

ALEXA Technology for Industrial Automation System

Aditya Badave¹, P. S. Kokare², Pooja Deshmukh³, Shubhangi Chavan⁴

^{1,3,4} UG Student, Dept. of E & TC Engg., SKNCOE, SPPU, Pune

² Assistant Professor, Dept. of E & TC Engg., SKNCOE, SPPU, Pune

¹adityabadave98@gmail.com

²premskokare@gmail.com

³poojadeshmukh493@gmail.com

⁴shubhangich55@gmail.com

Abstract

In this paper, we discuss about implementing automation in industries. The paper supports the concept of Industry 4.0. Industry 4.0 refers to the concepts of factories in which machines are augmented with wireless connectivity and sensors, connected to a system that can visualize the entire production line and make decisions on its own. In this project, we power our system using ALEXA, its speech services. Due to this, automation is possible in controlling the lighting system of the entire industry, assembly line, with the help of simple voice commands.

Keywords-Alexa, Amazon Echo Dot 3, WiFi to Bluetooth Converter, Constant Current LED Driver.

I. INTRODUCTION

Amazon Alexa, known simply as Alexa, is a virtual assistant developed by Amazon, first used in the Amazon Echo and the Amazon Echo Dot smart speakers. It is capable of voice interaction, making to-do lists, music playback, setting alarms, playing audiobooks, streaming podcasts, and providing weather, sports, traffic, and other real-time information, news. Users are able to use the Alexa capabilities by installing "skills" (additional functionality developed by third-party vendors, in other settings more commonly called apps such as weather programs and audio features).

Most devices with Alexa allow users to activate the device using a wake-word (such as *Alexa*); other devices (such as the Amazon mobile app on iOS or Android and Amazon Dash Wand) require the user to push a button to activate Alexa's listening mode, although, some phones also allow a user to say a command, such as "Alexa" or "Alexa wake". Currently, interaction and communication with Alexa are available only in English, German, French, Italian, Spanish,^[4] Portuguese, Japanese, and Hindi.[7]

The Smart Home space has been a prime focus with the introduction of devices such as Amazon Echo, Google Home, Samsung Smart Things among others. Automations has also been introduced in industries in the form of use of Programmable Logic Controllers (PLC's). Industry 4.0 is such an initiative. Industry 4.0 refers to the concept of factories in which machines are augmented with wireless connectivity and sensors, connected to a system that can visualize the entire production line and make decisions on its own. So controlling the machines and the lights over voice commands is one of the sector of Industry 4.0. The project focus on controlling the switching of lights as well as controlling their intensities over simple voice commands. The project uses Alexa, its speech services and a driver circuitry to control the working of the lights.[4][5]

II. LITERATURE SURVEY

In this paper proposed by Prof. Ms. R. Rajyashree, Vineela Kalluru and Himanshu Kumar, stated that machine-controlled workplace can be made automated to cut down the power consumption and to create it economic. Alexa Voice Services makes the place of work a lot more user-friendly and useful with an aim to make the industry automated. Voice controlling automation creates the working environment more effective and resourceful, time consumption is also reduced due to ease of use.[1]

In this paper proposed by Cu Pham, Yuto Lim and Yasuo Tan, suggested a way to use Alexa for the smart home based on echonet as well as the solution to support the combination of the common Service Platform Oriented structure and the advanced Device Cloud architecture.[2]

In this paper proposed by Hyunji Chung, Michaela Iorga, Jeffrey Voas, and Sangjin Lee states that due to virtual assistants become more intelligent and the IVA ecosystem of services and devices expands, there's a growing need to understand the security and privacy threats from this emerging technology. Several recent incidents have highlighted significant fragility in IVAs. With better diagnostic testing such exposure can be revealed and lead to more trustworthy systems.[3]

In this paper Andrea Horch, Michael Kubach, Heiko Roßnagel and Uwe Laufs has proposed definitions and differentiations in the context of Smart Buildings and in particular for the field of Smart Office. They differentiated between the terms Smart Home and Smart Office based on the services and applications as well as the involved types of user groups. The main contribution of this paper is a concept for the operation and use of Smart Office service devices, which shows how smart devices can be integrated into an existing office environment and how the devices can be controlled by a network calendar and a voice service as Amazon Alexa.[4]

