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Controlling and Monitoring the Various Applications of Embedded Wireless Sensor Network

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Abstract:

Advancements in silicon technology, embedded systems, sensors, micro-electro-mechanical systems, and wireless communications have led to the emergence of embedded wireless sensor networks .Embedded wireless sensor networks (EWSNs) consist of sensor nodes with embedded sensors to sense data about a phenomenon and these sensor nodes communicate with neighboring sensor nodes over wireless links. Many emerging EWSN applications in various domains, including surveillance, environment monitoring, traffic monitoring, volcano monitoring, and health care. In this paper, we consider ARM multi core which acts as hierarchical MCEWSN for information fusion such that controller receives sensing measurements from single-core sensor nodes equipped with temperature, LDR and smoke sensor through wireless network(Zigbee) and also it receives data from the camera. Once the sensor recorded values gets exceeded the threshold level a buzzer will be placed to alert the operator in the control room .Whatever information the controller receives, it will be displayed on Display unit and through Wi-Fi, we can watch the received data on remote pc/ laptop by unique IP address provided.

Index Terms:

WSN, EWSN, ARM, LDR, Wi-Fi, Zigbee.

I.INTRODUCTION:

A wireless sensor network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, 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 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.Embedded wireless sensor networks (EWSNs) consist of sensor nodes with embedded sensors to sense data about a phenomenon and these sensor nodes communicate with neighboring sensor nodes over wireless links. Many emerging EWSN applications (e.g., surveillance, volcano monitoring) require a plethora of sensors (e.g., acoustic, seismic, temperature, and, more recently, image sensors and/or smart cameras) embedded in the sensor nodes. Although traditional EWSNs equipped with scalar sensors (e.g., temperature, humidity) transmit most of the sensed information to a sink node (base station node), this sensetransmit paradigm is becoming infeasible for informationhungry applications equipped with a plethora of sensors, including image sensors and/or smart cameras.

Processing and transmission of the large amount of sensed data in emerging applications exceeds the capabilities of traditional EWSNs. For example, consider a military EWSN deployed in a battlefield, which requires various sensors, such as imaging, acoustic, and electromagnetic sensors. This application presents various challenges for existing EWSNs since transmission of high-resolution images and video streams over bandwidth-limited wireless links from sensor nodes to the sink node is infeasible. Furthermore, meaningful processing of multimedia data (acoustic, image, and video in this example) in real-time exceeds the capabilities of traditional EWSNs consisting of single-core embedded sensor nodes, and requires more powerful embedded sensor nodes to realize this application.

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Since single-core EWSNs will soon be unable to meet the increasing requirements of information-rich applications (e.g., video sensor networks), next generation sensor nodes must possess enhanced computation and communication capabilities. For example, the transmission rate for the first generation Mica motes was 38.4 kbps whereas the second generation Mica motes (MicaZ motes) can communicate at 250 kbps using IEEE 802.15.4 (Zigbee). Despite these advances in communication, limited wireless bandwidth from sensor nodes to the sink node makes timely transmission of multimedia data to the sink node infeasible. In traditional EWSNs, the communication energy dominates the computation energy.

For example, an embedded sensor node produced by Rockwell Automation expends 2000× more energy for transmitting a bit than that of executing a single instruction. Similarly, transmitting a 15 frames per second (FPS) digital video stream over a wireless Bluetooth link takes 400 mWFortunately, there exists a tradeoff between transmission and computation in an EWSN, which is well-suited for in-network processing for information-rich applications. and allows transmission of only event descriptions (e.g., detection of a target of interest) to the sink node to conserve energy. Technological advancements in multi-core architectures have made multi-core processors a viable and cost effective choice for increasing the computational ability of embedded sensor nodes.

Multi-core embedded sensor nodes can extract the desired information from the sensed data and communicate only this processed information,which reduces the data transmission volume to the sink node. By replacing a large percentage of communication with in-network computation, multi-core embedded sensor nodes could realize large energy savings that would increase the sensor network's overall lifetime.

II.PROPOSED SYSTEM:

The Block diagram depicts the architecture of a multi-core embedded sensor node in our MCEWSN. The multi-core embedded sensor node consists of a sensing unit, a processing unit, a storage unit, a communication unit, a power unit, an optional actuator unit, and an optional location finding unit.

