IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

Implementation of Light-load automation in a lab using AWS services

Jaidev Singh Dhariwal[1], Pratik Thombare[2], Sourabh Mali[3], Prof. Swapnil A. Namekar[4]

Department of Electrical Engineering, Bharati Vidyapeeth University College of Engineering Pune, Maharashtra

Abstract: There is an increasing demand of smart Facilities, where appliance react automatically to changing environment condition and can be easily controlled through one common device. This project presents a possible solution whereby the user control device by using their existing mobile number, where control is communicated to the NodeMCU from a mobile phone through its Android Application. The aim of this project is to design a circuit such that one can control Faculty or industrial appliances using the help of Wi-Fi.

This project presents the overall design of lab Automation System (LAS) with low cost and wireless system. It specifically focuses on the development of an "Internet of Things" (IoT) based lab automation system that is able to control light load via internet or by automatically programmed to operate from ambient conditions. In this project, we will try to design the development of a firmware for smart control which can successfully be automated minimizing human interaction to preserve the integrity within whole light load in the lab. We will use Node MCU, a popular open source IOT platform, to execute the process of automation. The aim is to design a prototype that establishes wireless remote control over a network of lights and fans present in the lab

Keywords: light load, Automation, 8051 microcontroller, Arduino, Node Mcu, Authorization, Wireless control

I. INTRODUCTION

Before understanding light load lab automation, it is compulsory to understand Home Automation is a combination of 2 different words having their own wide meanings- Home + Automation. To know clearly about the topic, we must have the idea of both. Home is a dwelling-place used as a permanent or semi-permanent residence for an individual, family, household or several families in a tribe. It is often a house, apartment, or other building, or alternatively a mobile home, houseboat, yurt or any other portable shelter. Larger groups may live in a nursing home, children's home, convent or any similar institution. A homestead also includes agricultural land and facilities for domesticated animals. Where more secure dwellings are not available, people may live in the informal and sometimes illegal shacks found in slums and shanty towns. More generally, "home" may be considered to be a geographic area, such as a town, village, suburb, city, or country. In short, a home is generally the place where one lives permanently, especially as a member of a family or household. Automation- Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heattreating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. Some processes have been completely automated. The biggest benefit of automation is that it saves labor; however, it is also used to save energy and materials and to improve quality, accuracy and precision. The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when General Motors established the automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. Concluding both the information's we get the definition of home automation.

From here Stipulate the light load lab automation, lab automation refers to the use of automated systems to control and monitor various laboratory equipment and processes, typically involving low-power devices and instrumentation. This type of automation is particularly useful for laboratories where small-scale experiments and tests are conducted, such as in research and development, quality control, and academic settings. Light load lab automation systems can include a range of features, such as automated data acquisition and analysis, remote monitoring and control, automated sample handling and processing, and integrated scheduling and reporting capabilities. These systems can also be designed to integrate with existing laboratory equipment and software, allowing for easier simulation of lab functions and human interaction, Light load refers to systems or operation that take light voltage load preferably less than five volts such as fans, lightbulbs, tube lights, charging points etc, Light-load lab automation systems are designed to be efficient, costeffective, and easy to use, requiring minimal human intervention. They are typically used in laboratory settings where

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

low-power devices and instrumentation are used, such as in research and development, quality control, and academic labs. These systems can be used for a wide range of applications, including sample preparation, analysis, and data acquisition. They can also be used for monitoring and controlling equipment remotely, as well as for scheduling and reporting laboratory activities. Overall, light-load lab automation systems are a valuable tool for improving efficiency and productivity in laboratory settings. light-load lab automation systems is the industrial extension of building automation. It is the automation of the control and monitoring of laboratory equipment and processes, focusing specifically on low-power devices and instrumentation. These systems can improve the accuracy and precision of experiments, reduce human error, and increase throughput and efficiency. Additionally, the integration of light-load lab automation with existing laboratory equipment and software can streamline workflows and enable better collaboration among researchers and scientists. Some examples of light-load lab automation systems include automated pipetting, microplate handling, and liquid handling systems. Overall, the use of light-load lab automation systems can help laboratories to operate more efficiently, reduce costs, and improve the quality of their research and testing. appliances, security locks of gates and doors and other systems, to provide improved convenience, comfort, energy efficiency and security. Home automation for the elderly and disabled can provide increased quality of life for persons who might otherwise require care givers or institutional care. The popularity of home automation has been increasing greatly in recent years due to much higher affordability and simplicity through smartphone and tablet connectivity. The concept of the "Internet of Things" has tied in closely with the popularization of home automation. A home automation system integrates electrical devices in a house with each other. The techniques employed in home automation include those in building automation as well as the control of domestic activities, such as home entertainment systems, houseplant and yard watering, pet feeding, changing the ambiance "scenes" for different events (such as dinners or parties), and the use of domestic robots. Devices may be connected through a home network to allow control by a personal computer, and may allow remote access from the internet. Through the integration of information technologies with the home environment, systems and appliances can communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits

