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Home Control and Sensing Using IoT

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***Abstract*— Home automation is a system in which all the home appliances can be controlled automatically in order to convene the desires of safety, comfort, and efficiency. The internet is providing all kind of information with the click of the button; this helps to connect people and makes their life simpler. The Internet of Things (IOT) is the ever-growing network of physical objects which can be used for connecting, controlling and running intelligent objects which are connected to the Internet through an IP. Accidents that occur in the home are mostly fire accidents. To ensure the safety, security, and comfort of the home and home appliances, we are using temperature and gas sensors. In this paper, a home automation system based on the internet of things is developed. This allows the user to automate all the devices and appliances of home. The user can control the household devices from anywhere in the world. Smart home automation using a micro-controller based raspberry pi 3b board and a web page is proposed in this paper. This paper presents a low-cost Smart Living System, which uses website based User Interface for control of home appliances, namely the air cooler, door, lights, TV, and window.**

***Index Terms*—Raspberry Pi, Wi-Fi, Internet, Temperature sensor, Gas sensor.**

I. INTRODUCTION

Rapid technological advancements were required to satisfy the increasing requirements for an easier and comfortable lifestyle. Home automation systems are intended to provide convenience, energy efficiency, comfort and security. As the demand for handiness increases, smartphones have gradually turned into an all-purpose handy device that can access the Internet and other local networks. However, their system only works on wireless networks and requires a module for each appliance to be controlled by the system, thus, making it uneconomical and limited.

For more flexible and cost efficient control system, Raspberry Pi is recommended by the researchers to be used as a control system for Home Automation. Not only that it has a small size, home devices could also be directly connected to GPIO ports through relays or motor drivers making the system to be cost-effective and insubstantial.

Home devices are connected to the Raspberry's IO ports where a python script is programmed to control the home devices. The problem with this system is, when a change must be done to the system (to add commands or add home device), a new program must be uploaded to the Raspberry pi3.

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II. PROPOSED SYSTEM ARCHITECTURE

The recent existing studies on home automation focus on wireless home automation that mainly focuses on addressing the problems or power consumption range of operation, convenient living, and the cost of the whole system. Modules must be used in order to control home appliances like lights, power outlets, IR operated devices and temperature sensors.

Figure 1: shows that how the home automation system will operate. The home appliances, namely: window blinds, ceiling lights, door, air-condition unit and television, is controlled using a mobile, PC or any internet connected systems. These appliances are connected to the Raspberry Pi's GPIO pins using a motor driver and a relay driver. The IOS device and the Raspberry Pi are connected to the same local network. The gate valve for irrigating the plants is operated with the help of high torque stepper motor.

III. IMPLEMENTATION DETAILS

Figure 1: shows that how the home automation system will operate. The five appliances, namely: window blinds, ceiling lights, door, air-condition unit and television are controlled using a mobile or using a personal computer. These appliances are connected to the Raspberry's GPIO pins using a relay and a motor driver. The mobile and the RasperryPi are connected to the same local network

IV. HARDWARE DESIGN

In this section, we present that hardware part of the home automation system. This section is divided into two parts which consist of the hardware design using an 8-channel relay module and an L298N motor driver, temperature sensor and gas sensor.

