A Robust Implementation Design Smart Digital Laboratory Based IoT

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ABSTRACT: Internet of Things (IoT), an embedded technology helps enable breakthrough services by interconnection of physical and virtual things, intelligent interaction and Machine- to-Machine (M2M) communication between environments, objects and interoperable information technologies. IoT has found many applications in the fields of medicine, transportation, farming, manufacturing and automation. In the present scenario, the appliances of a laboratory like lights and fans are left on, even when not in use, which leads to a rise in power consumption of the laboratory. IoT can be used to automate the laboratory which will help in effective power consumption, minimal human assistance required and easy monitoring of the laboratory. This paper proposes a Smart Automation System for the departments computer laboratory. The system will monitor the changes like temperature and lighting conditions of the environment, produce analyzed results by controlling the appliances as well as report abrupt changes.

KEY WORDS: SMART LABROTARY, CORTEX, LDR, DHT11, IoT

I. INTRODUCTION

Smart Laboratory implementation which is built across IoT and Mobile communication technologies to supervise the overall activities of the laboratory including power consumption and application of devices, sensing environmental parameters, thereby providing a smart environment with balanced energy consumption and comfort. The system monitors the consumption pattern of the devices and uploads it to their server and establishes remote control of appliances from anywhere thereby reducing power wastage. At The Internet-of-Things or more commonly referred to as "IoT" , opened possibilities of multiple devices like Sensors, appliances, and types of equipment to connect through the Internet to create a system to serve a designed purpose [1]. A smart laboratory system is based on IoT concepts by using various sensors for data input [2] and a device with mobile applications that are capable of viewing, monitoring, and managing data [3]. Such features like alarm triggers based on threshold settings, automation of environmental equipment, and security features. A study from the Vellore Institute of Technology stated that Internet of Things (IoT) as an environment, in which things, animals, or individuals are provided with unique identifiers and the capabilities to transmit data over the network without requiring human-to human or else human-to-computer interaction [4][5]. Environmental monitoring in laboratories, manual processes still exist. Human supervision and operations are needed to perform tasks. With the advancement in technology and work processes, smart laboratories [1] came about to optimize workflows of laboratories and minimize the workloads of the personnel inside the laboratory. The Internet of Things made the use of multiple sensors and devices interconnect as one system to create monitoring, managing, and automation of the environment convenient. Mobile devices like tablets and mobile applications [6] in use with wireless technology like the internet, made information access more available at any given time.

This is the Simple project based on the lab automation. In the modern world or time, the technology is improving day by day. In this time the people want to do work with less effort. And this can be achieved with the help of this project. The idea is to plant several sensors around the lab and give a calculated feedback to the response these sensors receive. An example would be having PIR sensors around the lab that would detect the presence of human and turns the fan ON or OFF. For light control, there will be LDR and if the illumination in the lab and turns the light ON/OFF according to the room's lighting changes from high to low. And this project is to be overall cost effective. While the idea to improve lab is the priority of this project work, importance is made to ensure that this system is affordable to all those who need it. The setup cost may initially be a bit high, but in the long run it is expected that there will be a reduction in both electricity.

II. PROBLEM STATEMENT

Lab automation systems which is referred 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.

Laboratory Automation is a method to control or monitor computers from remote places by means of a smart phone or computer. Laboratory Automation not only helps you control the computers but also helps saving energy too like it helps detecting devices on standby and turn them off when not in use and thus saves energy. Like we all know that more usages of a hardware are become non- existence or faulty. Therefore, the better option is to increase the usages of software over hardware to protect the environment waste.

III. LITERATURE SURVEY

This paper describes a Laboratory Automation System using IoT devices.The project is published as open source software and hardware. Published in: 2020 21st International Symposium on Electrical Apparatus & Technologies (SIELA)

In this paper we presented the a Lab Automation System (LAS) using Nodemcuesp8266 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.Published in: 2020 21st International Symposium on Electrical Apparatus & Technologies (SIELA)

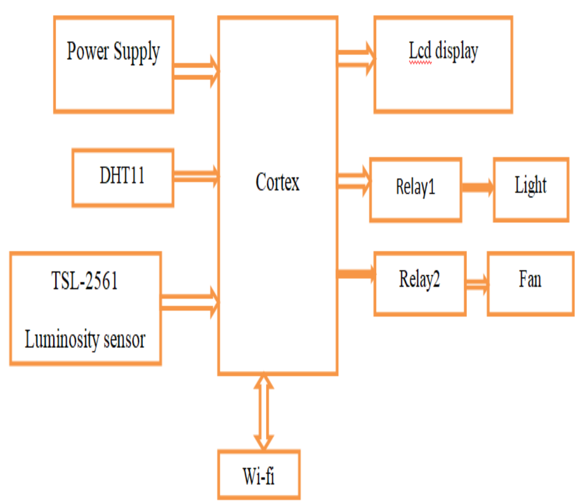
Prospective authors are requested to submit new, unpublished manuscripts for inclusion in the upcoming event described in this call for papers. Published in: IEEE Transactions on Automation Science and Engineering (Volume: 2, Issue: 2, April 2005)

An automation system uses the portable devices as a user interface. They can communicate with an automation network through an Internet gateway, by means of low power communication protocols like Wi-Fi [5]. The emerging technologies of Internet of Things (IoT) can be utilized to better manage energy consumption. In the following, few related research works in this field are briefly discussed.

