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Machine Learning Trained Edge Computing Device for PhysicallyDisabled

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Abstract. Biomedical devices play a crucial role in community as these are revolutionizing with breath taking approach in both the medication and the exposure of many diseases. The paper aims to Design edge-based home automation using ESP-32 for Physically Disabled People. Edge computing is an applicable manner to meet the immense estimation and flat-dormancy conditions of deep learning on edge devices and implements increased interests in isolation, bandwidth efficiency, and expandability. ESP-32 receives data from the sound sensor and recognizes the voice command which is already trained and trigger the relay. Automated system using ESP-32 with voice command controls the home appliances. The paper mainly focuses on disabled people to facilitate integrated system that is easy–to–use using Machine learning Technique. The home automation system allows one to control household appliance centralize wireless control unit. This paper aims to control home appliances with user handy, economical, effort less installation for Physically disabled people.

Keywords: Deep Learning, ESP-32, Home Automation, Supervised Machine Learning.

1 INTRODUCTION

Deep learning in a short time ago been profoundly outstanding in machine learning over a range of utilization domains, together with natural language processing, computer vision, and immense info studies, amid others. To illustrate, the new improvement of sensors and camera in a bold in New York City provoke sincere interest from privacy auditor [1]. Edge computing is a workable explanation to encounter the inactivity, expandability as well as isolation objections. It's, a rare number of computing resources contribute computational skills close to the edge devices [2]. Edge computing technique is previously being expand by countless industries; for example, a dominant fundamental Internet service worker in the US along with nationalist fast-food string have one and another already setup by edge computing proximity [3],[4]. The main reason behind developing this kind of device is to save human time and manpower. Nowadays, everyone wishes to complete their work as quickly as it can be with the least amount of time. It is easily fulfilled by converting their normal homes into a very well-designed home automation system. Due to advancement in electronic technologies, the field of home automation is rapidly increasing and making their life easy.

2. METHODOLOGY

Home automation makes home more customized, comfortable, efficient, and riskless. Machine learning is appreciable for Problems for which the present solution depends up on a lot of fine adjustment or long details of rules: one Machine Learning design can often clarify code and perform better than the traditional approach. The applications of Machine Learning are 1) Analyzing images of products 2) Detecting tumors in brain scans 3) Automatically classify news articles.

2.1 Deep Learning:

This model is areflection of a mixture of biases and weights [5]. These are diversified by an expansion function (ADAM [6]) based on atarget function that measures the diviningskill of the model. Depending on the guidance period various learning techniques.

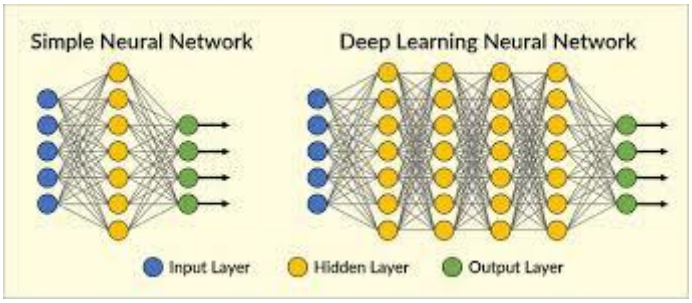

Fig. 1. Deep Learning Neural Network

A deep neural network (DNN) [7] shown in Fig.1. is an ANN (artificial neural network) with mass figure of course among the incoming and outgoing functions.

2.2 Supervised Machine Learning:

In this sort of machine learning, the training data given to the machines work because the supervisor that teaches the machines to forecast the output accurately. Supervised learning may be a course of providing input file also as correct output data to the machine learning model.

Edge machine Learning shift aloof from spread DNN coaching in information. In information centers, mass trainings is dead on the far side alternative employees, with specific employee claiming or a separation of the model (called as model parallelism) or a partition of set (known as data parallelism). During both the system designs are correctly analyzed, parallelism data is mostly recycled in functional systems [10] and is the destination of the rest of this field. In knowledge correspondence, entity workers discover the ascend of their provincial separation of the data set, that is then possessed by a basic framework server, a few assortments estimation performed so the updates issued come behind to the employees.For example, Deep Cham [11] consists of a master edge server that convoy domain-aware perception and faces perception on finish accessories, exploiting the vision that users linked to the equal edge server could have identical domains.