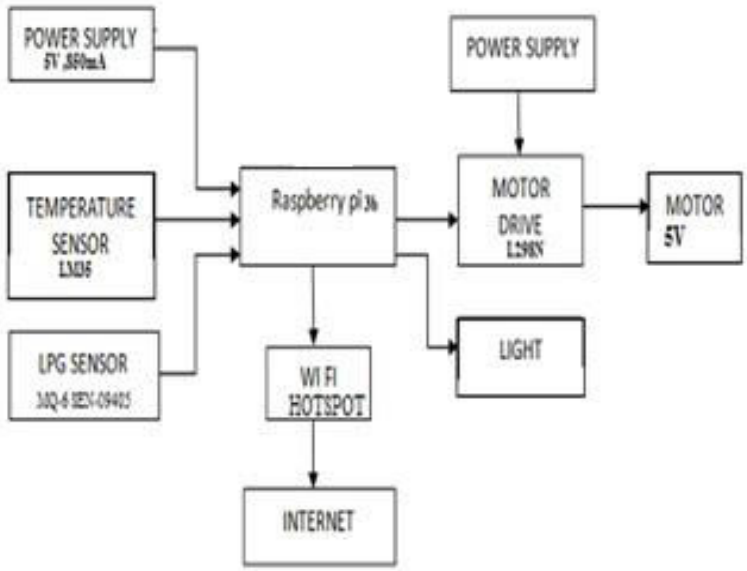

Fig. 1. Hardware Design

a) Relay Module

Many numbers of appliances in this study are connected to the Raspberry Pi through a relay module. The appliances are the ceiling lights, fan, air-conditioning unit, television, doors, windows, motor pump and mobile charger. Figure 2 shows that how these three appliances are connected to the relay and how this relay acts as a medium to connect the appliances to the Raspberry pi.

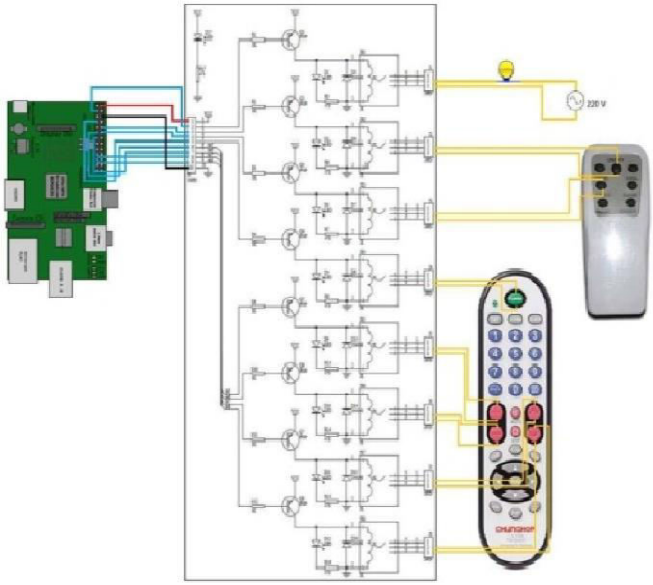

Fig. 2. Relay Module

b) L298N Motor Driver

The L298N motor driver is used to control the motors that are needed to the operation of the window blinds and door. Two 24-volts DC motor are used and are connected to the motor driver. The motor driver has 4 input pins which are connected to the corresponding GPIO pin of the Raspberry Pi3b, 2 of these input pins are used for the operation of a motor. A sequence of 1-0 would make the motor turn clockwise. On the other hand, a sequence of 0-1 would turn the motor anti-clockwise. By connecting the motor to the appliances in a specific way the motion of the motor can be used to operate the opening and closing of the window blind, gate valve, and the door. The motor driver is connected to the Raspberry Pi's GPIO pins as shown in Figure 3.

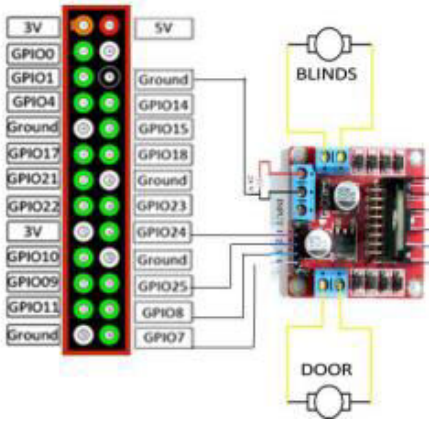

Fig.3. L298N Motor Driver

c) MQ-6 SEN-09405 Gas Sensor

MQ-6 Sensor is a simple-to-use liquefied petroleum gas (LPG) sensor which is suitable for sensing LPG concentration in the air. LPG consists of mostly propane and butane gas concentrations in the air. The detecting concentration range varies from 200 to 10000ppm.output from the sensor is an analog resistance. Some properties of this sensor are high sensitivity to LPG, fast response, small sensitivity to alcohol and smoke. Powers the heater coil with 5V connect the output to an ADC. This sensor has the stable and long life with the simple drive circuit. The cost of the sensor is low which is suitable for this application.