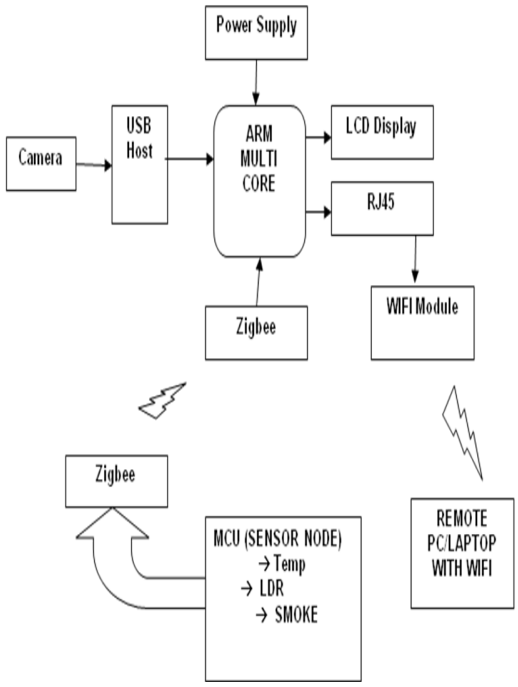

Figure.1 Block Diagram

We consider ARM multicore which acts as hierarchical MCEWSN for information fusion such that controller receives sensing measurements from single-core sensor nodes equipped with temperature, LDR and smoke sensor through wireless network(Zigbee) and also it receives data from the camera. Whatever information the controller receives, it will be displayed on Display unit and through wifi, we can watch the received data on remote pc/laptop by unique IP address provided.

III. HARDWARE IMPLEMENTATION:

The Friendly ARM9 is a single board computer based on a Samsung S3C2440 ARM9 microprocessor. The board measures 10 cm x 10 cm, ideal for learning about ARM systems or integrating into numerous products. The Samsung S3C2440 features an ARM920T core, a 16/32-bit RISC microprocessor, to provide hand-held devices and general applications with cost-effective, low-power, and high performance micro-controller solution in a small form-factor.

The S3C2440 is developed using 0.13 um CMOS standard cell and a memory compiler. In addition, it adopts a new bus architecture called Advanced Microcontroller Bus Architecture (AMBA).

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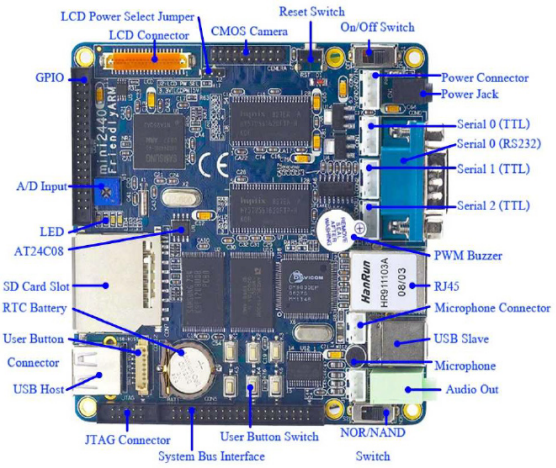

Figure.2 S3C2440 ARM9 Board

By providing a comprehensive set of common system peripherals, the S3C2440 minimizes the overall system costs and eliminates the need to configure additional components.The S3C2440 includes the following components:

- separate 16 KB instruction and 16 KB data cache.
- MMU to handle virtual memory management.
- TFT& STN LCD controller
- NAND flash boot loader
- system manager (chip select logic and SDRAM controller)
- 3-ch UART
- 4-ch DMA
- 4-ch timers with PWM
- I/O ports
- RTC
- 8-ch 10-bit ADC and touch screen interface
- camera interface
- AC97 audiocode interface
- IIC-BUS interface
- IIS-BUS interface
- USB host
- USB device
- SD host & multimedia card interface
- 2-ch SPI
- PLL for clock generation.

ZIGBEE:

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or in the works are:

- Home Automation
- ZigBee Smart Energy
- Commercial Building Automation
- Telecommunication Applications
- Personal, Home, and Hospital Care
- Toys

ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys. ZigBee Router (ZR): As well as running an application function a router can act as an intermediate router, passing data from other devices.

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ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

The protocols build on recent algorithmic research (Ad-hoc On-demand Distance Vector, neuRFon) to automatically construct a low-speed ad-hoc network of nodes. In most large network instances, the network will be a cluster of clusters. It can also form a mesh or a single cluster. The current profiles derived from the ZigBee protocols support beacon and non-beacon enabled networks. In non-beacon-enabled networks (those whose beacon order is 15), an unslotted CSMA/CA channel access mechanism is used. In this type of network, ZigBee Routers typically have their receivers continuously active, requiring a more robust power supply.However, this allows for heterogeneous networks in which some devices receive continuously, while others only transmit when an external stimulus is detected. The typical example of a heterogeneous network is a wireless light switch: the ZigBee node at the lamp may receive constantly, since it is connected to the mains supply.

WIFI:

Wi-Fi is a local area wireless technology that allows an electronic device to exchange data or connect to the internet using 2.4 GHzUHF and 5 GHz SHF radio waves. The name is a trademark name, and is a play on the audiophile term Hi-Fi.The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". Many devices can use Wi-Fi, e.g., personal computers, videogame consoles, smartphones, digital cameras, tablet computers and digital audio players. These can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can comprise an area as small as a single room with walls that block radio waves, or as large as many square kilometres achieved by using multiple overlapping access points.

Wi-Fi allows cheaper deployment of local area networks (LANs). Also spaces where cables cannot be run, such as outdoor areas and historical buildings, can host wireless LANs. Manufacturers are building wireless network adapters into most laptops. The price of chipsets for Wi-Fi continues to drop, making it an economical networking option included in even more devices.

