ISSN 2320-9984
Volume 10 Issue 4 | December 2022 ISSN: 2320-9984 (Online)
International Journal of Modern Engineering & Management Research
Website: www.ijmemr.org

Affordable Smart Home Automation Utilizing Arduino: A Pragmatic Approach

Rohan Rajoriya
Lecturer
Kalaniketan Polytechnic College
Jabalpur, (M.P.) India
Email: rohanrajoriya@gmail.com

Rupesh Kumar Dharne
Lecturer
Kalaniketan Polytechnic College
Jabalpur, (M.P.) India
Email: rk.dharne@gmail.com

Abstract—A cloud-based platform known as an Internet of Things (IoT) cloud makes it easier to manage IoT devices by allowing users to remotely control, monitor, and analyze data from linked devices. By offering capabilities for device communication, data storage, visualization, and automation, it acts as the foundation for Internet of Things applications. The process of building an Internet of Things (IoT)-based smart home entails developing a system that links and controls a variety of domestic appliances, including remote control, automation, and monitoring features.An amazing project for internet-based device control and monitoring is smart home automation using Arduino Cloud has been introduced. You may use online interfaces or mobile apps to communicate with your smart home, manage IoT devices, and create dashboards with Arduino Cloud. This research paper summarize how to use Arduino Cloud to create a smart home automation system.

Keywords:— *IoT, Arduino Cloud, NodeMCU*

1. INTRODUCTION

People's life now revolve on technology, as smartphones allow for remote appliance control via the Internet of Things. Regardless of time or place, this technology makes it simple to communicate and interpret data produced by appliances, increasing their use and accessibility.

IoT systems use networks, microcontrollers, and sensor antennae to gather, send, and analyze data. They have boosted income and expanded electricity grids, smart cities, industries, and supply chains. However, proprietary protocols, a lack of standardization, and the number of linked devices raise security and privacy issues. Researchers, industry leaders, and government officials must work together to safeguard device security and user privacy. ICT and data are used in IoT applications, including smart cities, to increase sustainability and draw in urban regions. Establishing smart cities requires cooperation between public and private sectors.

The research paper explores IoT-based home automation over the cloud, highlighting its benefits and challenges. It introduces essential elements like sensors, devices, and communication protocols, and highlights the advantages of cloud-based solutions like improved scalability, flexibility, and security. Challenges include data privacy, interoperability, and reliability. The advent of IoT has revolutionized home automation, allowing remote control and monitoring from mobile devices or computers.[1]

2. LITERATURE SURVEY

In order to enhance communication and enable human engagement with virtual surroundings, Kevin Ashton launched the

Internet of Things (IoT) in 1999. Kitchens, agriculture, and health are just a few of the industries that use it. Because it makes houses more hospitable even when family members are not there and enables remote management of equipment, home automation is becoming more and more popular. It also helps people with physical disabilities.[2][3]

One affordable option for home automation is an Internet-Based Wireless Home Automation System for Multifunctional Devices. With the use of an open-source platform and a microcontroller, consumers can operate electronic items without requiring a full automation infrastructure. To conserve energy and manage integrated sensors and other devices, the system makes use of Google Assistant or Alexa, a web server control panel interface, and Android voice control.[4][5]. This study examines Wi-Fi-based home automation, with a particular emphasis on GSM and Bluetooth-based systems. The study examines earlier research on automation systems based on GSM and Bluetooth, emphasizing its shortcomings [6]. The selected system is appropriate for elderly and physically disabled people since it provides greater accessibility, dependability, and range than conventional switchboards. Additionally, the system is more dependable and accessible.[7][8]

3. IoT ARCHITECTURE

Perception, transmission, and application are the three phases of the five-layer Internet of Things (IoT) architecture. In order to recognize other intelligent things and geographical aspects, the perception layer gathers data from sensors and embedded devices. By connecting smart objects and data transit, the network layer exchanges and stores the data gathered by these devices. Applications such as databases, data mining, middleware, and smart homes are made possible by the application layer, which gives users access to software resources. Data from the transport layer is gathered and assessed by the processing layer, which also extracts pertinent information and eliminates irrelevant data. Although it may be vulnerable to attacks like zero-day and business logic attacks, the business layer regulates user privacy, IoT application administration, and application behavior. Password validation, encryption methods, and improper programming are common security problems. Storage and security issues in the IoT architecture are addressed by the five-layer approach.[9]

