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Smart Home Automation using Voice Recognition

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Abstract: ***This modern era is about pursuing your passion, people not only focus on work but take up several hobbies to follow, either it be learning a new instrument, hiking, or vlogging your life. Everything must be done within 24 hours of a day. This creates a never-ending demand for technology that could encourage full utilization of time by eliminating the basic and mundane tasks of individuals. Inspired by this stream of thoughts we are developing a system that provides a cost-effective solution to the problem by creating a voice-operated home automation system. This is achieved by using the principles of the Internet of Things integrated with Neural Libraries. We can create an environment in which several appliances can be operated on voice commands, either it be turning on a fan or closing a door all are just one command away. The system utilizes BOLT IoT with a voice flow application to make an economical, scalable, and user-friendly home automation model.***
Keywords: IoT, Voice recognition, Smart home, BOLT IoT, Integromate.

I. INTRODUCTION

Automation refers to self-governing devices that use pre-decided decision flow and feedback mechanisms to do processes with minimal human intervention. The term itself was coined in 1946 by D.S. Harder mainly refers to the manufacturing industry but the history of automation dates back to at least 1500BC where a water clock was used to keep track of time. After the water clock thousands of automations like automatic fountains, printing press, looms, mills etc were followed. The goal of any automation is to reduce the human efforts required to bring tasks to fruition. Automations allow people to explore new fields and discover new paths by freeing up manpower. Machines for a long time were dependent on humans for information. Clock cycles, preferences, decision trees, etc. all were designed and gathered by humans, this introduced several errors as humans are unable to feed real-time data with 100% accuracy. The modern era needed machines with their own means of gathering and processing information. This was achieved by incorporating sensors in devices to gather real-time data which opened new gateways for technology. But each device gathering the same information is a waste of resources, hence machines should communicate between themselves and utilize collected data to give precise results. This need gave birth to the Internet of Things. Internet of things is the connection and communication between physical objects that exchange data and information over the internet or other media. The basic idea of IoT was started in 1982 when the modified coca-cola vending machine became the first device to connect to ARPANET. The machine reported its inventory and temperature of newly loaded drinks. The term IoT was first coined and defined by Peter T. Lewis. According to Peter Lewis, The Internet of Things, or IoT, is the integration of people, processes, and technology with connectable devices and sensors to enable remote monitoring, status, manipulation, and evaluation of trends of such devices.[1]



Fig 1-The "Only" Coke Machine on the Internet

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IoT has seen a significant rise in its versatility by being integrated with voice recognition technology. Though voice recognition has gathered a lot of steam in past decades is a fairly old technology that first appeared in the Radio Rex toy in 1922, 63 years before IoT. From being a pure frequency detector to now utilizing deep neural networks, voice recognition has improved by leaps and bounds. This is mainly because speech is the most common and efficient way of communication that easily transcends the literacy barrier and makes technology more readily accessible to people with physical impairments.

Smart homes are one of the applications of IoT where common appliances are paired with sensors and processors such that the process of monitoring and controlling household appliances becomes easy. As we talk of IoT usage it mainly focuses on physical interaction, but we can make it more advanced and efficient by incorporating voice recognition which offers a versatile method to communicate between human and home appliances. Our paper aims to deliver a home automation system that incorporates all the above-mentioned technologies to give seamless user interaction and execution of daily activities.