IV. SOFTWARE SPECIFICATIONS AND FRAMEWORK:

Software Specifications:

1.Operating System : Linux
2.Qt for Embedded Linux
3.Platform : OpenCV (linux-library)

1.Linux Operating System:

The Linux open source operating system, or Linux OS, is a freely distributable, cross-platform operating system based on Unix that can be installed on PCs, laptops, net books, mobile and tablet devices, video game consoles, servers, supercomputers and more.

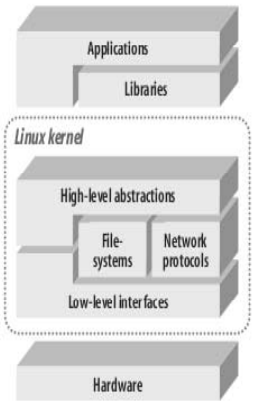

Figure.3 Linux OS Architecture

2.Qt for Embedded Linux:

Qt for Embedded Linux is a C++ framework for GUI and application development for embedded devices. It runs on a variety of processors, usually with Embedded Linux. Qt for Embedded Linux provides the standard Qt API for embedded devices with a lightweight window system.

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3.OPEN CV Library:

Open CV is an open source computer vision library originally developed by Intel. It is free for commercial and research use under a BSD (Berkeley Software Distribution) license. The library is cross-platform, and runs on Linux, Windows and Mac OS X. It focuses mainly towards real-time image processing, as such, if it finds Intel's Integrated Performance Primitives on the system, it will use these commercial optimized routines to accelerate itself.

V. RESULTS:

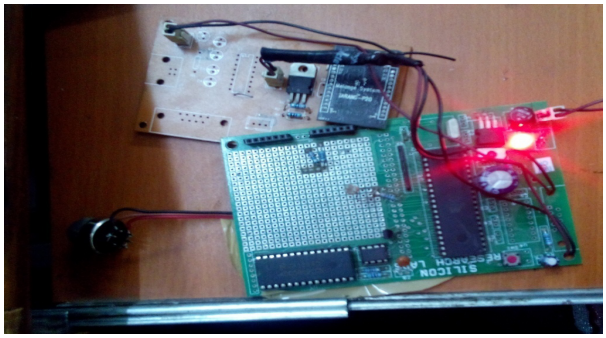

Figure.4 Hardware Kit

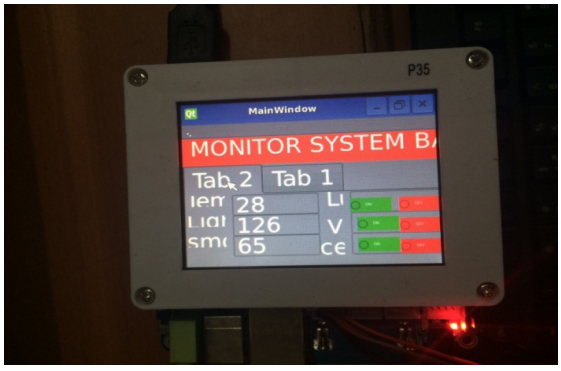

Figure.5 output of sensor values in LCD display at remote area

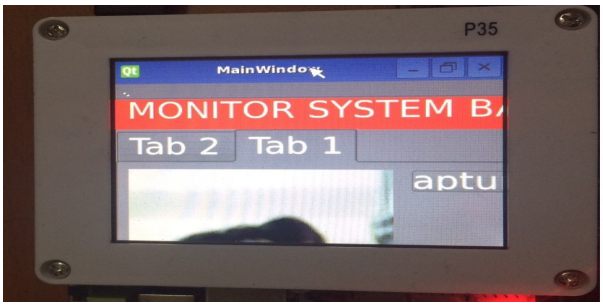

Figure.6 output of video streaming in LCD display at remote area

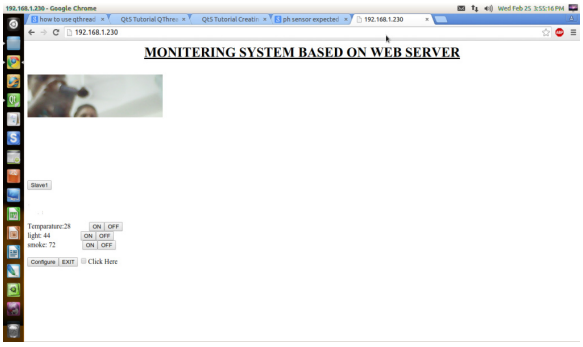

Figure.7 output of video streaming and sensor values in web page

VI. CONCLUSION:

Our main objective of this paper is to monitor and control the operations performed in the remote area, also to give continuous readings of sensor values detected by multiple sensors. Like temperature, smoke, light sensors and also if any of those value exceeds the threshold limit it have been alerted by a buzzer.

All the parameters achieved successfully on both transmitter and receiver side. It has been developed by integrating features of all the hardware components and software used.

VII. FUTURE SCOPE:

In future it has wide scope of using GSM in order to alert and to inform the particular authorized operator if certain value exceeds the threshold level. In other way this is the most secured way to alert the operator in current location through message from remote area.

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