In this paper Chan Zhen Yue and Shum Ping stated that in the near future, smart home system will be essential to everyone with the ever-improving Google Home and Amazon Echo. This paper presents the design and implementation of a low-cost voice activated smart home system which can be integrated with many basic subsystems and tailored to personal needs. With the Alexa Skill Kits and Raspberry Pi, every appliance can be controlled from anywhere without direct interaction with them.[5]

Tatjana Erić, Sandra Ivanović, Sunčica Milivojša, Milica Matić and Nikola Smiljković analyzed the existing voice recognition software, and possibility of integrating them with the HA system. The choice of the speech to text conversion technology determines the system architecture. Based on the analysis, they concluded that the future work should focus on the integration of with the existing HA system.[6]

III. MARKET SURVEY

Amazon Echo – Smart Speaker with ALEXA

Echo connects to Alexa to play music, make calls, set music alarms and timers, ask questions, control smart home devices, and more — instantly. You can stream music by commanding alexa to play from Amazon Prime Music, Saavn, and Gaana – just by asking for a song, artist, or genre. Echo hears you from any direction - even while music is playing. Echo is designed around your privacy. You can press the microphone off button to disconnect the microphones. You can even get calendar, traffic, weather and news updates, set alarms, manage shopping lists, control compatible smart home devices with Alexa. Alexa is always getting smarter and adding new features and skills like booking a cab, playing games, and more.

Alexa supports WiFi 802.11 a/b/g/n protocol. Alexa uses Advanced Audio Distribution Profile (A2DP) support for audio streaming from your mobile device to Echo or from Echo to your Bluetooth speaker. It uses Audio/Video Remote Control Profile (AVRCP) for voice control of connected mobile devices. Bluetooth speakers requiring PIN codes are not supported for Alexa as there is no provision to input the password for connecting. After a brief study of various reference papers related to this topic, we have gathered information about the basic ideas about this project. These papers give basic ideas about the different elements used in this project. Referring these papers has made it easy to understand the idea of the project as well as implementing it.[7]

IV. FRAMEWORK OF PROJECT

A. Proposed work.

Figure 1 shows block diagram & overview of the project. The input, that is the commands are given by the user in the form of voice commands. Alexa is activated over its command word – ‘Hey Alexa’. Then Alexa starts to record the voice. Then this recorded voice is sent to Amazon Voice Services. This voice signal is converted into text at the Amazon Voice Services. As per the request from the user, the command is processed and required action that has to be taken is send to Alexa by Amazon Voice Services over the internet.

When Alexa receives the information of what action should be performed, it sends the signal to the associated device over WiFi. This WiFi signal is converted into Bluetooth signal by the interfacing module. The output signal, that is the Bluetooth signal is send to the LED driver circuit. We have used

a constant current driver. The LED lights are connected to the driver. So, now the turning on or off of the LEDs as well as other actions like dimming can be controlled over voice commands.

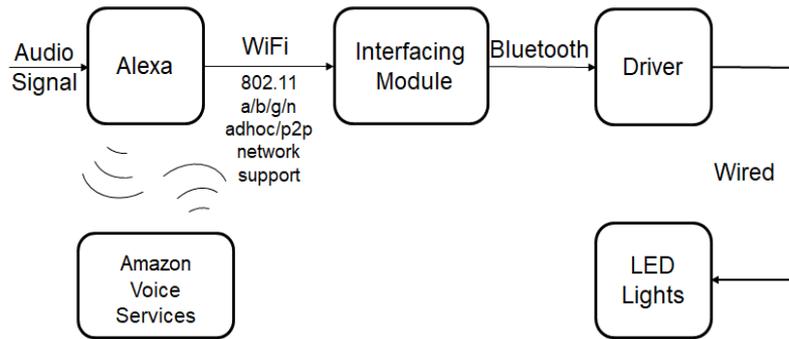


Figure 1 Block Diagram of the System

a. ALEXA (Amazon Echo Dot 3)

