WIRELESS HOME AUTOMATION SYSTEM

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Abstract. In this paper, a novel design prototype for home automation is presented, where it uses WiFi technology as its communication network. The proposed prototype consists of two modules, where one is a web server the first one is the web server that serves as a system core which organizes, controls, and monitors users’ home. Users and system administrators are controlled either using LAN or internet. The second is a hardware module, which interface sensors and actuators in the home automation system. When compared to commercial home automation systems in the market, the proposed system is cost-effective. The proposed automation prototype controls different devices like security and power management components. The proposed system is highly flexible and scalable with good accuracy.

Keywords—Wireless, LAN, Home automation, WiFi, MicroControllers

INTRODUCTION

Now a day’s utilization of home and building automation systems are increasing to the greater extent. They provide sophisticated infrastructure for private homes. However, for commercial buildings they have centralized control over all the devices and leads to less comfort. These automation devices are primarily used to control the lighting and temperature. Because of the centralized nature, overall size and cost of the system increases. Moreover, energy requirements for the system operation is also a key issue in the current automation systems.

Existing automation systems depend on wired correspondence. Models incorporate KNX, LonWorks and BACnet. Utilizing a conventional wired system doesn’t represent an issue as long as the systems are arranged previously and introduced during the physical development of the structure. Assuming, in any case, previously existing structures ought to be expanded with automation systems, this requires a lot of exertion and much cost since cabling is essential.
Clearly, automation systems lend their hand to help the people. In the previous scarcely any years, automation innovations arrived at their forward leap. automation systems are used in many applications ranging from automation home organizations and cell phones to carport entryway openers. Currently, researchers started exploring the remote automation and respective guidelines also need to be done which need to provide important data to everybody who is searching for the most reasonable systems that serve as prerequisites.

Highlights and Benefits of Home Automation Systems lately, remote systems like WLAN have become predominant technology in many home systems management. Similarly, in home and building automation systems, when compared to wire, wireless technology plays the most vital role and shows positive response in many favors.

1) Reduction in establishment costs: As wireless technology is employed, no cables are required for installation and hence the establishment costs are cut down. Wired connections in automation system require cabling, where the cost depends on the material used in the cabling

2) Ease of organization, establishment, and inclusion: The Wireless hubs are very easy to mount at anyplace. The cabling cannot be used or be stretched in many remote places. A nursery home or the yard that are associated with the home network is implemented with wireless hubs for wireless communication. This serves as a typical example for automation systems. However, innovation in automation provides additional features that makes a big difference in developing the security in the systems.

3) System versatility and simple augmentation: While designing the network the designer’s need to let the open for expansion of the infrastructure, where it is a fundamental design view. Similarly, the system needs to accommodate new or changed features which need to be considered while deploying a system in remote places. When compared to wired connection, in wireless automation, extra hubs and expensive cables are not required. Therefore, cable trifling is avoided. The wireless augmentation creates successive remote establishments.

4) Aesthetical advantages: As already defined, the necessity for remote hubs is very simple. Because of the wireless characteristics, it covers the large area and it also helps to assist by fulfilling the prerequisites of the system. Such Models implement the structures with all-glass and chronicle design structures where it does not plan or permit for laying of links.

5) Cell phone Integration: In many remote organizations, PDAs and Cell phones with the automation systems are developing all over the place. However, if the physical area of the gadgets is not available, then the critical point is considered as the point where the gadgets are no longer reachable. Common models incorporate an architect who interfaces with the network, plays out a specific administration task, and separates in the wake of having completed the undertaking; or control of blinds utilizing a controller. For every one of these reasons, remote innovation isn't just an appealing decision in remodel and restoration, yet additionally for new establishments.
1 Problem Statement:

1.1 Challenges

Both home and commercial automation systems have four main challenges [4], they are firmness, expense of possession, firmness, reasonability, and trouble in accomplishing security. The key fundamental targets of that exploration is to plan and to execute a new innovative and free home and building automation system that is fit for managing and mechanizing the majority of the house devices through a simple sensible web and hardware interface to run the practical and real automation systems. Our proposed design prototype has a flexible and highly adaptable design where it uses WiFi network techniques which interconnects appropriate hardware modules to operate home automation servers. This further reduces operating cost and that increases the capacity of updating, and configuration in systems utilizes secure remote LAN associations between circulated equipment modules and workers, and more secure correspondence conventions among clients and workers.

1.2 System Design

The proposed system prototype of home automation system is distributed in nature where it comprises server and other interface modules equipment. Server controls each equipment in the interface module where they are organized to deal with multiple components interface modules effectively. Thus, the different interface modules are used to control actuators based on the sensors inputs and alerts are triggered to the user. The server is nothing but an ordinary PC, with a WiFi card, and combined to form a web worker. ASP.net is used for the web server programming and hence web server upholds asp and.net application framework 4.0, and for windows OS systems IIS7.0 is used. This software can be obtained from the browser of any PC that is connected to the internet which is similar to LAN utilizing server IP, or remotely from any PC or portable handheld devices connected with the web is a suitable internet browser that holds asp.net framework through unique server IP (web IP). WiFi technology is chosen as the network backbone structure for the organization system where it associates servers with appropriate interface modules. WiFi is selected to provide secure connection and thus it improves system security. It also helps to build highly versatile and adaptable systems. However, in future if the server plans to establish new equipment interface modules which includes gateways, repeaters or hubs remote LAN, where these devices will perfectly tackle the current issue. The key important parts of the server are to supervise, control, and monitor different systems segments, which empowers interface modules to execute their relegated actions (through actuators), and it to report the appropriate scenario to server’s with set off values from sensors.

