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Android based Interactive Home Automation System through Internet of Things

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***Abstract*— In today's world automatic systems are preferred over manual system. Wireless Home Automation system(WHAS) using IoT is a system that uses computers or mobile devices to control basic home functions and features automatically through internet from anywhere around the world. It is meant to save the electric power and human energy. Home automation is the automatic control and monitoring of household appliances and residential house features like doors, gate and even the windows. Events can be programmed to be triggered under specific conditions, and this can have a great role in reducing the total energy consumed by some appliances. On the other hand, the system can suggest smart task scheduling. In simple installations, demotics may be as straightforward as turning on the lights when a person enters the room. In advanced installations, rooms can sense not only the presence of a person inside but know who that person is and perhaps set appropriate lighting, temperature, taking into account the day of the week, the time of day, and other factors.**

Keywords—Home automation System (HAS), Internet of Things (IoT), Cloud networking, Wi-Fi network, Raspberry Pi, Arduino, PubNub, Parse.

I. INTRODUCTION

A. *Overview:*

Home automation is a technique to use computer/smartphone in controlling Home appliances and Home features. Directly controlling and seamlessly staying connected with the home systems used every day via a mobile device would significantly enhance quality of life. It is not only about remotely controlling the lights, AC, fan, audio systems, curtains, television, kitchen appliances, garage doors, sprinklers from Smartphone from anywhere. Again it is not merely about regularly monitoring the security of home from workplace miles away. It is about exploiting the latest of what technology has on offer. A smart home offers all of these – comfort, convenience, monetary savings, and safety. An indispensable part of a modern home to give it a luxurious look & feel.

B. *Background:*

Homes of the 21st century will become more and more self-controlled and automated due to the comfort it provides, especially when employed in a private home. The "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, and Computing. . A home automation system is a means that allow users to control electric appliances of varying kind. HASs includes centralized control of lighting, appliances, security locks of gates and doors and other systems, to provide improved comfort, energy efficiency and security system. HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and elderly due to their complexity and cost, do not always accept these systems.

Many existing, well-established home automation systems are based on wired communication. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building. But for already existing buildings the implementation cost goes very high. In contrast, Wireless systems can be of great help for automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

II. PREVIOUS WORK

A. *Design of Smart Home Control System Based on Cortex-A8 and ZigBee*

In [1], the system uses Cortex-A8 and ZigBee. The system consists of three parts include user intelligent control terminal, embedded home gateway and home ZigBee wireless network.

It can perform functions such as safety and alarm, the indoor environment testing, household electrical appliances control and intelligent lighting and other functions. Users can access Internet web to monitor the home furnishing remotely. The users can also use cell phone with Android smart furnishing control client applications to interact remotely with home furnishing device.

B. Home Automation Using Internet of Things

In [2], the system uses Intel Galileo that employs the integration of cloud networking, wireless communication, to provide the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed to be low cost and expandable allowing a variety of devices to be controlled. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyse the condition of various parameters in the home anytime anywhere.

C. An Android Based Home Automation System

In [3], an Android based home automation system that allows multiple users to control the appliances by an Android application or through a web site is presented. The system has three hardware components: a local device to transfer signals to home appliances, a web server to store customer records and support services to the other components, and a mobile smart device running Android application. Distributed cloud platforms and services of Google are used to support messaging between the components. Distributed cloud platforms and services of Google are used to support messaging between the components. Such a design of service and data distribution through public and free Google platform makes the system cost-effective.

D. Low cost Arduino/Android-based Energy-Efficient Home Automation System with Smart Task Scheduling

In [5], Home Automation techniques is used to design and implement a remotely controlled, energy-efficient and highly scalable Smart Home with basic features that safeguard the residents' comfort and security. System consists of a house network (sensors and appliance actuators to respectively get information from and control the house environment). As a central controller, used an Arduino microcontroller that communicates with an Android application, user interface. House network brings together both wireless Zigbee and wired X10 technologies, thus making it a cost-efficient hybrid system. Events can be programmed to be triggered under specific conditions, and this can have a great role in reducing the total energy consumed by some appliances. On the other hand, the system can suggest smart task scheduling. The scheduling algorithm presented is a heuristic for the Resource-constrained-scheduling problem (RCPSP) with hybrid objective function merging both resource levelling and weighted completion time considerations.

