Real time Implementation of Home appliance control using ALEXA

S Somesh¹, N Senthilnathan², M Sabarimuthu³, A Santhosh Kumar⁴, R Rishikesanan⁵, V Bala⁶

1- UG Scholar, Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, India
2- Professor, Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, India
3- Assistant Professor, Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, India
4-6- UG Scholar, Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, India

someshsaravanankeceee@gmail.com

Abstract. In recent years, Internet of Things (IOT) is being playing a major role in automation of Industries. Smart home systems are being employed in buildings to improve energy efficiency and reduce power wastage. Voice recognition is the current trend in automation. Regular methods of switching systems are difficult for paraplegic persons and blind persons since blind people can’t use the SMS method of automation. So voice recognition methods are preferred. Voice recognition systems involve calibration and programming to accept the user commands and operate the appliance. Amazon Echo dot, a smart speaker has an internally programmed Artificial Intelligence known as Alexa. It offers dual interaction and can be used to connect to Smart devices. To remedy the high cost of smart devices, we register a name in Alexa server as a smart device which comprises a Wi-Fi module and a relay. The Smart speaker and the Wi-Fi module form a single way communication which helps in controlling of appliance.

1. Introduction
The Machine Interaction has led to voice recognition. Speech recognition makes use of inbuilt algorithms and programs to interface with the user command to perform the specific. Home automation makes of lighting and other appliance control and it can be even extended to industries if calibrated properly. Automation calibration and setting need not be same for all kinds of applications. Engineers use complex algorithms and calibrations to meet up with the specific demands. Automation is essential for smart city construction. It involves in many kinds of process such as Traffic monitoring, water monitoring, sewage control etc… Smart home system involves appliance control,
security control which also includes metering of light, moisture and other parameters of the home. The household appliance must be interconnected through IOT any other means to act as an intelligent smart device. Amazon developed a smart speaker known as Amazon Echo dot. It has an interactive artificial Intelligence programmed inside it which is known as “Alexa”. The device is able to play music, podcasts, weather forecasting, interaction etc... It can be used in Smart home systems to be used for not only appliance control but also to provide home monitoring. In India, automation systems for home automation systems are very costly so low cost systems. Alexa integrated systems offer low cost automation to homes and buildings. Through Alexa app and Server, we can register the load device names as smart devices and enable as home automation.

2. Literature
The There are several studies which deals with the pros and cons of various automation methods. Several methods of home automation systems are available such as Blue tooth control, Wi-Fi control, IOT systems, SMS and through Remote control. Automation greatly helps in reduction of labour, improves energy efficiency, faster communication etc... One of the earliest interpersonal intelligent Artificial Intelligence developed was “Siri”. It was developed by Siri Inc. Later when apple acquired Siri, it was introduced on iPhone 4S. It was also intended to be released for Blackberry and Android devices. Ana et al. [1] proposed the use of Siri, Artificial Intelligence to be used for Home automation. It was designed to recognize the voice recognition commands through interconnected Zigbee networks. But the problem was that it was uneconomical and it can’t be used to indicate the status of appliance owing to the absence of sensors. Also, it was available only for IOS users. Piyare&Tazil [2] et al., Mr.Vaibhav Malav[3] proposed the use of Bluetooth for short range control of appliances. It makes use of Cell phone to transfer the commands to the Arduino controller wirelessly. But the disadvantage is its short range of operation and its low data rate. S. Hidayat et al. [4] proposed the control of Home automation system using Bluetooth technology. Raspberry is attached to a relay system and by using the Voice command, the device is controlled. But the device proves to be costly and the wired medium is needed to be used. Also, there was another problem which greatly reduced its performance. Its operating time was more than a minute which was highly undesirable since the appliance require faster turn on and off process. P.S.N.Priyanka et.al [5], Shreya Ghosh et.al [6] proposed Home automation control system employing DTMF. Even though DTMF systems are simple, they produce call tariff problem and a manual is needed for the key identification. Mobile communication based control of appliance employing GSM technology is discussed by Rozita Teymourzadeh et.al [7] in their paper. The sharing of same bandwidth by multiple users can create transmission interference. Ma Naing et.al [8] proposed automation employing Arduino. Even though programming of Arduino is simple, it’s structure and building takes a huge cost when developed on a large scale. Also the systems mentioned above are not suitable for blind persons. So voice recognition is a good way to address these problems. But the voice recognitions need to have the ability to understand the commands correctly and to give the proper responses. They should even be able to interpret our commands in the noisy environments. One such system is the AI “Alexa” which is incorporated in a device known as “Echo dot” [9-20]. This device built on Particle photon connects to the voice controlled intelligent personal assistant service Alexa, which responds to the word “Alexa”. Alexa Voice Service (AVS) is Amazon’s intelligence voice recognition and natural language understanding service. Similar to Alexa, Google Assistant is an artificial intelligence-powered virtual assistant developed by Google that is primarily available on mobile and smart home devices. It can engage in two-way conversations. The full-bodied sound of Amazon makes it better suited to your audio tastes [21-30].