In this mode of arrangement, servers may include and disregard component interface modules. The modules contain which triggers fundamental macros and are capable of redoing the functions to perform activities for complex scenarios. Such functions can be triggered either physically or in response from other components like movement sensors, wifi modules or any observation from cameras. Similarly, Servers have certain functions to trigger the element which allow the systems to automate the lighting system, where it stops the lights on certain regular or irregular conditions.
In working condition mode, component interface modules notify the server with errors, and it will execute its predefined and customized functions for sensors and actuator which are connected either through direct wired or wireless connections. The interface modules have the ability to control the energy consumptions in the board systems like regulators, lighting, ventilation, warming, cooling and security systems which includes alarms, cameras, entryway locks and movement identifiers,

1.3 Systems Requirements

The key components that are required for the proposed automation systems are highlighted in the diagram.

1) Well-defined user interface: User can clearly depict the system functionality in both local or distant home automation systems, through simple online interface.

2) Security and validation: Only validated and approved customers can login to the both local and remote systems to manage, control, and monitor the component modules connected to the automation system. The system also recognizes the intruders which should always quickly notify the owner with caution. Moreover, owners have the lock login ability for some time.

3) Low expense for hub: Hubs are used to collect the data from different sensors and it is the central point for multiple wireless devices. More hubs are required for efficient automation in buildings Be that as it may, the market requires serious execution as opposed with wired connections which need to be conveyed at this low system cost. In Addition, conventions are need to increase the hub quantities where for guaranteeing message conveyance

4) Inclusion of maximum region: Another key feature lies in the way in which the gadgets are structured in automation systems over the scattered regions to the large extent. Since handsets should not consume much energy because they can't be worked with a transmission run adequate for sensors to reach.

1.4 Design and its Implementation

A. Layout of Proposed Automation System

The proposed design prototype encompasses three significant building blocks: the server, the hardware and product bundle interface modules. When the server is associated with the web, then the Clients use a similar technique to login to the server application. Because of that remote clients can access server online applications through the web by using the internet browsers.

B. Proposed Home Automation System Functions (Home Region Interface).

The proposed wireless automation system has the ability to control the additional parts in client’s home:

- Temperature
- Recognition of Motion
- Recognition of fire and smoke
- Status of door
- Indication of Light level
• Examining the video

The proposed system can control the following

• Environment
• Functionality of Lights
• HVAC operation
• Window and Door open/closure Conditions
• various machine operations”

C. Client Characteristics

The proposed design prototype is a tool for the assessing client, where clients are characterized as one of the guidelines in the Windows operating systems where it utilizes the Internet for retrieval. Wayfarer General is an important client who has the most utilization of the system's usefulness. Overseer; who also control and manage the access and authorizations strategy of the security systems. They are capable of adding or deleting client accounts.

D. Plan and its Implementation Constraints

The Proposed prototype uses HTML, CSS and ASP. The client application is executed in ASP. Net, whereas the hardware interface applications are executed using C Language.

E. Assumptions and its Dependencies

• The segment of system is consistent
• Each system user have a unique User ID and password
• Controlled by a single Administrator.
• Server should consistently run in windows systems
• The Internet should be accessible.
• Proper programs need to be implemented
• Appropriate Hardware Components are interfaced
• Users are skilled with PC operations

F. Programming Design Concept

Programming of the proposed design uses Microsoft Visual Studio 2010 and asp.net, Server application program runs on Windows OS where it requires IIS web server, and " Net" is used. The server application programming is hosted at a central point in the web where the server has genuine IP.
Server application programming is capable of setup, arrangement and it keeps the entire home automation system active. Servers use information bases and update the logs for automation systems. In this approach, we utilize XML records for systems logs. The Arduino programming, assembled utilizing C language, utilizes microcontroller as well. Arduino programming collects the information from different associated sensors. Then it applies suitable operations to actuators which are already pre-defined in the server. It also performs other additional functionalities which is used to record the history in the server DB and performs reporting as well.

G. Class Description

1) Data source log
   Log text records has specific format where it can be loaded up with information. It contains the date of the day and a log number.
   - Write - Log Entry: Function to write the information into the log record by using a stream.

2) Data source XML
   - It contains the data for all tasks which includes User, Sensors and Automation
   - Adding User: It performs the functionality to add new users to the systems
   - Get User Hex: Hex data is used for security where it checks both login name and secret password, along with that an arbitrary number that is generated for every user is also validated. This number is unique for each time the client signs into the systems
   - Validate User: Validate whether entered username and secret key is matched with the spared XML record or not.
   - Sensor Status: Retrieve a last status of sensor from the XML document

![Fig. 1. Proposed home automation system architecture](image-url)
Computerization Time: Sets the time for the automation in hours, minutes, and seconds. It also helps to change the information of a particular parameter in the XML document like capacity name: computerization Door, automation Temp, automation Appliance, automation Motion, automation Security and automation Duration.