A. WHY IMPLEMENT AN AUTOMATION SYSTEM?

It’s so necessary to know the benefits of this technology so that we can make our interest in learning it.

There are Eight Reasons to Automate an area

1. Make tasks more convenient – Many tasks that are repetitive in nature can be accomplished automatically or with fewer steps using automation. Instead of turning off or dimming four different lights when you want to watch a movie, automation allows you to accomplish this task with one button?

2. Save money on utilities – Utilities can amount to several hundred dollars per month. automation can turn off lights or lower the thermostat automatically when you aren’t using them and easily lower your utility bills by 10% to 25%.

3. Increased safety – Many accidents happen because of poor lighting. Automation can automatically turn lights on in closets, stairways, and other dark places when you enter and decrease the chance of accidentally tripping or running into things.

4. security – Although any type of security is a priority for everyone, high installation cost or monthly monitoring charges make security systems cost prohibitive for many homeowners. Automation provides an inexpensive solution to security.

5. Good for the environment – In a time when we are all becoming more environmentally aware, home automation provides a good solution to help preserve our natural resources. Automation products can reduce power consumption and automatically turn off lights and appliances when they aren’t in use.

6. Peace of mind – Never again worry about your home/lab/area of concern while you’re away. Using video cameras and an Internet connection, you can check on the status of your lab or equipments from anywhere in the world using a PC or web-enabled phone.

7. Learning experience for students – Technology is here to stay and the more your children learn about upcoming technology the better prepared they are for the future. Turn your home into a classroom, as your home automation projects become a learning experience for your children.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

8. Novel exposure to technology- Home automation provides an opportunity for people to experience and interact with new technology. By automating tasks, individuals can become more familiar with the use of devices such as smart thermostats, voice assistants, and smart lighting systems. This exposure can lead to increased comfort and confidence in using technology, which can be beneficial both personally and professionally. Additionally, home automation can provide an opportunity for individuals to experiment with creating custom automations and integrating different devices, leading to a deeper understanding of how technology works and how it can be used to improve daily life.

II. SYSTEM OVERVIEW

Home automation is definitely a new term if we talk about Indian market but in western countries it's very common. Several home automation devices already in market, which is either based on any microcontroller (like 8051, Atmega) or discrete components (like the circuits of capacitors, resisters or inductors). But this project is different from the previous ones. We are using the latest Microcontroller ' Arduino' which is more handy and easy to use/ understand than the previous microcontrollers.

A.1 Arduino

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer

A.2 ANDROID SMARTPHONE

The second most important part of the project is Android Smartphone. Android is the name of latest tech trend. Android is a mobile operating system (OS) based on the Linux kernel and currently developed by Google. With a user interface based on direct manipulation, Android is designed primarily for touchscreen mobile devices such as smartphones and tablet computers, with specialized user interfaces for televisions (Android TV), cars (Android Auto), and wrist watches (Android Wear) [11] . We are using it to show the information which we get from the sensors and also send instruction to the MCU via Bluetooth so that we can control the things that are connected to the Arduino. In Android app store there are lots of apps that can be used for the automation purpose like ArduDroid, Arduino Command, Arduino Smart Home, Ardudroid etc.

