IOT BASED LAB AUTOMATION SYSTEM

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Abstract
In this paper we presented the a Lab Automation System (LAS) using Nodemcu esp8266 that employs the integration of cloud networking, wireless communication, which provide the user with remote control of lights, fans, and appliances within their lab and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed with low cost and expanded in lab to control variety of devices.
Keywords: IOT- internet of things, WLAS- wireless lab automation system.

I. INTRODUCTION

1. Overview

Labs will become more and more self-controlled and automated due to the comfort it provides, especially when employed in a private lab. Lab automation system is a means that allow users to control electric appliances. Many existing, well-established lab automation systems are based on wired communication.[2] In contrast, Wireless systems can be of great help for automation systems. With the wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

2. Advantages of lab automation systems

1) **Reduced installation costs:** First and foremost, installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as the professional laying of cables (e.g. into walls) is expensive.

2) **System scalability and easy extension:** Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations, in which cabling extension is tedious. This makes wireless installations a seminal investment.

3) **Integration of mobile devices:** With wireless networks, associating mobile devices such as PDAs and Smartphones with the automation system becomes possible everywhere and at any time, as a device's exact physical location is no longer crucial for a connection (as long as the device is in reach of the network).

For all these reasons, wireless technology is not only an attractive choice in renovation and refurbishment, but also for new installations.

II. ANALYSIS OF SYSTEM

Problem Definition: Lab automation systemswhich is refered here , face four main challenges, these are high cost of ownership, inflexibility, poor manageability, and difficulty in achieving security. The main objectives of this work is to implement a existing [1],[2], lab automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface.[4] The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to lab automation server. This will decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration.

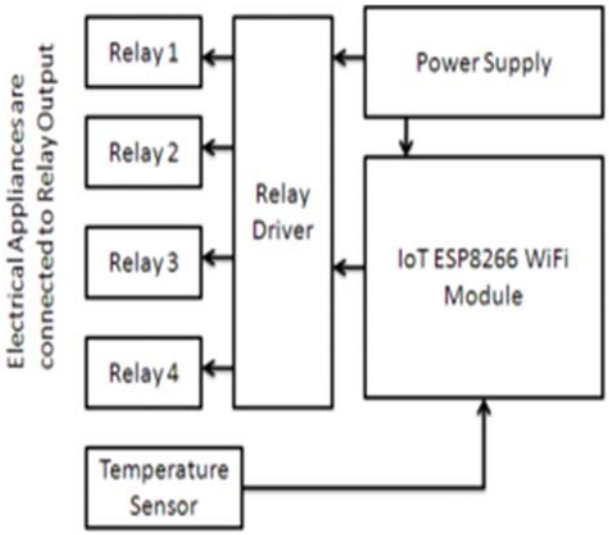

FIG.1: BLOCK DIAGRAM FOR IOT LAB AUTOMATION

IOT implemented system Feature:

Server controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors)[1], [3] &[5]. The Nodemcu esp8266 development board, with built in WiFi card port to which the card is inserted, acts as web server. Automation System can be accessed from the web browser of any local PC in the same LAN using server IP, or remotely from any PC or mobile handheld device connected to the internet with appropriate web browser through server real IP (internet IP). WiFi technology is selected to be the network infrastructure that connects server and the sensors. WiFi is chosen to improve system security (by using secure WiFi connection), and to increase system mobility and scalability.

III. SYSTEM DESIGN AND IMPLEMENTATION

A. Lab Automation System :

The referred model (Fig.1) of the lab automation system is as shown in the figure1.[1],[2]. The model consist of different sensors like temperature, gas, motion and LDR. Initially the Nodemcu esp8266 connects to the internet through WiFi.[2], [4] & [6].

When the connection is established it will start reading the parameters of sensors like p1, p2, p3 etc. The threshold levels for the required sensors are set as t1, t2, t3 etc. The sensor data are sent to the web server and stored in the cloud. The data can be analyzed anywhere any time. If the sensor parameters are greater than the threshold level then the respective alarm a1, a2, a3 etc.[6] will be raised and the required actuation is done for the controlling of the parameters. In the proposed model the temperature, gas leakage, motion in the house is monitored.

The temperature and the motion detection is stored in cloud for analysis. If the temperature exceeds the threshold level then the cooler will turn on automatically and it will off when the temperature comes to control. Similarly when there is a leakage of gas in the house alarm is raised giving the alert sound. The required lights are turned on/off automatically by detecting the light outside the house. The user can also monitor the electric appliances through the internet via web server. If the lights or any electrical