2.3 Programming Languages:

Python is a compiled programming language that uses friendly and modern scripting syntax. Designed in such a way that almost human-level readability, the scripting nature of Python enables the programmers and coders to test their hypothesis and run their algorithms very quickly. This is the reason why structural programming languages like C++, Java, Perl, and that require hard coding are not commonly favored for Machine Learning. To summarize, whether coding beginner or an experienced programmer, lot of time has to be spent for learning Python, which is very ideal for performing a multiplex set of Machine Learning tasks. All of the reasons make Python a very important language to use in machine learning tasks.

2.4 Deep Learning Platform

Google Collaboratory or Colab is a Google Research product. It is a machine learning product which allows anyone to write and execute python program through web browser.Colab notebooks are Jupyter notebooks. Jupyter may be a browser-based and ASCII text file tool that combines libraries taken languages and appliances for visual image[12]. Using this type of automation makes it obvious to duplicate and share mathematical works since the measures and conclusions area unit given in an exceedingly self-reliantstyle [13]. Google Collaboratory provides zero configuration, easy sharing and free access to GPUs. Google Collaboratory has the intention of research and propagate machine learning literacy [14].

3. Simulation Result

3.1 Training &ExperimentingData for ON & OFF Command:

The following picture describes how the data is trained. 64 samples of each voice command have taken, and the values are in the form of CSV (commonly separated values). To get these values one need to speak our voice command into the sound sensor multiple times. However, during result pronunciations do matter a lot. In the below Fig. 2. trained data for voice command ON is taken.

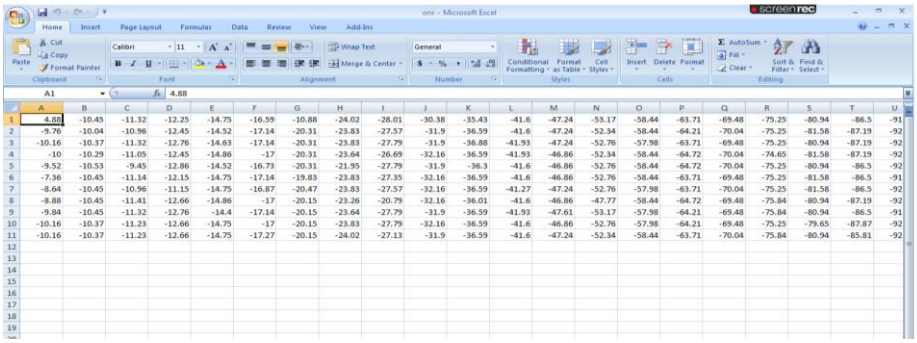

Fig. 2. Training data values for the ON command

The below Fig.3. represents the output while experimenting the voice command. During experimenting the output is shown for the voice command ON.

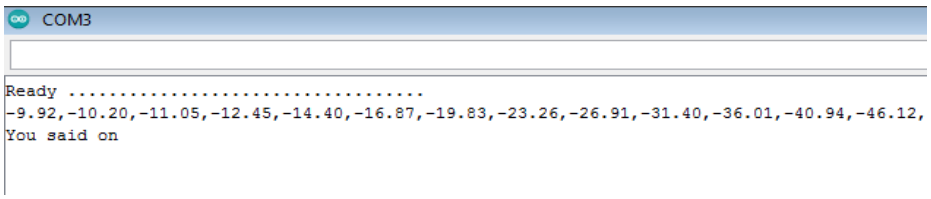

Fig. 3. Experimenting the ON command

Let us see all the training and experimenting results of all the voice commands used in this project.These values are for the OFF-voice command; 64 samples are taken at a time and more than 10 samples of each voice command shown in Fig.4.