III. PROPOSED SYSTEM

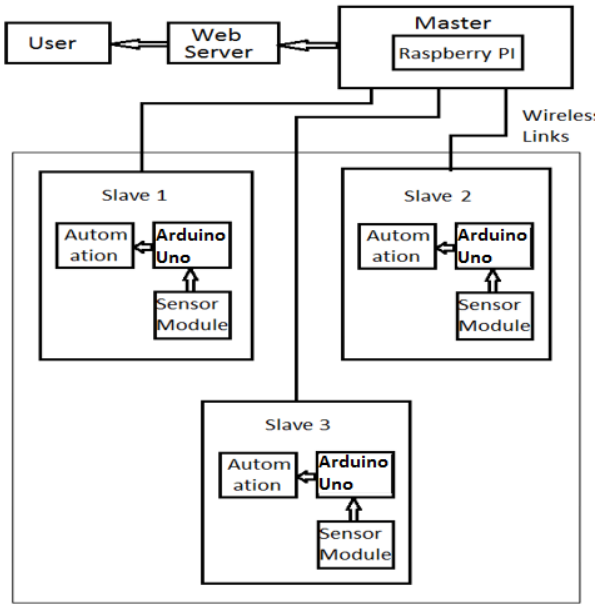

Figure 1: Detailed Design

The system mainly and simply involves the following three components: local hardware, web server, and mobile smart device. The local hardware includes Raspberry Pi and Arduino and the local network devices to connect household appliances. The web server computer offers Google Cloud Messaging (GCM) service to connect the system with the local hardware and the mobile smart devices. Indeed, Google Cloud Platform is used for supporting the bidirectional communication between local device and web server and also mobile device and web server. The web server also provides a web site for the users of the system (the customers and the administrators) to deal with the records stored in the database of the system. The last component is the mobile smart device running Android operating system, such as smart phone or tablet, on which the Android application software of the system is installed to make the mobile customers contact with and manage the in home devices via the server. The Android application on the mobile smart device also provides its users

with a user friendly and non-complex graphical interface to easily control the automated machines at home.

A. Different Subsytems:

Intelligent lighting subsystem: The lights can change to brighter or darker and the change is soft. The brightness can be adjusted continuously and the last set of lighting effects can be saved automatically. So we do not need adjust again. We can get a light scene combination we want such as home mode, living mode, eating mode, sleep mode etc. when only pressing a key. There is also one key mode to control all equipment's which makes the control more flexible.

Intelligent electrical appliances control subsystem: When this subsystem nod receives the command send from the client through wireless, it will parse out whether to drive the relay closed or open to control the power of the household appliances on or off. The selection of the relay should be according to the actual voltage of the equipment. At the same time it also needs the appropriate external circuit to makes the circuit works stable.

Intelligent window curtain subsystem: It can make the curtains and windows opening or closing in electric control mode. There are many ways to control such as control panel, remote controller, remote control and automatic control. The automatic control method that can automatically control the opening or closing of the curtain according to the light intensity information, window closing operation according to the rain and wind strength information. If the power supply breaks off, the system can operate manually.

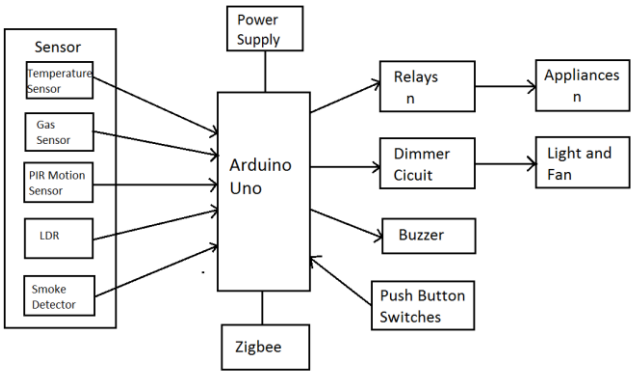

Figure 2: Slave Design

Intelligent environment control subsystem. Controller controls each sensor to capture the information such as temperature, humidity, air quality and so on. Then these information after process is sent to the coordinator. The coordinator send the data to the embedded home gateway. After analysis of the indoor environment, the adjustment commands are sent to the related equipment to make the temperature and humidity constant, to keep the air fresh and to keep indoor environment comfortable.

Intelligent safety assurance subsystem: It can detect abnormal phenomenon in home using infrared detectors, infrared sensor of door and window, combustible gas sensor and smoke detectors and so on. When the combustible gas sensor detect the leakage of gas or smoke detectors detect the smoke concentration exceed in the standard, it will automatically start the exhaust fan and trigger the window switch. Thus the window is open to make indoor and outdoor air circulation to reduce the risk. When the infrared detector detect any break in people, monitoring camera will shot down his image immediately. Then his facial features information and family face information in database will be compared to analyses whether illegally entering. This can effectively avoid the occurrence of false alarm condition. If the above abnormal phenomenon occur, the infrared alarm will automatically ringing. Meanwhile the system would also notify the security people to be arrived at the scene at the first time.

