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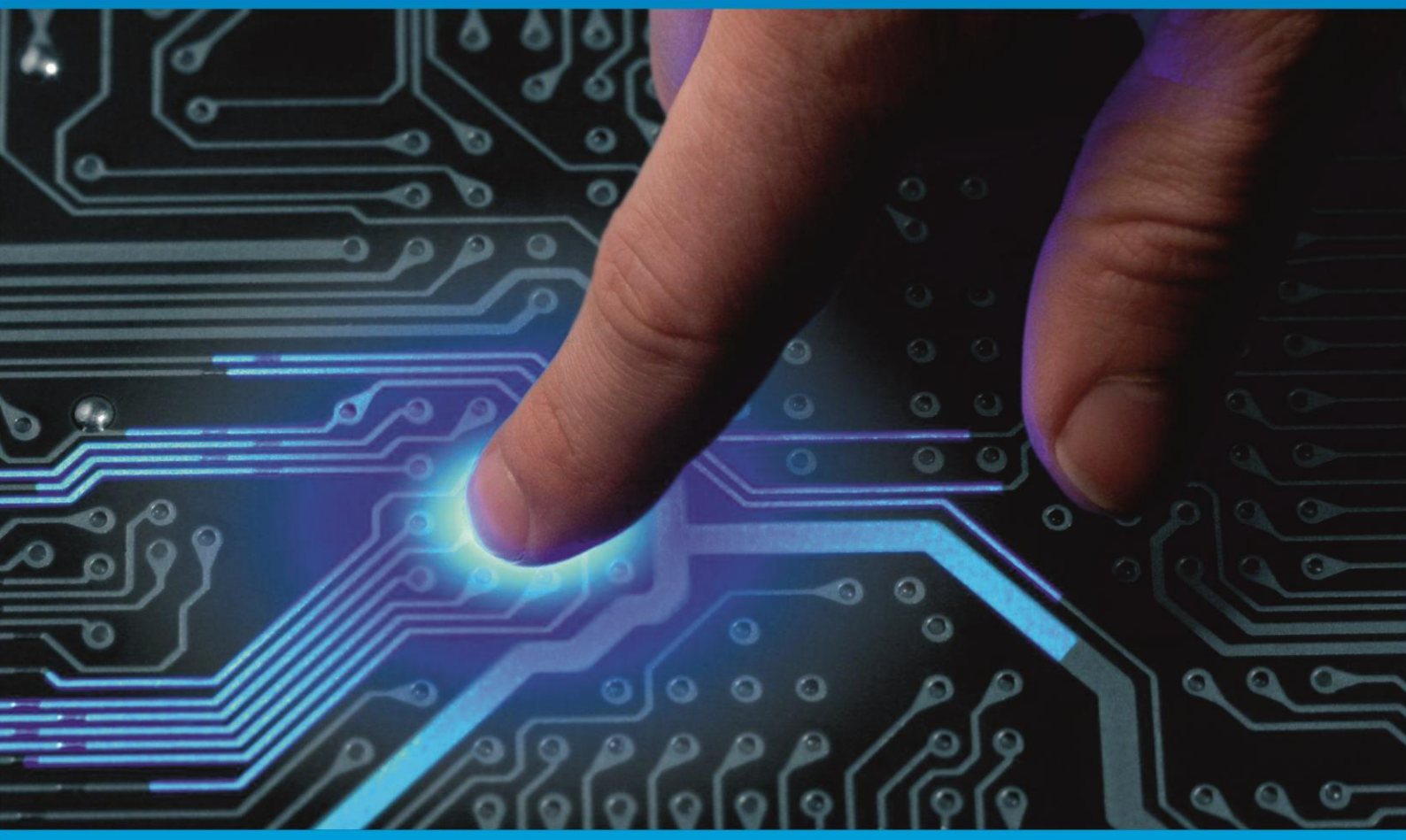

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Synchronized 2-Way Home Automation System Using Raspberry Pi Zero W

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ABSTRACT: In this rapidly growing technological era, advancement of day to today things are at high speed. To make the life luxurious, automation is playing an important role. Here, I am talking about Home Automation System (HAS) controlling home appliances through mobile or laptop using internet from anywhere with accuracy. This paper adds the improvement in the system of getting synchronized status of home appliances using current sensor SO3V31000 which converts the alternating current to direct current and sends the signal to Raspberry Pi Zero W. As per the signal passed to Pi, general purpose input output (GPIO) pin status can be updated to get the synchronized status of home devices.