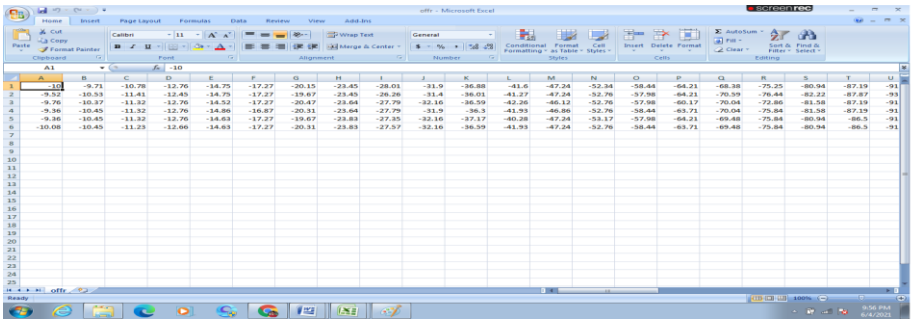

Fig. 4. Training Value for the OFF command

The below Fig.5. represent the output while experimenting the voice command. During experimenting the output is shown for the voice command OFF.

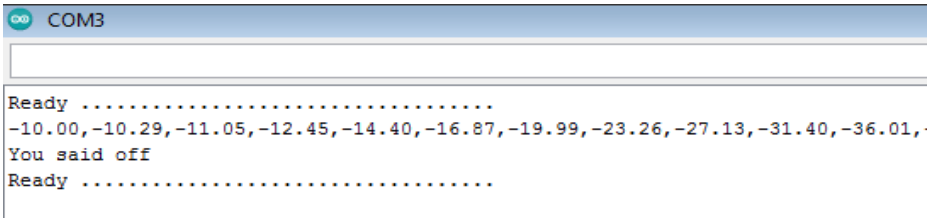

Fig. 5. Experimenting OFF command

3.2 Training Data and Experimenting for Variegated Colorant Voice Commands for distinct application

These values are for RED voice command shown in Fig.6; 64 samples are taken at a time and more than 10 samples of each voice command.

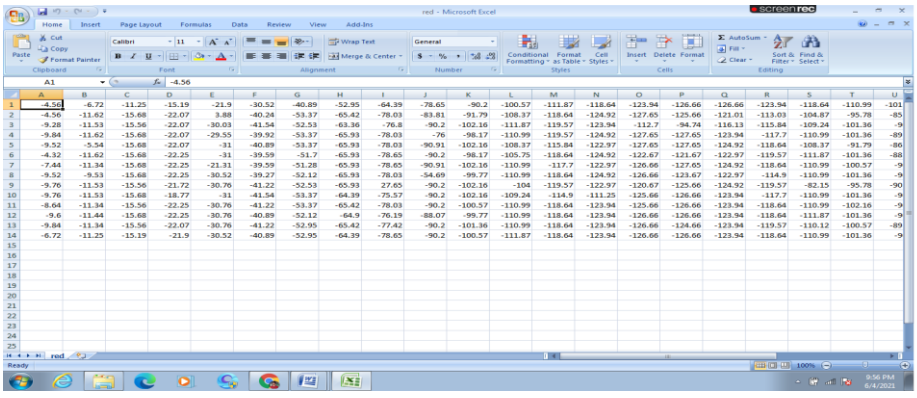

Fig. 6. Training Value for the Red command

The below Fig.7. represents the output while experimenting the voice command. During experimenting the output for the voice command RED.

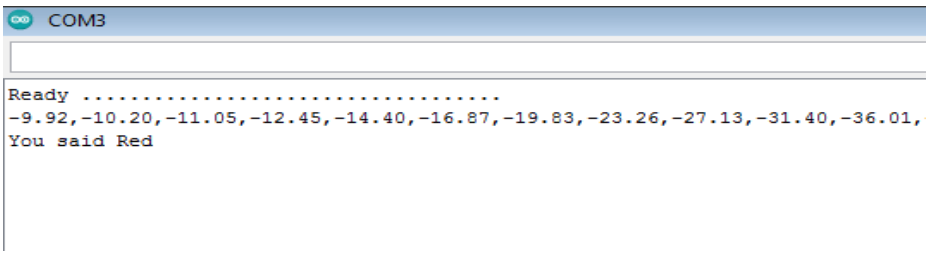

Fig. 7. Experimenting RED command

These values are generated for the YELLOW voice command shown in Fig.8.; 64 samples are taken at a time and more than 10 samples of each voice command.