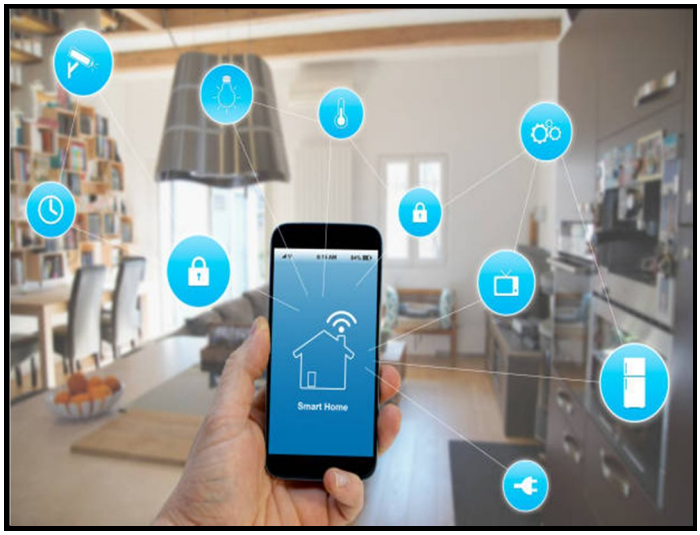


Fig 2- Smart Home Control

II. METHODOLOGY

The home automation system is a system developed to facilitate individuals with an effortless & seamless mechanism to control and manage household appliances. The primary ideology of this paper is to provide a home automation system by integrating voice recognition with the internet of things. The resulting technology reaps the benefits of both worlds to deliver a feasible and handy medium to accomplish mundane tasks. For achieving this, we have utilized Bolt IoT, a platform that eases the development process of IoT applications. We have applied a voice application algorithm for accomplishing our goal and trained a model on the same that is integrated with google cloud to store data and perform analysis. The relay modules and jump wires are used to attach devices for analog current conversion. By utilizing the integromat platform, the system developed provides a seamless interconnection between the BOLT IoT chip and Voice flow.

A similar system can be found in most modern cars where speech recognition is paired with IoT to reduce distractions for drivers. From connecting navigation to receiving notifications or making a call from the mobile phone all can be carried out using voice commands.

A. Research Approach

The driving idea behind our projects originates from our own need to automate menial tasks that seem to bog down on us throughout the day, it may be laundry, remembering to switch off the water heater, etc occupies unneeded space on our mind leaving no room for more important endeavors. Hence we decided to create our own home automation system to facilitate our needs. But then we stumbled upon a great quote by Vlad Sejnoha, in concern with voice recognition

"The principle here is, the user is using his or her speech to shorten the distance between their intent and their desired outcome,"[2]

Which made us realize that to truly minimize the time wasted and make technology accessible we need to incorporate voice recognition technology. This technology enables the differently-abled person(dyslexia, physical handicap, blind, etc.) to have far richer and more fulfilling experiences by eliminating the need for a visual and touch interface.

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B. Method Approach

1) *Hardware Side:* We will implement our system by connecting relay modules to analog pins of BOLT IoT, which allows easier analog-digital conversion. We will then connect jumper wires to the relay module to switches/plugs of appliances.
2) *Software Side:* From a software perspective, we are going to make use of a local python system framework for establishing a connection between the Bolt IoT chip and the google cloud using integromat. We will connect the Bolt IoT chip with the Internet of Things using the python code so that we can call the instance of Bolt IoT cloud and if it is successful then we can perform functions like reading, writing, and implementing on it so that later on when communication takes place between cloud and Bolt IoT in order to store, we will require cloud connection and further it will be collected at python framework. We can also make use of another software called IFTTT which is particularly used to make our connection with the cloud.

C. IFTTT

IFTTT or "If This Then That" is a platform that utilizes APIs to communicate with different services to trigger specific events. It eases the development of automation by providing a user-friendly automation interface. Once an applet is created all efforts on our part are done as IFTTT will ensure proper connection and implementation of created functionality. We can also install widgets on phone devices, IOS, etc which are button shortcuts allowing one to access applets without even opening the app.

D. INTEGROMAT

Integromat is a free online service that connects and helps to automate workflow using visual builders. It eases the process of developing cumbersome integrations due to the availability of built-in tools and eliminates the need for coding, for example, its drag and drop feature enables users to join various services and make complex automation.

API or Application Programming Interface is an intermediary which facilitates communication between host and client. A webhook is a one-way data-sharing API. It is triggered when certain events happen to request data from another source.



Fig 3- Integromat

E. BOLT IoT

BOLT IoT is an IoT platform that fast tracks the development process by providing interconnected portals and chips. It has a Wi-Fi chip to connect sensors and devices with a BOLT chip through a remote connection. The chip can be independently run as it has an inbuilt power source. It also caters to both Analog & Digital power requirements by allowing easy conversion between them.