KEYWORDS: Synchronized 2-Way Home Automation, Raspberry Pi Zero W, PHP, IOT, AC to DC converter.

I.INTRODUCTION

Home Automation is controlling home appliances; it may be light, fan, refrigerator, doors, electric heater, television and other household activities, through smart phone or laptop anytime anywhere using internet. HAS is basically comprises of sensors, actuators and software and such components connected to physical home devices and electrical circuit. The network connectivity is required to communicate with devices. Nowadays and in coming future, HAS is being widely used to control devices around the home. Home automation is now not limited to home, it is being used in offices/commercially also to save energy, manpower and for security concerns.

Figure 1:- Home automation system architecture

This paper presents a synchronized 2-way home automation to control the home appliances by using smart phone or website. It will turn ON or OFF the home appliances through smart phone and electrical physical switches too. This concept is implemented by using Raspberry Pi Zero W and SO3V31000 AC to DC converter. The organization of this paper is as follows, Section II describes research review and Section III & IV describes the existing system and proposed system with block diagram. Section V & VI describes about the Hardware and Software requirements. Section VII deals with the results and discussion of the model and Section VIII describes the conclusion & future work followed by references in the Section IX.

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II. RESEARCH REVIEW

By reading and understanding below mentioned papers came to know that in home automation using raspberry pi zero w the research is done up to this extent and further gathering the information from these papers and built an improved version of existing ones:

[1] Yadav, V., Mishra, D.K., Singh, P. and Tripathi, P.K. et al. [2020] has been proposed the "Home automation system using Raspberry Pi Zero W" describes the usage of raspberry pi zero w with relay to ON/OFF the led using web server and using python language to implement the code for setting the GPIO pins and also describing the advantages of Raspberry pi zero w over Arduino Uno Rev 3 and also showing the successful implementation and working of switching ON/OFF the led.

[2] Radhika; Nisha et al. [2020] has been implementing the Raspberry Pi 3 Model B is the third generation Raspberry Pi. This card sized single board computer can be used for various applications and takes the place of the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B.

[3] Nisarg Shroff; Pradeep Kauthale; Amit Dhanapune; Sarika N.Patil et al. [2017] in this author uses the raspberry pi-3 works on 3.3v and 5v DC supply. The relay driver is connected to these electrical home appliances that are light, lock & fan. When Passive Infrared sensor is sensed through a person then web camera captures the image and sends the same to android app using raspberry pi.

[4] Sunil Kumar; Astha Sharma et al. [2017] has been proposed method used for appliances which sense the physical events then make an evaluation of them into a overflow of data, information, expands wellbeing, security, comfort and vitality reserve funds. The building components of home automation are sensors, actuators and Building Administration System.

[5] K. Venkatesh; P. Rajkumar; S. Hemaswathi; B.Rajalingam et al. [2018] In this system, author used Raspberry Pi and establish the internet connection for the purpose of automation using IOT by accessing the IP address. Smart phone and Raspberry Pi are connected through Wi-Fi. Raspberry Pi is being used as the board controller to connect the home appliances through input and output port.

[24] Katta Nagendra Babu, Kondaveeti Sai Bhargavi, Khagga Vijaya Lakshmi, Akula Ravi, Katta Sasidhar et al. [2018] have been implemented the proposed system as the system uses Raspberry Pi, Relay circuit, Pi camera are the main part of the project here the Raspberry Pi acts as a web server and microcontroller also for programming. As per the Programming done in the Microcontroller, the Web page is displayed on the screen in which the buttons are viewed as ON/FF. The proposed system consists of Raspberry Pi, Pi camera, Relay module, PIR sensor, Ultrasonic Sensor, Servo motors, Web server.

III. EXISTING SYSTEM

Controlling the home appliances through mobile app or website at any time, but can't be accessed correctly from anywhere, if status of home device is not known then how it can be managed from anywhere i.e. exact status of device can't be judged.

IV. PROPOSED SYSTEM

To overcome this drawback of existing system, use current sensor or AC to DC converter SO3V31000 converts AC to DC that can check the current passing through home device or not and then that AC current is converted into DC and then that DC signal is passed to Raspberry Pi Zero W which can accordingly change the pin status programmatically.