The Echo Dot is Amazon’s small, puck-like smart speaker with the firm’s Alexa voice assistant built in. New for the third generation is a softer, more rounded aesthetic with fabric sides. It is also slightly larger in all directions, measuring 99mm in diameter and 43mm tall. At the back is a circular power socket, replacing the microUSB socket of the old Dot, and a standard 3.5mm analogue socket for connecting to a stereo. On top you have the volume buttons, action button and the microphone mute button.

Alexa is basically used in our system to give commands over voice. When Alexa detects its activating word, that is ‘Hey Alexa’, it starts recording the audio that is followed by it. This audio recording is sent to Amazon Voice Services over the internet.

b. Amazon Voice Services

The Alexa Voice Service enables you to access cloud-based Alexa capabilities with the support of AVS APIs (Amazon Voice Service Application Program Interface), hardware kits, software tools, and documentation. It simplifies building voice-forward devices with Alexa built-in by handling complex speech recognition and natural language understanding in the cloud. This reduces the development costs and accelerating the time to market. Best of all, regular Alexa updates bring new features to the connected device and add support for a growing assortment of compatible smart devices.

It receives the recorded audio and convert them into text. For this it uses its speech-to-text conversion. Then the command is analyzed. The action that is to be performed is selected from the data stored by the main server. The action that should performed is told to Alexa over the internet.



Figure 2 Working of Amazon Voice Services.

c. Interfacing Module

Wi-Fi/Bluetooth wireless technology is ubiquitous today in many of our electronic devices. We have cellphones, laptops, home gateway boxes and even refrigerators that can be connected via Wi-Fi/Bluetooth to be synced or transfer large data files. Wi-Fi/Bluetooth modules need to be able to plug into various different designs from different customers, thus the modules have to be built to withstand multiple different electrical scenarios. Diodes Incorporated has the various components needed to enable Wi-Fi/Bluetooth modules function at their optimum and also be used in different systems.

The module basically converts the WiFi signals given by the Alexa into Bluetooth signals. This has to be done as the LED driver works on Bluetooth signals and does not support Wi-Fi signals.

d. LED Driver (Constant Current)

The LM317L is an adjustable 3-terminal positive voltage regulator capable of supplying 100mA over a 1.2V to 37V output range. It is exceptionally easy to use and requires only two external resistors to set the output voltage.

LM317L offers full overload protection. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

LM317 makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM317L can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current. It receives the Bluetooth signals and action is performed based on it.

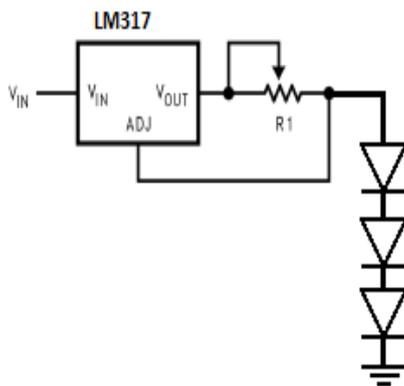


Figure 3 Constant Current LED Driver using LM317L

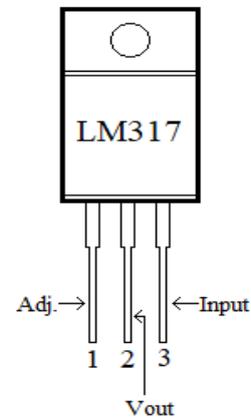


Figure 4 LM317L

e. LED

An LED is a type of diode that turns electrical energy into light. For those that don't know, a diode is an electrical component that only works in one direction. Basically, an LED is an electrical component that emits light when electricity flows through in one direction, from the Anode (positive side) to the Cathode (negative side).