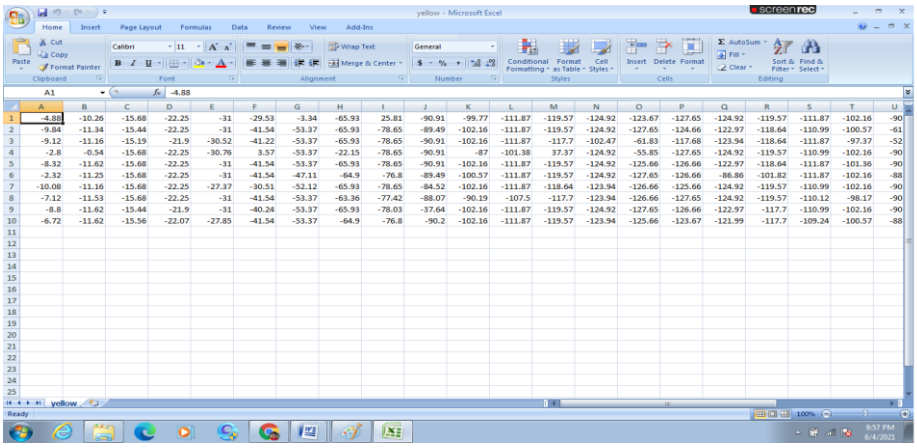

Fig. 8. Training Value for Yellow command

These values are for YELLOW voice command, 64 samples at a time and more than 10 samples of each voice command shown in Fig.9.

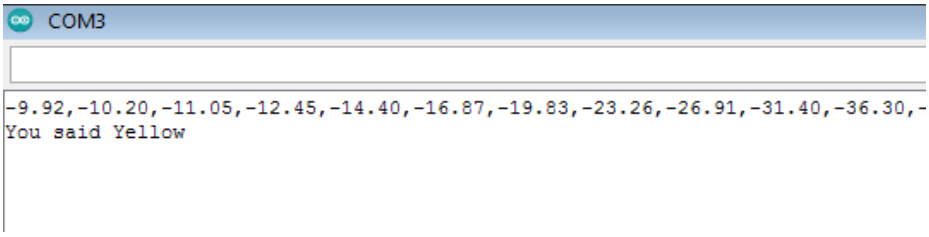

Fig. 9. Experimenting the Yellow command

4. PROPOSED SYSTEM

The Sound sensor attached to the ESP32 takes input commands and correspondingly send them to ESP32. When a command pass, to turn ON a bulb through the sound sensor, the data is relayed to the ESP32 and its GPIO pin turn ON a relay. The system in forward state updates the serial monitor on the command given whether it is ON/OFF then it functions according to the respected voice command. The hardware design of the voiced based home automation system consists of Relay alongside the ESP32 circuit card. The appliance is connected to the Relay and therefore the relay connected with ESP32.The appliance can be of either kind but in this project, RGB LED bulb is used.Hardware for voiced based home automation system are ESP32, Sound sensor, Relay, Laptop and Bulb.ESP32 comes with a GPIO pin that is a connector to electronic devices. It acts as a CPU for the entire systemand it is provided with an audio input through the sound sensor.

The software design of the system focuses on how to control the system through a voice that would enable home device such as bulb with intention in mind that it should be very helpful to physically disabled people. The system runs perfectly as the input data is already trained using supervised learning techniques so there is no problem in working. Although everything seems to be fine still there is a minor problem using this device and that is pronunciation matters a

lot. Users need to pass the exact level of voice command which he/she delivered during the training. Then the only system recognizes the command and function accordingly. In this proposed home automation system specially designed RGB LED bulb is used that changes the color in a sequence and depending on this sequence voice commands are arranged. The flow chart given below Fig.10. explains the order need to be followed.