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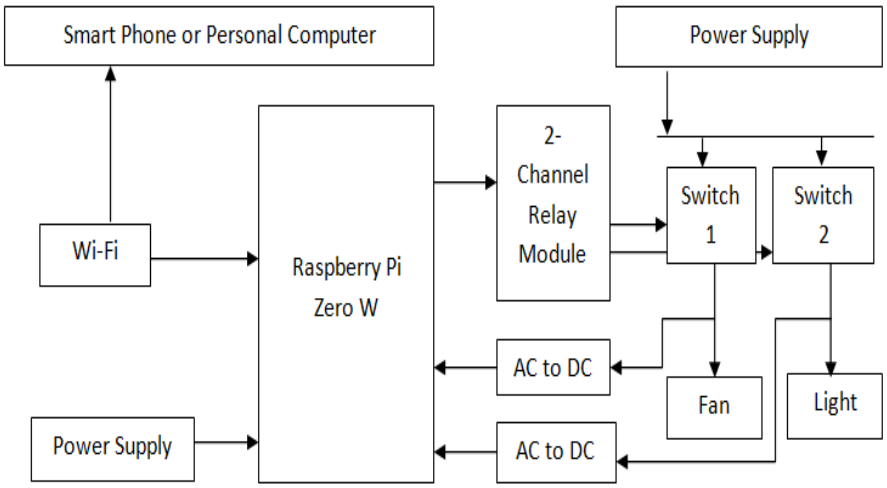

Figure 2: Block Diagram of Proposed System

V. HARDWARE REQUIREMENTS

Raspberry Pi Zero W: The Raspberry Pi Zero W is the smallest and cheapest Raspberry Pi computer, launched in Feb 2017. With built in wireless LAN and Bluetooth, plus a mini-HDMI and micro-USB connector that enables a range of input and output options. A built in camera serial interface enables you to quickly add a camera module. It is having 40-pin GPIO header, enabling you to connect and control devices. A separate version called Raspberry Pi Zero WH has pins pre-soldered to the header (or you can add it by your own).

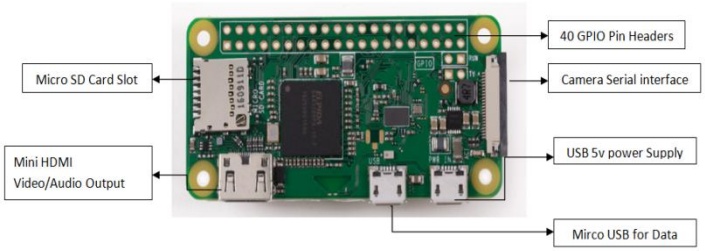

Figure 3: Raspberry pi Zero W

Relay Module: The 2-Channel 5-V Relay Module is a relay interface board which can be used to control high current loads such as lights, motor, solenoid valves, and AC load. It is designed to interface with microprocessor and microcontroller such as Raspberry pi. The relays terminal (NO, NC and COM) is being brought out with screw terminal. It has LED also to indicate the status of relay.

Figure 4: 2-Channel 5v Relay Module

AC to DC Converter (SO3V31000): This converter intakes AC Input Voltage: 110 - 260V power supply and provides Output Voltage: 0.2 - 3.3V (DC). It has total 4 pins out of which 2 are AC input pins and another one is 3.3V DC output and other is ground pin.

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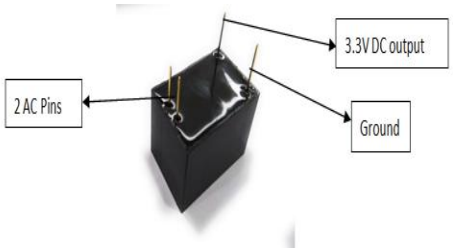

Figure 5: SO3V31000 AC to DC converter

Other hardware requirements:

- **Jumper Wires -** requires to connect raspberry pi and relay.
- **Charger -** to provide power supply to raspberry pi zero w having output of 5v**.**
- **Internet Connection -** to access the HAS from anywhere.
- **Mobile device or laptop -** to access the interface to control home devices.
- **MircoSD Card -** requires micro SD card of 16 GB to install operating system, apache server and main home automation controlling webpage. Along with SD card, card reader is also required.
- **Copper wires -** to connect physical switches with relay to communicate with home appliances in synchronized 2-way.

VI. SOFTWARE REQUIREMENTS

Raspberry Pi OS is official operating system for all models of the Raspberry Pi.

