

# Voice Controlled Smart Switches And Smart Door Lock Using Internet Of Things

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**Abstract**—Most of the senior citizens find it hard to manage their daily house hold and depend on others to assist them. Even the simplest tasks such as switching off a tube light becomes difficult, since it is tough for them to get up immediately. Home Automation, which is now becoming a small part of every house in society, can find a solution to help elderly persons. The paper focuses on designing and building a low cost system which would eliminate the need to manually turn off various devices such as TV, tube lights, fan etc. Smart phones can replace remotes which operate these appliances. Voice commands from Google assistant enables the devices to turn on through controlled switching using Wi-Fi module in the proposed idea. An electronic door lock security system is also included which would further provide them an effortless living, which involves a real time electrical lock operated by a microcontroller, thus eliminating the need of keys.

**Index Terms**—Controlled Switching, Wi-Fi module, Home Automation, Smart phone, Electrical lock.

## I. INTRODUCTION

THE houses of the 21st century will become more and more self-controlled and automated with the advancement in technology due to the comfort it provides, especially when employed in a private home. The paper is based on the concept of Internet Of Things. The concept of Home Automation aims to bring the control of operating your everyday home electrical appliances through voice commands, thus giving user affordable lighting solutions, better energy conservation with optimum use of energy. The home automation device that we've built can be integrated with almost all the home appliances and can be used to control them through voice commands. To facilitate the wireless connectivity with the system, the Node MCU version 1 is used and all the home appliances can in turn be connected and controlled by Google Assistant. Apart from just lighting solutions, the concept also further extends to have an overall control over your home security as well as build a centralised home entertainment system and much more.<sup>[9]</sup>

Previously implemented systems have used ZigBee modules to interface the internet with the device which is quite

expensive. Some have used Bluetooth, DC Server Motors as well. The paper proposes a cost-effective method and hence makes the system economical. It offers a lot of flexibility over the wired systems. It comes with various advantages like ease-of-use, ease-of-installation, avoid complexity of running through wires or loose electrical connections, easy fault detection and triggering and above and all it even offers easy mobility. The smart home market is taking off as IoT device prices come down and the general public comes to understand the benefits of these products. From smart homes, the next logical step is smart cities, which would take the IoT to the next level.<sup>[10]</sup> Smart homes are just one small part of our daily lives that the Internet of Things will transform in the coming years. It's no secret that the IoT market is now very actively evolving and growing, dozens of new start-ups appear every day. According to the research of many large companies and publishing houses spending on IoT technologies, apps and solutions will reach €250B (\$267B) by 2020.<sup>[13]</sup> These huge numbers show how demanded this market among investors and that in the coming years it will only grow.

The integration of the two concepts (IoT and Home Automation) provide innumerable benefits, which lead to motivation towards this system. Considering the difficulties faced by the senior citizens and taking up issue as the problem statement, this idea was proposed in order to make their lives easier. Along with controlling home appliances, the paper also focuses on surety based door lock system. The appliances as well as the door lock system are controlled by voice commands which are interpreted with the help of google assistant with the help of an application software.

## II. RELATED WORK

Home Automation has been into innovation and development since many years and has gained a lot of importance recently. In alliance with Internet Of Things, it is now possible to regulate devices without being present near them. There have been several new technologies blended with these sub

disciplines in order to get better results and comfort for the user end.<sup>[11]</sup>

Previously several techniques have been implemented using different wireless technologies. One of such systems uses ZigBee technology<sup>[1]</sup>. Zigbee module has a very short range of connectivity. The data speed is lower compared to other wireless communication. Zigbee is not secure like WiFi. It does not have end devices available yet. Set up and maintenance cost is higher and transmission and network stability is low. Thus, Zigbee would not be a good option for Home Automation.

