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Web Based Home Automation and Security

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ABSTRACT

In 21st century where automation is playing important role in human life. Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only reduces human efforts but also saves energy and time. The main objective of home automation and security is to help handicapped and old aged people to enable them to control home appliances and alert them in critical situations. This paper puts forward the design of a Web based Home Security and Automation using the Arduino Uno microcontroller.

Keywords : SMART, Internet Protocol, DHCP

I. INTRODUCTION

Security is the degree of protection against danger, damage, loss, and crime. Security as a form of protection is structures and processes that provide or improve security as a condition. Security is a prime concern in our day-today life. Everyone wants to be as much secure as possible.

Home/Office Security describes both measures that prevent or deter attackers from accessing a home /office resources and guidance on how to design structures to resist various hostile acts. It can be as simple as a locked door, alarm system or as elaborate as multiple layers of armed Security guards and Guardhouse placement.

Home automation is the use of one or more computers to control basic home functions and features automatically and sometimes remotely. 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, architecture and computing. [1]

Home automation can include the scheduling and automatic operation of water sprinkling, heating and air conditioning, window coverings, security systems, lighting and food preparation appliances. Home automation may also allow vital home functions to be controlled remotely form anywhere in the world using a computer connected to the Internet. Besides the functions already mentioned, remote control can be extended to telephones and answering machines, fax machines, amateur radios and other communications equipment.We are planning to develop a SMART System that is both Reliable, Inexpensive and easy to use. Our system will be able to provide Security and Automation of the basic Components of the House.

Controlling Unit that Makes decisions by processing the Various Signals from sensors and Interpret user Commands. In this work we used Arduino Uno R3 Microcontroller.

1. Actuators Such as Servo Motors, Stepper Motors, Alarms and Webcams.

2. Transmission and Communication Media; in this project our main Transmission Media is the Internet and also a Serial Communications.

Our System integrates different Security and Automation mechanisms some of these are:

Internet: Used as the main Communication media between the Home and the Owner, We use the Internet to send Emails warning the User of Intrusion, allow the User to Control the Automated Components and also Watch LIVE Video from the Camera.

Surveillance: for recording Intruder activity and LIVE Stream the Video through the Internet. The Owner can Control where the Camera is looking.

Alarm System: This can be both Visual and Audible Warning to alert the Surrounding and also scare the Intruder.

II. Literature Review

A home security system by alarm and array of lights system was proposed by [1] This microcontroller based home security with password door lock system feature can also; perform day and night detection, laser beam monitoring system for windows, and magnetic monitoring for doors. In this project they used 80c51 Atmel microcontroller as a central controller, 4*3 keypad to enter password and 7 segment displays to show the entered password. If the user enters correct password the microcontroller directs the stepper motor to open the door but when there is an attempt of break-in the alarm will sound an alert.

Home security system prototype makes use of the 20pin At89c2051 microcontroller. The user is required to enter 5 digit pin to activate or deactivate the door lock security. The "#" serves as an enter key and the backspace by pressing "*" is implemented so that when the user enters a wrong password, this keys can be used to delete the previous entered pin. Windows and doors are monitored by laser beam and magnetic door sensor. If the beam and the magnetic door sensor get interrupted for a possible break-in, hence an alarm will sound and an array of light will blink.

Abhishek S et.al. [2] Proposed a model that will provide security to their home, office or cabin etc. via SMS using GSM technology. This project is designed to provide ubiquitous access to the system for the security using extensive GSM technology for communication purposes and microcontroller for device control. The highlights of our system are the long range of communication and password security. The security is provided by sending a message to our access number, controlling and acknowledgement is done through SMS code between our access number and the authenticated user.

Saito et.al [3] developed home gateway system for interconnecting home network consisting of IEEE 1394 AV network and X10 power line home automation network with Internet. This provided remote access functions from Internet for digital AV appliances like Digital Video Camera, Digital VCR connected to IEEE 1394 network and home appliances like TV, desk lamp, electric fan connected to X10 controller.

Al-Ali and Al-Rousan [4], developed Java based home automation system via World Wide Web. The home appliances were controlled from ports of embedded system board connected to PC based server at home.

Alkar et.al [5] implemented Internet based wireless flexible solution where home appliances are connected to slave node. The slave nodes communicate with master node through RF and master node has serial RS232 link with PC server. The nodes are based on PIC 16F877 Microcontroller. PC server is formed of a user interface component, the database and the web server components. An Internet

page has been setup running on a Web server. The user interface and the Internet front end are connected to a backend data base server. The control of devices is established and their condition is monitored through the Internet.

Tan et.al developed a system for controlling home electrical appliances over the Internet by using Bluetooth wireless technology to provide a link from the appliance to the Internet and Wireless Application Protocol (WAP) to provide a data link between the Internet and a mobile phone. However, technical details relating controller are not revealed.
Ximin et al.[6] designed and implemented an Internet home automation system. The design uses an embedded controller based on C8051F005 microcontroller which is connected to a PC-based home Web server via RS232 serial port. The home appliances are connected to the input/output ports and the sensors are connected to the analog/digital converter channels of the embedded controller. The software of the system is based on the combination of Keil C, Java Server Pages, and JavaBeans, and dynamic DNS service (DDNS) client. Password protection is used to block the unauthorized user from accessing to the server.

