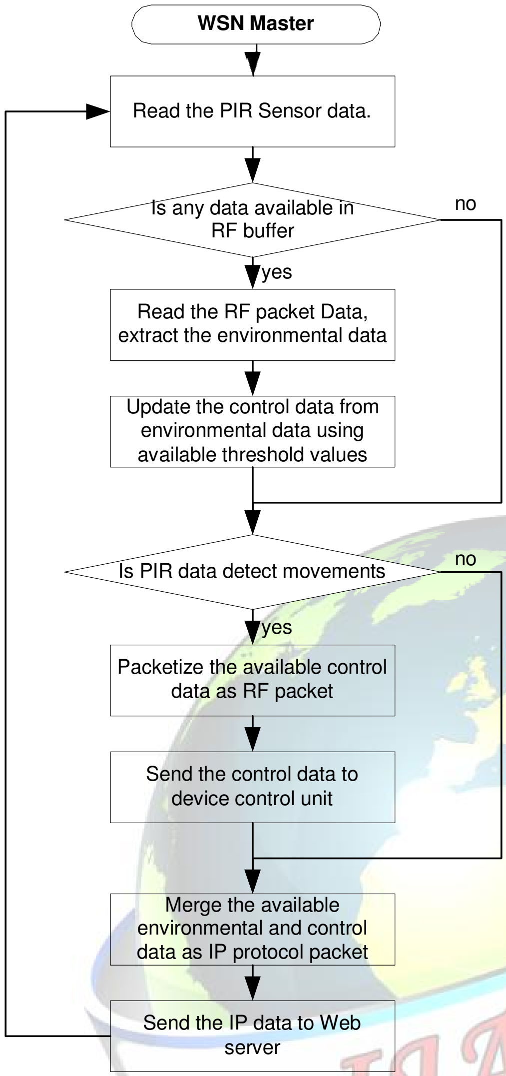

Figure7: WSN Master Unit

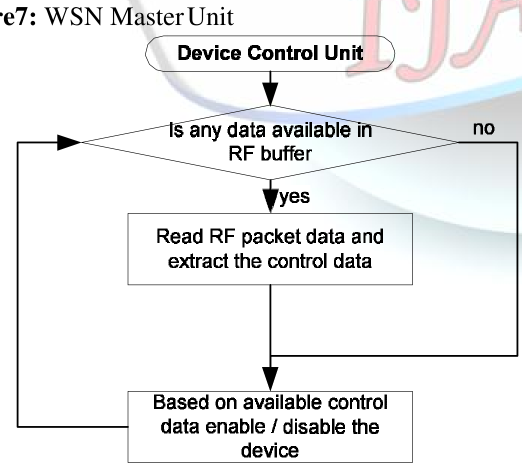

Figure8: Device Control Unit

V. CONCLUSION AND FURTHER ENHANCEMENT

CONCLUSION

As the innovation of new technology faces many problems during development stages, this integration of WSN and IoT also have challenges related to standardization, architecture and interfaces with other networks. The integration into the internet will allow for wide access to sensor data and collaboration between geographically disparate networks.

FURTHER ENHANCEMENT

Currently the communication from WSN master to the web server is an one way communication, the web server cannot access WSN master. The planned further enhancement is about accessing of WSN master to control the devices in the Device Control Unit.

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