There are systems using Bluetooth technology,<sup>[3]</sup> which is a short-range wireless data network originally proposed as an alternative to the messy tangle of computer accessory wires.<sup>[4]</sup> Although most mobile devices and many PCs today support Bluetooth, the technology comes with a few disadvantages. Bluetooth security is weak compared to Wi-Fi and other wireless data standards. The Bluetooth 4.0 Low Energy standard, at 26 megabits per second, is much faster than Bluetooth used to offer and suitable for occasional syncing and small backup operations. However, conventional Bluetooth is not a substitute for faster technologies such as Wi-Fi and USB. Thus, Bluetooth would not meet the necessary expectations for Home automation.<sup>[2]</sup>

Raspberry Pi is another powerful technology, it can be used to for real-time applications. Everything (both hardware, software and IDE) are open source, but it does have some limitations. It does not replace the users' computer, since the Ethernet is only a 10/100 and the processor is not as fast, it is time consuming to download and install software. It does not support multitasking. It is not compatible with other operating systems such as Windows. There are currently 1.3 billion Windows users around the world. Thus, it is not user-friendly.<sup>[12]</sup> To use the Raspberry Pi, it will take more than just 35 dollars to get it to do what you need through buying extra accessories such as the SD card, USB power supply, keyboard, etc and if you take into account the acquisition cost of the product. Also, it does not prove to be cost effective. It needs additional accessories such as the SD card, USB power supply, keyboard, etc. If Home Automation is implemented using Raspberry Pi, the set-up cost as well as maintenance cost would be quite expensive.

There are some systems which use conventional methods like using interfacing DTMF module or 8051 micro-controller. DTMF module demands phone call to regulate devices. Hence, it is not comprehensible to be used for Home Automation. 8051 is outdated micro controller which is hardly into use. Its a 8 bit micro controller which limits the data to be transferred.

Overcoming the limits of previously defined methods, ESP8226 WiFi module is found to be good enough for incorporating for Home Automation. It is cost effective and has an integrated support for WIFI network. Reduced size of the board makes it compatible and portable for applications demanding mobility. Moreover, energy consumption is very less when compared to other wireless technology. Several technical papers based On IoT and Home Automation show the use of ESP8226 with Arduino UNO.<sup>[5]</sup> But it demands a

micro controller. Hence, NodeMCU has been used in the proposed system. It is a micro controller with ESP8226 module. Thus, it makes the system more compatible by reducing the number of hardware components.

For door lock system, the proposed methods uses an 12V electronic solenoid door lock. If the 12V DC supply is given, then it unlocks and if the supply is turned off, then it locks the door. Instead of having phrases as voice commands for door lock, the user has to spell the password as well. This password can be as long as possible. At the same time, it gives the option for the user set either alphanumeric or numeric password.

Previously defined door lock methods use Web application to check the status of the lock, unlock/lock it. Though it seems to be versatile, it is difficult for set-up. Database is needed to store the password.<sup>[6]</sup> One of the systems have implemented RSA algorithm. It is applied in a novel gesture password electronic lock system, using smartphones as the communication carrier and unlocking device, featuring the strengths of RSA encryption But it limits the range of operation. The lock can be controlled only if the user is near the door.<sup>[7]</sup> Other systems use Block Chain Network, which is quiet efficient, but needs many other modules, like GSM, communication module, sensors and data storage chips increasing the number of components<sup>[8]</sup>.

In the proposed system, the lock can be controlled from any place as long as the smart phone with Google Assistant is connected to internet and the Node MCU is connected to internet. Thus, counter balancing the demerits in the existing systems, the system proposed proves to be a better method for unlocking Door.

### III. METHODOLOGY

#### A. Requirement Specifications

##### 1) Hardware Components:

- i. Node MCU The ESP8266 is a System on a Chip (SoC), manufactured by the Chinese company Espressif. It consists of a 32-bit micro controller unit (MCU) and a Wi-Fi transceiver, as shown in Figure 1.



Fig. 1: Node MCU v1.