A.3 CONNECTING MEDIUM

After setting up all things in MCU and installing application in the Android device, we face a very common problem of connectivity. How to connect these 2 different devices with each other? We have several wired/ wireless technologies that we can use to connect these devices. The choice of the technology is fully based on the range of connectivity. Some technologies are as follows

1) Bluetooth- Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

2) Wi fi- Wi-Fi is a local area wireless computer networking technology that allows electronic devices to network, mainly using the 2.4 GHz UHF and 5 GHz SHF ISM radio bands. The WiFi Alliance defines Wi-Fi as any "wireless local area network" (WLAN) product based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". However, the term "Wi-Fi" is used in general English as a synonym for "WLAN" since most modern WLANs are based on these standards. "Wi-Fi" is a trademark of the Wi-Fi Alliance. The "Wi-Fi CERTIFIED" trademark can only be used by Wi-Fi products that successfully complete Wi-Fi Alliance interoperability certification testing. Many devices can use Wi-Fi, e.g. personal computers, video-game consoles, smartphones, digital cameras, tablet computers and digital audio players. These can connect to a network resource such as the Internet via a wireless network access point.

3) RF-Radio Frequency is a rate of oscillation in the range of around 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations; however, mechanical RF systems do exist.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

4) Ethernet Sheet- Ethernet is a family of computer networking technologies for local area networks (LANs) and metropolitan area networks (MANs). It was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3, and has since been refined to support higher bit rates and longer link distances. Over time, Ethernet has largely replaced competing wired LAN technologies such as token ring, FDDI, and ARCNET. The primary alternative for contemporary LANs is not a wired standard, but instead a wireless LAN standardized as IEEE 802.11 and also known as Wi-Fi.

III. LITERATURE REVIEW

Nowadays, one of the significant global concerns is reducing the energy consumption to the energy crisis. Therefore, it is necessary to find reliable alternative sources of energy, capable of replacing the existing ones or reducing the total energy consumption of electronic devices [4], and BMS can address these goals. There are a lot of methods to make the houses smart. In all of them, we need a central controller, sensors and some controllable networked devices to gather with existing protocols like KNX, Zig-Bee, X10, Z-Wave, Modbus, etc. This paper presents an affordable method for home automation with Arduino and Modbus protocol. In this approach, we use MY SCADA v6.02 software for monitoring and controlling the home remotely.

The remainder of this paper is organized as follows:

Section
2 defines different protocols which is used in BMS. In Section 3, some related works and literature are reviewed. The lowcost method and its details have been described in Section 4. After that, some suggestions are presented as future works in Section 5 and finally the paper will be ended by some concluding remarks in Section 6.

2 DIFFERENT PROTOCOLS IN BMS When designing a Smart Home Automation environment, one of the essential concerns is to decide on the communication protocol (or standard) that will be linked the “brain” to the different devices of the system. Some traditional communication protocols are X10, ZigBee, Z-Wave, Insteon, KNX, and Modbus. In the following, these protocols are explained briefly.

2.1 Z-Wave

One of the most popular wireless home automation protocol is Z-Wave that works at 908.42MHz frequency band using FSK (frequency shift keying) modulation and its data rate is 9.6 Kbit/s and supports 232 devices per network [10]. For connecting more devices bridging networks can be used. Z-Wave uses a Source Routing Algorithm to determine the fastest route for message delivery. Each Z-Wave device is embedded with a code, when a device is plugged into the system, the network controller recognizes the code, determines its location and adds it to the network. When a command comes through, the controller uses the algorithm to determine how the message should be sent. Because this routing can occupy a lot of memory on a network, Z-Wave has developed a hierarchy between devices: Some devices produce the messages, and some devices carry them and respond which is named as "slave." Z-wave has high data range; therefore, it can be used in long distance monitoring and control, but its security system is still weak which makes it unfeasible for congested networks [11].

2.2 Zig-Bee

There are many similarities between Z-Wave and ZigBee. For example, ZigBee is also a wireless home automation protocol, low-cost and low-power technology. It works with 802.15.4 wireless communication standard using PSK (Phase Shift Keying) modulation and its data rate is 250 kb/s and supports 65,635 devices per network [1].

In ZigBee and Z-Wave there are more than one way for the message delivery, so they are mesh networks [12]. In the study of L. Yanfei1 et al., Modbus protocol is embedded into ZigBee stack, because the information in the ZigBee wireless sensors cannot be viewed in real time by a friendly interface. Due to this combination, the interaction can be done well, and the information can be considered in a friendly interface [13].

2.3 KNX

KNX is a protocol for wired media, and it is known as an international standard. KNX defines several physical communication infrastructures such as twisted-pair power line media and a wireless transmission medium called KNX

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

RF. KNX does not provide any noise because it uses separate cable and Shield. The main differences between KNX and ZWave protocol are as follows:

1. KNX system has high power and security but its major problem is that transforming buildings built a few years to smart buildings is very expensive because the wiring should be replaced and in many parts of the building carving should be done. So it does not cost but in ZWave protocol, this problem does not exist because this protocol does not require new wiring.

