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IoT-based Home Appliances Control System Using NodeMCU and Blynk Server

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Abstract: The fundamental purpose of monitoring electronics appliances in the modern world by using Internet of Things (IoT) is to control them based on situational demands. With the advancement of technology, the need for efficient controlling is more as it optimizes performance and saves unnecessary wastage of power.The basic home appliances are fan, light and water pump which consume maximum power.Unnecessary wastage of power and resources by turning on lightsduring daytimeor high speed fans in winter season or water pump during overflow of water from tank can be avoided in this way. A system has been proposed to control home appliances anytime from anywhere in the world and efficiently utilize power by controlling appliances properly.Blynk app has been used to read data from sensors located in home environment and user controls home appliances based on these data. Being busy in hectic schedule of daily life user may not be able to read sensor data continuously to take some action through app. So the designed system sends an emergency notification in user's mobile app.

Keywords: IoT, Blynk app, Home appliances, Sensors

I.INTRODUCTION

IoT[1] allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. The present generation has been experiencing high speed internet by using 4G LTE cellular technology, which allows evolution of swifter IoT-based home automation systems. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which encompasses technologies like controlling of different home appliances like light, fan, water pump and many more. A system has been designed to connect sensor data with user's daily life. There are already many smartphone oriented remote controller products. However current products always have platform compatibility problems and additionally GUI in such systems is complex. This work proposes an approach to enhance and simplify the controlling and monitoring experience. With the use of sensors in home environment the appliances can be controlled remotely based on environmental conditions known from sensor data. The sensor data are processed by a microcontroller and delivered to mobile application through WEB server. The results of implementation and experimentation have shown the proposed system and platform that can provide more IoT application possibilities in daily life. Increasing reliability on mobile phone applications to deal with daily life scenarios has paved the way of modeling a system which will integrate sensors and actuators. This also allows users to observe data and send commands by using their mobile phone application. With the advancement of technology controlling and monitoring of electronics appliances using android application with the help of internet connection has become possible. It gives us the opportunity to have full control over a particular place even being far away from it. IoT allows usto control many devices simultaneously and reduces human efforts. This process is done in low cost and controlling of many devices in a simple circuit is possible. Our user-friendly interface allows a user to easily control home appliances through the internet. Relays are used to switch loads. The entire system is run by mains power using a step down transformer, rectifier, filter and a linear dc regulator. After receiving user's commands over the internet, microcontroller processes these instructions to operate these loads accordingly and display the system status on mobile application. Besides monitoring sensor data and controlling household devices, the proposed system provides additional features of emergency notification and automatic turn off of an appliance to prevent wastage of power. Thus this system allows efficient home automation over the internet.

The paper discusses how a system has been implemented to make use of IoT for controlling home appliances using NodeMCU and Blynk app. The different parameters of home environment are sent as input to Node MCU through the sensor-modules. NodeMCU receives instructions from user's mobile application and processes them to control actuator

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circuits of home appliances. The rest of this paper is organized as follows. Section IIbriefly discusses the related work in this field. Section III describes the system design. Architecture and implementation of proposed system are presented in Section IV. Experimental results are shown and discussed in Section V. Section VI concludes this paper and outlines future research.

II. LITERATURE SURVEY

Kumar Mandula [2] discusses about the process of home automation using Bluetooth and Ethernet. When connectivity between Arduino and smart phone is established using Bluetooth, short range wireless communication is possible in an indoor environment. Ethernet module is used for connecting Arduino board from any part of the world.

Bharat Bohora[3] designeda system based on Blynk framework which controlled and monitored appliances via smartphone by using Wi-Fi as communication protocol and raspberry pi as private server. All the appliances and sensors are connected to the internet via NodeMCU.

Ming Wang[4] in his paper discussed about his work on system that uses a smart central controller to set up a 433 MHz wireless sensor and actuator network (WSAN). A series of control modules, such as switch modules, radio frequency control modules, have been developed in the WSAN to control directly all kinds of home appliances.

P.Siva Nagendra Reddy [5] used android mobile to send commands to the Arduino board through Wi-Fi module and Arduino processed them to control all the home appliances. This system controlled the voltage levels of home appliances like fan, light etc. They got the status of their home appliances in their android mobile phone.
M L Sharma [6] developed a system in which a home automation system was interfaced with Android mobile devices. The mobile device and system communicated with each other via Wi-Fi.