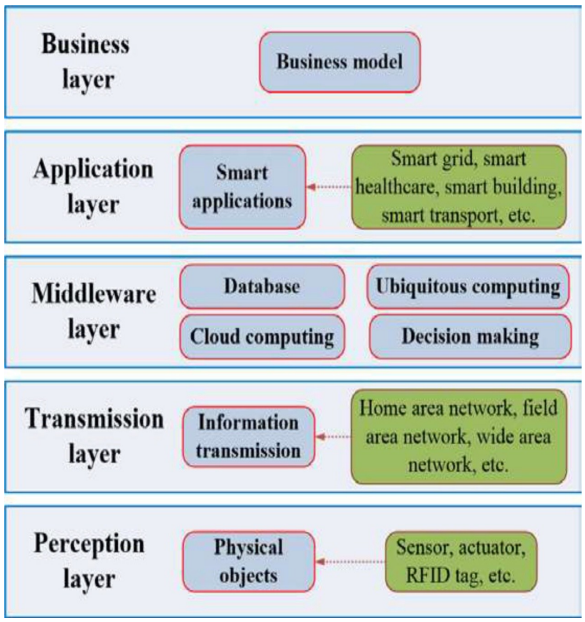


Figure 1. IoT Architecture

Among the numerous security issues raised by the Internet of Things (IoT) are preserving operational safety in nuclear reactor control systems and protecting energy consumption data in smart meters. To address these problems, a multi-layered approach is recommended, starting with device authentication, firewalls, intrusion prevention systems, access control, and secure booting. This approach ensures that devices may update and patch updates, run software, and authenticate before transferring data without sacrificing functionality or capacity. Collaboration across hardware, software, network, and cloud stakeholders is necessary for IoT devices to have effective security features. The internet of things may never be completely secure, but stakeholder collaboration can help overcome these challenges and ensure the safety and functionality of IoT devices.[17]

IoT Key Issues:

Table 1. IoT Key Issue Encountered

IoT Key Issues	References	Pros
Interoperability	10	Technical and semantic interoperability, IoT platforms and architectures, and general challenges.
Security and privacy	11	Issues with security and privacy, as well as the development and architecture of safe Internet of
Architecture	12	Application frameworks, hardware, cloud-centric, SOA, process architectures, and conceptual models.
Authentication and identification	13	IoT integrations with internet protocols (IPv6), authentication, and identity problems are discussed along with
Data processing and storage	14	Problems and solutions related to data analysis, visualization, and integration.
Reliability	15	connectivity, problems with mobility and routing, and the dependability of apps and infrastructure.
Scalability	16	problems with scaling across big platforms and geographical areas, as well as possible discovery services.

The foundations of IoT concepts and their applications are examined in this paper, with particular attention paid to the framework, components, applications, issues, and areas that need more study. Additionally, it talks about flaws such insufficient authorization, transport encryption, erratic network services, and security issues with online interfaces. The Internet of Things (IoT) has brought privacy risks such personal information, identification, localization, profiling, and interactivity into our everyday lives. With an emphasis on privacy, accessibility, and credibility, data security (DS) is the process used to ensure data, information, and framework. [18].IoT data protocols use wired or cellular networks to link low-power IoT devices that are not connected to the internet. Simple data transfer between devices is made possible by the publisher-subscriber messaging paradigm of the lightweight MQTT protocol. It is intended to address unstable communication networks and operates on top of the TCP/IP protocol. However, MQTT's implementation is completely platform- or vendor-specific due to its absence of a specified data representation and device management framework.[19][20]

4. RESULT ANALYSIS

For the Arduino IoT Cloud, an online version of the Arduino IDE application, there is a free companion software called the Arduino IoT Cloud Remote. Using a dashboard for "things" that stand in for the gear and software needed to construct a project, it enables users to manage projects. An open-source platform for prototyping, Arduino has the ability to read inputs and convert them into outputs. It serves as the project's brain and is appropriate for hobbyists, designers, and artists. Data monitoring, variable synchronization, scheduling, support for Amazon Alexa, and dashboard sharing are some of the capabilities offered by the Arduino IoT Cloud. Users may connect, control, and keep an eye on gadgets from any location in the world using the Arduino IoT Cloud. They can also use code to personalize their devices.

NodeMCU

ESP8266-12E chips are used by NodeMCU, an open source Internet of Things platform. It has a USB to serial chip, is affordable, works with breadboards, and can be powered by a simple USB to mini USB adaptor. This module includes software from the Espressif system that operates on the ESP8266 wifi SoC and is intended for creating Internet of Things applications based on the ESP8266. This development board provides access to the GPIO (General purpose Input/Output) subsystem. There are numerous ESP8266-based modules available, and each one has advantages and disadvantages dependent on the use case.