IV. HARDWARE DESCRIPTION

The proposed work aims at designing a smart laboratory that facilitates remote monitoring and control of the lab devices using mobile application . In this system, each lab device is interfaced with a data acquisition module that is an IoT object with a unique IP address resulting in a mesh wireless network of devices.

1) BLOCK DIAGRAM:



Server section

www.bosembedded.com/GPRS/dac19.txt.

Observations: T: 98fHeart bit: --

FIG 1: Block Diagram & Server Section Of Smart Labrotary

2). OVERVIEW OF BLOCKDIAGRAM

Smart laboratory implementation for management of subsystems of a university, including lighting conditions, air conditioning, heating, audio/video, controlling switches and security. It highlights the benefits for university and the students using the smart laboratory.

Secure and Smart Laboratory implementation with Wireless Sensor Network (WSN). The system is implemented using an Ambient lighting module. It uses Passive Infrared Sensor (PIR) and Environment Sensor (ES) for security. The difficulty faced by the system is that, WSN has limited computation, lack of communication resources, reduced power, shortage of storage, prone to attacks and lower bandwidth to communicate.

3. WORKING

The Smart Laboratory System will sense the temperature and the light intensity from the environment is sensed using the DHT11 temperature sensor and TSL2561 luminosity sensor. If the value of the temperature is beyond a certain threshold, then the fans of the laboratory will be switched on for a certain time interval, else switched off. Similarly, if the luminosity value is beyond a certain threshold, then the tube lights in the laboratory will be switched off for certain time interval, else switched on. When no motion is detected, then tube lights and fans of the laboratory will be switched off until motion is detected again.

The data from the sensors will be sent to the microcontroller CORTEX STM 32. The processing will be done by the microcontroller and appropriate actions will be taken (controlling tube lights and fans).

3.1. CORTEX/STM32

STM32F103C8T6 is a very powerful Microcontroller and with its 32-bit CPU, it can easily beat Arduino UNO in performance. As an added bonus, you can easily program this board using your Arduino IDE (although with some tweaks and additional programmer i.e. USB to U(S)ART converter).

The following image shows the front and back sides of a typical STM32 Blue Pill Board. As you can see, the layout of the board is very simple and some might even confuse it for an Arduino Nano.

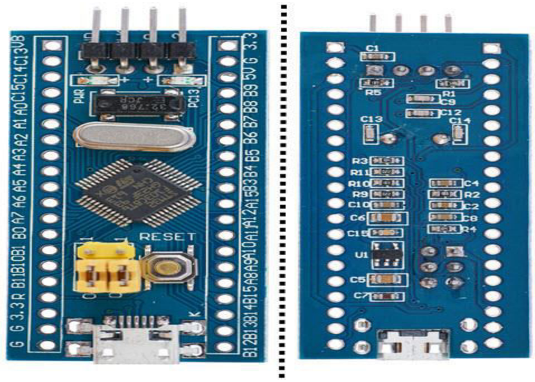


FIG 2: Cortex/Stm32 Module

An important thing about these boards is that they are very cheap, cheaper than the cloned version of Arduino UNO. I got this board for approximately $2.5 (₹180) in my local electronics store. So, it is obviously a cloned version (probably a counterfeit STM32 MCU?) and there are many cloned versions of the board available in the market.

3.2. LM35/ DHT11

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius(Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ˚ Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4˚C at room temperature and ±3⁄4˚C over a full −55 to +150˚C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1˚C in still air. The LM35 is rated to operate over a −55˚to +150˚C temperature range, while the LM35C is rated for a −40˚ to +110˚C range (−10˚ with improved accuracy). The LM35 series is available pack-aged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also avail- able in an 8-lead surface mount small outline package and a plastic TO-220package.

3.3. TSL-2561/Luminosity sensor

Luminescence sensors **detect visible and non-visible marks that illuminate when using ultraviolet (UV) light**. Fluorescent material and marks are reliably detected independently of their pattern, colors or surface conditions on any material. Luminescence sensors emit UV light with a wave length of approximately 375 nm

The TSL2561 luminosity sensor is an advanced digital light sensor, ideal for use in a wide range of light situations. Compared to low cost CdS cells, this sensor is more precise, allowing for exact Lux calculations and can be configured for different gain/ timing ranges to detect light ranges from up to 0.1 - 40,000+ Lux on the fly.

The best part of this sensor is that it contains both infrared and full spectrum diodes! That means you can seperately measure infrared, full-spectrum or human-visible light. Most sensors can only detect one or the other, which does not accurately represent what human eyes see (since we cannot perceive the IR light that is detected by most photo diodes).