2. One more problem with KNX is that if in this kind of intelligent system one module fails, that module and the smart keys should be repaired or replaced but in Z-Wave protocol even if a module or its keys fail, that part can be controlled manually and this is a great advantage because it may take several days to repair and manual control can solve the requirements of building for a few days till it will be repaired, while in KNX system it is impossible.

2.4 X10

X10 is one of the most popular protocols in Home Automation business, with millions of homes using it all around the world, mainly due to the cheap accessibility of its components. It primarily uses power line wiring for data exchange and control. For designing smart home with this protocol, the user just needs to plug electrical devices into the conventional power outlet with a suitable communication interface, so communication between transmitter and receiver will be done and the user will be able to turn on/off the device according to the code transmitters.

X10 has some limitations: communicating over power lines is almost unreliable because data may be corrupted with noise coming from other signals and it may translate electronic interference as a command and react, or it may not receive the command at all. The maximum devices that can be controlled by X10 are 256. An advantage of X10 is that it can use either wired power line or wireless radio communication method. However, its biggest disadvantages is that only one message can be passed through the transmission line at a specific time.

Nevertheless, X10 is relatively cheap and many devices are available to communicate with this protocol [9].

2.5 Insteon

Using a wireless network provides more flexibility for placing devices, but like power lines, they might have interference. Insteon offers a way for your home network to communicate over both power lines and radio waves, making it a dual mesh network [12]. If the message crosses over one platform, it will try the other. In addition to X10, this is the technology that communicates via both wireless and power line technologies.

2.6 Modbus

Modbus is a serial communication protocol to communicate with programmable logic controllers (PLCs). It is a method used for transmitting information over serial lines between electronic devices. The device requesting the information is called the Modbus Master and the devices were supplying information are named Modbus Slaves. In a standard Modbus network, there is one Master and up to 247 Slaves, each of them has a unique address from 1 to 247.

The Master can also write information to the Slaves. Modbus is typically used to transmit signals from instrumentation and control devices back to the main controller or data gathering system, for example, a system that measures temperature and humidity and sends the results to a central computer. The Modbus protocol includes ASCII, RTU, and TCP transmission mode, supporting traditional RS-232, RS422, RS-485 and the Ethernet equipment. Serial port Modbus has two standard network modes: ASCII mode and RTU mode. Due to the Ethernet Modbus equipment, the transmission mode is the Modbus/TCP protocol. The same transmission mode and parameters must be chosen for all equipment in Modbus network [14].

2.7 Power Line Carrier

Power Line Carrier System (PLC) is a technology which is used to send coded signals along a home's existing electrical wiring to programmable switches or outlets. These signals convey commands that correspond to "addresses" or locations of specific devices and control how and when those devices operate. The PLCs transmitter, for instance, can send a signal along home's wiring, and a receiver plugged into any electric outlet in the home could receive that signal and operate the appliance to which it is attached [1].

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

IV. RELATED WORKS

During the design process, home automation system must be efficient, easy to apply and at an affordable price. PLC (Programming Logic Control) is considered as an alternative to such systems. PLC is an electronic device designed to be used in the field of industry that controls a system or groups of systems through analog/digital data input/output terminals, providing general control employing inherent functions of timing, counting, data processing, comparing, sorting, data transfer and arithmetic operations. At the same time, use of PLC is efficient for several reasons such as being able to make changes to the software and for resuming the algorithm as the energy supplied back by saving data for a long time in the case of power failure [15]. In [3], the authors have used Delta DVP-10SX PLC for home automation.

G. D. Luca et al. in [16], monitored and managed a KNXbased home automation system through an Android mobile device in an efficient and safe way. In [17], the author used LabView software tool to control a smart house. The system can monitor the temperature, humidity, lighting, fire & burglar alarm, the gas density of the house and has the infrared sensor to guarantees the family security.

A KNX-ZigBee gateway studied by W. S. Lee et al., for interfacing between KNX and ZigBee systems, thereby enabling the integration of wired and wireless home automation systems [18].

K. Baraka et al. used X-10 and Zig-Bee protocols with Arduino microcontroller as a central controller to obtain a cost-efficient hybrid system [19].