It has 11 GPIO pins, and an analog input pins as well. It can be programmed normally like Arduino or any other micro controller. it provides Wi-Fi communication, which can be used to connect to the Wi-Fi network, Internet or host a web server with real web pages. The purpose of the use of Node MCU in the system is to interface the Google Assistant to turn on device. In other

words, the smart phone is connected to the controller in order to switch the state of the device.

ii. DC Solenoid lock

12V Solenoid lock is basically an electronic lock, designed for a basic cabinet, safe or door. It has a slug with a slanted cut and a good mounting bracket, as shown in figure 2 . When 9-12V DC is applied, the slug pulls in so it doesn't stick out and the door can be opened. It does not use any power in this state. It is easy to install for automatic door lock systems like electric door lock, safety locker system.<sup>[4]</sup>

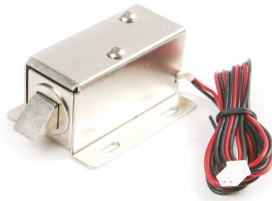


Fig. 2: 12V Solenoid Lock.

iii. 5V relay

5V 4-channel relay module is an interface board where in each channel needs a 15-20 mA driver current. Figure 3 shows the module used in system. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by micro controller.

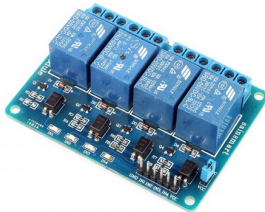


Fig. 3: 5V 4 channel relay module

2) Software Components:

- i. Arduino IDE The Arduino integrated development environment (IDE) is a cross-platform application that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. Node MCU is programmed using this application.

ii. IFTTT

IFTTT stands for If This Then That. With IFTTT, you can connect all your "services" together so that tasks are automatically completed. There are numerous ways you can connect all your services - and the resulting

combinations are called "Applets". An applet is triggered by changes that occur within other web services such as Gmail, Facebook or Telegram.

iii. Blynk

Blynk is a platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet Of Your Things. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

iv. Google Assistant

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. It accepts voice commands from the user and decodes them to perform the corresponding task. As a voice assistant, Google Assistant adds two-way conversation abilities to Google's earlier assistant service, Google Now, which is a web and text-based service. Assistant uses cognitive computing, machine learning and voice recognition technology.

v. Eagle CAD

Eagle CAD is a CAD design software tool by AutoCAD. This software is generally used to manufacture professional PCBs. In this project, Eagle CAD was used to design the Relay Driver circuit and also the power supply unit. The circuit diagram has to be initially created, called the schematics. Once Schematics are done, they are converted to layouts by creating PCB layouts.

## B. System Overview

The system has various modules which are inter-dependent and work in a logically set sequence in order to provide systematic operation of appliances, when needed. There are two basic components of the system- home automation and smart door lock. Figure 4 shows the block diagram of the system.

The controlling component in the setup is Node MCU (version1) which interfaces the commands from Google Assistant to the devices linked with it. The 12V solenoid door lock is controlled by Node MCU, as well. Power supply plays an important role here. The door lock and Node MCU require 12V and 5V DC supply respectively. Relays are connected to turn on devices which work with high current requirements. These relays in turn need 5V for their operation. The instruction given by the user is interpreted by Node MCU through Google Assistant, which then turns the devices on/off through relays. For the door lock system, along

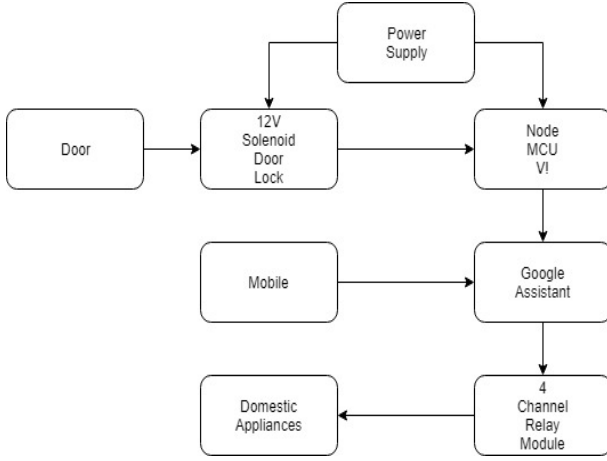


Fig. 4: Block Diagram of the system.

with the phrase or voice command, numeric digit causes the relay to switch its state and give supply to the door lock, which unlocks the door. When the user needs to turn off, the supply to the solenoid is cut off through relay using voice commands.