Somnath Singh [7] in his paper discussed about designing a web-based control of home appliances which allowed user to switch appliances on/off by clicking on a webpage specially designed to interact with those devices, by being anywhere in the world with a computer or a smart phone connected with the Internet.

Miss. Aboli Mane [8] used Blynk app in her project of home management system and security. Different sensors were connected with NodeMCU. With the help of Wi-Fi, NodeMCU was connected with Blynk app. On detection of any unwanted incident by different sensors, messages were sent to Blynk app.

III.SYSTEM DESIGN

The designing methodology of the system has two major portions: software design and hardware design. The hardware is designed by arranging microcontroller, sensors and actuators whereas software design includes programming that is written and uploaded in the microcontroller.The designed system shows microcontroller connected to sensor-modules and actuator-modules for monitoring and controlling household devices. This design section shows how different hardware components are set up. The specifications and information regarding various components are described below.The system is modeled to monitor data from three sensor-modules and control three loads by using mobile application.The proposed system appears as illustrated in fig1.The various functional units used in the system are as follows:

1. NodeMCU (NodeMicrocontrollerUnit) [9]-It is the central co-coordinator of the sensors and the actuators. This microcontrollerhas built-in support for Wi-Fi connectivity which allows it to send and receive data from mobile application via internet server. It reads sensor data and sends them to mobile application and receives commands from mobile application to control home appliances. It then drives the relay-module to control the appliances.

2. Sensor modules –They receive information about current ambient conditions in home environment and send them to nodeMCU. The following three sensor modules are used:
(a)DHT 11 [10] -It is used for sensing the ambient temperature and humidity prevailing in the room.
(b)Light sensor [11] -It is used to know the condition ofilluminance prevailing in the room.
(c)Ultrasonic sensor [12]-It is used to measure the depth of water level from the brim of tank.

3.Mobile application- [13] Blynk, a platform with iOS and android apps,provideswidgets to display sensor data received from nodeMCU and control output signals(to control loads) from nodeMCU to the actuator circuits.

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4.Internet server-[13]Blynk mobile application in smartphone and nodeMCU communicate by using Blynk server. Bidirectional transfer of data between nodeMCU and mobile app occurs through this server.

5. Switching modules-One such module is used for turning light on/off and the other one is used for turning water-pump on/off.The output signal from nodeMCU activates and deactivates the relay to perform switching operation.

6. Interfacing module-Besides having relay, this circuit consists of a diac, a triac, a capacitor and two resistances with different values for obtaining high and low speeds by altering firing angle of a triac.The circuit works on AC phase-chopping principle to control fan speed. To reduce RF interference a choke coil can be added to the circuit.

IV. SYSTEM ARCHITECTURE AND IMPLEMENTATION

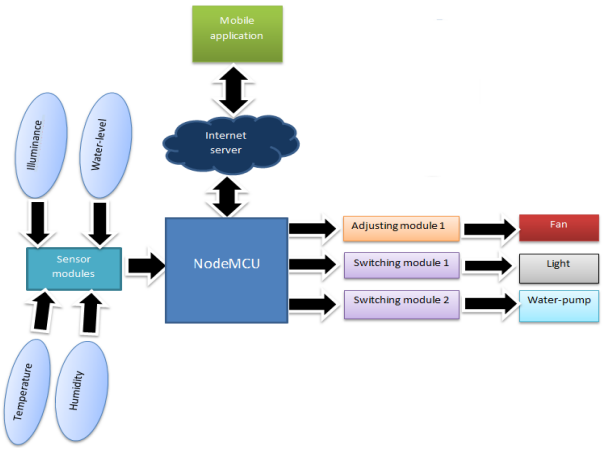

Fig.1 Overview of the proposed system

The proposed system allows the user to control the appliances of his home remotely anytime from anywhere by using smart mobile phones. The user can control his appliances via internet by using mobile application and monitor parameters of his household environment easily by reading sensor data in his mobile application.Fig.2shows the entire setupof the proposed system.ADC power supply of 5V is used as the power source for nodeMCU,sensor-modules and the relay board. Being powered up, nodeMCU searches for the preset SSID (Service Set Identifier) and connects automatically to the Internet.Sensor-modules send the variable data about ambient conditions to the nodeMCU.The user gets these data in his mobile application via internet server and then decides his action to control the appliances.On pressing the suitable button in application,nodeMCU gets the instruction via internet server and provides output signal to the actuator circuits.When the relay is turned on, the appliances get the power from 230V AC source.The switching circuit used for turning light and water-pump on/off can be used for turning the other household appliances like fan, air-conditioner,room-heater,micro-wave oven etc. on/off as well. The interfacingcircuit for speed regulation of AC fan can also be used for AC light dimming applications.