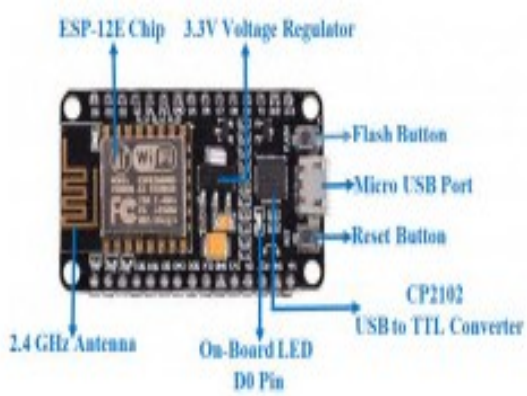


Figure 2: NodeMCU

Relay Module

An electrical switch controlled by an electromagnet is known as a power relay module.Relay modules are switching devices, which are circuits that need low-power impulses to function. It makes it possible for a circuit with a low power supply to control or turn on a circuit with a high power supply without integrating the two circuits or electrical appliances.

PCB

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate.

Steps and Procedure for performing the Project

Entire project is based over the "Arduino IOT Cloud platform". Below are some of the key features of this IOT platform : [30]

- Things
- Dashboards
- Devices
- Integrations
- Templates

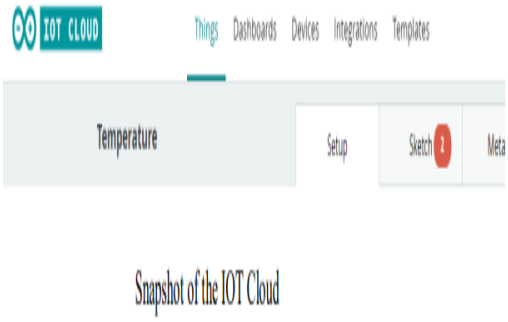


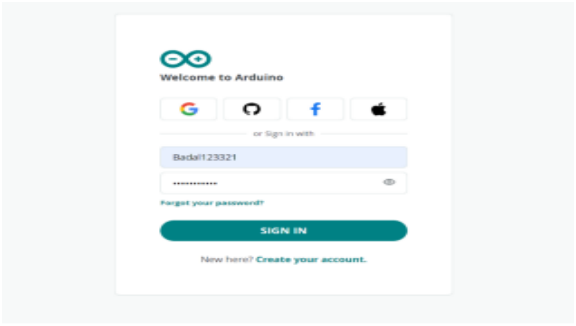
Figure 3: Arduino IoT Cloud

Open the browser and search for Arduino IoT Cloud in the search bar and look for the website www.create.arduino.cc

The website contains all the confidential information of users including the (Password, Usernames and the Gmail address), each user can create or signup for their individual account to access the features of this IOT cloud platform. "Create.arduino.cc" provide multiple options to its users to create an Account,

Option-1 users can choose for signup by selecting the CREATE ONE option were they can provide all the personal information like Full Name, Date of Birth, Location etc etc.

Option-2 Signing up directly by selecting the GMAIL option (there's no need to provide any personal information).



Home Page (www.create.arduino.cc)

Figure 4: Arduino Home Page

Create "THINGS"

This option contains all the important Variable information like (Humidity, LED, Temperature), Network connectivity for pairing devices to access the device with a Wifi and Bluetooth which is mandatory to run the project.

SELECT -> LED – boolean type

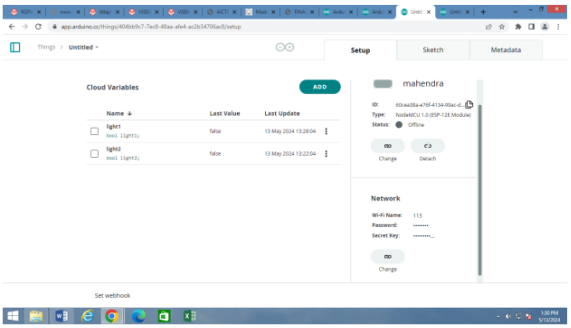


Figure 5: "Create Things" dashboard

Pair your Device by providing the appropriate SSID and the Password of your Wifi

Figure 6: Node ID Details

Create "DASHBOARDS"

The Dashboard is responsible for handling the entire Layout of the project basically it provides a U.I (user interface) which enables the users to interact with the IOT platform. List of components or widgets that are needed to create dashboard for the device are – LED Switch (on/off)

Create "DEVICES"