#### IV. IMPLEMENTATION

##### A. Hardware Implementation

The hardware implementation involves connection of NodeMCU with the relay module. But the power requirements of both the components are different. The output of GPIO pin (which is HIGH) of NodeMCU is 3.3V and the relay module needs 5V to operate. Hence from 3.3V to 5V, the difference is bridged by a self designed power supply implemented using PCB. The output of GPIO pin is connected to the power supply, which in turn is connected to relay module. the relay module is then used to control the domestic appliance.

1) *Power Supply*: The power supply unit for NodeMCU is a 9v supply. This can be provided either by converting 230v AC to 9v DC through Power Supply Unit or it can be powered by connecting the NodeMCU to a battery pack via the micro-USB cable. Figure 5 shows the circuit layout for PCB design implemented using Eagle CA.

2) *Relay Module*: The relay module which controls the AC sockets switching is controlled using the Relay Driver. This needs an input of 9v and has an onboard regulator which regulates the voltage to 5v. The relay module itself is powered by 9v supply which is given to the nodeMCU. The door lock requires 12v DC supply. This has to be provided by an independent source as it is used to control the door lock. This 12v supply is provided by using a 12v 1Ah battery which can easily control the door lock.

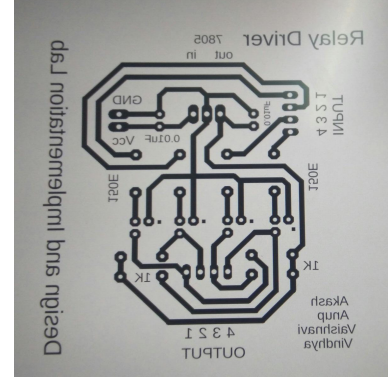


Fig. 5: PCB layout

3) *Node MCU*: NodeMCU is connected to relay driver module which consists of various transistors which can be used to convert 3.3v logic to 5v logic for relay module since relay module works at 5v. This relay driver's output is connected to the relay module which is used to switch on or switch off AC sockets. This is the connection required to make a regular AC socket into a smart IoT controlled socket.

##### B. Software Implementation

The software implementation covers are range of criterion which supports the project system. The two interfaces used were Blynk and the IFTTT. Blynk is an application used for online services and the IFTTT is to modulate the switches of the NodeMCU. The further elaboration individually is given as follows:

1) *Blynk*: Blynk is an android/ ios application which can be used to create IoT projects and link IoT modules to other various online services such as webhooks. First the switches are created in Blynk and the pins are specified. Once this is done, an authentication key is generated. This key is private and confidential. This authentication key is used in the webhooks to control the pins of nodeMCU connected to the internet. Figure 6 and Figure 7 show the the initial setup of Blynk and its interface with ESP8226 respectively.

2) *IFTTT*: IFTTT which stands for "If This Then That" is both a website and a mobile app. The IFTTT is a web based service wherein you can create chains of simple conditional statements called the applets. The proposed system consists of a trigger and an event. The trigger is provided by saying a simple phrase in Google Assistant and the event is provided by linking the Google Assistant to the Webhooks services.

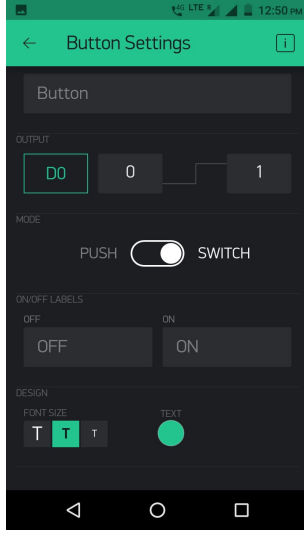


Fig. 6: Initial setup.

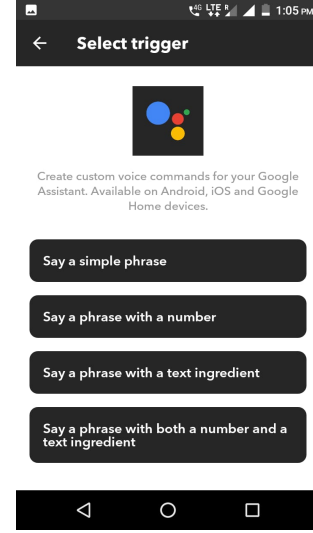


Fig. 8: Google Assistant Initialization.