Fig.2: The entire setup of proposed model

The implemented system performs three functions viz. light on/off,water-pump on/off and controlling speed of fan.User reads level of ambient light intensity(sensed by light sensor module) inmobile

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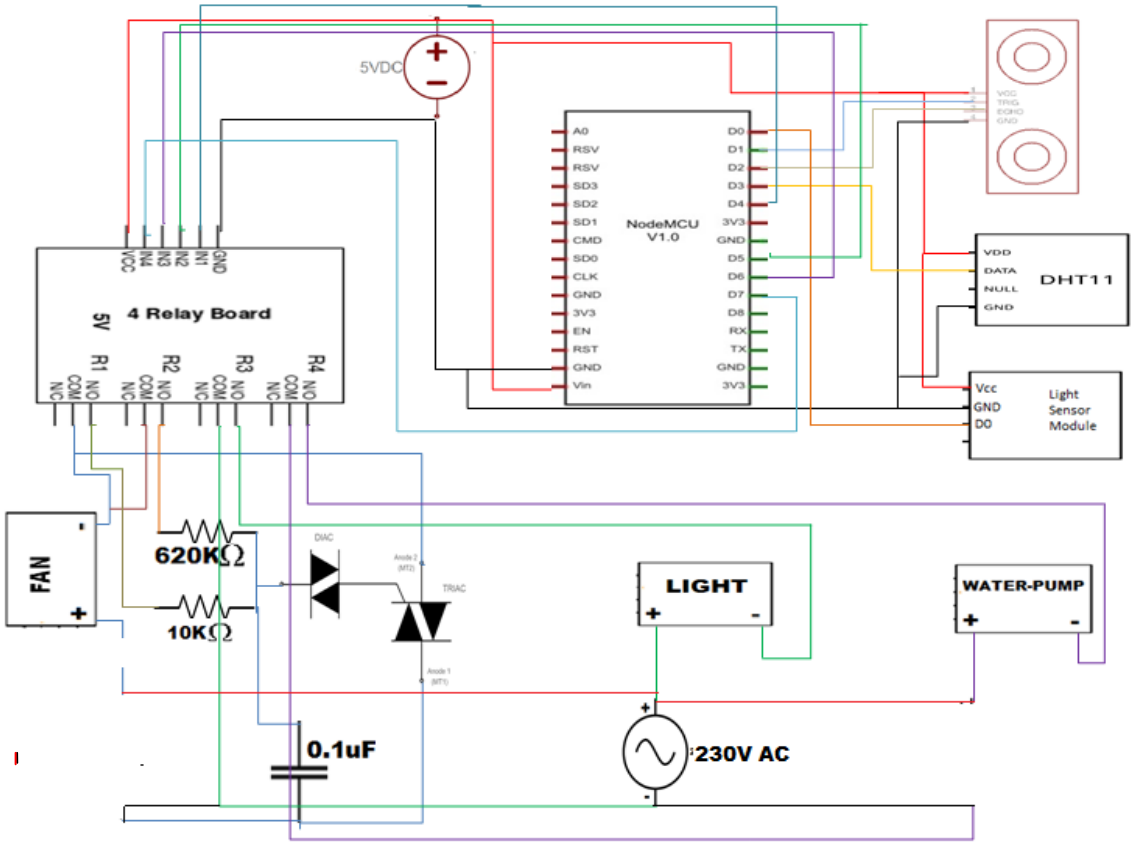

Fig.3: Schematic diagram of circuit

application and turns light on/off bypressing button in app. Likewise, he reads water-level of tank (sensedby ultrasonic sensor module) and takes action to switchpump on/off by pressing button in app. In case the pump is on when water-level reaches a predefined threshold, user gets a notification in his phone which informs him about the high water-level. If the user does not switch off the pump and there is a further rise of water-level then the pump is turned off automatically by nodeMCU when water-level rises to a certain height. On failure of nodeMCU in turning off the pump at this water-level,the water-level rises higher and after this level reaches a specified value user gets a second notification in his mobile which informs him about such failure. After getting this notification user has toturn off the pump from his app. To control the speed of fan user checks his application display to read values from DHT11 module about ambient temperature and humidity. User presses proper buttons in his app to adjust the speed of fan. The designed system provides a two-level speed controlling mechanism.Fig.3 shows the system architecture.