This option contains all the device (Hardware) configurations and information in the above project its Esp8266 - Node MCU. Select "Set up a third party device"

Search for Node MCU (1.0) module

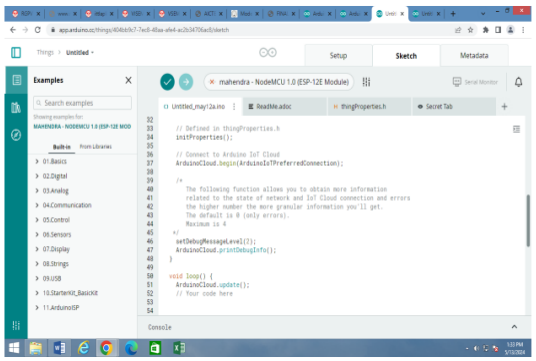
After completing the above steps successfully a Secret-Key will be generated and

Providing the right key is mandatory for pairing the device to access the Wifi and Bluetooth connectivity.

Note - The secret key needs to be Correct.

Create "SKETCH" and upload the CODES

"Sketch" is the heart of this entire project the sketch handles all the logical and programming part the project to run the Device and fetch the readings of components of a dashboard area. Maintaining all the connectivity of the device (Bluetooth, wifi). The sketch Acts like a carrier which carries all the coding and programming part to operate the device.



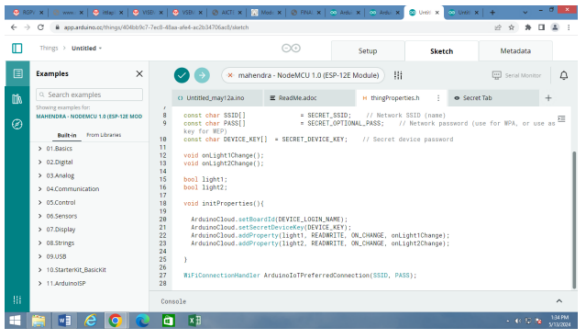


Figure 7a and 7b: Sketch

Real Time Project:

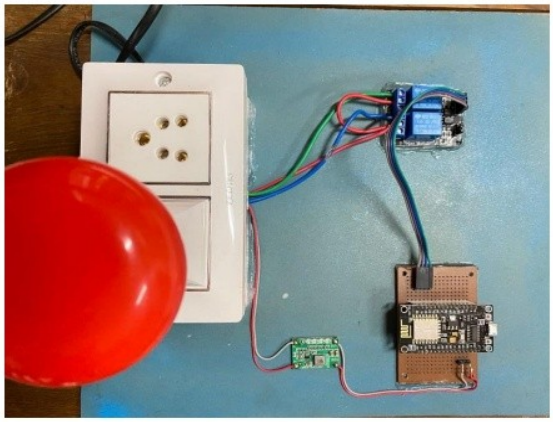


Figure 8: Real Time Scenario

5. CONCLUSION & FUTURE WORK

It is anticipated that the integration of increasingly complex technology and the growth of the Internet of Things will define the future of home automation. Using a smartphone or tablet, smart home automation allows you to keep an eye on what's happening in the house even while you're far away.

The system can be adjusted to track temperature and humidity, provide real-time weather statistics reporting, and more. Smart devices and appliances can now simulate daily routines thanks to developments in IoT and AI technologies, and this is only the beginning. In regions such as those with rain forests or volcanoes, the Internet of Things-based weather station is useful for tracking the weather. This is particularly crucial given the dramatic shifts in the weather that we are currently witnessing.

REFERENCES:

[1] Abdulrahman, T. A., Isiwekpeni, O. H., Surajudeen-Bakinde, N. T., & Otuoze, A. O. (2016). "Design, Specification and Implementation of a Distributed Home Automation System". *Procedia Computer Science*, *94*, 473–478. https://doi.org/10.1016/j.procs.2016.08.073

[2] A.R.F., S. (2018). "*Android based Automation and Security System for Smart Homes*".