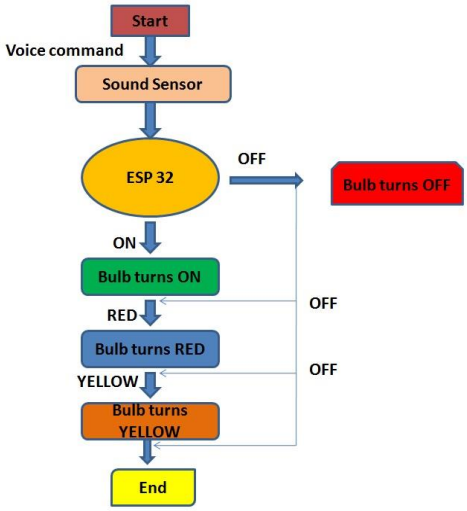

Fig.10. Proposed System Flow Chart Representation for different colorant applications

The system is in Automatic mode. When the user wants to function automatically, first the voice command should be "ON" ESP32 recognizes the command as it is already trained, and it turns on the bulb. Then the next command needs to be OFF, and the bulb gets OFF. Now the voice command should be RED the bulb turn to RED color and then the next voice command should be OFF, and then the voice command should yellow and at last voice command should be OFF. In this pattern, the voice commands are given to the device. The Overall system is shown in Fig.11.

If any changes made in voice command order, then the bulb will not function. The flow chart given below describes in detail how to pass the voice commands. The working of the project depends on training and experimenting. Let us understand how the data is being trained. To train the data sound sensor will be commanded multiple times.

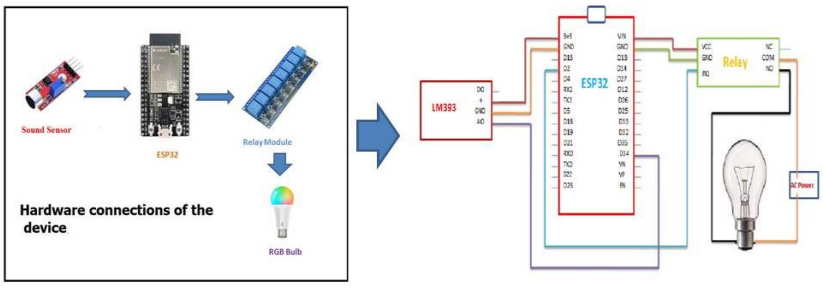

Fig. 11. Overall System Design

The values received should be collected in the form of an excel sheet and this can be done by renaming the notepad file with (command name.CSV). In this project, it has been trained four voice commands, so four datasets folder with respect to their command names are made. For example, our first voice command is ON so our folder name should be (ON.CSV). Then using the Google Collaboratory platform, it is executed in python code with four datasets and the output received by this is considered as header file.

Then header file is created for the model and executed interfacing code along with the header file to test the device. Now when the command ON is passed, the command gets recognize as it is stored, and the command is displayed as ON. Similarly, the remaining commands will also be displayed according to the data.

In this project by connecting the relay to the ESP32and programmed in such a way that when the user passes the colorant variegated commands like ON, RED and YELLOW relay get triggered HIGH and similarly when the user passes the command such as of the relay triggered LOW.

As already mentioned, the user needs to pass the commands provided in the flow chart for proper functioning of the device. In this model everything is automated, easy to use, controlled by Voice command, no extra application is required, and controlling system can be changed as per requirement. It is easily understanding as it works on ESP-32, saves time. Any home appliance can be controlled, easy installation and user friendly.

5. VALIDATING THE EXPERIMENTATION RESULTS

Screenshots of the output shown in Fig.12. When a user says ON. Serial Monitor display "You said ON" and Relay get triggered.