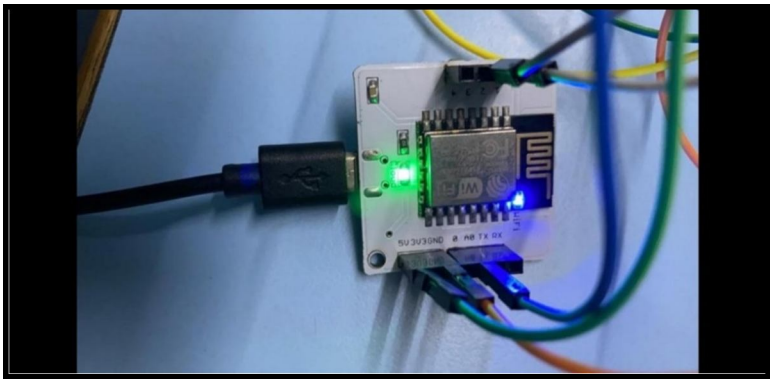


Fig 4- Bolt IoT chip

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F. Relay Module

A Relay Module is an electrical switch that opens and closes the circuit based on electric input. It works by the electromagnetic principle. It is used to detect faults and disconnect affected areas to prevent damage. This system is based on the design of fuse and alters the current traverse into the switching appliances. This protects an device from running out of the high voltage breakdown by terminating the connection after direct current over passes a threshold that can damage the appliance.

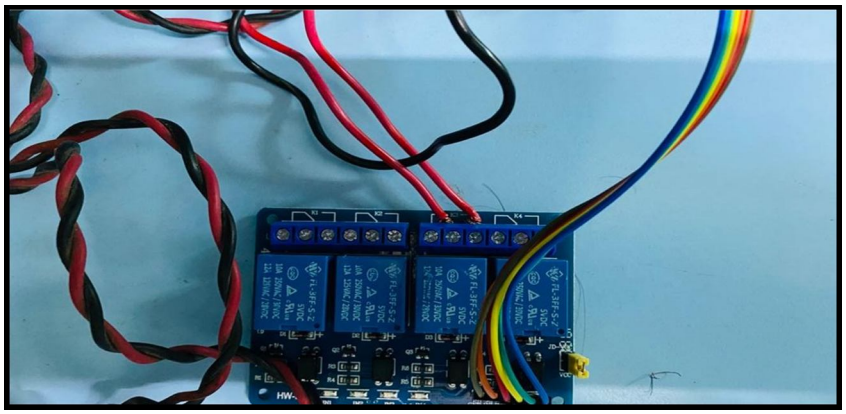


Fig 5- Relay Module

G. Wires

The wires are conductors traditionally used to carry electricity or telecom signals. They are used here as connectors to connect different components of the system.

H. Power Source

Power source performs a dual role in the system, not only does it power BOLT IoT and connected devices but it also gives static energy to the Wi-Fi that in turn helps the Wi-Fi modules to perform its assigned task smoothly.

I. LED

Light-emitting diode emits light and heat when excited electrons and holes combine at the P-N junction. The colour of light is determined by the energy required by electrons to cross the bandgap. Here we have used LEDs as a model output device and as proof of concept

III. ALGORITHM

This section discusses the platform and major modules, packages used to carry out home automation using a voice recognition system.

A. Integromat

Integromat is an online free tool that provides seamless connection of API with hardware to access its services one must create an account with integromat, choose a webhook linked to bolt IoT cloud, This webhook can call read or write functionality that takes a pin and its state as input and then can interact with BOLT cloud to have the desired effect. Another feature of integromat is that it allows the addition of widgets which allows us to enhance the smart home experience by adding widgets like Evernote to our home automation system.

B. Rest API

A REST API is an API that adheres to the REST or representational state transfer architectural style restrictions and allows users to interact with RESTful web services. It is often considered as the backbone of the internet of things as it is flexible, scalable, and offers high performance while utilizing lesser bandwidths than its counterparts. It uses methodologies defined by the RFC 2616 protocol like delete, post, etc.