LED is an acronym standing for 'Light Emitting Diode'. Basically, LEDs are like tiny light bulbs, they just require a lot less power to light up and are much more efficient in producing high light outputs. Surface Mount LEDs are diode(s) that can be placed on a substrate (circuit board) with a silicon dome over the diode to protect it. We carry high-power Surface Mount LEDs from industry leaders Cree and Luxeon. Both are excellent in our opinion, that is why we carry them after all. Some prefer one over the other but that comes with experience and knowing what to look for. Cree tends to have higher listed Lumen outputs and are a market leader in the High-Power LED sector. Luxeon, on the other hand, has excellent colors and thermal control.

V. RESULTS

Simulation:

For average luminance of 116 lux (Room height: 2.8m, Light loss factor: 0.8)

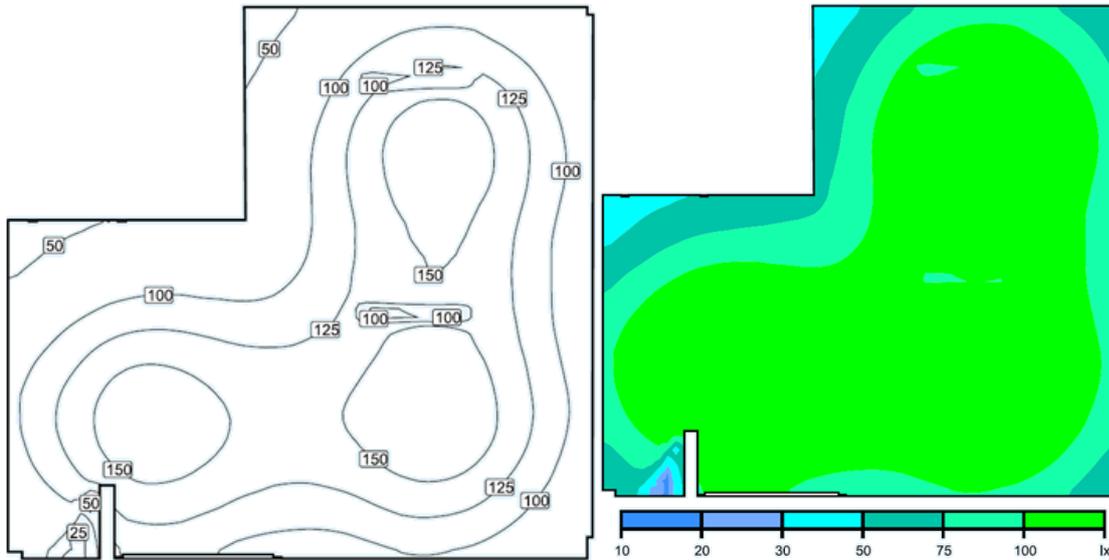


Figure 5,6 Distribution of light (values in lux) in different areas of room

For average luminance of 246 lux (Room height: 3.5m, Light loss factor: 0.8)

