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Smart valve control system for LPG cylinders using IoT

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Abstract*— Liquefied Petroleum Gas (LPG) is one of the most widely used domestic fuels. It is consumed in households for cooking and is also used for industrial purposes. Being a commonly used fuel, it is prone to occasional accidents in cases where the gas cylinder nozzle is not closed properly during the night, or when the user is out of the house. This may lead to safety hazards, causing damage to life and property. Currently, cylinders are operated only physically by the user. It is human nature to be occasionally inattentive, forgetful or negligent. Sometimes when the user leaves their home, they may forget to close the cylinder nozzle properly. This causes gas leakages, which are dangerous. This work is focused on building a system that uses Internet of Things to control the opening and closing of gas nozzles or valves using a mobile or web application remotely. The user can check if their home gas valve is open or closed on the application, and can use it to either close or open it as per their need. This way, they have more control over their home, contribute towards reducing wastage and create a safer environment.

Keywords*— IoT, Home Automation, NodeMCU

I. INTRODUCTION

Liquefied petroleum gas (LPG) is a widely used domestic fuel in developing countries. It is a highly flammable and volatile mixture of hydrocarbon gasses produced through the refinement of petroleum. is one of the chief fuels used for cooking and other industrial purposes in India. Although it is a very Gas clean and viable fuel, it is highly flammable and poses a great danger to society if not stored properly. Gas leakages are common occurrences, and can cause massive damage tolife and property if ignited. There is a need to increase awareness on how to handle the gas stove and LPG; the lack of knowledge puts one at an increased risk of burn injuries.

Home Automation using the Internet of Things is an easy and convenient method to control many aspects of a house even from afar. It is a very helpful method in cases where there is a sudden emergency or a need to instantly operate a device at home at a time the user may not physically be at home. This can be very helpful in power conservation, and prevention of accidents, by providing a higher degree of control over appliances and gadgets.

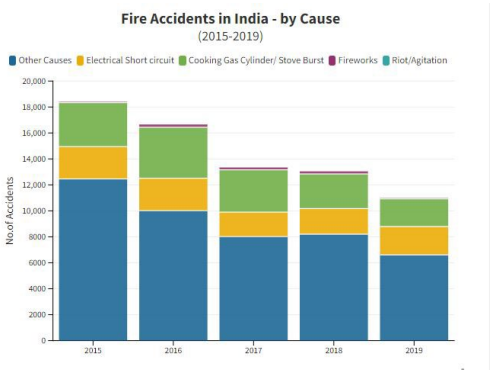

Figure 1: Data showing the various causes of fire accidents [17]

The above mentioned figure shows the various causes for fire accidents between 2015 – 2019 in India. It can be observed that gas leakage and gas cylinder explosion is one of the key causes for such accidents taking place. This is a relatively large proportion that

can be greatly reduced with a little bit of vigilance & caution. Our work is aimed at contributing towards prevention of such accidents.

There is an ironical pattern to most of the LPG related accidents, something that can be avoided by adhering to safety guidelines, oil industry officials say. Cooking gas cylinder explosions are often reported early in the morning and sparked invariably by people, just out of bed, switching on the light or striking a match to light the burner. In many cases, the cylinder leak happens through the night. When people make a trip out of town, one of their main concerns is if they have closed their gas nozzle properly, and it is often too late when they realize it. This not only wastes a valuable fuel resource, but is also a critical safety hazard. Negligence, forgetfulness and inattentiveness are the main causes behind gas leakages.

Our system provides a control system that can control and operate the gas nozzle from different locations by using the internet. Using our system, we can prevent leakage and wastage of gas, and also create a safer environment.

II. LITERATURE SURVEY

A home automation system typically connects controlled devices to a central smart home hub. The user interface for control of the system uses either wall-mounted terminals, tablet or desktop computers, a mobile phone application, or a Web interface that may also be accessible off-site through the Internet.

In [1] comparatively speaking to other systems, the suggested system offers a unique communication protocol to monitor and control the home environment with capability beyond merely switching, and it does so without the need for a dedicated server PC. Light switches, radios, and other appliances will be used to illustrate the viability and efficiency of this system. The suggested home control system has integrated power plugs, temperature sensors, gas sensors, and motion sensors.

In [2] the main goal of a home automation system is to make it simple for users to operate various home appliances using the Android app on their smartphones while also saving energy, time, and money. The alarm will sound whenever a burglar tries to enter the house, and the user will receive a message on his mobile phone anytime someone else tries to enter the owner's home. This system also helps the user safeguard their houses from thieves when they are away from the home. The number of people entering the residence is also displayed on an LCD panel using this method.