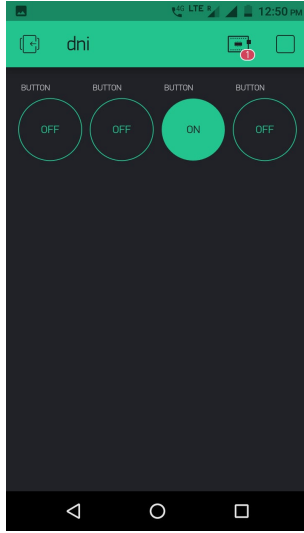


Fig. 7: Blynk Interface



Fig. 9: Voice Command Setup.

The Google Assistant trigger allows one to create a personalized trigger based on a simple phrase. The phrase used must be different for all switches. The trigger is connected to webhooks event. Once this is triggered, a particular URL, consisting of authentication token, present in the webhooks is accessed and the nodeMCU pins output is controlled. The URL is configured during the creation of applet itself. In the proposed system, 8 such applets were created to switch on and off 4 different AC sockets. Figure 8 through 11 show the

sequence of steps taken for setting up the applets to perform the desired action.

### C. Integration of the project modules

The NodeMCU was connected to the relay driver unit. This relay driver unit consisted of 4 inputs and 4 outputs. This was mainly used to convert 3.3v logic to 5v logic, as the NodeMCU runs on 3.3v and the relay module runs on 5v. The main components present in relay driver are resistors,



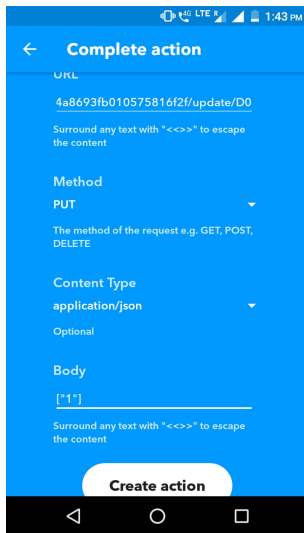


Fig. 10: Creating Action.

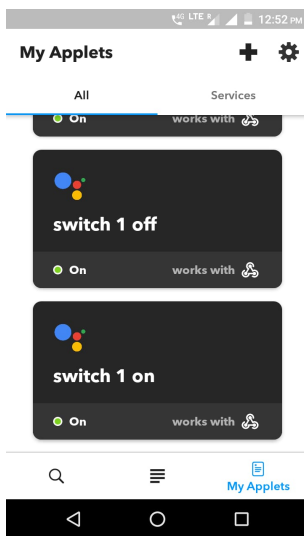


Fig. 11: Designed Applet.

voltage regulator and transistors. The input to relay driver is 9v and the regulator regulates the voltage to 5v suitable for the relay.

The output of relay driver is connected to relay module which has 4 relays. The AC supply is connected in series along with relay as a switch. So, when a device is connected to the socket, the circuit is not completed until the relay connection is not closed. All the relays on board runs at 5v. The input to this module can be either 5v supply from the

relay driver or the 9v supply used by the NodeMCU.

One of the relay input is connected to 12V DC supply and door lock in series. If the relay is activated, 12v is connected to door lock, thus controlling the lock. This relay switching can be controlled through NodeMCU output which is controlled by voice input. This is the basic system integration.

## V. RESULTS AND DISCUSSION

The use of Node MCU in the design was found to be a better option when compared to others existing wireless communication technology. On giving Voice Commands through Google Assistant the devices could be regulated easily without any .Moreover the delay in switching the state of the device from off to on or vice-versa is minimum. Figure 12 shows the working model of the the system. The integrated system was found to give maximum cost efficiency when compared to other methodologies employed previously. Four AC sockets could be converted from regular sockets to voice controlled smart sockets using this method, since four-relay module was used. The design can be extended to more relay switch setup. The main advantage is the cost efficiency and the simplicity of the design. Any regular AC socket can be converted into a voice controlled switch using this method.