J. Han et al. used ZigBee to measure and transfer the power and energy of home appliances at the outlets and the lights, and Power line communication is adopted to monitor solar panels [20]. In [21], a low cost secure cell phone based, flexible home automation system was presented. Home appliances are connected to the Arduino BT board and it communicates with cell phone with wireless, and the cell phone script is written in Python.

V. METHOD AND CASE STUDY

The designed system is microcontroller based on a WLAN system named Arduino. Arduino is a singleboard microcontroller that uses ATMega 328 as its microcontroller. Parameters such as light intensity, switches, or even an e-mail can be received by Arduino. After processing, outputs such as turning on an electrical device, LED color changing, or sending or receiving an email can be performed. Arduino is an open-source programming environment that costs free. It can communicate with many software like Flash, Processing, MaxMSP, etc. Compared to other microcontroller platform, Arduino boards are relatively cheap and decrease the cost of automation considerably. In this case, a room contains a DHT temperature and humidity sensor, a motion sensor, light sensor and a smoke sensor as inputs and four lamps, an alarm and an air conditioner system, as outputs that controlled by Arduino board. Furthermore, some relays are used to convert 220v (nominal voltage for most of the electrical devices in Iran) to 5v (standard voltage for Arduino). Besides, this system can be controlled and monitored remotely by the use of an industrial open source software called "my SCADA" through World Wide Web. Fig .1 shows the overview of the conceptual architecture of the proposed method.

can also send an email or message to the particular number

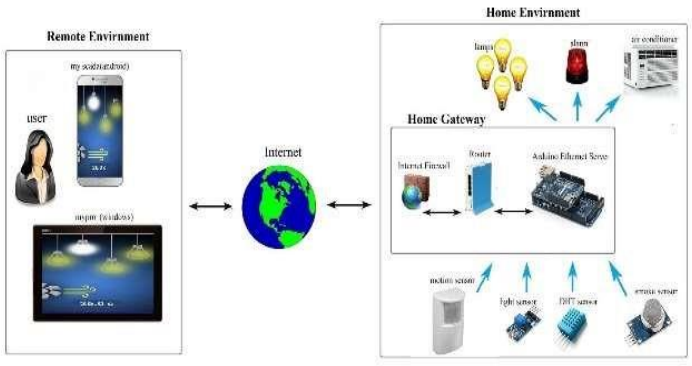


Figure .1 the overview of the conceptual architecture.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

In the following, we summarize how the inputs and outputs communicate with each other and how the system is controlled.

4.1 Air conditioner system DHT sensor collects data from temperature and humidity in real time and sends it to Arduino for processing.

This data is compared with the set point number that user determines it in Arduino program. According to the previous situation and new data coming, the next command will be issued. The system used in this experiment contains several switches divided from off up to maximum value of cooling or heating. The output of the control system switches between this cases to keep the room's temperature at a particular value (which can be changed by the user). Separation of the cooling and heating mode is done through monitoring software that will be explained further.

4.2 Lighting system

In order to control the status of the lamps, two approaches are considered. At first, the light sensor collects data about the light intensity of inside and outside the room in a radius of two meters and sends it to the controller. In the controller, similar to air conditioner system this data goes into a closed-loop system and is compared with the set point value. Then according to the previous situation and new data, the next command will be issued. Beside this loop, a motion sensor fixed at the corner of the room observing the whole space, checks if any movement is done or not and reports to the controller in real time. If there is no movement for ten minutes, all the lamps and air conditioner will be deactivated and vice versa once the action is viewed, all loops activities are resumed.

Note that to avoid consecutive switching between different actuators and hurt them, the comparison of all loops is made to a range of changes, not to a specific one.

4.3 Fire Suppression System

Smoke sensor checks the status of the room in real time and activates the alarm upon detection of smoke. It

4.4 Central controller

As previously mentioned, we use an Arduino board as the central controller. The program is written in C++ by the use of Modbus library for network connection. In this program, the relation between each input and output is specified and all commands are issued by Arduino. In order to access the outputs both manually and by mobile (graphically), we have to use the closed-loop system in which if the users change the status of each outputs manually, the changes should be illustrated on the mobile and vice versa. Therefore, some registers are embedded in Arduino code that mention the Modbus outputs to check the status of each output at real time and show on mobile software.

