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Wireless Control System for Automating Home Appliances and Security Using Android Application

Mr. Sanket Anil Vora*, Prof. S.S.Kendre
PVPIT, Bawdhan,Pune, India; PVPIT, Bawdhan,Pune, India
sankyvora90@gmail.com

Abstract

In recent years, the home environment has seen a rapid introduction of network enabled digital technology. This technology offers new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. Moreover, with the rapid expansion of the Internet, there is the added potential for the remote control and monitoring of such network enabled devices. However, the adoption of home automation systems has been slow. This paper identifies the reasons for this slow adoption and evaluates the potential of ZigBee for addressing these problems through the design and implementation of flexible home automation architecture. A ZigBee based home automation system and Wi-Fi network are integrated through a common home gateway.

Keywords: WSN, XBEE, ZISAS, RF, LPG, IR, IC, LCD

Introduction

Wireless sensor networks have been becoming increasingly essential in recent years because of their ability to manage real-time situational information for various novel services. Recently, the scope of WSN technologies has been expanded to places such as the home, in order to provide the residents with various intelligent services, such as home automation services or home energy management services. However, due to their architectural constraints, such as the trade-off between the performance and cost, WSNs are not effectively implemented in home environments. Therefore, this paper proposes a ZigBee-based intelligent self-adjusting sensor in order to address these concerns. This paper presents a situation-based self-adjusting scheme, an event-based self-adjusting sensor network, and hardware and middleware implementation. We also introduce some smart home services using the proposed system. We implemented our system in real test bed and conducted an experiment. Our experiment shows that we reduce the system's energy consumption.

We designed and implemented a ZigBee based intelligent self-adjusting sensor for home energy management service considering these limited characteristics of sensors. We used the ZigBee technology for networking and communication, because it has low-power and low-cost characteristics [8], which enable ZigBee to be widely used in home and building environments. Our system has distinct characteristics, as follows:

1) **Flexible middleware architecture:** The existing WSN generally has fixed system architecture, because a WSN only needs to perform a uniform task under the given environments. For example, all sensors in the coverage area simply gather data and transmit data to a sink node to provide a periodic measurement application. However, this is not suitable for dynamic environments, such as a home (i.e. required services and surroundings are frequently changed). Thus, we design flexible three layered middleware architecture.
2) **Situation based self-adjusting:** Compared to the existing systems which control the system parameters in accordance with predefined rules, ZiSAS can autonomously reconfigure middleware, network topology, sensor density, and sensing rate based on the environmental situation. That is, ZiSAS collects and analyzes situational information, and then autonomously modifies itself to relieve WSN's hardware/ software limitations.
3) **Event based sensor control:** a sensing rate and node density are important issues in WSNs. The existing WSN does not consider a situation change. However, depending on the service scenarios, gathering data from all sensors is an unnecessary operation. Moreover, it wastes network resources to gather data from no-event areas.
4) **Context-aware service:** The proposed system is able to create the adaptive home services according the location and the resident. The ZiSAS continuously gathers environmental information and

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analyzes the current situations to provide the residents with context-aware services.

Related work

The adoption of home automation technology by consumers has been limited. We propose that, from the home automation domain analysis, the problems limiting wide spread consumer adoption can be grouped into five general categories. Firstly, complex and expensive architecture: the existing systems architectures generally incorporate a personal computer for the purposes of network management and provision of remote access. This adds additional complexity to the system, hence increasing the overall fiscal expense. Secondly, intrusive installation: the majority of systems require varying levels of physical wiring in their architectures. This, in some cases, is due to the expense of the alternative wireless technologies. Hence, these systems require intrusive and expensive installations. Thirdly, lack of network interoperability: both home networks and the home automation systems which utilize them have been developed and adopted in an unplanned and ad-hoc manner. This has lead to a home environment consisting of a complex maze of heterogeneous networks. These networks and the systems that utilize them normally offer little interoperability; leading to three potential problems

- Duplication of monitoring activities, due to lack of interoperability;
- The possibility of interference, between co-existing networks; and
- The potential for two simultaneous, autonomous actions on co-existing networks, interacting and resulting in an undesirable outcome.

Fourthly, interface inflexibility: the existing systems offer varying approaches for users to control and monitor the connected devices. However, this is normally limited to a single method of control, which offers users limited flexibility. The systems which provide more than one interface device normally provide different user interfaces and risk confusing users. Finally, security and safety: the existing approaches have not focused on security and safety problems that may arise from their implementation. Moreover, the systems that offer some degree of security have neglected the problems with sharing information between devices produced by multiple vendors for the purposes of establishing security.