Colak Ilhami et al., 2008 [7] developed Internet controlled Heating Ventilation Air Conditioning (HVAC) system. The system can be controlled by three different units (web based remote control, remote control by hand-held device and keypad control mounted on AC). The hardware system of AC is controlled by PIC16F877 microcontroller. A DAQ board inserted into PCI bus of web server is used to control system over web. User is able to access system parameters over web by logging and setting parameters on forms available on main control page. User submits forms to web server having CGI program which performs requested tasks and reports status of system operation. The current operational parameters of the system are measured by microcontroller and displayed on LCD. Using web camera focused on LCD, these parameters are monitored online by client PC.

III. System Design and Description

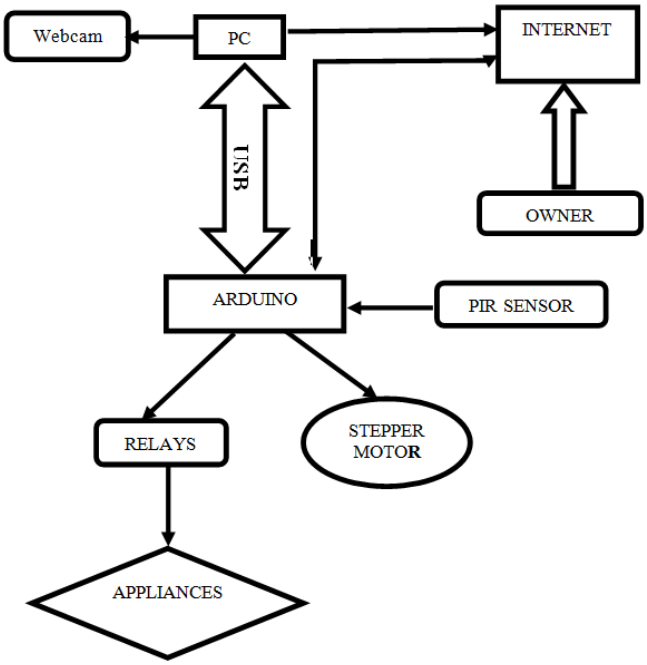

Figure 1. System Block Diagram

The above System block diagram describes the overall working structure of our system and the signal flow.

From the diagram above we can see that a Microcontroller in our case an Arduino Uno is the central part of the system, it monitors signals from sensors such as PIR sensor and also user commands to give the appropriate outputs such as alarming the surrounding or turning the Air conditioners On/Off. Our Arduino is connected to the internet using an Ethernet shield that is attached to the Arduino, the Ethernet shield will allow our Arduino to be able to connect to the internet and also act as a server The Ethernet shield has a unique Mac address and also acquires a unique IP address using DHCP or by assigned static IP address. By accessing this unique IP address the contents on the Arduino can be served to a client on the network. The Ethernet shield has a micro SD card slot which it uses as a storage space., files such as HTML, JS or CSS can be stored and served to the clients connected.

An intrusion detection sensor in our case an Ultrasonic ping sensor scans the perimeter for an intruder and when it detects an intruder a certain limited distance from the perimeter the Arduino sets of an Alarm and also sends a byte to a C# application running on a computer which it turn sends an a notification to the owners e-mail account.

The owner has a web based Control Console which enables him/her to control their Home appliances and also watch the LIVE video transmitted through the webcam. This Webfile(HTML/Javascript) will be stored in an SD card on the Arduino's Ethernet Sheild and will be served to the connected clients.

A. Design of the Web based Interface

Since our system is dependent on World Wide Web it requires the design of an easy to use Web based Control Console that will allow the owner a full control of the Home and also watch the LIVE video stream.

The Design of this Web based interface is achieved by using HTML5, Javascript and CSS.

Figure 2. Finished Web Interface

Basic Idea of HTTP Request and Response

In every Client - Server connection the clients browser sends a default HTTP Request Header which specifies the contents it wants to load, this activity is performed when things such as buttons or images are clicked in which the clients asks a request for the contents by sending the request header and if the content is available the server sends a HTTP Response header. In our system we used this method to tell our Arduino which specific button is pressed

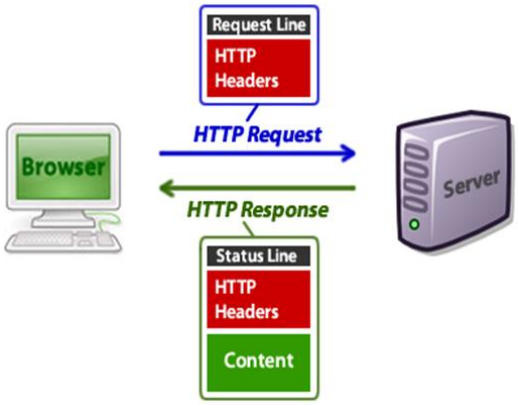

Figure 3. HTTP Headers

HTTP headers are the core part of these HTTP requests and responses, and they carry information about the client browser, the requested page, the server and more. A typical HTTP Request header might look like this