Note that all of the lamps and air conditioner system work with 220v in this case (Iran) and the nominal voltage for Arduino is 3-5v. So we need to convert this voltage during connecting the outputs to Arduino. Relays are used to convert the voltage. Relays consist of two sides: power side that lamps and air conditioner are connected here, and stimulation side which is connected to Arduino. Fig .2 shows the relay board used in this case.

Figure .2 Relay board used in the proposed case (consists of 8 independent relays)

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

4.5 Network connection

In this paper one industrial protocol named as MODBUS is used to control and monitor the system through network communication. Modbus protocol is able to connect more than 240 devices through a network. Here network communication is done by the Arduino Ethernet shield and a wireless router device.

Arduino Ethernet Shield is made based on the Wiznet W5100 Ethernet chip which provides the ability to network with TCP and UDP [3]. The program is written by an open source software "my SCADA designer," that exclusively related to My SCADA Company, and the similar program is written for Arduino board in C++ by the use of Modbus library for network communication. Modbus program is loaded into mobile (by the dedicated Android application) or Windows software named" mypro" and Arduino code is loaded to Arduino board with USB cable. The user can connect to the router by mobile remotely (wireless), and the router is connected to Arduino Ethernet Shield through Ethernet cable (wired). Now it is possible to control the outputs and monitor the status of the lamps, the room temperature, air conditioner and access to choose the air conditioner mode. Fig .3 shows the overview of the conceptual architecture.

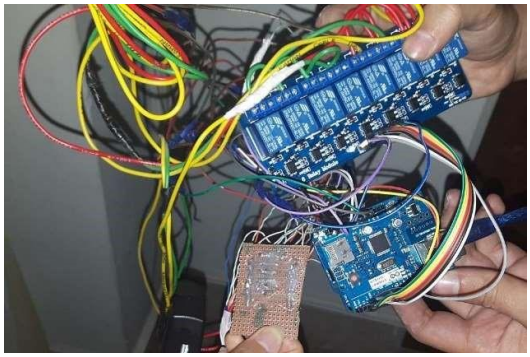


Figure .3. Total scheme central district of the smart room

4.6 myDESIGNER program

myDESIGNER software lets you create visual features, datalogs, alarms, notifications, trends, reports, etc. myDESIGNER has many functions to speed up project design including an integrated Tag database, master objects, parametric screens, or direct import and export to Excel. Once the project is created, it is ready to use on any device such as a server, tablet or even smartphone while providing the best in class customer experience thanks to crisp, scalable graphics and responsive layout. By using this program, the designer assigns a specific address to each component specified by an appropriate picture. In this paper, each output component works at digital form and refers to a specific register that user has determined it before. It means that if the user touches each component, its register will be active and suitable command will be delivered.

Fig .4 shows designed program for this case.

Figure .4. The designed visual programmed for remote control

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

FUTURE WORKS

Here some suggestions are listed to increase the quality of using it and its security:

1. To decrease the amount of wiring, especially in pre-built places, Arduino can communicate with other wireless protocols like ZigBee.
2. In big places, it can be embedded with multi sensors at specified intervals and then their information is collected to make a decision by central controller. Microcontroller used here consists of 54 input/output pins (both analog and PWM I/O). If more outputs (or inputs) required, two approaches can be suggested, using Arduino expansion shield or exploiting more than one microcontroller communicated by MAX485 device. Beside, different types of controller can be used in BMS. One controller is master and communicates to other slave controllers. Final decisions are made at master controller. Then it sends commands to a nearest slave controller to apply changes.
3. Instead of Arduino Ethernet shield, one Wi-Fi module can be connected to Arduino and one android (or java) application can be connected to it (instead of myscada software).
4. Sometimes it is difficult to connect to mySCADA software or all users do not have this application on their mobiles. One solution is to connect mySCADA and one Raspberry Pi board in which every user can access to mySCADA program only needs an internet connection on every smart devices.
5. A. AWS SERVICES USED FOR SERVER LESS COMPUTING

There are four major deployment services used for server less web application namely Amazon Application programming interface (API), AWS Lambda, Amazon DynamoDB, Amazon Simple Storage Service(S3) [4].