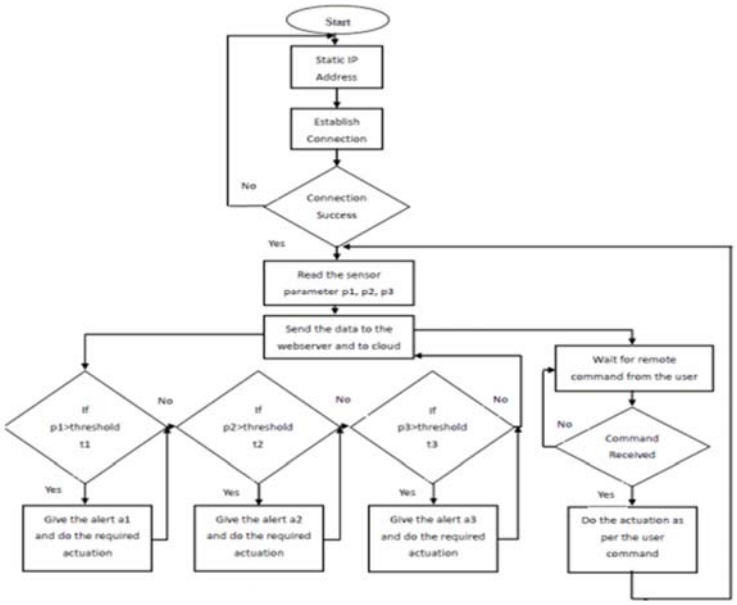

Fig:2: IOT based lab automation system working flowchart.

B. Functions of Automation System : The proposed lab automation system can control the following appliance:

-Lights on/off/dim
-Fan on/off
-On/off different appliance

C. Software design Front End Design:

HTML is a format that tells a computer how to display a web page. The documents themselves are plain text files with special "tags" or codes that a web browser uses to interpret and display information on your computer screen.[7] HTML stands for Hyper Text Markup Language; an HTML file is a text file containing small markup tags. The markup tags tell the Web browser how to display the page. An HTML files must have an htm or html file extension. Cloud Storage: Cloud computing is the practice of using remote servers on the internet to manage, store and process data instead of using a personal computer.

D. Implementation Setup

When the connection is established it will start reading the parameters of sensors. Experimental setup of HAS A model house is built for the lab automation system Relay is used toswitch the electrical appliances like light, fan etc. The Nodemcu esp8266 is placed in store room or garage. The Nodemcu esp8266 is connected with WiFi card with the antennas for the connectivity with Iinternet

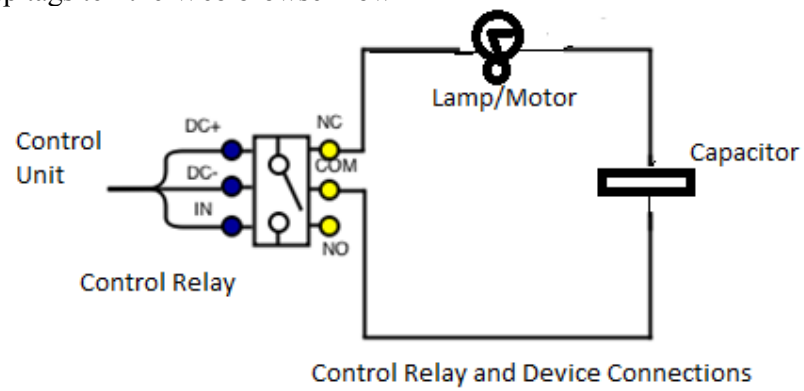

FIG:3. Relay & Device

IV. HARDWARE DESIGN:

ARDUINO ESP8266 ESP8266 is an impressive, low cost WiFi module suitable for adding WiFi functionality to an existing microcontroller project via a UART serial connection.[1],[8] &[9]. The module can even be reprogrammed to act as a standalone WiFi connected device–just add power! The feature list is impressive and includes: 802.11 b/g/n protocol Wi-Fi Direct (P2P), soft-AP Integrated TCP/IP protocol stack. NodeMCU is an open source IoT platform.

FIG:4. NODEMCU ESP 8266

In the above figure is a nodemcu esp8266 microcontroller used in the proposed lab automation system installed in the laboratory.[1],[10]. This microcontroller comes with the inbuilt Wi-Fi module.

FIG:5. CONNECTION OF IoT LAB AUTOMATION SYSTEM WITH AC MAINS

The above figure shows the connection procedure of the relays used in the lab automation with the AC mains. The NC terminal of the relay is been connected in parallel to the ground line of the wire. The COM of the relays is been connected to the 230V supply line of the switch board circuit.

FIG:6. PRACTICAL IMPLEMENTATION OF LAB AUTOMATION SYSTEM

The above figure shows the practical implementation and working of the lab automation system installed in the laboratory. The circuit is installed on the wall and the inbuilt Wi-Fi module is used to connect and control the Lights and Fans of the laboratory

V. GUI: The above figure shows the HTML based webpage used to control the ON/OFF functionality of the lights and fans in the laboratory. This page can be used to control the lab automation system by connecting to the Wi-Fi of the NodeMcu esp8266. The Wi-Fi is password protected at the time of setup.

FIG:7. HTML Webpage of the lab automation system

CONCLUSION

The lab 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.[9] 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. This will help the user to analyze the condition of various parameters in the lab anytime anywhere.

Future work

Using this system as framework, the system can be expanded to include various other options which could include lab security feature like capturing the photo of a person moving around the house and storing it onto the cloud. This will reduce the data storage than using the CCTV camera which will record all the time and stores it. The system can be expanded for energy monitoring, or weather stations.[10] This kind of a system with respective changes can be implemented in the hospitals for disable people or in industries where human invasion is impossible or dangerous, and it can also be implemented for environmental monitoring.

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