In [3] with the help of an integrated micro-web server and internet protocol (IP) connectivity, this article offers a low-cost, flexible, and home management and monitoring system that allows for remote access to and control of equipment and devices via an Android-based smartphone app. In contrast to existing systems, the proposed system offers a novel communication protocol for monitoring and managing the home environment with features more than simply switching. It also does not require a dedicated server PC. Manufacturing of products is made possible by smart home interfaces and device definitions that guarantee compatibility with Wi-fi devices from different electrical equipment, meter, and smart energy manufacturers. This project provides intelligent light and fan operation. The system at this place has connections for lamp control and temperature control. depends on light.

In [4] a multi-purpose, affordable, and adaptable solution for smart home monitoring and control is presented in this study. The device is an ESP32-based node-MCU platform with Internet access for remote device control. The system sends sensor data to the Firebase database and can accept server-issued commands, enabling automated control. based on Android a mobile application is created to update the Firebase database's information, communicate with it, and monitor and manage different household appliances Several sensors, including temperature, humidity, and pressure, were used to show the system's viability. A prototype of the home automation system included motion, light, humidity, and LPG (MQ-6) sensors. In the proposed system's authentication and validation, the system's performance is meticulously examined, and it is also evaluated.

In [5] To facilitate numerous house automation, a system for linking sensors, actuators and other data sources is presented in this work. The system, known as qToggle, relies on the strength of an Application Programming Interface (API), the cornerstone of a straightforward and widely used communication strategy. qToggle often uses sensors or actuators that have an upstream network connection and implement the qToggle API. The majority of qToggle's devices are built on Raspberry Pi boards and/or ESP8266/ESP8285 chips. Users of a smartphone application now have access to a variety of home gadgets and sensors. The qToggle system is user-friendly, and adaptable, and can be improved by utilizing various accessories and add-ons.

In [6] The purpose of this study was to suggest a low-cost voice-controlled (Google Assistant) home automation system for managing common household appliances. The design of GACHA (Google Assistant Controlled Home Automation) was successfully executed, proving the efficacy of the strategy presented

in the article. For elderly persons and people with disabilities using a wheelchair who can't reach the switch to turn the gadget ON/OFF and depend on others, this approach is very dependable and effective.

In [7] the proposed home automation system makes use of the Arduino UNO microcontroller and the esp8266-01 connection module to show the efficiency and viability of the system. It enables remote control of several devices, including lights, fans, and televisions, and decision-making based on sensor data. Through experiments performed under various environmental circumstances, we have evaluated our system.

In [8] the suggested system has two operating modes: the admin side, where users can create a full-scale prototype of the home, and the user side, where users can easily control any device in the home using a GUI-based interface. The proposed system is also capable of making decisions on the functionality of each home gadget. For making decisions about whether to turn on or off home appliances, a machine learning technique called SVM with a linear kernel is used. While the current methods cannot make intelligent decisions and do an in-depth analysis, the proposed approach also ensures secure IoT device identification and authentication utilizing blockchain technology.

In [9] the primary goal of this article is to create a system that would enable users to remotely operate connected household appliances using an Android app. The goal of this initiative is to conserve both human and electric energy. This system includes a Node Mcu node and an android app. Relays connected to Wi-Fi are used to connect household appliances to Node MCU. The user of this system can use an internet connection to control linked household appliances from afar.

In [10] review of numerous home automation systems reveals that a variety of technologies are employed to construct this kind of system. Each of the suggested systems has been provided, contrasted, and discussed in this study, some advantages and disadvantages of the systems This analysis clarified many home automation systems, such as SMS-based, ZigBee-based, Arduino microcontroller-based, Android app-based, Bluetooth-based, mobile-based both cloud-based and IoT-based. Because of how it performs, its simplicity, affordability, and dependability, the residence automation system is establishing itself in the worldwide market, and that day, The day, when every house is a smart home, won't be too far off.

In [11] usage of The OpenHAB server and household appliances can communicate thanks to wireless network infrastructure. As a proof-of-concept that the states of the appliance could be controlled and monitored remotely with improved security using JSON Web Tokens, the prototype integrated all items into a single switching board. Additionally, machine learning and learning algorithms for adaptive control could be used to automatically handle sensor settings.