3. Problems found
Paraplegic persons and blind persons at home find difficult to operate appliance manually. Even though remote control of appliance is available, blind persons find it difficult to operate it. So voice recognition systems greatly help for such people. Voice recognition systems on advanced level are
costly to afford which is unnecessary for simple control of home appliance. So we make use of commercially available AI such as Google Assistant, Alexa etc… Even though Alexa integrated systems are available, the commercial systems need to reconfigure the Wi-Fi every time when the load gets shut down [31-36]. This leads to unnecessary time consumption. Also the commercially available smart devices compatible to the Alexa systems are costly which makes it difficult for large scale installation.

4. Proposed System
The proposed system makes use of Alexa integrated with a Wi-Fi network which is configured in an ESP8266 Wi-Fi module. The load (device) name which is to be addressed in the voice command is registered in the ALEXA Server. This eliminates the need to frequent reconfiguring of Wi-Fi using the ALEXA app. This is done by registering a Wi-Fi name in the ESP node and the Alexa cloud server so that it automatically connects itself to the Wi-Fi.

5. Block Diagram:
The working of the block diagram is shown in figure 1. The 230 V supply is rectified, filtered and made it to operate the relay. The Echo dot is always ON waiting for the wake word. The voice command gets processed through Alexa cloud server. Alexa cloud server has an inbuilt Voice recognition system known as Alexa Voice Service. The commands from the cloud are received by the ESP8266 which processes the command and activates the relay. Every device is given a name inside the Node MCU through programming. Every time the command is passed, the data is recognised from the registered server through the internet and the proper relay is activated.

Figure 1. Block Diagram
6. Components required

6.1. Amazon Echo dot

Alexa is an interactive artificial system developed by Amazon. This core is incorporated in a device known as Amazon echo dot. It can be used to listen to music, control home appliance etc… Different types of Echo dots are available which we can use based upon our needs. The figure 2 is the second generation model of Echo dot. Its added advantage is its application in smart home monitoring systems such as temperature control etc… They are suitable for many devices such as Philips Hue etc… It can be called with a wake word “Alexa”... The internet is connected from the Echo dot through Wi-Fi. Echo dot has an added advantage of recognising voice commands even among the noisy environments and can be operated even from a certain distance. The commands need not be perfectly grammatical. The voice recognition system in the cloud is very good at understanding even the simplistic commands.

6.2. ESP8266 Node MCU:
It is a low cost device which enables to apply many IOT applications. It can act as both the access point (create hotspot) and can act as Wi-Fi connectivity. It is easy to program with Arduino Uno. Its features include I2S, I2C interfaces, GPIO pins, 10 bit ADC etc… It works on IEEE 801.11 Wi-Fi configuration. The Processor is L106 32-bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106Micro running at 80 MHz and 32 Kb instruction RAM (period) at the end.

6.3. **Load Relays:**

The load is connected by means of a 5V Relay module. The figure 4 is an electromagnetic relay consisting of three pins namely VCC, INI, and GND. VCC and GND acts as polarity whereas the IN acts as a pulse for the operation of relay. Based on the configuration of NC or NO, the relay can be made to either ON or OFF when the pulse is given. The electromagnetic relays are very faster in action thus avoiding unnecessary time delay. Relays are faster in approach and based on the number of devices used to operate, we can use the appropriate relays for example such as two channel, three channel and multi-channel relays. Different appliances have different ratings. So before using a relay, the current and voltage rating of the appliance should be considered otherwise the relay might not withstand the excess voltage and current parameters. The ESP8266 operates with the DC 5V of Input and output and so it becomes much easier to integrate with the Relay.

6.4. **Rectifier:**

![Figure 4. Relay](image)

![Figure 5. Bridge Rectifier](image)
The load is connected by means of a 5V Relay module. But the supply is AC. So it is necessary to convert to AC to DC. Figure 5 shows the bridge rectifier circuit. The two diodes D2 and D5 conduct during one half cycle and the another sets of diodes D1 and D4 conducts during another half cycle. This together forms an output of pulsating DC. But the output is not pure DC. It is pulsating because of the unidirectional ripples. This can be eliminated by employing capacitive filter circuits at the end of Rectifier output which eliminates the ripples.