- Install Raspberry pi OS using new out of the Box software (NOOBS), download the NOOBS through this link (www.raspberrypi.org/downloads/), and click on the download zip button. After downloading, extract the zip file and follow the steps given there.

Establish Wi-Fi Connection and SSH: For the Raspberry Pi Zero W to connect to Wi-Fi on boot, we need to add a file named wpa_supplicant.conf on the SD card image. Create a text file inside boot and named it wpa_supplicant.txt. Need to enable SSH which is disabled by default and then Install Wiring PI on it.

Download & Install Putty & Apache Server: Download the Putty through this link https://www.putty.org/ and install it on computer to access the raspberry pi through IP address. Install Apache on raspberry pi using command after connecting with putty

PHP: Install PHP on raspberry pi using this command**:**

sudo apt install php libapache2-mod-php -y

Now, everything is ready, deploy the web page having user friendly interface and PHP code for controlling the home appliances.

Other Software Required:

- **FileZilla** to transfer files to and fro. And **WinRar** to unzip the downloaded OS file.

Coding and Prototype Implementation:

PHP code to set mode of GPIO pins:

- Set GPIO mode to Output
  system("gpio mode 24 out") ;
- Set the GPIO mode to Input
  system("gpio mode 27 in") ;

Coding and Prototype: PHP coding page showing how to set the mode of GPIO pins and how to check the current status of specific pin:

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```
</script>
    </head>
    <body>
        <div id="check_physical_switch_status">
    <?php
    //GPIO set Mode to Input
            system("gpio mode 27 in");
            exec ("gpio read 27", $status, $return );

            if ($status[0] == "0" ) { echo("<script> alert('if block status '+$status[0]); change_pin_to_on_state(5);</script>"); }
    else if ($status[0] == "1" ){ echo("<script> alert('elseif block status '+$status[0]); change_pin_to_on_state(5);</script>"); }

