

TEKNOFEST
AEROSPACE AND TECHNOLOGY FESTIVAL
ARTIFICIAL INTELLIGENCE IN HEALTHCARE
COMPETITION

(Category of Medical Technologies)

Project topic

Orthotics and prosthetic technologies

PROJECT DETAIL REPORT

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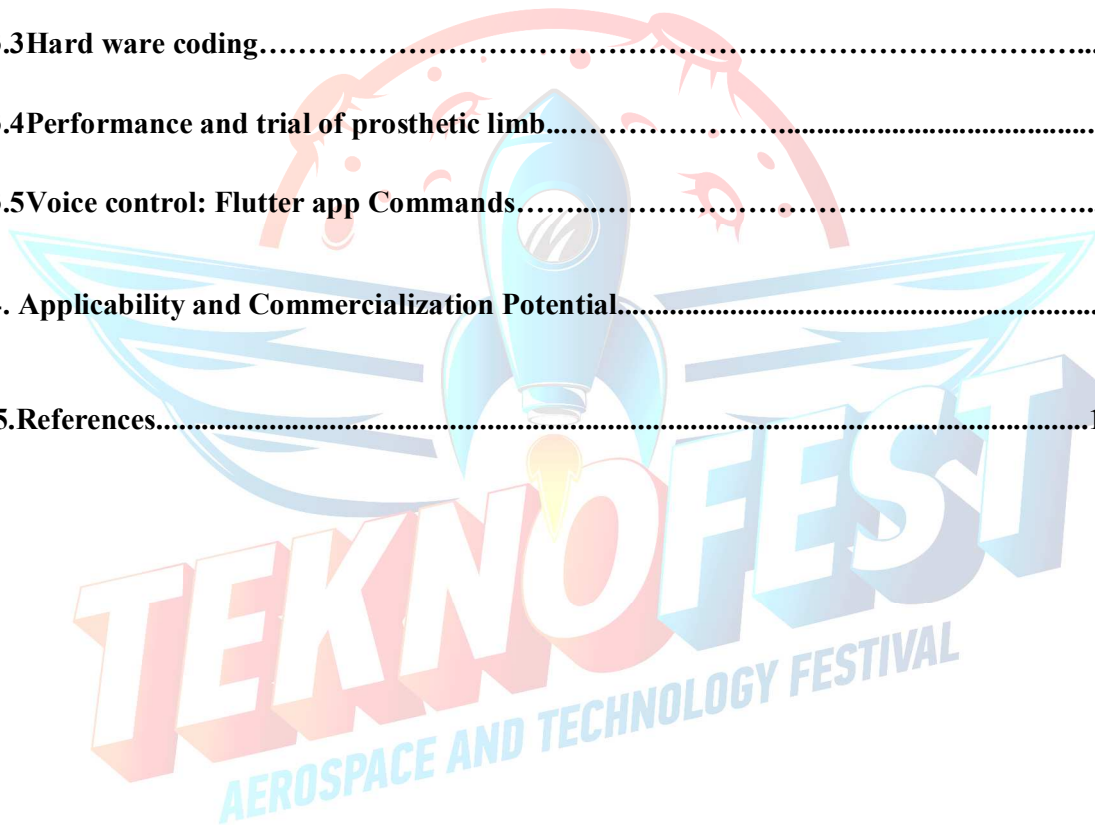
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**PROJECT NAME: Voice controlled Prosthetic hand for
quadroplegics**

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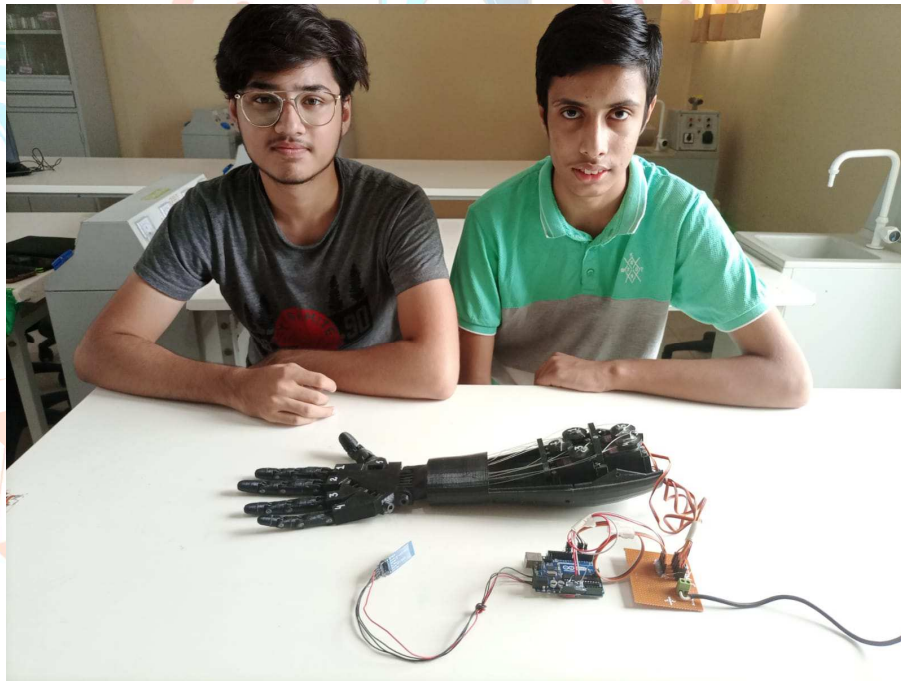
Project topic

☐ Orthotics and prosthetic technologies

1. Problem Description and Current Situation Assessment

Many people are suffering disabilities in upper body parts. Voice-controlled methods allow direct communication between the user and machine. Disable person may use this technology to improve their independence and maximize their capabilities.