1) Amazon Application Programming Interface(API)

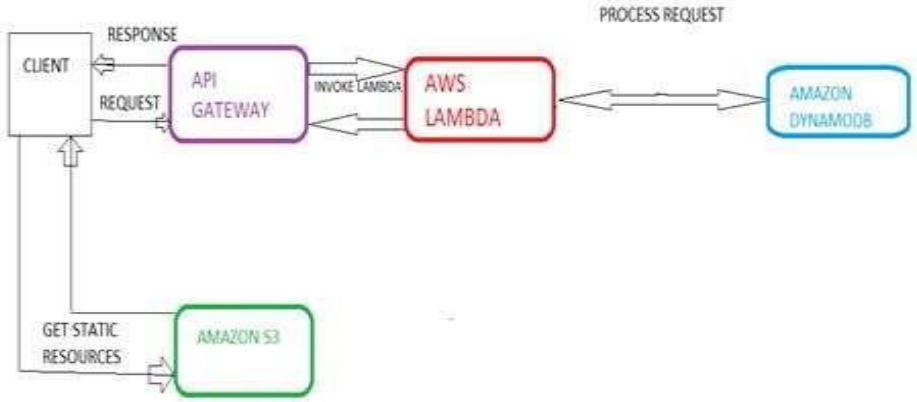
API means Application programming interface. It is used to access data, business logic from backed services. Means it allows two applications to interact with each other. It is an system which allows to communicate with other system either hardware or software as it works as an bridge between the system and other devices. API Gateway is a fully managed service it helps developers to create, publish, maintain, monitor and secure API at any scale .API act as front door for application to access data, business logic or functionality from your backed services. It can handle concurrent API calls ,including traffic management ,CORS support,authorization and access control.[2][7]

2) AWS Lambda

It is server less computing mechanism which helps you to run your function code.As per the specific work you want to do for your application you want to work on. In AWS lambda we create function in language we want to write in and than AWS lambda performs or executes the task it is assigned for. It can perform any type of computing. Each lambda function runs in its space. Each function is provided with necessary RAM and CPU . Customers is charged for only the amount of function runs during the process by the cloud platform the organization is using.[3][4][8]

3) Amazon Simple Storage Service (S3)

It is an simple storage service that stores the data in the form of buckets. It is an web service provided by AWS. It is used to store and receive data from anywhere on the web. It is secure place widely increased and prevent energy losses significantly. to store the data. You can store images ,word files, PDF files, etc. as it is an object storage service. You can store data up-toa maximum of 5TB. Files are stored in form of bucket .A bucket is like a folder which we usually see in our PC,mobile etc. Advantages of amazon S3 is create buckets, store data in buckets, download data, provide permissions, provide standard interfaces, provide security. S3 object based objects consists of key,value,version id, meta data, sub resources, access control information. [8][9]



IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

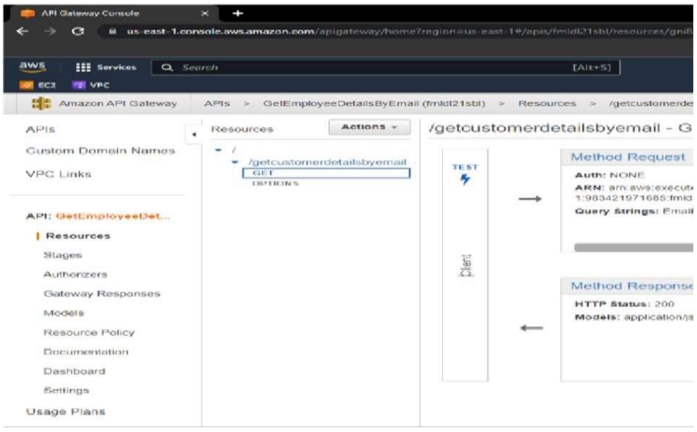
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 6, June 2023

DOI: 10.17148/IJIREEICE.2023.11614

4) Amazon DynamoDB

It is a fully managed no SQL database service.It gives fast and reliable performance with scalability you don't have to worry about hardware property setup and configuration software patching or scaling.It also offers encryption which removes the burden of protecting sensitive data. With DynamoDB you can create database table which store and receive any amount of data and serve any level of traffic you can scale up and scale down your tables capacity without down time or performance degradation.You can use AWS management console to Figure1: Block diagram of server less web application monitor resource utilization and performance matrix. It provides on demand back- ups . It helps to protect your tables from accidental write or delete operations. It has high availability and durability.[4][5]