It works by breaking down each transaction into submodules that are responsible for some part of the transaction, making these API very flexible. All calls are stateless hence no data retention happens during multiple calls. REST API due to its advanced features is preferred for cloud functionalities and the same has been used by BOLT.

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C. BOLT IoT

BOLT IoT platform offers an immense number of features making it very attractive for developers. BOLT cloud not only allows the programming of BOLT chips but also acts as a base providing graphs, data storage capabilities, and giving alerts via messages. BOLT is also lucrative due to its Machine learning algorithms which can predict IoT data and highlight anomalies present.

BOLT IoT contains a WIFI chip that allows us to access and update our system from remote locations. We connect relay modules at Analog ports of BOLT IoT as we can provide voltage in the range from 0-255 allowing more precise control.

Using Python libraries, we will connect bolt IoT chips with the python framework. A pin represents a physical input or output carrying an electrical signal. Every input or output signal goes through a physical pin from or into a component. The pins and chips can be triggered using Rest API.

D. IFTTT

IFTTT or "If This Then That" is a company started in 2010 by Tibbest and Jesse Tane. It offers various applets, connections, and the use of API which allows communication between multiple services. The user can make their own applet by choosing the trigger event or "IF" condition which can be anything, tweet, message, time, etc and select the corresponding response which may again call on APIs, sending notification to your mobile device, adding text to Evernote, etc all are made possible by IFTTT, for example:- uploading pictures to Instagram from your google drive. We have made use of IFTTT because it makes connections between Google cloud and IoT seamless and easy to code.

E. Google Assistant

Google Assistant is a voice AI brewed by google to offer voice recognition services to people. Google's voice recognition is a state-of-the-art technology which uses statistical language models trained over billions of queries to reach Google assistant's present capabilities. Hence, we incorporated the same for its accurate search results, voice-accent interpretations, lag-free experience, and having publicly available APIs.