Fig.4. MQ-6 SEN-09405 Gas Sensor

d)LM35 Temperature Sensor

The LM35 sensor is a precision integrated-circuit temperature device. The output voltage of this device is linearly proportional to the centigrade temperature. When compared to linear temperature sensors this sensor has the advantage that the user not required to perform centigrade scaling. Some features of this sensor are Calibrated Directly in Celsius (Centigrade), accuracy is 0.5°C (at 25°C), the range of this sensor is from −55°C to 150°C. Cost is low due to wafer-level trimming, Operating voltage from 4 V to 30 V, Draining current of this sensor is less than 60-μA, it has a very low self-heating ability, that is 0.08°C in Still Air.

Fig.5. LM35 Temperature Sensor

V. SOFTWARE DESIGN

a)IoT

Internet of things is creating a new world, where people can update their knowledge of their materials which they own and can manage their assets in better-informed ways. In this paper, a status of the home appliances can be analyzed by using IOT concept. The status information will automatically get upload in the cloud. If the user login into the web page, it shows the status whether the selected home appliances is under on or off condition, so the user can know the condition of the selected appliance. In this project, we are going to use a Raspberry Pi to monitor two kinds of data from anywhere in the world: the readings coming from a sensor, and

the snapshots taken by a camera. Using the Raspberry Pi makes things much easier as it would be with any other platform.

b) HTML

HTML is used by web programmers to describe the contents of a web page. It is not a programming language. HTML is used to indicate what kind of text is such as, a heading, paragraph or specially formatted text. Matched sets of angle brackets are used to specify all HTML and are usually called tags. A CSS stand for Cascading Style Sheets which describes how HTML elements are to be displayed on paper, screens or in other media.CSS saves a lot of work and multiple web page layouts can be controlled at once.

Fig. 6. HTML Login Section

The Apache projects are characterized by a shared, consensus-based improvement process and an open software license. The Apache HTTP Server which is also called Apache. Apache is the world's mainly used web server software.

Figure 5, Shows that it supports password authentication and digital certificate authentication. Because the source code is freely available, anyone can adapt the server for specific needs and the large public library of Apache add-ons is available. We can develop and modify server settings towards the necessities of the customer. Apache makes use of ASCII for the actual settings documents within. This makes most of them very easy to give since it is actually eastern in order to modify the actual documents utilizing any kind of textual content publisher. Programming languages such as PHP, Perl, and Python are supported by apache.

c)HTML Interface with Raspberry Pi3

Raspberry pi is connected to HTML web page by Setting up the wireless network adapter with a static IP address and a lightweight web server that is presented in this paper which is an excellent choice for the Raspberry Pi. But currently, the raspberry pi3 is can serve a web page layout to any device which contains browser on the same network as itself. A button is placed to indicate the start live updates and stop live updates, so the web page loads up. When the start button is pressed, with the intervals of one second, a JavaScript module polls a Python script on the raspberry pi3. Current time is returned by the python script on the raspberry Pi to the JavaScript and that information is displayed on the web page. It does not matter in just getting and displaying the time remotely, in addition to that, it can be expanded to send/receive data from/to the spi or i2c bus, set/clear GPIO pins etc… python can be used for any data processing and it can be done either on the server side or the processing can be done on the client side using

JavaScript. The web server which is running on the Pi3 needs the authorization to access the GPIO pins, this can be done easily by adding the GPIO group to the web server web user account. By doing so, the pins can be controlled without the need of root permissions.

```
+ expand source  view plain
01. <html>
02. <body>
03. Raspberry Pi Network Interface Test
04.
05. <p>
06. <input type="button" onClick="startLiveUpdates()" value="Begin Updates">
07. <input type="button" onClick="stopLiveUpdates()" value="Stop Updates">
08. </p>
09.
10. <div id="outputarea">output area</div>
11.
12. <script>
```