[3] Bachuwar, V. D., Ghodake, U. R., Lakhssassi, A., & Suryavanshi, S. S. (2018). "WSN/Wi-Fi Microchip-Based Agriculture Parameter Monitoring using IoT". *2018 International Conference on Smart Systems and Inventive Technology (ICSSIT)*, 214–219. https://doi.org/10.1109/ICSSIT.2018.8748638

[4] Behrendt, F. (2019). "Cycling the Smart and Sustainable City: Analyzing EC Policy Documents on Internet of Things, Mobility and Transport, and Smart Cities". *Sustainability*, *11*(3), 763. https://doi.org/10.3390/su11030763

[5] E. Isa and N. Sklavos* "Smart Home Automation: GSM Security System Design & Implementation" Computer Engineering & Informatics Department, University of Patras, Greece, Journal of Engineering Science and Technology Review, *10* (3), 170–174. https://doi.org/10.25103/jestr.103.22

[6] Jose, A., & Malekian, R. (2015). Smart Home Automation Security: A Literature Review. *The Smart Computing Review*. https://doi.org/10.6029/smartcr.2015.04.004

[7] Li, X., Jiang, Y., Rodriguez-Andina,

J. J., Luo, H., Yin, S., & Kaynak, O. (2021). "When medical images meet generative adversarial network: Recent development and research opportunities". *Discover Artificial Intelligence*, *1*(1), 5. https://doi.org/10.1007/s44163-021-00006-0

[8] Mehmood, Y., Ahmad, F., Yaqoob, I., Adnane, A., Imran, M., & Guizani, S. (2017). "Internet-of-Things-Based Smart Cities: Recent Advances and Challenges". *IEEE Communications Magazine*, *55*(9), 16–24. https://doi.org/10.1109/MCOM.2017.1600514

[9] Mogali, S. (2015, September). "*Internet of Things and its role in Smart Kitchen"*.

[10] Naseem, Z., Ahmed, I. N., & Mirza, Z. (2021). "Propagation Models For Wireless Communication System Irjet Journal Propagation Models For Wireless Communication System". *International Journal of Research in Engineering and Technology*, *Volume: 05 Issue: 01 | Jan-2018*, 237–242.

[11] Nawalagatti, A. (2022). "IoT: A Boon for Advancement of Technology". *International Journal for Research in Applied Science and Engineering Technology*, *10*(5), 652–655. https://doi.org/10.22214/ijraset.2022.42159

[12] Noura, M., Atiquzzaman, M., & Gaedke, M. (2019). "Interoperability in Internet of Things: Taxonomies and Open Challenges". *Mobile Networks and Applications*, *24*(3), 796–809. https://doi.org/10.1007/s11036-018-1089-9

[13] Okubanjo, A., Okandeji, A., Abolade, O., & Alao, P. O. (2021). "Development of GSM Based Home Automation System Using Arduino UNO Microcontroller". *6*, 599–606.

[14] Parihar, Y. S. (2019). "*Internet of Things and Nodemcu A review of use of Nodemcu ESP8266 in IoT products"*. *6*, 1085.

[15] Perwej, Dr. Y., Aboughaly, M., Kerim, B., & Harb, H. (2019). "*An Extended Review on Internet of Things (IoT) and Its Promising Applications"*. *Volume 7*, Page 8-22. https://doi.org/10.5120/cae2019652812

[16] Piyare, R., & Tazil, M. (2011). "Bluetooth based home automation system using cell phone". *2011 IEEE 15th International Symposium on Consumer Electronics (ISCE)*, 192–195. https://doi.org/10.1109/ISCE.2011.5973811

[17] Saifuzzaman, Mohd., Hossain, A., Nessa, N., & Narin, F. (2017). "Smart Security for an Organization based on IoT." *International Journal of Computer Applications*, *165*(10), 33–38. https://doi.org/10.5120/ijca2017913982

[18] Samih, H. (2019). "Smart cities and internet of things". *Journal of Information Technology Case and Application Research*, *21*(1), 3–12. https://doi.org/10.1080/15228053.2019.1587572

[19] Sharkawy, A.-N., Hasanin, M., Sharf, M., Mohamed, M., & Elsheikh, A. (2022). "Development of Smart Home Applications Based on Arduino and Android Platforms: An Experimental Work". *Automation*, *3* (4), 579–595. https://doi.org/10.3390/automation3040029

[20] Singh, P. K., Singh, S., Ashish, Usman, H., & Urooj, S. (2022). "Recent Advances and Future Trends of IoT-Based Devices. In *Energy Harvesting"*. Chapman and Hall/CRC.

[21] *Software*. (n.d.). Retrieved from https://www.arduino.cc/en/software/

[22] Sridhar, H. S., Somvanshi, S., Ramsinghani, M., & C., N. (2022). "*Designing of Smart Home Automation Using IoT"*. 1–6. https://doi.org/10.1109/ICERECT56837.2022.10059802

[23] V. Sudharani, D. S. (2018). "Smart Home Automation System using Arduino and IOT". *International Journal of Science and Research (IJSR)*, *7*(9), 182–184. https://doi.org/10.21275/ART2019985