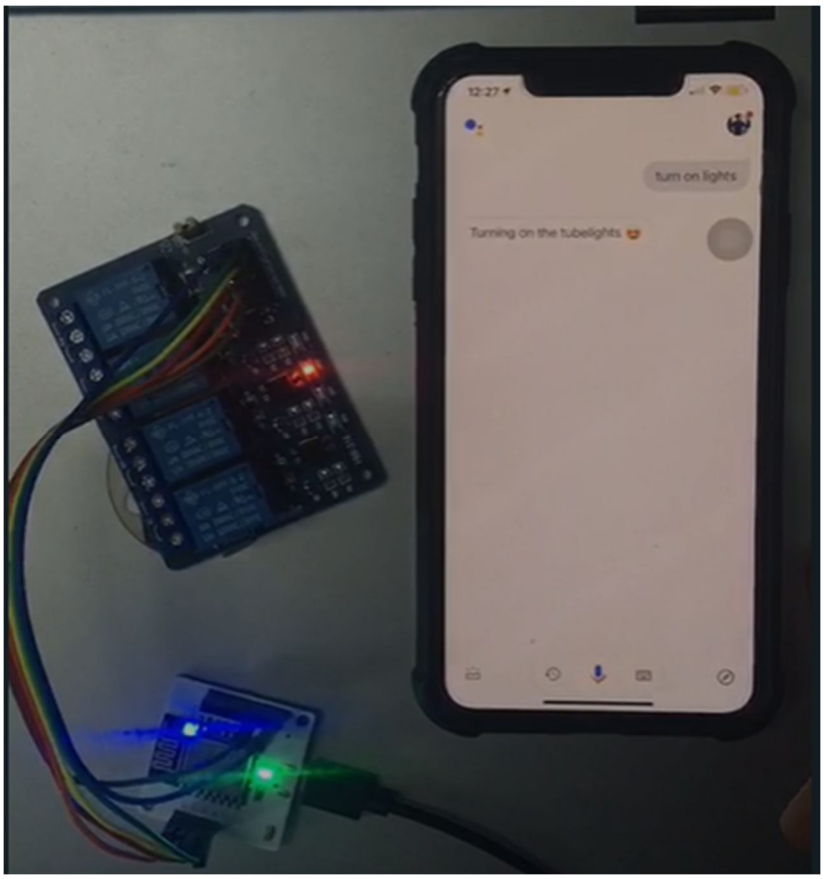


Fig 6- Google Assistant

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F. Flowchart

The following flowchart explains inner working of smart home automation using voice recognition system. Flowchart shows connection and communication between various components discussed in previous section and elaborates on how the process flow work. To operate the system one must trigger google assistant either through app or using phrase "OK Google" and issue the command, as one give out voice command, the google cloud will interpret the command and send the same to integromat through webhook. Integromat software will then compute the required steps that must be performed for completion of said command and accomplish requisite steps by forwarding function calls through BOLT API. BOLT chip would then set required pins high so that the switch connected to relay modules would get on, hence switching "ON" the bulb.