In [12] the ThingSpeak platform is used in this study to demonstrate a cutting-edge approach to home automation. Better security, data management, and data visualization are all provided by ThingSpeak.Utilizing wireless networks reduces the cost of wiring and switching. When no loads are present, power consumption also decreases inside the building. The sensed data is evaluated in the cloud, and mobile applications deliver real-time statistics. To further explain the functionality and performance of the suggested solution, a prototype is put into use. The doors, curtains, lights, and fans are all automatic. Mobile applications make it simple to operate home appliances. The suggested method also offers real-time statistics on environmental conditions.

In [13] the system's goal is to automate tasks using the Bluetooth functionality integrated into mobile phones. The system's many hardware and software components are discussed. The entire application software was created using Android and the C programming language. For any Automation System based on an Android mobile phone and Bluetooth, the HAS provides a good paradigm.

In [14] the suggested solution can allow the user total discretion over how to create their own smart home for their residence. To operate the appliances in the smart home, an easy-to-use and interactive smartphone app are created in Android Studio. A home can be designed in a matter of minutes with the help of the drag-and-drop feature added to the smartphone app. Both local and distant modes of operation are available for controlling the appliances, with local mode operating just on the Raspberry Pi server without the requirement for an internet connection. The user has access to their home appliances when they are away thanks to a Microsoft Azure cloud database server.

In [15] by attaching basic appliances to the Internet of Things, it has been experimentally demonstrated that home automation utilizing this technology operates satisfactorily and that these products can be successfully managed remotely over the internet. This clever, reasonably priced, and adaptable system not only keeps track of sensor data from things like temperature, gas, light, and motion sensors but also initiates a process in response to a need, like turning on the light when it becomes dark. Additionally, it promptly stores the sensor parameters in the cloud (Gmail).

In [16] the home management and monitoring system described in this work is low-cost, adaptable, and uses an embedded micro-web server with IP connectivity to allow users of Android-based smartphones to access and operate devices and appliances remotely. Compared to similar systems, the suggested system offers a novel feature that eliminates the need for a dedicated server PC. Using a communication protocol, the home environment can be monitored and managed in ways other than simple switching. Devices like light switches, power plugs, and temperature sensors are used to illustrate the system's viability and effectiveness.The suggested home control system incorporates a current sensor.

III. PROPOSED SYSTEM

Our solution offers a control system that enables internet-based control and operation of the gas nozzle from various locations. By using our method, we can avoid gas leaks and wastage while also making the environment safer. Our proposal primarily focuses on using a mobile application to regulate the gas pipeline. The system consists of the following parts:

- ESP8266 NodeMCU
- Relays
- Mobile Phone with stable internet connection
- OPEN/CLOSE module to control the gas pipeline

The above mentioned figure shows the proposed block diagram of the system. The user configures commands for the gas pipeline's operation via a mobile application. A module is attached to the pipeline node that can be managed by a mobile application. The mobile application decodes the user's switch mode instruction and communicates a signal to the NodeMCU unit over a wireless network set up using Wi-Fi. The NodeMCU's built-in Wi-Fi module enables the microcontroller to connect via Wi-Fi to a device and receive user commands over a wireless network. The module regulates the gas flow in the gas pipeline or shuts it off if the gas pipeline is open. If the gas pipeline is shut off, the module may need to open it. The mobile application is then updated with the gas pipeline's most recent status.

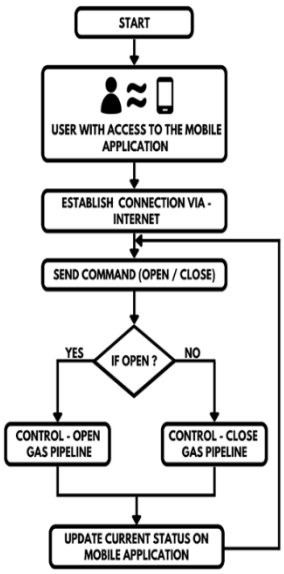

Figure 2: Block diagram of proposed work

The block diagram gives the functionality of the overall project. This system has two main modules: the hardware interface module and the software communication module. At the heart of this system is the ESP8266 NodeMCU. All communications and controls in this system pass through the microcontroller. In the hardware module, if the gas pipeline is open, the module controls the flow of gas in the gas pipeline or turns it off .If the gas pipeline is closed, the module opens the pipeline. In the software module, after authentication, you can control the module using a mobile application which shows buttons to change the GPIO states in the database and the current status of the module will be updated and stored in cloud databases.

A. Requirements

- NodeMCU board: It is an open-source development kit that enables us to test the viability of our IoT solutions using MicroPython or Lua, the kit's native programming language. A Wi-Fi capable chip, the ESP8266, is found on the NodeMCU board.