V. RESULTS

The Blynk application provides the facility to read sensor data and control appliances easily. For three appliances there are three different tabs namely light, motor (for water pump) and fan. In each tab there is a display widget which shows sensor reading presently fetched from nodeMCU via Blynk server and the button widget is clicked to change the state of appliances. The present state (on/off) of appliance appears on the button widget. The screenshots captured in mobile while using the application show the results of controlling different appliances.

Light on/off: Fig.4 and fig.5 show application screen on light tab. The display widget, labeled as brightness, shows the ambient illuminance. The button widget shows the present status (on/off) of light. User turns light on/off by pressing the button.

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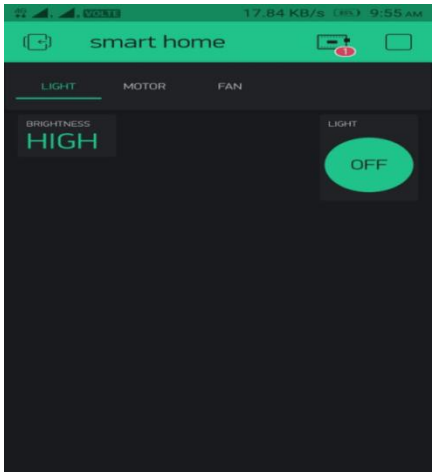

Fig.4: Application screen on light tab shows brightness is high and light is off

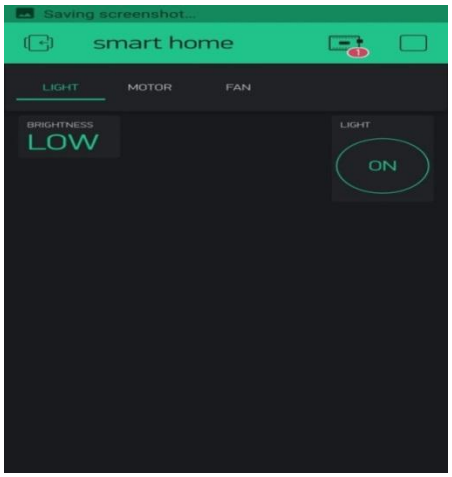

Fig.5: Application screen on light tab shows brightness is low and light is on

Fan speed control: When the tab named as fan is used, one display widget on the top-left corner shows ambient temperature and the other display widget on the top-right corner shows humidity.When only the button labeled as hi is clicked the fan speed is high whereas when only the button labeled as low is clicked the fan speed is low.When both the buttons are off then the fan is off but when both the buttons are on then the fan rotates at high speed. The application screen is shown in fig.6 and fig.7.

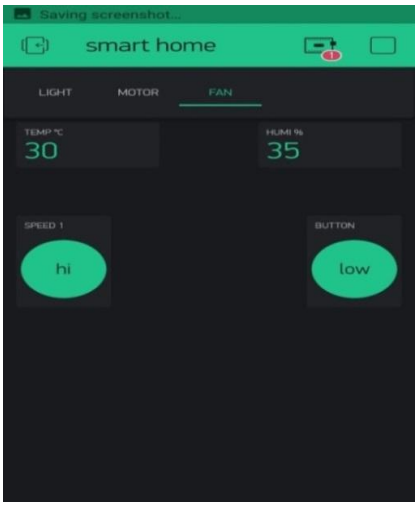

Fig.6: Application screen on fan tab shows both buttons are on

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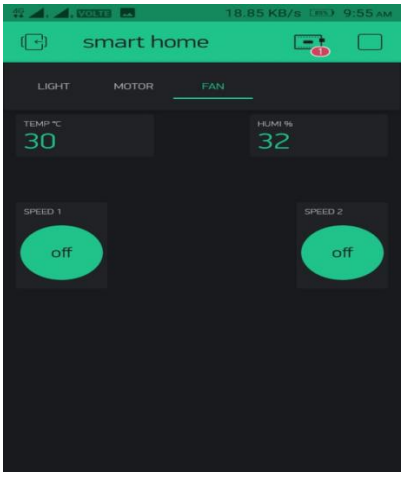