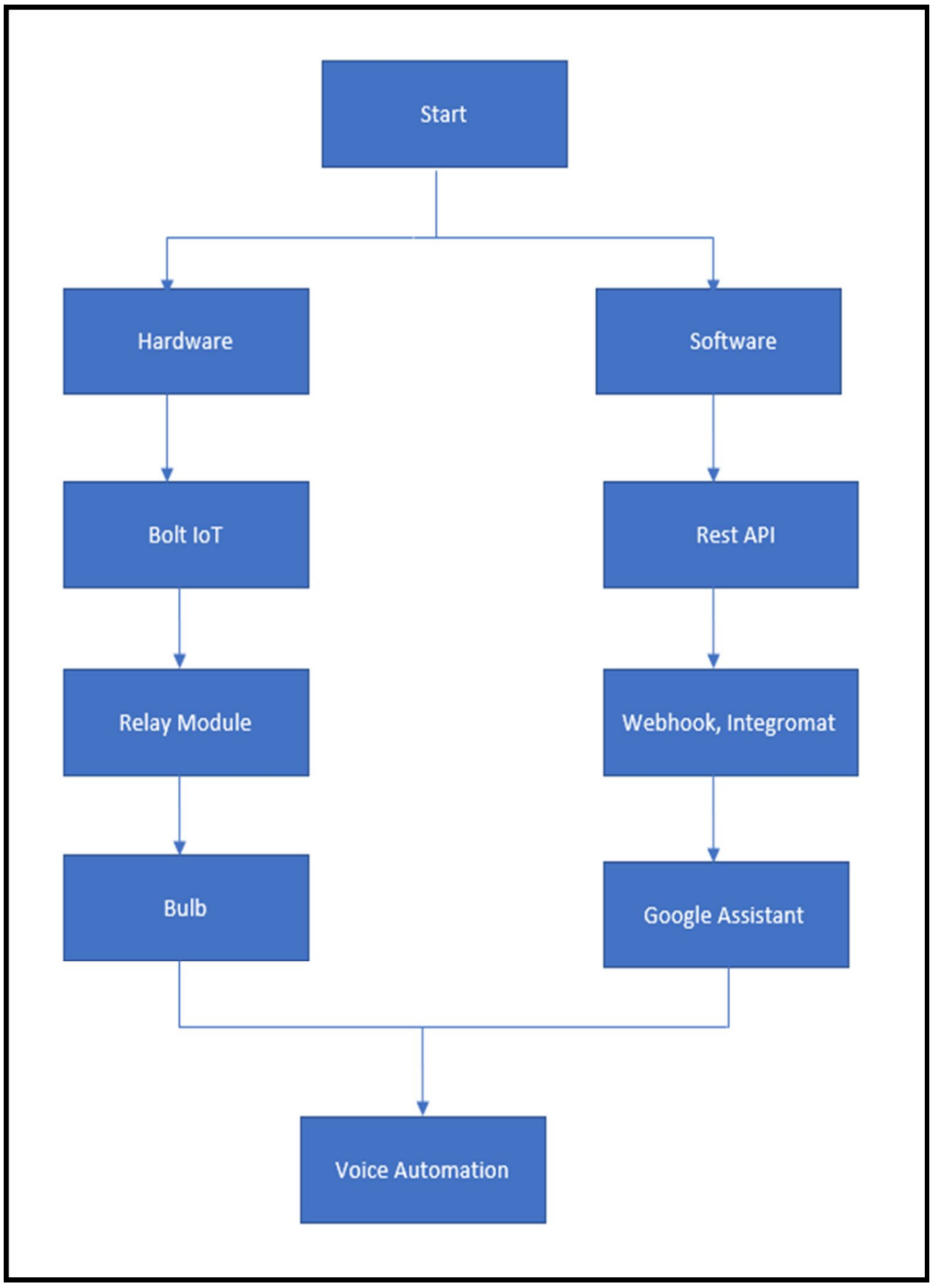


Fig 7- Flow Chart Of The System

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IV. RESULT

The idea put forward by this paper is to augment the functionalities of IoT with the use of voice recognition technology. The BOLT IoT's blue and green light indicates a successful connection to WIFI and BOLT cloud respectively. This allows us to use voice commands and the rest APIs to trigger BOLT functions and control home appliances. For successful implementation, the user first gives a command via google assistant for example," OK google turn on the light ", this will commence the implementation process. Google Cloud will interpret the voice command, and send required data to integromat using rest API. According to the stored program, an integromat will use BOLTs webhook to trigger functions, which will lead to a change in pin voltage and in turn switching on and off the devices.

