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

RTOS Based Device Control And Energy Monitoring System

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***Abstract*— This paper is an RTOS based architecture designed for the purpose of data transmission between two controlling units through EWSN without collision. It also contains Energy and Environmental monitoring system using Internet Of Things (IoT). RTOS is a Process which will be done between hardware and application. Here, stack is the one which is used to avoid the independency of the layers from one with another inside the protocol comes under the standard IEEE802.15.4.Mostly, during the packets transmission some collision may occur. This collision has to be avoided to prevent the data loss during the transmission. This project deals with the data transmission between two units in the exact time without any collision. The data transmission time is increased with the protocol standard. One of the section runs with RTOS and LPC2148 as master node and another as normal data acquisition node to which sensors are connected. Data acquisition node uses the Peripheral Interface controller. Communications between two nodes (hardware and application) are accomplished through IEEE 802.15.4. 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. Today this networks are used in many industrial, environmental and home applications.**

***Keywords*—RTOS; Internet of Things; Device Control; Energy monitoring; Embedded System**

NOMENCLATURE

RTOS – Real Time Operating System
IoT – Internet Of Thing
EWSN – Embedded Wireless Sensor Network
ADC – Analog to Digital Converter
RF – Radio Frequency
IR – Infra Red
IDE – Integrated Development Environment
LDR – Light Dependent Resistor
PIC – Peripheral Interface Controller

I. INTRODUCTION

The RTOS is to manage the allocation of these resources to users in an orderly and controlled manner. This sensor node is compsed of a micro-processors, transceivers, displays and analog to digital converters. Sensor nodes are deployed for industrial process monitoring and control. The sensing parameters can be displayed as graph in Master node. The basic view of this technique is to reduce the possibility of collision and to meet the critical requirement of timing for data transmission of environmental, industrial and home applications. The system in this paper was designed using Small RTOS as the software development platform. 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 worldwide 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. *Limitations of existing Design*

Collision is possible and data loss during the transmission. Time-critical operations must be processed within interrupts (ISR).Split of time-consuming functions that exceed *Super-Loop* cycle. No layer architecture and no data acquisition node.

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B. *Real-Time Operating System*

The embedded real-time operating system (RTOS) is the platform of the development of the embedded software. In recent years, RTOS is commonly used in the 32-bit SCM with the development of semiconductor industry in common use. RTX51 is a multitasking real-time operating system used in the series of ARM LPC2148 single-chip. The C/OS-II is the open source real-time kernel.

It can be used for all kinds of 8, 16, and 32-bit SCM or digital signal processor (DSP). Because the code capacity of the RTX51 is 6k, and a lot RAM is needed, so it has no source code. The C/OS-II is the source code, but also needs a large scale external RAM, so it does not fit this project. Small real-time operating system uses the stack management mechanism of the RTX51 Tiny. Small RTOS has the following features: (1) the open source code; (2) portable; (3) it can be solidified; (4) preemptive; (5) interrupt management; (6) the space of RAM is small; (7) it supports establishment, awakening, sleep, deletion, message queue, semaphore, dynamic memory allocations of the task of the real-time system. The Small real-time system has strong practicability in small and medium-sized project. It is especially important for those occasions with requirements of low costs.

III. PROPOSED SYSTEM ARCHITECTURE

A. *FEATURES OF THE PROPOSED SYSTEM*

The system monitoring the environment status such as light level, temperature, gas and electrical parameter readings such as voltage, current, energy and other features are:

- The proposed system consists of the Transmit Unit and the Master Node. In which the receiving section consists of an ARM controller working in RTOS and device are controlled.
- Software stack have protocol standard IEEE802.15.4
- With IoT the Machine-to-Machine (M2M) communication also can be enabled
- Good flexibility in Addition or deletion of sensors infrastructure

B. *PROPOSED ARCHITECTURE COMPONENTS*

This architecture contains two components

1. Transmit Unit: Collecting the environmental and parameters data, processing these data using analog to digital converter (ADC). Based on the processing result it sends the sensor data to Master Node. It also transfers the environmental and electrical parameters data to the IoT server with IP protocol using router.
2. Master Node: Receive the environmental data through RF transceiver. RTOS is running in the Master Node and it will control the device using multitasking with time critical operation.