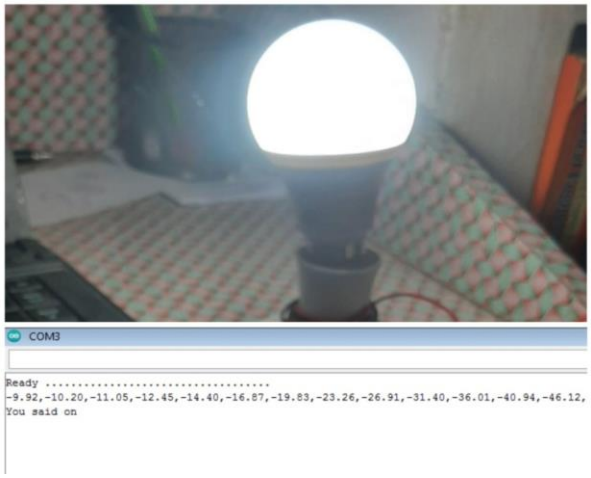

Fig. 12. Validation on the Experimented data for 'ON' Command

When a user says OFF. Serial Monitor display "You said OFF" and LED gets off as shown in Fig.13.

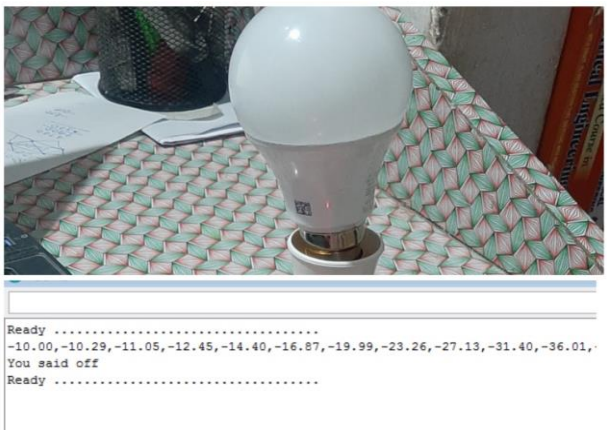

Fig. 13. Validation on the Experimented data for 'OFF' Command

Similarly, Color Changing Command as follows.

When user says RED, Serial Monitor display "You said RED" and LED turned to RED as shown in Fig.14.

Fig.14.. Validation on the Experimented data for 'RED(COLORANT)' Command

When user says YELLOW. Serial Monitor display "you said YELLOW" and LED turned to YELLOW as shown in Fig.15.

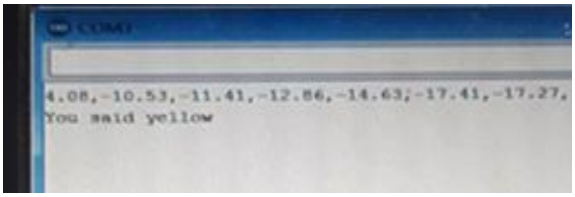

Fig. 15. Training Validation VALUES for Colorant

Screenshot of the parallel voice commands to turn ON and OFF the LED bulb as shown in Fig.16.

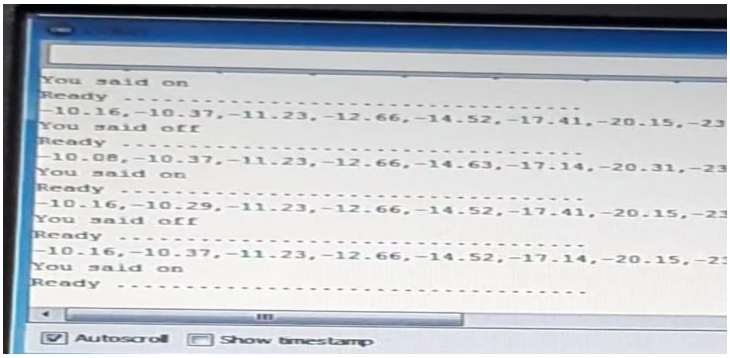

Fig. 16. ParallelVariegated Colorant Voice Commands for use of distinct application

6. CONCLUSION

The main aim of this project is to style a system that it can produce maximum output with minimum complexity for Physically disabled using Deep Learning Techniques. Trained voice-controlled home appliances are made to scale back human efforts. It'll be helpful for physically challenged people to command with their voice only.There are some issue's that arises when using this technique, that is pronunciation. The system takes it at quite high level of sensitivity. So, whenever the user wants to use the system, thus it must produce the word with the right pronunciation in the training period. The training done by the set of values is one of the most challenging criteria for correct authentication to enable the output for aoutcome.

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