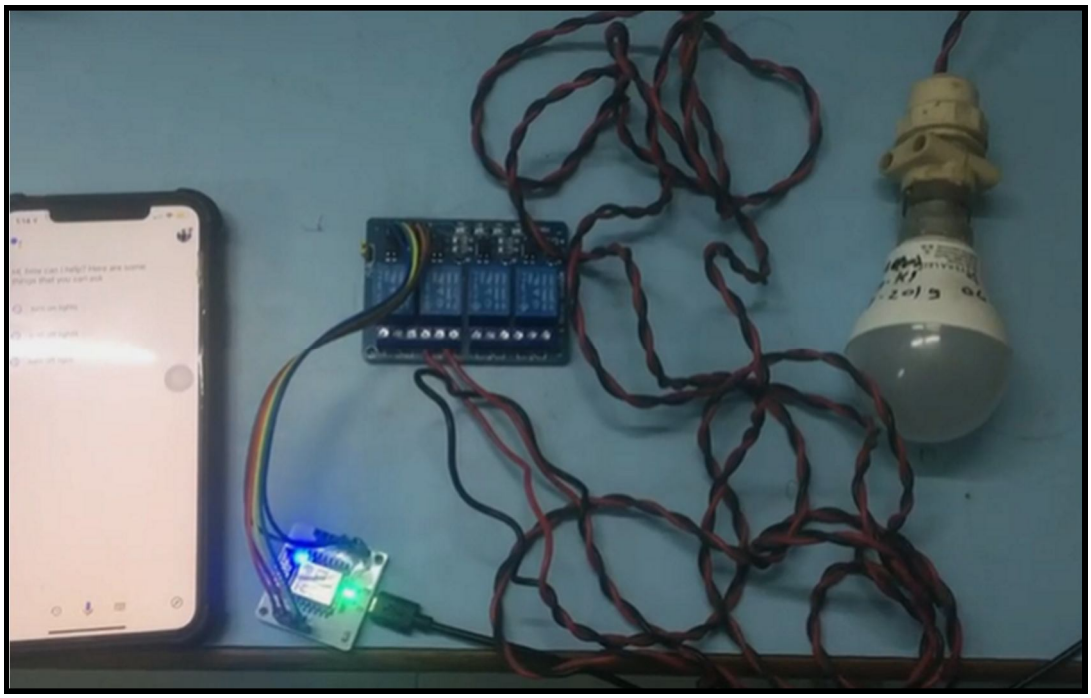


Fig 8- Connection with the bulb

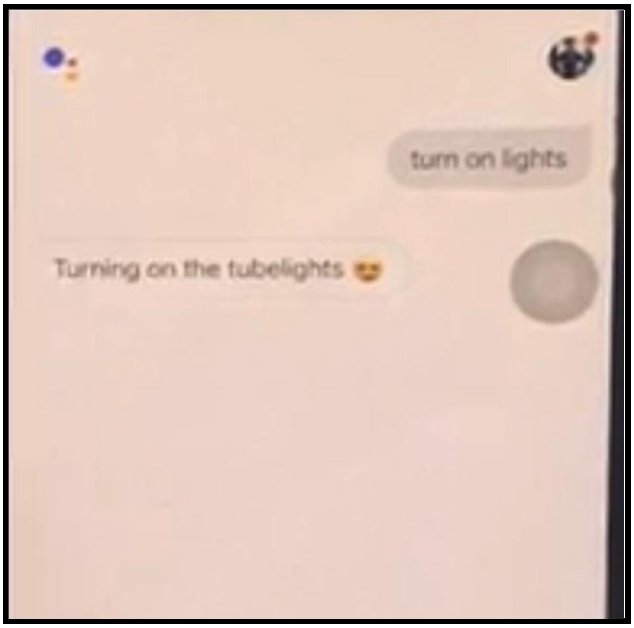


Fig 9- Message display on saying " turn on lights "

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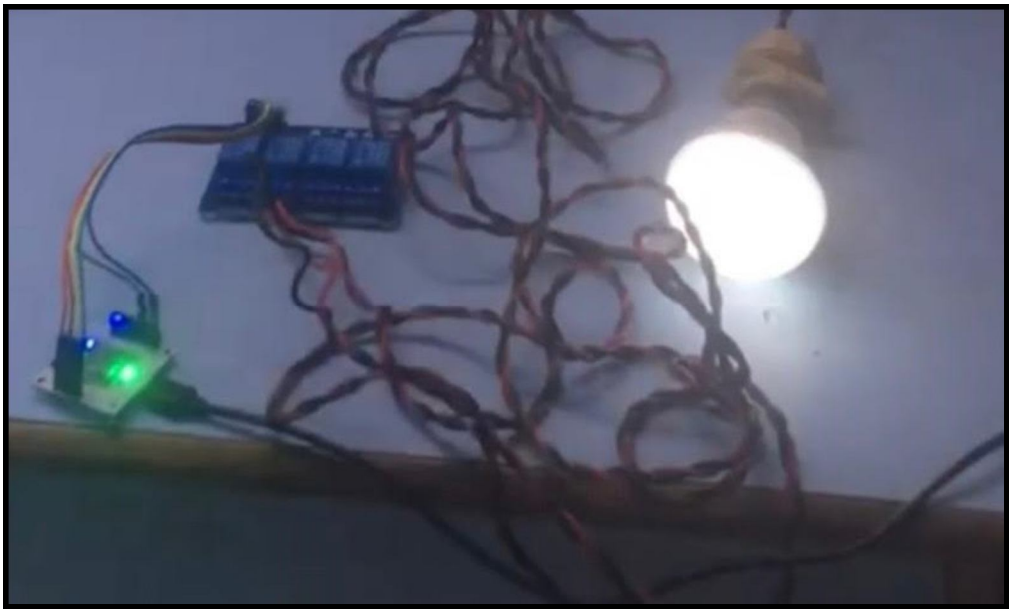


Fig 10- Bulb Glow's after the google assistant command

Our system being affordable open floodgates for various applications, one can integrate a software like Evernote, which can be utilized to take transcripts during meetings. Opening curtain blinds when the sun rises, maintaining house temperature by switching on ACs and heaters according to room temperature, etc. Also, Google maps and GPS together can enhance system functionality better by not only triggering functions on the basis of voice but also on device location. The system contributes to user life by alleviating the weight of mundane tasks and making life easy.