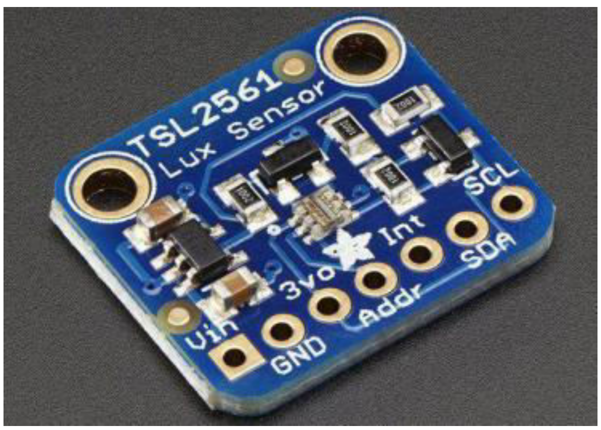


FIG 3: Luminosity Sensor

3.4. DC MOTORS

A DC motor with gear box attached to the shaft, which is mechanically commutated electric motor powered from direct current (DC). Generally used in DIY projects, Battery operated toys, Radio controlled vehicles, Robotic projects etc.

DC motors consist of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator. Applying a voltage to the coils produces a torque in the armature, resulting in motion. It contains three major parts

3.5. BUZZER

Welcome to the CUI Product Spotlight on piezo and magnetic buzzers. Learn about CUI's buzzer product line, including a description of the main technologies used, their working principles, key specifications and possible applications.

3.6. IOT

A wireless router is a device that performs the functions of a router and also includes the functions of a wireless access point. It is used to provide access to the Internet or a private computer network. It can function in a wired LAN (local area network), in a wireless-only LAN (WLAN), or in a mixed wired/wireless network, depending on the manufacturer and model.

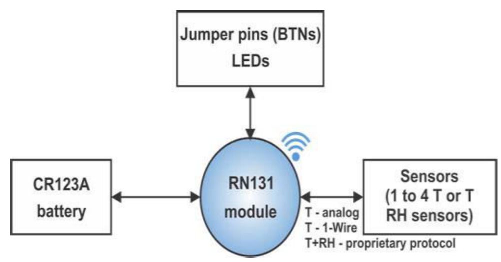


Fig 4: Wi-Fi Network Scenario

Wi-Fi technology may be used to provide Internet access to devices that are within the range of a wireless network that is connected to the Internet. The coverage of one or more interconnected access points can extend from an area as small as a few rooms to as large as many square kilometres. Coverage in the larger area may require a group of access points with overlapping coverage. For example, public outdoor Wi-Fi technology has been used successfully in wireless mesh networks.

V. RESULT

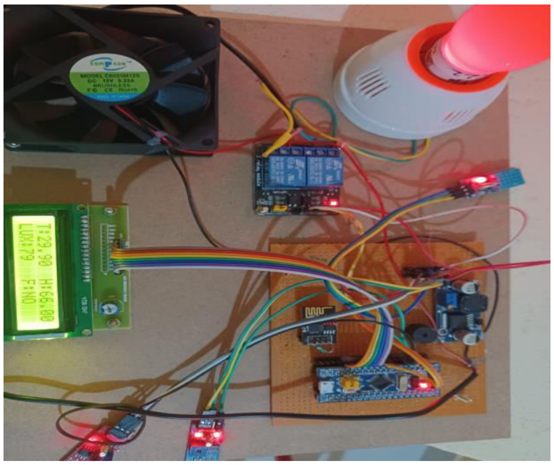


FIG 5: Hard Ware Kit Digram

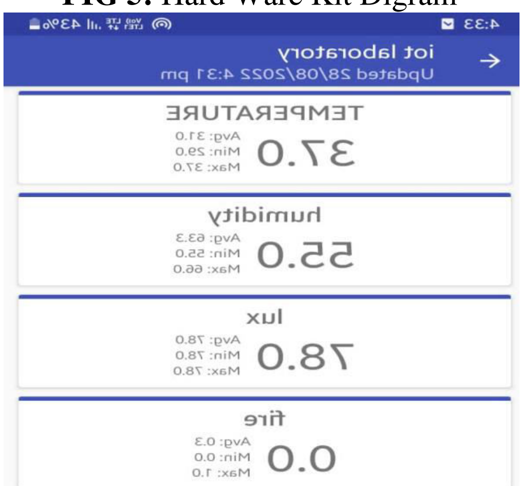


FIG 6: IoT Updated Information

VI. CONCLUSION

The system extends the home automation technology to the college laboratories, and hence to create a smart laboratory. The smart laboratory reduces the amount of power consumed throughout the day. Thus, the system helps in managing energy efficiently. Also, the automation of the laboratory leads to its improved organization and reduces staff involvement in simple administration tasks

The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to lab automation server. It has the capability to reduce the excess usage of the power consumption and it will reduce the electricity bill upto 10% to 15% and manual switching of the computer and stuffs. So our project is very effective and eco-friendly.

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