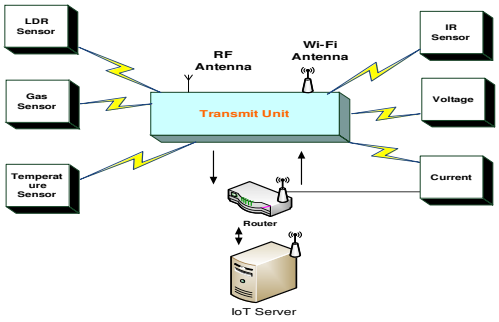

Figure 1: Architectural Components

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

Transmit Unit contains

a. PIC 16F8667
b. ESP8266 –Wi-Fi Transceiver
c. RFM75 – RF transceiver
d. Sensors – LDR,LM35,GAS and IR

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.

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.

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.

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.

GAS detector is a device which detects the presence of various gases within an area, usually as part of a safety

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system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down.

IR sensor work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum.

Voltage is sensed by using a Potential Transformer and the obtained signal is rectified at the first op-amp stage and amplifier at the second op-amp stage.

Current is sensed from by using Current Transformer and it is rectified at the first op-amp stage and amplifier at the second op-amp stage.

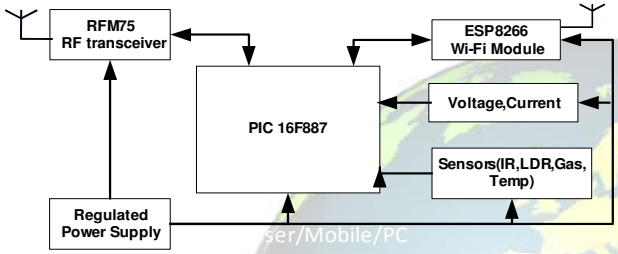

Figure 2: Transmit Unit Block Diagram

Master Node is constructed with

a. ARMLPC2148 – 32bit microcontroller
b. RFM75 – RF transceiver
c. LCD(16x2)
d. LAMP
e. VENTILATOR
f. BUZZER

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.

LCD can display 16 characters per line and there are 2 such lines. Each character is displayed in 5x7 pixel matrix.

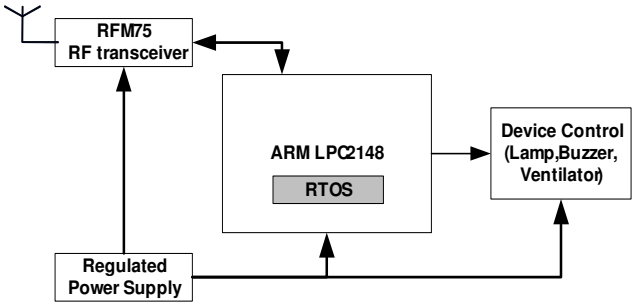

Figure 3: Master Node Block Diagram

Note: The detailed information about each device is available at corresponding manufacturer data sheet.

B. System Softwares tools set

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

Keil µVision: This is LPC2148 software development tool which is used to develop the Master Node software functionalities with Real Time Operating System(RTOS). 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.

CCS: This Code Composer Studio IDE is highly optimized and feature-rich ANSI C compiler for Microchip PIC® MCUs. CCS 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.

It allows developers to manage every aspect of their embedded software development, from design through device programming and debugging. It 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

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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 two component and each component has its own software unit. The communication of sequence is as below

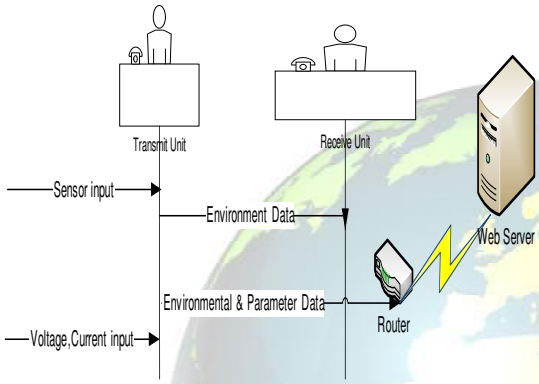

Figure 4: Software Sequence Diagram

Transmit Unit:

Transmit Unit have four sensors are connected as input to ADC of the Transmit Unit to read the sensing data. Christo Ananth et al. [3] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received.

Transmit Unit will transmit the web data to web server through router.