Proposed model

We have connected sensors input to the two nodes. one is LPG gas sensor which is used to sense the leakage of the gas .if gas will get leak the exhaust fan will get automatically on through blue tooth module and alarm get activated. also we have keep facility that if security comes to door, user want to open the door .by sending password of door remotely he can open the door to avoid destruction in home.

Second one IR sensor, it will connect to home window, door, and compound of garden. So if any intruder will come from any of this means without user notice alarm will get ON. Remotely u can control the home. The values from sensor are sending to the server through blue tooth module.

The different application includes when a person enters the room, the light turns on. In the case of a smoke detector when fire or smoke is detected, the lights in the entire house begin to blink to alert the resident to the probable. Home unit continuously ask for data to the nodes through zig-bee. Zig-bee is used for wireless communication.

Node1: consist of ir and water level sensor. IR will connect to home window, door, and compound of garden. So if any intruder will come from any of this means without user notice alarm will get ON. Water level sensor is used to measure the level of water. And perform actions accordingly.

Node2: consist of smoke sensor and LPG sensor. lpg gas sensor which is used to sense the leakage of the gas .if gas will get leak the exhaust fan will get automatically on and alarm get activated .Smoke sensor is used to detect the Fire. And accordingly action will get performed.

Block diagram

Home unit:

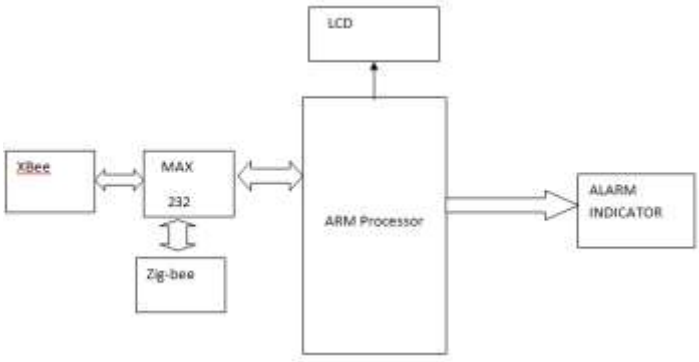

Figure 1: Block Diagram At Home Unit

In Home unit we can use ARM 7 microcontroller for controlling and computation of different signals. LCD is connected to it for displaying the messages or status of the system and the status of the home appliances. Bluetooth and zigbee is used for wireless communication. These

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two devices are interfaced to microcontroller using driver IC MAX232. Alarm indicator is used to alert the owner of home about the status of home appliances. Relay drivers are used to drive home appliances (ON/OFF). These Relay drivers get signal from microcontroller.

Node 1:

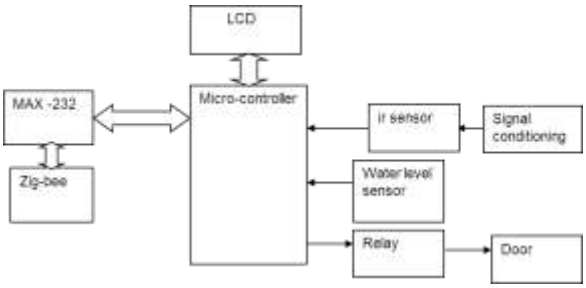

Figure 2: Block Diagram At Node 1

At node 1 All the assembly is same like home module but it has extra sensors attached with it. IR sensors are used to detect the status of door and windows. These signals coming from IR sensors are given to signal conditioning circuit. Depending on the status of this signal relays drives the door n windows (open/closed).Another water level sensor is interfaced with the microcontroller which will check the water level and avoid overflow.

Node 2:

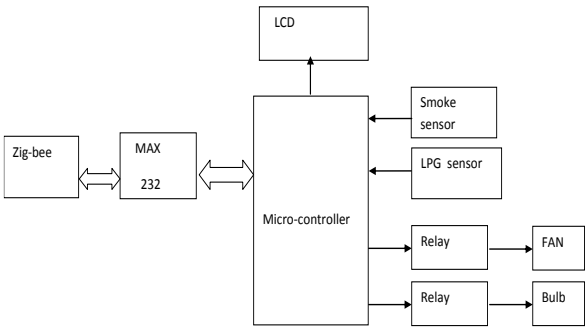

Figure 3: Block Diagram At Node 2

At node 2 zigbee is used for wireless communication. Different sensors like smoke sensor, LPG sensor are used to sense the smoke and leakage of LPG. This is a feature added to the system to increase the security. Relay is used to drive home appliances like Bulb, Fan (ON/OFF).