CONCLUSION

In this paper we first give the definition of smart home and home automation. After that, more about the most popular protocols used in home automation were explained. Then we introduced our low-cost system for home automation that was based on Arduino microcontroller and the way it has been controlled by network communications and Modbus industrial protocol. It has been shown that we could control and monitor all of the electrical devices controlled by the complicated and expensive controller before. By operational planning to make more homes automated using the presented idea, the number of smart homes can be

REFERENCES

[1] R. J. Robles. and Tai-hoon Kim, "Applications, systems and methods in smart home technology: a review ", International jurnal of advanced science and technology, february 2010, pp 37-48.
[2] M.Flax, "Intelligent buildings ",IEEE communication magazine , April 1991, pp 24-27.
[3] A. Adriansyah, and A. Wahyu Dani, "Design of small smart home system based on arduin," Electrical Power, Electronics, Communications, Controls, and Informatics Seminar (EECCIS), 2014, pp. 121–125.
[4] A. Florea ,I. Băncioiu , "Future house automation ", 19th International Conference on System Theory, Control and Computing (ICSTCC), oct 2015, pp699-704.
[5] C. Bolchini, A. Geronazzo, E. Quintarelli, " Smart buildings: A monitoring and data analysis methodological framework ", Building and Environment, ,may 2017, pp1-16 .
[6] M. Duranton, K. de Bosschere, A. Cohen, J. Maebe, H. Munk, " The HiPEAC vision ", May 2015.
B.Yuksekkaya, A. Alper Kayalay, M. Bilgehan Tosun, M. Kaan
Ozcan , A.Ziya Alkar ,''A GSM, Internet and Speech Controlled Wireless Interactive HomeAutomation System'', IEEE Transactions on Consumer Electronics,Vol. 52, No. 3, AUGUST 2006,pp 837-843
[7] F. Suba, C. Prehofer, and J. van Gurp, "Towards a common sensor network API: practical experiences " International Symposium on Applications and the Internet, 2008 pp.185,188.
[8] C. Withanage, R. Ashok,C. Chau Yuen,k. Otto, "A comparison of the popular home automation technologies ", IEEE innovative smart grid technologies, 2014, pp600-605.
[9] C. Reinisch, W. Kastner, G. Neugschwandtner, and W. Granzer, "Wireless Technologies in Home and Building Automation ", IEEE, 2007.
[10] M. Zareei, A. Zarei, R. Budiarto, and M. A. Omar, "A comparative study of short range wireless sensor network on high density networks" 17th Asia-Pacific Conference on Communications (APCC) 2nd, October 2011, pp.247252.

DOI: 10.17148/IJIREEICE.2023.11614

[11] B. Park, "Mobile IP-based architecture for smart homes International Journal of Smart Home, vol. 6, no.1, 2012.
[12] L. Yanfei1, W. Cheng, Y. Chengbo, and Q. Xiaojun, "Research on ZigBee Wireless Sensors Network Based on Modbus Protocol " International Forum on Information Technology and Application, 2009.
[13] P. Dao-gang, Z. Hao, Y. Li1, and L. Hui1, "Design and Realization of Modbus Protocol Based on Embedded Linux System ", International Conference on Embedded Software and Systems Symposia, 2008.
[14] O. Bingol, K. Tasdelen, Z.Keskin, and Y. E. Kocaturk, "Web-based Smart Home Automation: PLCcontrolled Implementation ", Acta Polytechnica Hungarica, Vol. 11, No. 3, 2014.
[15] G. D. Luca, P. Lillo, L. Mainetti, V. Mighali, L. Patrono, and I. Sergi, "The use of NFC and Android technologies to enable a KNX-based Smart Home ", International Conference on Software, Telecommunications and Computer Networks, 2013.
[16] B. Hamed, "Design & implementation of smart house control using LabVIEW ", International Journal of Soft Computing and Engineering (IJSCE), Volume 1, Issue 6, 2012.
[17] W. S. Lee, and S. H. Hong, "Implementation of a KNX-ZigBee Gateway for Home Automation ", 13th IEEE International Symposium on Consumer Electronics, 2009.
[18] K. Baraka, M. Ghobril, S. Malek, R. Kanj, and A.Kayssi, "Low cost Arduino/Android-based Energy-Efficient Home Automation System with Smart Task Scheduling ", 5th International Conference on