    echo("</div>");
    ?>
    <script src="script-as-Input.js"></script>
    </body>
</html>
```

Figure 6: PHP code: setting GPIO pin status and reading pin status

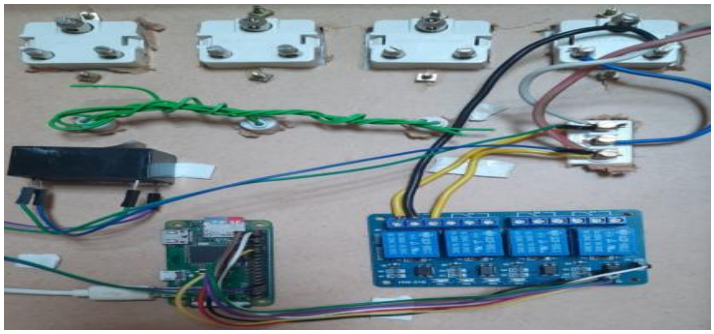

Figure 7: Wiring diagram prepared for implementing the proposed system

VII. RESULTS & DISCUSSION

As followed by the above steps, home automation system is ready to use, open the webpage or mobile application to ON or OFF the devices to see the expected results. Following screenshots shows the user friendly interface to ON or OFF the connected devices. For prototyping, behind the scene small lights are used. Here are results as expected from the proposed system.

Light on first 3-Pin plug is in OFF state at initial stage as physical 2-Way switch is in OFF state, below figure is also showing the same:

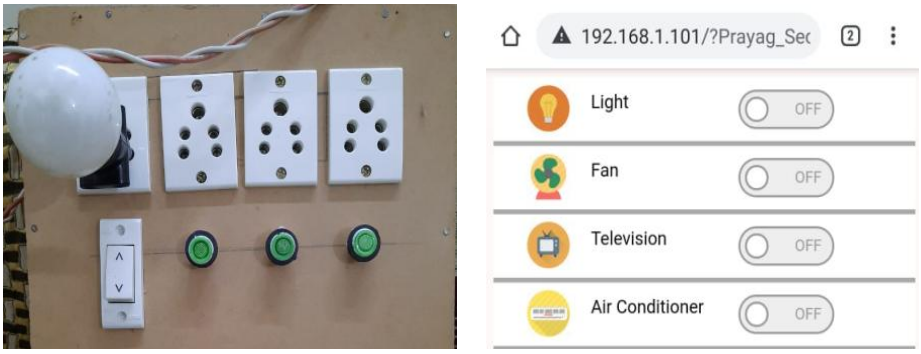

Figure 8: Showing bulb is in OFF state at initial state (Left) and Web page showing the status of devices at initial state (Right)

So, when we tap on the toggle button of Light, showing in the figure 5.3, then it will turn ON the Bulb and toggle button too, also changes the GPIO pin status.

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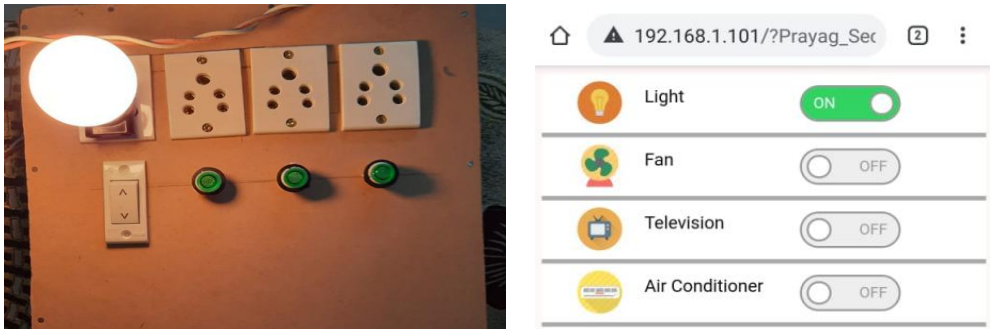

Figure 9: Showing the ON state of Light when switched ON from Web page(Left) and Web page showing the ON state of Light(Right)

When we switch OFF the bulb from physical 2-Way switch, it will turn OFF the bulb and simultaneously it will send the signal to GPIO pin to change the pin status accordingly as the electricity is not passed to the device/appliance and turn the toggle button to OFF state on web page, so that synchronized information can be maintained regarding the status of home device/appliance. Further vice versa test cases can be verified when switching ON/OFF from web page/physical switch.

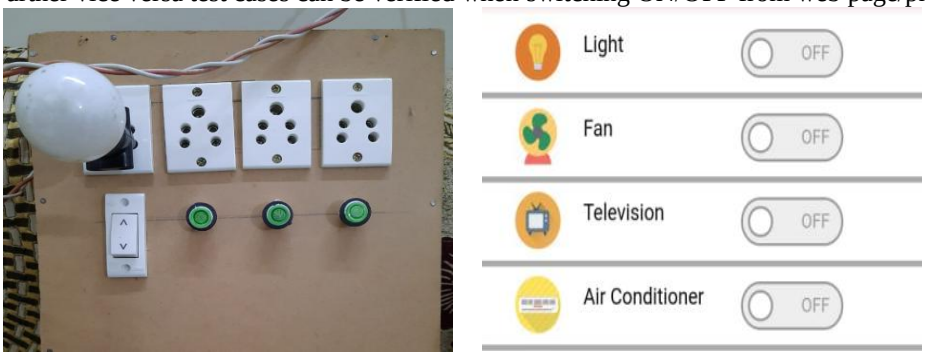

Figure 10: Showing bulb in OFF state when switched OFF from 2-Way physical switch (Left) & Showing synchronized status of Light, as switched OFF from 2-way physical Switch (Right)

Hence, home appliances can be accessed with accuracy.

VIII. CONCLUSION & FUTURE WORK

In this research paper, Raspberry Pi Zero W with ac to dc converter provides the synchronized 2-way accessibility of home appliances remotely with accuracy i.e. having exact status of device provides the clarity to switch on or off the device depending on the current status of device. In this system, we used SO3V31000 AC to DC converter that checks the current flowing through the device or not accordingly sends the signal to GPIO pins of Raspberry pi zero w. Tried other two current sensors for the same purpose i.e. ACS712 and clamp meter but they are not directly compatible with Raspberry pi zero w and also both are costly too as comparative to SO3V31000 converter. Also, extra device will be required for other two above mentioned sensors to accommodate in the system which increases the complexity and cost too. So, finally after doing more research on it, finalizes to go with SO3V31000 and got the required result of getting the synchronized status of device. The proposed provides the flexibility to accommodate in the existing electrical switch boards and to make them smart. It gives the facility to save the electricity when user forgot to switch-off the devices and left the home. In case of emergency also, devices can be controlled remotely.

And the proposed system takes the one second to provide the current status of device and in future this can also be reduced to milliseconds or micro too. Due to its multipurpose use this system will be very effective and efficient in future.

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