- Relay: An electromagnetic switch that can turn on or off a much greater electric current and is driven by a relatively tiny electric current. Relay modules exist whose electromagnets can be powered by both 3.3V and 5V. Both are compatible with the ESP8266.

- Arduino IDE: We require an IDE in order to upload our code to the NodeMCU device. Although we utilise the Arduino IDE, there are other options available.

Using relays with the ESP8266 is the best way to remotely control appliances. The user uses the mobile application in setting commands for functioning of the appliance. The user can control the module from anywhere using the mobile application.The Node MCU unit is the microcontroller or the main controlling unit of the system. The NodeMCU (***N***ode ***M***icro ***C***ontroller ***U***nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.

A relay is an electrically operated switch. Usually, like any other switch, it can be turned on or off, with or without current. It can be controlled through low voltages such as 3.3V provided by ESP8266 GPIOs and helps to control high voltages. Such as 12v, 24V, or mains voltage (220V or 240V).

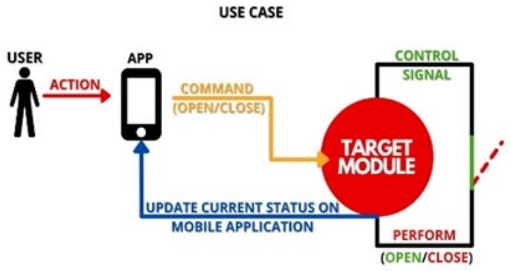

Figure 2: NodeMCU (ESP8266)

The working of the server is as follows:

- There is a web page running a PHP script with some toggle buttons that allows to control the outputs on and off.
- When you press the buttons, it updates the output state and saves it in your database.
- More buttons can be added or deleted from the dashboard
- Then, there is an ESP8266 or even multiple boards that make HTTP GET requests every X number of seconds to the server;Finally, according to the result of that HTTP GET request, the ESP board updates its GPIOs accordingly.

From figure 4, let us say that a user who is really distant from home has neglected to turn off their LPG gas cylinder at home. The user can access the module that is attached to the LPG cylinder via a mobile application with internet access and turn it off instead of manually operating the gas cylinder. Wi-Fi links the microcontroller to the mobile application. When you press a button, the GPIO state changes and the action is carried out because the microcontroller has GPIO states that carry the instructions for the target module (Open/Close). The GPIO states are then stored in a database on a cloud server when the updates are uploaded there.

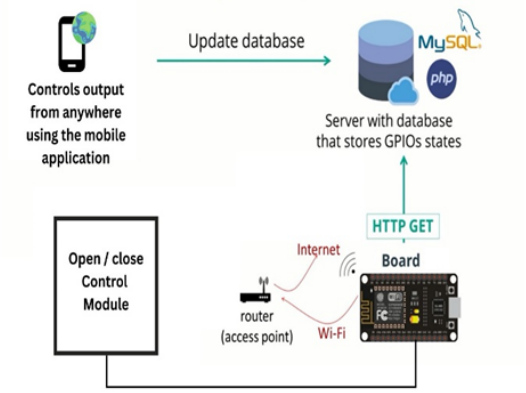

Figure 3: Server mainframe

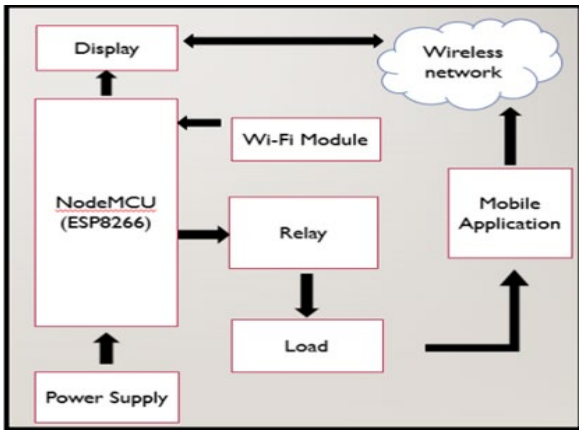

Figure 4: Workflow diagram

IV. CONCLUSION

The ESP8266 node MCU and Wi-Fi were used in the system's design and as transmission medium. The aforementioned paper reaches the conclusion that home automation systems utilize wireless technology. Consumers may now easily control their home appliances thanks to home automation technologies built on Arduino, GSM, and Android. Each suggested system's hardware design specifications are discussed in depth and evaluated.

Its low cost, ease of use, and remote control are chosen as design criteria for the system. The proposed system, however, has the ability to integrate with contemporary hardware and is also able to share information across devices, which is the fundamental requirement for the smart city applications.