7. Circuit Diagram

![Circuit Diagram](image)

Figure 6. Circuit Diagram

8. Flowchart:
The below Figure.6 explains the step by step process of working of Alexa integrated automated system as a flowchart.
9. Working:
The device name which has to be controlled is pre-programmed and registered in the ALEXA server. So every time, we call upon the device name to be turned on and off, ALEXA gets its information from its Server through the internet connection. When we give the Wake word “ALEXA”, the device (Echo dot) gets ready to accept the command which is indicated by the blue circular light. When we give the command such as “Alexa, turn on the light” or in some similar manner which is recognised by its advanced AI system, the command gets processed through the Server and the processed signal is transferred to the ESP8266. The ESP8266 is registered with the APP KEY to enable connecting to the phone and the Wi-Fi and to help in auto connection to the Wi-Fi, a SSID name and its password is registered in the ESP module. Each ESP is distinguished from one another by its APPKEY. The command gets received by the ESP8266 and the command gets interfaced with the programming of the ESP module. Based on this, the relay gets turned ON. The Command signal irrespective of the load device activates the load. They operate irrespective of the voice of the user and it is greatly useful in Automation system in offices. By simply connecting to a Wi-Fi network whose name can be configured in the ALEXA cloud server, automation of appliance becomes easier.

10. Conclusion
Voice Automated system greatly helps in automation and for helping paraplegic persons since they can’t use remote or any other means. Voice automation is extremely helpful for blind people since normal remote controlled home appliance systems make use of IR remotes which has to be showed towards the appliances for control. Voice command systems can be done even by illiterate person by simply mentioning the device name and telling “ON” or “OFF”. These systems are highly reliable and it can be operated even by integrating with Mobile phones since they operate with Wi-Fi. Hence they can be operated from anywhere. Systems such as Blue tooth or Wi-Fi employed remote control systems even though they are efficient, only the registered smart phones can be used to operate the appliance. The voice automated system eliminates the disadvantage and makes the system accessible to everyone.

References
[1] Marie, A., Benedict, I., Zandrae, A., Neil, A., Gustilo, R. 2015 Home Automation Using Raspberry Pi through Siri Enabled Mobile Devices.
[2] Piyare, R., and Tazil, M. 2011 Bluetooth based Home Automation System using Cell Phone
[3] Mr. Vaibhav Malav, Mr. Raushan Kumar Bhagat, Mr. Rahul Saini , Mr. Udit Mamodiya Conference 2019, Research paper on bluetooth based home automation using Arduino
[4] Sitharthan R, Geethanjali M and Pandy TKS 2016 Adaptive protection scheme for smart microgrid with electronically coupled distributed generations Alexandria Engineering Journal 55(3) 2539-2550
[5] Fathima AH, and Palanisamy K 2014 Battery energy storage applications in wind integrated systems—a review IEEE International Conference on Smart Electric Grid 1-8
[6] Prabaharan N and Palanisamy K 2015 Investigation of single-phase reduced switch count asymmetric multilevel inverter using advanced pulse width modulation technique International Journal of Renewable Energy Research 5(3) 879-890.
[7] Jerin ARA, Kaliannan P and Subramaniam U 2017 Improved fault ride through capability of DFIG based wind turbines using synchronous reference frame control based dynamic voltage restorer. ISA transactions 70 465-474
[8] Sitharthan, R, Sundarabalan CK, Devabalaji KR, Nataraj SK and Karthikeyan M 2018 Improved fault ride through capability of DFIG-wind turbines using customized dynamic voltage restorer Sustainable cities and society 39 114-125
[9] Prabaharan N and Palanisamy K 2016 A single-phase grid connected hybrid multilevel inverter for interfacing photo-voltaic system *Energy Procedia* **103** 250-255

[10] Palanisamy K, Mishra JS, Raglend IJ and Kothari DP 2010 Instantaneous power theory based unified power quality conditioner (UPQC) *IEEE Joint International Conference on Power Electronics, Drives and Energy Systems* 1-5

[11] Sitharthan R and Geethanjali M 2017 An adaptive Elman neural network with C-PSO learning algorithm-based pitch angle controller for DFIG based WECS *Journal of Vibration and Control* **23**(5) 716-730

[12] Sitharthan R and Geethanjali M 2015 Application of the superconducting fault current limiter strategy to improve the fault ride-through capability of a doubly-fed induction generator-based wind energy conversion system *Simulation* **91**(12) 1081-1087

[13] Sitharthan R, Karthikeyan M, Sundar DS and Rajasekaran S 2020 Adaptive hybrid intelligent MPPT controller to approximate effectual wind speed and optimal rotor speed of variable speed wind turbine *ISA transactions* **96** 479-489

[14] Sitharthan R, Devabalaji KR and Jees A 2017 An Levenberg–Marquardt trained feed-forward back-propagation based intelligent pitch angle controller for wind turbine generator *Renewable Energy Focus* **22** 24-32

[15] Sitharthan R, Sundarabalan CK, Devabalaji KR, Yuvaraj T and Mohamed Imran A 2019 Automated power management strategy for wind power generation system using pitch angle controller *Measurement and Control* **52**(3-4) 169-182