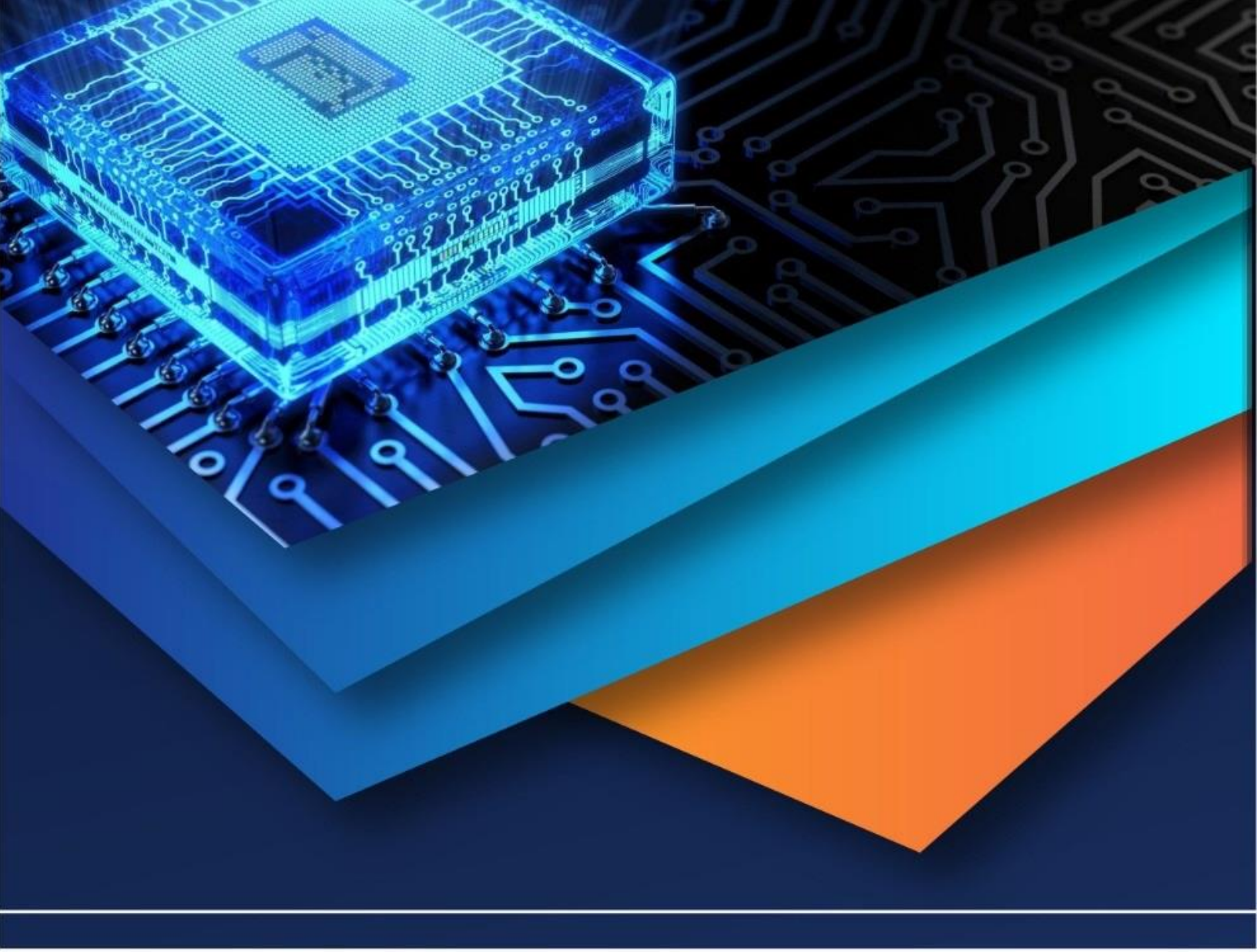
V. FUTURE SCOPE

As we have established throughout the paper, harmonizing voice recognition with the Internet of Things is the right step towards the future. The applications are not only limited to switching on or off appliances but can become an integral part of a person's daily life by suitable upgrades to meet the expectations of the consumers better. One can order groceries, schedule maintenance, keep up with the world, and much more. This is already evident as cars like MG Astor, have a voice-operated user interface, amazon smart stores that remove human interaction and bill your account directly. The scope of IoT truly is endless and impeccable.

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