REFERENCES

[1] International Journal of Scientific & Engineering Research, Volume 6, Issue 6, June-2015 795 ISSN 2229-5518 IJSER © 2015 http://www.ijser.org Design of a Home Automation System Using Arduino Nathan David, Abafor Chima, Aronu Ugochukwu, Edoga Obinna

[2] Advanced Computational Intelligence: An International Journal (ACII), Vol.3, No.3, July 2016 Surinder Kaur1 , Rashmi Singh1 , Neha Khairwal1 and Pratyk Jain1(home automation and security system)

[3] International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 6 Issue 3 March 2017, Page No. 20694-20698 Index Copernicus value (2015): 58.10 DOI: 10.18535/ijecs/v6i3.53 J.Chandramohan, IJECS Volume 6 Issue 3 March, 2017 Page No. 20694-20698 Page 20694 Intelligent Smart Home Automation and Security System Using Arduino and Wi-fi J.Chandramohan1 , R.Nagarajan2 , K.Satheeshkumar3 , N.Ajithkumar4 , P.A.Gopinath5 , S.Ranjithkumar6

[4] International Conference on Communication and Information Processing (ICCIP-2020) Available on: SSRN Internet of Things based Integrated Smart Home Automation System Uma Pujaria , Prasenjeet Patilb , Nilesh Bahadurec , Manvita Asnodkard

[5] An IoT-Based Smart Home Automation System Cristina Stolojescu-Crisan 1,* , Calin Crisan 2 and Bogdan - Petru Butunoi , Sensors 2021, 21, 3784.

[6] International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072 © 2018, IRJET | Impact Factor value: 6.171 | ISO 9001:2008 Certified Journal | Page 2074 Google Assistant Controlled Home Automation Manish Prakash Gupta.

[7] International Journal of Pure and Applied Mathematics Volume 118 No. 17 2018, 769-778 ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version) Arduino based home automation using Internet of things (IoT) Lalit Mohan Satapathy, Samir Kumar Bastia Nihar Mohanty.

[8] Volume 2020 Article ID 4579291 An Intelligent, Secure, and Smart Home Automation System Rizwan Majeed,1Nurul Azma Abdullah,1Imran Ashraf,2Yousaf Bin Zikria,2Muhammad Faheem Mushtaq,1,3and Muhammad Umer

[9] International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429 Volume 8 Issue XI Nov 2020- Available at www.ijraset.com © IJRASET: All Rights are Reserved 846 Home Automation System Rajwinder Singh1 , Tejinder Thind2

[10] IJARCCE ISSN (Online) 2278-1021 ISSN (Print) 2319 5940 International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 6, Issue 3, March 2017 Copyright to IJARCCE DOI10.17148/IJARCCE.2017.63173 733 Literature Review on Home Automation System Neha Malik1 , Yogita Bodwade1

[11] Hindawi Journal of Sensors Volume 2020, Article ID 8868602, Design of a Secure Wireless Home Automation System with an Open Home Automation Bus (OpenHAB 2) Framework Robert A. Sowah , Dale E. Boahene, Dalton C. Owoh, Rexford Addo, Godfrey A. Mills, Wiafe Owusu-Banahene, Gifty Buah, and Baffour Sarkodie-Mensah

[12] (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 11, No. 6, 2020 An IoT based Approach for Efficient Home Automation with ThingSpeakMubashir Ali1 , Zarsha Nazim, Waqar Azeem3 , Khadija Javed6 , Maria Tariq, Muhammad Haroon4, Aamir Hussain.

[13] International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072 © 2016, IRJET | Impact Factor value: 4.45 | ISO 9001:2008 Certified Journal | Page 1337 Android Based Home Automation System Using Bluetooth & Voice Command - Implementation Bhavik Pandya1, Mihir Mehta2,Nilesh Jain3,Sandhya Kadam4.

[14] Home automation using general purpose household electric appliances with Raspberry Pi and commercial smartphone Imran AshrafID1, Muhammad Umer2, Rizwan Majeed2 , Arif Mehmood3 , Waqar AslamID3 , Muhammad Naveed Yasir2 , Gyu Sang Choi1.

[15] ISSN: 2278 – 1323 International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 5, Issue 9, September 2016, IOT based Interactive Controlling and Monitoring System for Home Automation Uma Gurav, Chandradeep Patil.

[16] International Journal of Internet of Things 2013, 2(1): 5-11 DOI: 10.5923/j.ijit.20130201.02 Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone Rajeev Piyare.

[17] https://factly.in/number-of-fire-accidents-in-the-country-reduced-over-time/