System architecture

This section describes the conceptual design of a flexible and low cost home automation infrastructure. The home's low data rate, control and monitoring needs are catered for using Zigbee.

A home gateway is implemented to provide interoperability between the heterogeneous Zigbee and Wi-Fi networks, and facilitate local and remote control and monitoring over the home's devices. A virtual home is implemented for the provision of real time security and safety for the home and its inhabitants. Remote user can access the system using the Android Application. They are then wirelessly transmitted to the Home Gateway using the homes ZigBee network. These communications are checked and processed by the home gateway. This checking process involves communication with the home networks coordinator, which is integrated with the home's device database and contains the status of all connected devices. Once checked the communications are sent to the real home automation system and the respective device. Additionally, a local ZigBee based remote control can be used to directly control connected devices.

Advantages:

Remotely monitor and control HACS system has many advantages such as remote controlling of home appliances, availability and ease of users.

The system contains low cost components easily available which cuts down the overall system cost.

The ease of deployment is due to wireless mode of communication (zig-bee).

Zig-bee Technology

ZigBee is a radio frequency (RF) communications standard based on IEEE 802.15.4. The general architecture of a Zigbee based home automation network. The Zigbee coordinator is responsible for creating and maintaining the network. Each electronic device in the system is a Zigbee device managed by the coordinator. All communication between devices propagates through the coordinator to the destination device. The wireless nature of ZigBee helps overcome the intrusive installation problem with the existing home automation systems identified earlier. The ZigBee standard theoretically provides 250kbps data rate, and as 40kbps can meet the requirements of most control systems, it is sufficient for controlling most home automation devices. The low installation and running cost offered by ZigBee helps tackle the expensive and complex architecture problems with existing home automation systems, as identified earlier.

Advantages

Remotely monitor and control HACS system has many advantages such as remote controlling of home appliances, availability and ease of users. The system contains low cost components

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Result obtained

In Proposed System we will be using Sensor nodes for Smoke Detection, LPG Detection, Water level Detection and IR Sensor for Sensing status of Door and Window. We have been using relay to reduce the power required to run appliance. For this whole System we are using Wireless Sensor network.

Fig. 4 shows that the LPG leakage is detected and indicated on LCD

Figure 4: Ouput For Lpg Detection

Fig. 5 show the communication using Zisas technology to communicate between the slave and home module

Figure 5: Communication Between Slave 1 And Home Module

Fig. 6 shows that the Smoke is detected and indicated on LCD
and fan is used as exhaust.

Figure 6: ouput for smoke detection

Simulation result

Below is the simulation result for the Arm Processor connected to the LCD and showing the output.

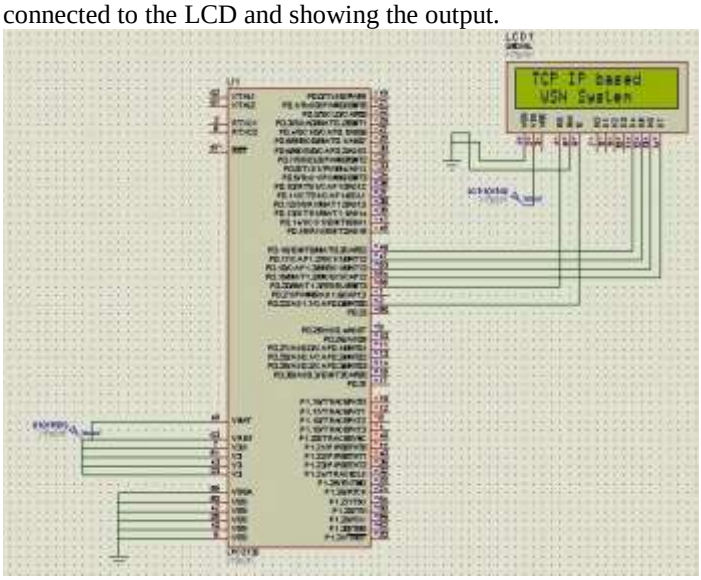

Figure 7: Simulation result of lcd interface with arm processor

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