[16] Sundar DS, Umamaheswari C, Sridarshini T, Karthikeyan M, Sitharthan R, Raja AS and Carrasco MF 2019 Compact four-port circulator based on 2D photonic crystals with a 90° rotation of the light wave for photonic integrated circuits applications *Laser Physics* **29**(6) 066201

[17] Sitharthan R, Parthasarathy T, Sheeba Rani S and Ramya KC 2019. An improved radial basis function neural network control strategy-based maximum power point tracking controller for wind power generation system *Transactions of the Institute of Measurement and Control* **41**(11) 3158-3170

[18] Rajesh M and Gnanasekar JM 2017 Path observation based physical routing protocol for wireless ad hoc networks *Wireless Personal Communications* **97**(1) 1267-1289

[19] Palanisamy K, Varghese LJ, Raglend IJ and Kothari DP 2009. Comparison of intelligent techniques to solve economic load dispatch problem with line flow constraints *IEEE International Advance Computing Conference* 446-452

[20] Sitharthan R, Ponnuasamy M, Karthikeyan M and Sundar DS 2019 Analysis on smart material suitable for autogenous microelectronic application *Materials Research Express* **6**(10) 105709

[21] Rajaram R, Palanisamy K, Ramasamy S and Ramanathan P 2014 Selective harmonic elimination in PWM inverter using fire fly and fireworks algorithm *International Journal of Innovative Research in Advanced Engineering* **1**(8) 55-62

[22] Sitharthan R, Swaminathan JN and Parthasarathy T 2018 March. Exploration of wind energy in India: A short review *IEEE National Power Engineering Conference* 1-5

[23] Karthikeyan M, Sitharthan R, Ali T and Roy B 2020 Compact multiband CPW fed monopole antenna with square ring and T-shaped strips *Microwave and Optical Technology Letters* **62**(2) 926-932

[24] Sundar D Sridarshini T, Sitharthan R, Madurakavi Karthikeyan, Sivanantha Raja A, and Marcos Flores Carrasco 2019 Performance investigation of 16/32-channel DWDM PON and long-reach PON systems using an ASE noise source *In Advances in Optoelectronic Technology and Industry Development: Proceedings of the 12th International Symposium on Photonics and Optoelectronics* 93

[25] Sitharthan R and Geethanjali M 2014 Wind Energy Utilization in India: A Review *Middle-East J. Sci. Res.* **22** 796–801 doi:10.5829/idosi.mejsr.2014.22.06.21944
[26] Sitharthan R and Geethanjali M 2014 ANFIS based wind speed sensor-less MPPT controller for variable speed wind energy conversion systems *Australian Journal of Basic and Applied Sciences* 8:14-23

[27] Jerin ARA, Kaliannan P, Subramaniam U and El Moursi MS 2018 Review on FRT solutions for improving transient stability in DFIG-WTs *IET Renewable Power Generation* 12(15) 1786-1799

[28] Prabaharan N, Jerin ARA, Palanisamy K and Umashankar S 2017 Integration of single-phase reduced switch multilevel inverter topology for grid connected photovoltaic system *Energy Procedia* 138 1177-1183

[29] Rameshkumar K, Indragandhi V, Palanisamy K and Arunkumari T 2017 Model predictive current control of single phase shunt active power filter *Energy Procedia* 117 658-665

[30] Fathima AH and Palanisamy K 2016 Energy storage systems for energy management of renewables in distributed generation systems *Energy Management of Distributed Generation Systems* 157

[31] Rajesh M 2020 Streamlining Radio Network Organizing Enlargement Towards Microcellular Frameworks *Wireless Personal Communications* 1-13

[32] Subbiah B, Obaidat MS, Sriram S, Manoharn R and Chandrasekaran SK 2020 Selection of intermediate routes for secure data communication systems using graph theory application and grey wolf optimisation algorithm in MANETs *IET Networks* doi:10.1049/iet-net.2020.0051

[33] Singh RR and Chelliah TR 2017 Enforcement of cost-effective energy conservation on single-fed asynchronous machine using a novel switching strategy *Energy* 126 179-191

[34] Amalorpavaraj RAJ, Palanisamy K, Umashankar S and Thirumooorthy AD 2016 Power quality improvement of grid connected wind farms through voltage restoration using dynamic voltage restorer *International Journal of Renewable Energy Research* 6(1) 53-60

[35] Singh RR, Chelliah TR, Khare D and Ramesh US 2016 November. Energy saving strategy on electric propulsion system integrated with doubly fed asynchronous motors *IEEE Power India International Conference* 1-6

[36] Singh RR, Mohan H and Chelliah TR 2016 November. Performance of doubly fed machines influenced to electrical perturbation in pumped storage plant-a comparative electromechanical analysis *IEEE 7th India International Conference on Power Electronics* 1-6