GET /tutorials/other/top-20-mysql-best-practices/ HTTP/1.1
Host: net.tutsplus.com
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US; rv:1.9.1.5) Gecko/20091102 Firefox/3.5.5 (.NET CLR 3.5.30729)
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Keep-Alive: 300
Connection: keep-alive
Cookie: PHPSESSID=r2t5uvjq435r4q7ib3vtdjq120
Pragma: no-cache
Cache-Control: no-cache

And Such a HTTP Response from the server usually looks like this
HTTP/1.1 200OK"
Content-Type: text/html
Connection: keep-alive

In our system there are 6 set of buttons used to control the webcam direction, Fan and Curtain Stepper motors., each button has a specific name or id assigned in HTML, so any time one of this buttons are pressed the browser sends a HTTP Request header string which includes the name or id of the button. Example for the "FAN ON" button the HTML code goes as such

```
<button type="button"id="fanon" onclick="fanon()">FAN ON</button>
```

and the respective Javascript code used to send a HTTP Request to the server is shown below function

```
fanon() {

nocache = "&nocache=" + Math.random() * 1000000;
var request = new XMLHttpRequest();

request.open("GET","?fanon" + nocache,true);
                    request.send(null);

}
```

So every time the FAN ON button is clicked the onClick() event runs the fanon() function which simply sends a default HTTP request using the GET method but with addition of a string which we will use to identify the button name in this case "?fanon". This ?fanon string is what our Arduino based Server looks for in the HTTP request.

B. Methodology Used to LIVE stream video from the Webcam

One of the services provided by our system is the LIVE video stream of the webcam to the client, this is a big challenge because the 8 bit Arduino is not capable of processing the huge amount of RGB data produced by the webcam let alone transmitting it through the internet. Therefore we came up with very simple but effective way of transmitting the webcam video to the client. This method uses a thing that we are very familiar to us, YouTube as we all know YouTube provides a live streaming service for people with an account, so by simply Signing in to YouTube, creating a LIVE event and embedding the video into the webpage designed we managed to get an effective way for this difficult challenge.

```
<iframewidth="560"height="315"
src="//www.youtube.com/embed/8YMICnn8su0"
frameborder="0" allowfullscreen></iframe>
```

Another way for streaming LIVE video is to use commercial software one of this software is called Broadcam video streaming server this software creates a server in which clients will connect to and watch videos from the Computer in which it is running from. But this software requires a configuration change in the routers for it to function. This can be achieved easily on home networks in which the owner has the access.

C. System Programming

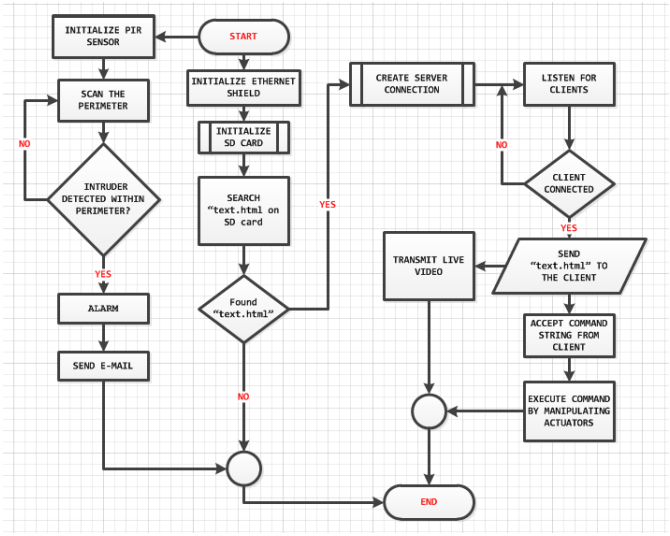

Figure 4 System Flow Chart

IV. Conclusion and Future Work

Right after our system is initialized it displays the IP address of the server found using DHCP and if obtaining IP fails using DHCP it will display the Static IP address., After this task is completed it will look for the HTML file stored on the SD card it will notify the owner if the file is found or not.

When a client is connected(request is sent to the Arduino IP address) our system will load the html file to the clients web browser .This web page contains buttons that control the camera angle, the stepper motor and the Fan. When the client clicks one of this buttons a HTTP request is sent to the Arduino. The Arduino will interpret this requests and perform the respective task this can be rotating the servo motor or turning on the fan.

Based on the testing we made we conclude that our system has accomplished the Objective we set up at the beginning of this project, We have successfully built a web based Home security and automation system that enables owners to monitor and control their homes in real time with very little cost. Our system has achieved most of its objective by making SMART home system that can be installed with very little cost.

This System is highly expandable and opens for numerous options to be added to make it a much better Automation and Security System. Some of these additional features that can be included can be:

- Bionics, which include Face recognition, finger print scanning and Eye scanning technologies to improve security and reduce unauthorized access.
- Including various sensors such as Temperature, Smoke,vibration and various others that will increase the awareness of the owner about all the variables around his/her Home.
- Adding better Warning systems such systems that will notify police when a break in occurs.

V. REFERENCES

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