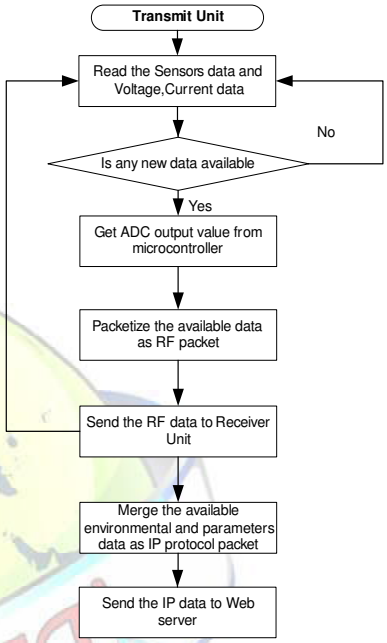

Figure 6: Transmit Unit

Master Node:

This component will take care about De-packetizing the RF data packet and extract the environmental data. It creates the control data with the help of available threshold value. Based on received control data enable / disable the device. The multitasking operating system - Real Time operating system (RTOS) running in LPC2148.It will control the device and displayed in LCD. RTOS will control the device using multitasking with time critical operation.

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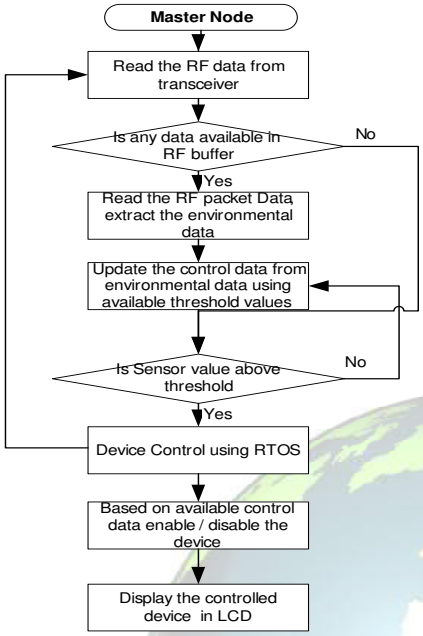

Figure 7: Master Node

V.CONCLUSION

Environmental device control and energy monitoring system of the home application used the chips PIC16F887 and ARM LPC2148 as the design core. The embedded software is designed based on the RTOS development. The micro real- time system is used to meet the changeable needs of the user. The real-time system kernel and the user program can be realized in a single chip. Integration of Transmit Unit 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.

REFERENCES

[1]. Zhou,Hongpo. Development Method Based on Embedded System [J]. Microcomputer Information200672-55-57.

[2]. Chen,Mingji, Zhou,Ligong.Princple and Application of Embedded Real-Time Operating System Small RTOS51 [M].Beijing Beihang University Press. 2004,1.

[3]. Christo Ananth, S.Shafiqa Shalaysha, M.Vaishnavi, J.Sasi Rabiyathul Sabena, A.P.L.Sangeetha, M.Santhi, "Realtime Monitoring Of Cardiac Patients At Distance Using Tarang Communication", International Journal of Innovative Research in Engineering & Science (IJIRES), Volume 9, Issue 3,September 2014,pp-15-20

[4]. Wang,Huijiao Dong,Rongsheng Gu,Tianlong. Design and Implement of the Embedded GPRS Terminal Unit Based on the MCU of AT91R40008. Microcomputer Information2005,10-2 28-30.

[5]. Keil Software, Inc.RTX-51/RTX-251 User's guide[M].1997 ,9.

[6]. Jean J.Labrosse. Embedded Real-Time Operating System µC/OS- [M]. BeijingBeihang University Press..2003,5.

[7]. M. Kranz, P. Holleis, A. Schmidt, "Embedded Interaction: Interacting with the Internet of Things", IEEE Internet Computing, Vol. 14, pp. 44-53, 2010.

[8]. M. Starsinic, "System Architecture Challenges in the Home M2M Network," IEEE Applications and Technology Conference, pp. 1-7, May 2010.

[9]. R. W. Schulte, Y. V. Natis, "Service Oriented Architectures", Part 1, SPA-401-068, Gartner Group.

[10]. R. W. Schulte, Y. V. Natis, "Service Oriented Architectures", Part 2, SPA-401-069, Gartner Group

[11]. Newcomer, G. Lomow, Understanding SOA with Web Services (Independent Technology Guides): Addison-Wesley Professional, pp. 27-28, 2008

[12]. Kreger, "Fulfilling the Web Services Promise", Communications of the ACM, Vol. 46, pp. 29-34, 2003.

[13]. Z. Shelby, "Embedded Web Services", IEEE Wireless Communications, Vol. 17, pp. 52-57, 2010.