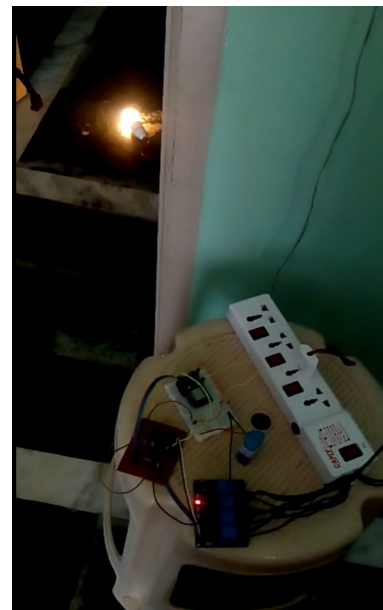


Fig. 12: Working model

## VI. CONCLUSION

Though being a quite efficient system, there is always a further scope in implementation. The project can be further improved by adding various features such as auto switch off features through location detection. These features help save electricity. The other feature which can be added is a mobile notification when an appliance such as geyser is switched on. These appliances are being manufactured with in-built timers

these days, but the existing models can be used efficiently through such smart devices.

This technology can be extended to all the AC sockets in a home. It should be coupled with the mechanical switches to make it more user-friendly. The device can be linked with other smart devices such as Amazon Alexa which can be used to recognize voice commands. An upgraded version of such module linked with AI and machine learning along with voice output is present in Facebook creator, Mark Zuckerberg's home, called Jarvis.

A secured way of accessing the voice controlled interface can be implemented. The voice controlled interface shall be a customised one and built on android platform that is the android studio. The security aspect plays an important role as it restricts the access of the system to the authorized users only, an essential add on to the already efficient system. An authorized personnel with appropriate credentials must be allowed to access the system, an android interface can be the best suitable for the security criteria.

Internet of things, the core of the system strengthens the idea of bringing connectivity and technology into the hands of commoner. In this paper, Home Automation Using Smart Switches and Smart Door lock, with a innovative approach is proposed. The usage of cost effective materials to build the working system makes the proposed method a stand-out. The system makes use of the building topology to construct a logical transition between various appliances and widgets.

#### REFERENCES

- [1] Interactive Voice-Controller Applied to Home Automation by Jinn-Kwei Guo, ChunLin Lu\*, Ju-Yun Chang, Yi-Jing Li, Ya-Chi Huang, Fu-Jiun Lu and Ching-Wen Hsu
- [2] Voice Control of Home Appliances using Android by Norhafizah bt Aripin, M. B. Othman.
- [3] A Bluetooth Based Sophisticated Home Automation System Using Smartphone by Sukhen Das, Sanjoy Ganguly, Souvik Ghosh, Rishiraj Sarker, Debaparna Sengupta.
- [4] Mobile based Home Automation using Internet of Things (IoT) by Kumar Mandula, Ramu Parupalli, CH.A.S. Murty, E. Magesh, Rutul Lunagariya.
- [5] Home Automation Using Internet of Thing by Shopan Dey, Ayon Roy.
- [6] Door Lock System via Web Application by Charoen Vongchumyen, Pakorn Watanachaturaporn, Chompoonuch Jinjakam, Akkradach Watcharapupong, Watjanapong Kasemsiri, Kiatnarong Tongprasert, Aranya Walairacht .
- [7] Development of Electronic Locks Using Gesture Password of Smartphone Base on RSA Algorithm by Chin-Tan Lee\*, Yi-Chin Chung, Tung-Chun Shen and Ko-Wei Weng.
- [8] Blockchain based Smart Door Lock system by Donhee Han, Hongjin Kim, Juwook Jang.
- [9] <https://www.enocean.com/en/internet-of-things-applications/smart-home-and-home-automation/>
- [10] <https://circuits4you.com/2016/05/19/iot-based-home-automation-project/>
- [11] <https://www.directenergy.com/blog/smart-home-technology-senior-citizens/>
- [12] <https://sites.google.com/site/mis237groupprojectraspberrypi/home/what-is-raspberry-pi/pros-and-cons-of-the-raspberry-pi>
- [13] <https://www.quora.com/What-is-the-future-of-IOT-in-India>