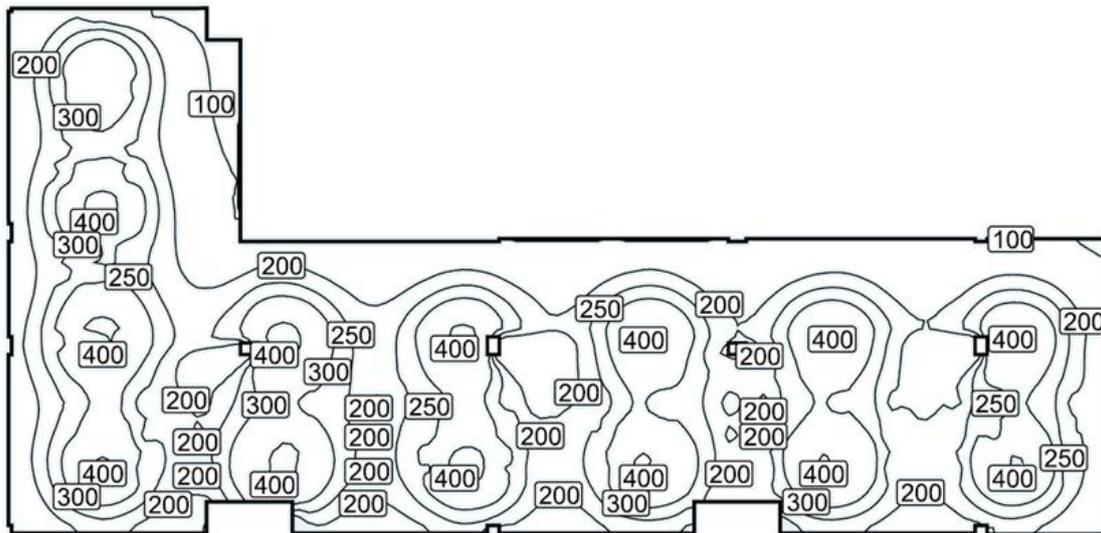


Figure 7 Distribution of light (values in lux) in different areas of room

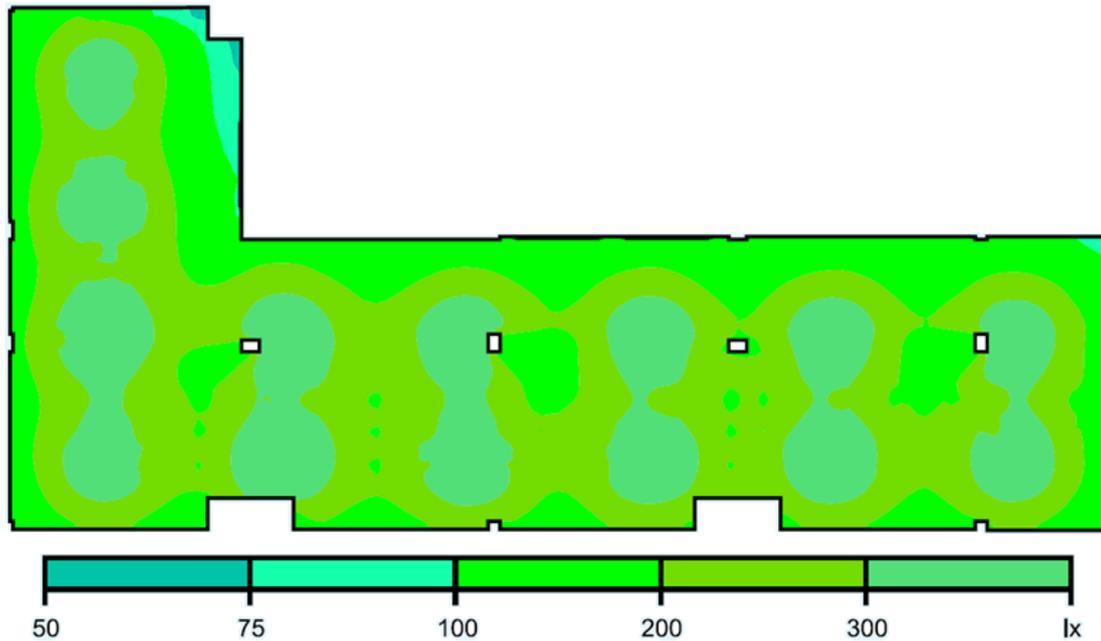


Figure 8 Distribution of light (values in lux) in different areas of room

VI. CONCLUSION

Machine-controlled workplace could be a place with all the automation created to cut back the ability consumption and to create it economical to figure. Alexa Voice Services build the workplace a lot of fascinating and useful with an introduction to the automation. Voice controlling automation creates the working environment more virtual and imaginative, which ease to work also reduce the time consumption.

Due to the use of LED lights the system is energy efficient. Error probability is reduced due to reduced interference of humans. As the system uses LED lights instead of Smart Bulbs the overall lighting cost is reduced. As no complex system is used this system is easy to implement.

VII. FUTURE SCOPE

The range can be considerably increased. With suitable changes it can be used in all weathers and in all temperatures as well as for outdoor purposes. We can develop a mobile application and control the system from any location.

It can further be developed to sense any sort of emergency and contact the police, ambulance and/or fire brigade on its own.

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