B. Android software design

Software of the proposed home automation system is divided into server application software, Microcontroller (Arduino and Raspberry Pi) firmware and Android Application.

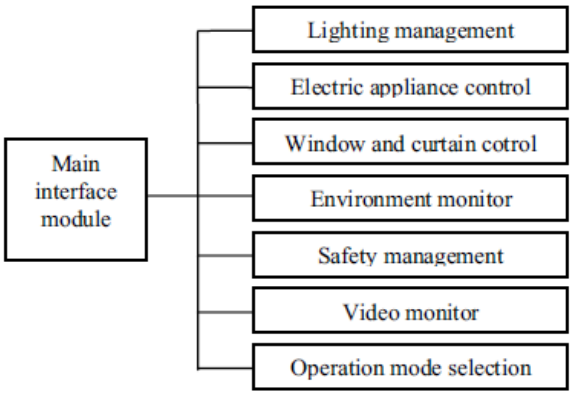

Figure 3: Module layout of Android Interface

IV. ANALYSIS AND DESIGN

A. Design Specification:

The system is designed keeping in mind the following key requirements:

- Clients should be able to quickly and seamlessly connect to and disconnect from the system.
- Connections from all kinds of clients must be handled simultaneously; i.e. Bluetooth, Wi-Fi and Internet.

- Change in the status of an appliance should be propagated to all clients in real-time.
- Customizable time-based profiles to automatically activate and deactivate appliances based on the time of day.
- Hardware should be widely compatible with different PC configurations.
- Provide a simple and user-friendly interface on the client side.

B. Data Flow Diagram:

The mobile device connects to the server PC through Bluetooth or Wi-Fi or through the internet. The user sends commands to the server from the mobile device. The microcontroller is connected to the server via USB. On receiving commands from the mobile device, the server sends commands to the microcontroller over the USB connection. The microcontroller is directly connected to the relays and it can enable or disable them. The relays are connected to the electrical system of the building so that they can control the plug points.

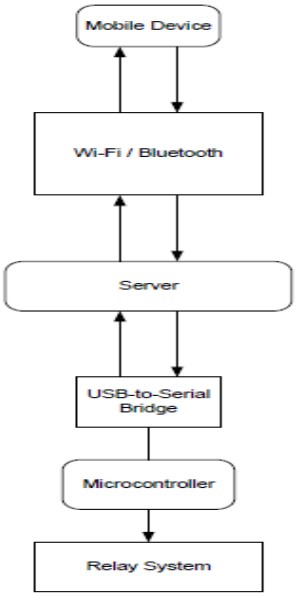

Figure 4: Data Flow Diagram

C. Use Case Module:

Bluetooth or Wi-fi Client Control

When a Bluetooth or Wi-Fi client connects to the server, the server sends it the current status of the appliances so that it can be displayed on the mobile device. When the user sends a command from the mobile device, the server receives it and forwards it to the microcontroller, and then sends updated status of all the appliances to all the clients connected to the server.

Additionally the Wi-Fi client continuously monitors the signal strength, and detects when the user leaves or enters the room according to its configuration, and it can send commands to activate or deactivate appliances.

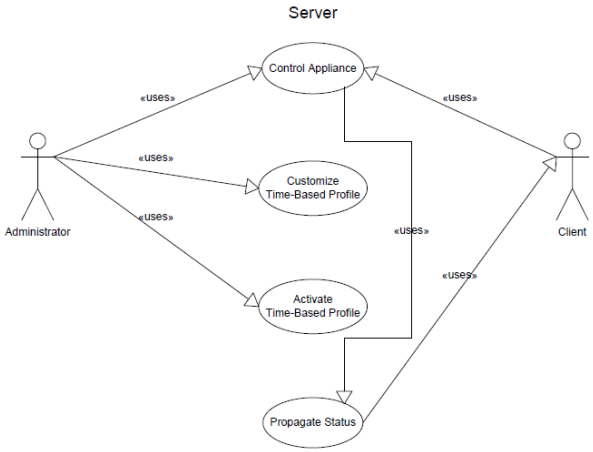

Figure 5: Use Case Module

Time Based Profile

The time-based profiles are configured on the server interface. The server checks whether it's time to activate a particular profile and sends the corresponding commands to the microcontroller to activate or deactivate the corresponding appliances.

CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere. It also includes home security feature like capturing the photo of a person moving around the house and storing it onto the cloud. This reduces the data storage than using the CCTV camera which will record all the time and stores it.

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