3) Automator

It is a key element and is responsible for all sorts of automation processes which includes the observation of sensor status to the environment and accordingly automated rules are framed out.

- Initialization: In this phase, status of all the sensors and actuators are initialized and. Sensor value is set to 0, and the actuators value is also set to 0 in the last update in the XML information records.
- Retrieve Data from XML: It retrieves the information from XML where it checks all of the sensors and apparatus. Usually, it contains keyword which is used to retrieve the data from the XML file. Based on the keyword, required data is retrieved from the XML documents.
- Dependency Check: During automation process, the status of particular sensor that depends on some other sensor is checked.
- Watcher: The primary function of the Watcher is to work as a watchman. It monitors each and every sensor and actuators around the clock and refreshes its statuses from the XML document. At certain point when all states become valid, automation starts to executed.
- Measurement of Sensor: The values from the sensors are measured to see the last updates. The output from the sensors are connected to the automation systems to computerize the operations.
- Enact Appliance: It initiates all connected machines that are triggered by the automation system in running mode.
- Manager: Each and every component is responsible for keeping the entire system active.
- Processor: The required information is introduced and loaded into the different sections of the system which will process function and process the data in various modules.
- Inclusion of Auto Engine: The automation sections are loaded into the system that need to be observed.
- Remove Automation: Deletes all sort of automation from the systems and XML document, it also prevents the systems from the usage.
- New Automation: Avail all the different sort of automation and transferred to to run today.
- Go for Automation: The conventional systems are converted from manual to programmed control. In future, the user has full control and there is always provision to stop the automation.
- Inclusion of Auto engine: The required automation section is loaded into the systems and its functionalities are observed.

H. Data Flow:

The data flow in the system is as follows where it starts from the Login interface, then it passes through the Security Module. The approved data is transferred to Data Source and it is logged using the Logger Interface. User uses login interface to login the system. Then, the entered data is passed to the security module to validate the data. In this module, it is transferred to 128-bit hex key and checks the availability in XML files, then the user approved for further process. The execution of the certain automations that are already saved by the user are performed by the Automator. In order to perform this action, it collects the data from different data source XML files, then it compares the data with user entered values using the control interfaces. Once the changes are identified, then the necessary changes are sent to the Communication Module to apply it on the Hardware Interface to perform the action. In this process, the changes are written in the Logger using the Log Interface.
I. Hardware Design of the prototype

The second part of the proposed home automation system design was the choosing of a suitable micro-controller. The requirements for the micro-controller are; a RS232 port, a fair amount of output Digital I/O, and a reasonable speed.

Fig 2: Proposed system use cases

In our proposed design, EEPROM is required to enable the system which stores the status of the device, username, password of the login credentials and hence the data is not lost during power shortages. It is helpful in exchanging the data between home automation servers from one side and sensors, and actuators from the other side. WiFi technology is used for successful communication. In Arduino kit, WiFi module is connected through RS232 communication protocol. Both the sensors and actuators associated with hardware interface module are connected through cables and they are placed separately to protect the Arduino from interference that occurred due to the disturbances in the home and commercial automation systems.

The sensors and actuators are directly connected to the hardware interface module; an isolating interface is needed to protect Arduino from interference caused by home automation components. PCB layout for WiFi Arduino shield is presented in figure 3 and Three input alarms are shown in figure 4. PCB Layout for shield and three output actuators are provided in figure 5 and 6.

J. Layout of Hardware

Hardware part of the system primarily comprises of four different PCBs which includes Arduino, WiFi, alarms, and actuators.
Fig 3: Layout of hardware

Arduino is an open source assessment Kit available online. It mainly depends on 8-bit Atmel microcontroller, which is the heart of the hardware interface module, which is always helpful in exchanging the data between home automation servers from one side and sensors, and actuators from the other side. WiFi technology is used for successful communication. In the Arduino kit, the WiFi module is connected through RS232 communication protocol. Both the sensors and actuators associated with hardware interface module are connected through cables and they are placed separately to protect the Arduino from interference that occurred due to the disturbances in the home and commercial-automation-systems.

K. Implementation snapshots:

Fig 4: Implementation-snapshot-1
CONCLUSION

This paper proposes a novel automation system with minimal effort, secure, self-configurable, local and remote controlled features. The primary purposes of the proposed system are to control both home and remote commercial devices using the WiFi technology framework and to associate its parts by fulfilling necessities and prerequisites of the client. When compared to existing frameworks, WiFi Technology based network arrangement is highly capable and that has ended up with remote controllable feature which gives home security at low cost. Thus, the proposed system accomplishes the key objectives and goals of home automation framework. The design framework model is clearly examined and that presents the essential model to control home equipment efficiently. The prototype design and architecture was discussed and the modal holds good in security perspective as well. Finally, the proposed framework is highly versatile and adaptable in nature.

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