Fig. 7. HTML Interface with Raspberry Pi3

d) Wi-Fi (wireless networking)

Wireless technology powers most home networks, many business local area networks and public hotspot networks. A family of new versions of Wi-Fi called sequentially 802.11b, 802.11ac 802.11g, 802.11n, and so on. Each of these related standards can communicate with each other, although newer versions bid better performance and more features. Wi-Fi can be configured in one of two modes either in infrastructure mode Wi-Fi or ad-hoc mode Wi-Fi. Nearly all Wi-Fi setups use infrastructure mode, where client devices within range all connect to and communicate through a central wireless access point. Ad hoc Wi-Fi follows uninstructed architecture that allows clients to connect directly to each other without the use of an access point.

The Web is a computer where the web content is stored. The Website is a collection of web pages while the web server is a software that responds to the request for web resources. The Web server responds to the client request in either by, Sending the file to the client associated with the requested URL and Generating response by invoking a script and communicating with the database. Web Server Architecture follows the following two approaches. They are Concurrent Approach, Single-Process-Event-Driven Approach. The concurrent approach allows the web server to handle multiple client requests at the same time. Such as Multi-process, Multi-threaded, Hybrid method.

e)PYTHON

Python is an interpreted computer language that design philosophy emphasizes programmer productivity and code readability. Python is a very useful programming language for web applications. PHP is a server-side scripting language designed for web development. Now, it is used as general purpose programming language. The web server sends the resulting output to its client, usually in form of a part of a web page; for instance, PHP code can generate a web page's HTML code, an image, or some other data. PHP is also used include a command line interface capability and in standalone graphical applications. PHP can handle forms, i.e. gather data from files, save data into to a file, through email you can send data, return data to the user. You add, delete and modify elements within your database with the help of PHP. Using PHP,

we can restrict users to access some pages of the website. It can encrypt data from the front end. Five important uniqueness make PHP's practical nature possible Simplicity, Efficiency, Security, Flexibility, Familiarity.

f) Python With Raspberry Pi

Python is highly recommended as a language that is easy for newcomers to programming. The latest version of the Raspbian OS comes bundled with both Python 3.3 and Python 2.x tools. A Raspberry Pi GPIO Python library that is available to program the GPIO pins on Raspberry Pi with Python. The RPi.GPIO Python library allows you to easily configure and read-write the input/output pins on the Pi's GPIO header within a Python script.

```
import RPi.GPIO as GPIO

# to use Raspberry Pi board pin numbers
GPIO.setmode(GPIO.BOARD)

# set up the GPIO channels - one input and one output
GPIO.setup(11, GPIO.IN)
GPIO.setup(12, GPIO.OUT)

# input from pin 11
input_value = GPIO.input(11)

# output to pin 12
GPIO.output(12, GPIO.HIGH)

# the same script as above but using BCM GPIO 00..nn numbers
GPIO.setmode(GPIO.BCM)
GPIO.setup(17, GPIO.IN)
GPIO.setup(18, GPIO.OUT)
input_value = GPIO.input(17)
GPIO.output(18, GPIO.HIGH)
```

Fig. 8. Python with Raspberry Pi (Coding)

VI. CONCLUSION & FUTURE SCOPE

In this paper, a prototype for smart home automation using a raspberry pi and IoT is presented. Through this, the user can control nearly thirty home appliances. This future work will be carried forward to control all the appliances present in home and agricultural areas. So that, many people can use IoT for low-cost implementation of the hardware module. This system is highly scalable and many other features like security, energy monitoring, and health monitoring can be integrated. In the near future, the concept of an internet of things can be seen in applications like Industrial automation and management through the internet, machine-driven fireplace exit systems, improvement of security problems in extremely restricted areas, environmental monitoring in weather stations and in industries where the human invasion is impossible or dangerous.

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