Fig.7: Application screen on fan tab shows both buttons are off

Water-pump on/off: On sliding to the tab motor we see three widgets – the leftmost one is the button widget, the middle one is the notification widget and on the rightmost corner there is display widget. Button is used for turning pump on/off based on ultrasonic sensor value on display widget.When displayed value reaches a predefined threshold for water-level then notification widget notifies about the overflow of water from tank. Fig.8 shows normal application screen on motor tab, fig.9 shows application screen with notification and fig.10 shows the notification when mobile phone user is not working on the application.So even during normal activities in mobile, the user gets a notification when water is about to overflow from tank.

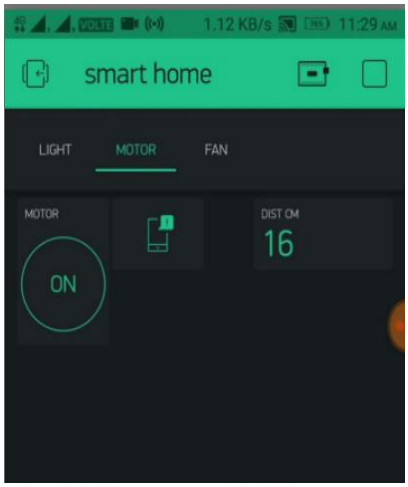

Fig.8:Application screen on motor tab shows status of motor and reading from ultrasonic sensor

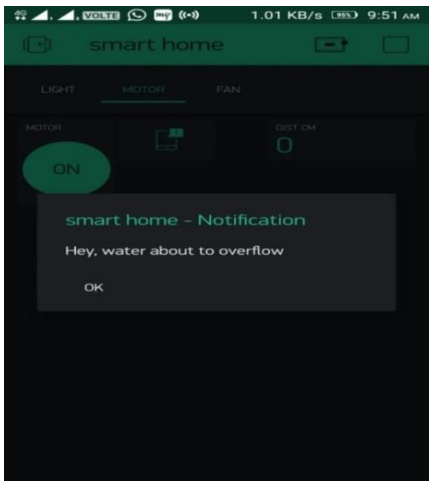

Fig.9: Notification on mobile screen when user is working on application

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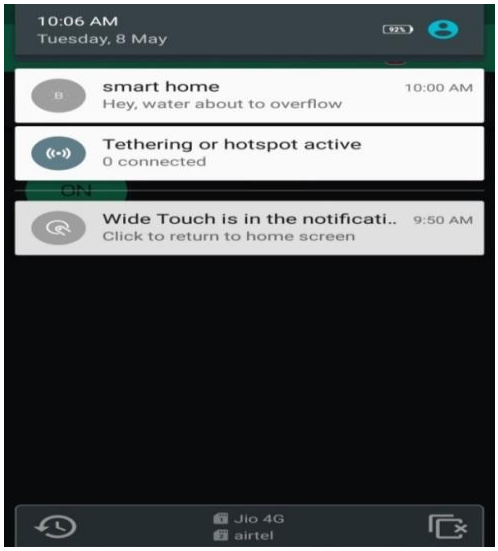

Fig.10: Notification on mobile screen when user is not working on application

VI. CONCLUSION

This work can further be upgraded by using different sensors and different home appliances. Since smart phones are widely used nowadays, this user-friendly system can be used for benefitting the mass. The cost of the system is also within reach.The circuit used for controlling AC fan speed can also be implemented in AC light dimming applications. The features of automatic turn off and sending emergency notification can be very useful in geyser and air-conditioner.When water is heated to a particular temperature in geyser, it can be automatically turned off or when room temperature is lowered to a specified value the air-conditioner can be turned off automatically. In both the above cases notifications can also be sent to user through his/her Blynk app. Mobile application development companies with dedicated teams are working extensively on IoT-based applications that are connected to the cloud. Not only old-aged or physically challenged people can be benefitted using this, but any person with a smart phone can monitor and control the electronic devices without much difficulty.As awareness grows, the adoption rate is likely to increase for IoT-based mobility solutions that will automate business operations and end-to-end processes.

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