The study aims to design a hybrid prototype of prosthetic hand controlled by voice that works on voice-controlled techniques. The prosthetic hand is designed on a 3D modeling software SOLIDWORKS and analysis is done using ANSYS. The design will be fabricated using suitable materials and a modern manufacturing tool known as additive manufacturing, which will then be actuated by servo motors that are controlled by a microcontroller.



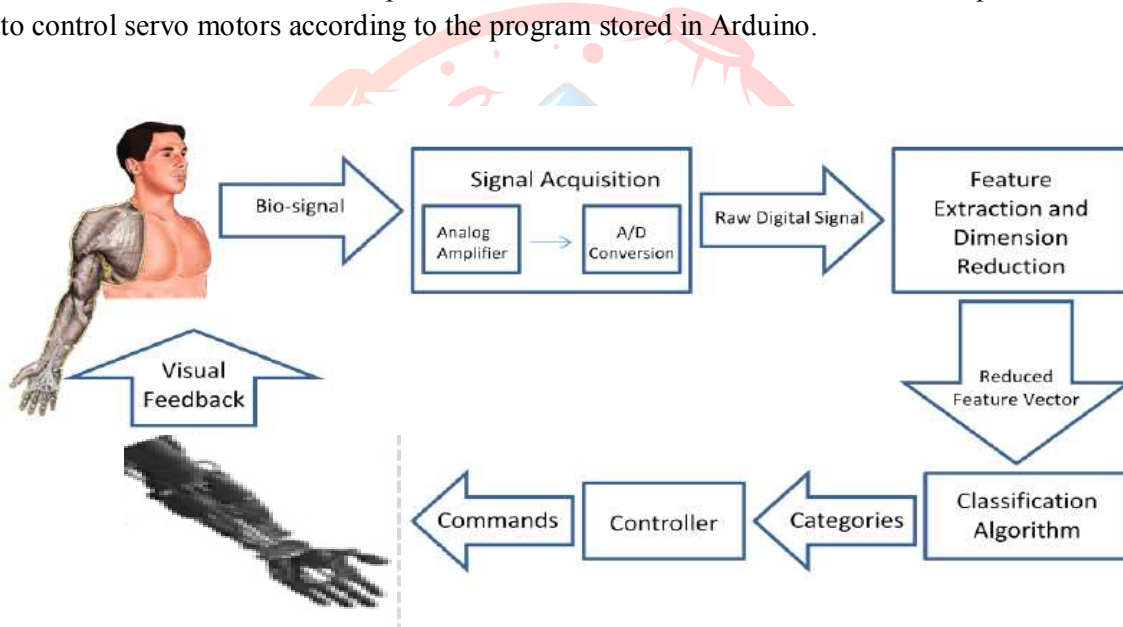
2. Originality

Many people are suffering from amputations and natural disabilities in upper body parts. For such people, they lose their mobility and the ability to manage daily activities as, disabled persons surely need some assistance for doing their daily tasks and to perform their daily routine chores.

When an arm is amputated or lost, a prosthetic device can play an important role in rehabilitation. An artificial limb can improve mobility and the ability to manage daily activities, as well as provide the means to stay independent. When we look at the early prosthetics, they are very simple and immovable like metal hook, wooden shaft and pegs but their appearances are very different from the human hand. Later on, there is some advancement on both function and appearance. As technology improved the hand is powered through electrical and pneumatic means.

The voice control is used in which prosthetics are interfaced with computer and operated using voice commands. In this project voice control is used to control the movements of prosthetic hand.

Voice control: Flutter app assistant feature of transcription is used. Speech coding is being done on DART. When the user speaks the word, it is transcribed then this transcription is used to control servo motors according to the program stored in Arduino.



The initial goal of this project is to make a cost effective and domestically applicable prosthetic hand. The working on 3D printed prosthesis is done very rapidly in the world and many advancements have been made in this field.

Due to the limitations and complexity of EMG-based hand prostheses, we decided to explore the option of a much simpler approach based on voice control. Assuming that the subject does not have any speech impairment, voice commands are much easier to interpret than the EMG signals to control the prosthetic hand. Therefore, the first and foremost advantage of this approach is that the associated prosthesis is extremely comfortable and easy to use, and there is no pain or fatigue involved in its use.

Further advantages of the voice-controlled prosthetic hand designs are:

- 1) simple to use and so that its more energy efficient.
- 2) It has simple fitting of the hand, as there is no need to place EMG electrodes on the skin.
- 3) No need to train the user, allowing for a faster adaption time.

Anthropomorphic motion of this prototype using voice-controlled techniques have been successfully achieved.



This concept has great potential for improving the function of people with upper limb amputations, especially for high-level amputations, in which the disability is greatest. It hoped that future research will develop the technique further and build synergistically with other exciting research areas.

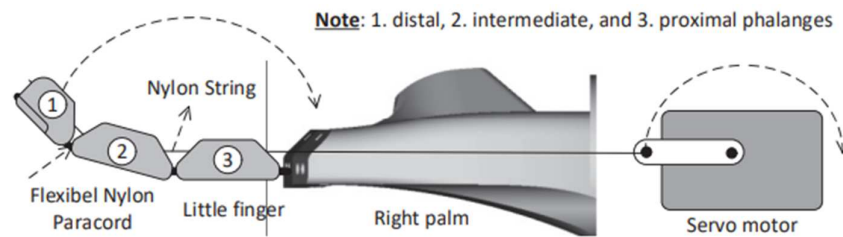
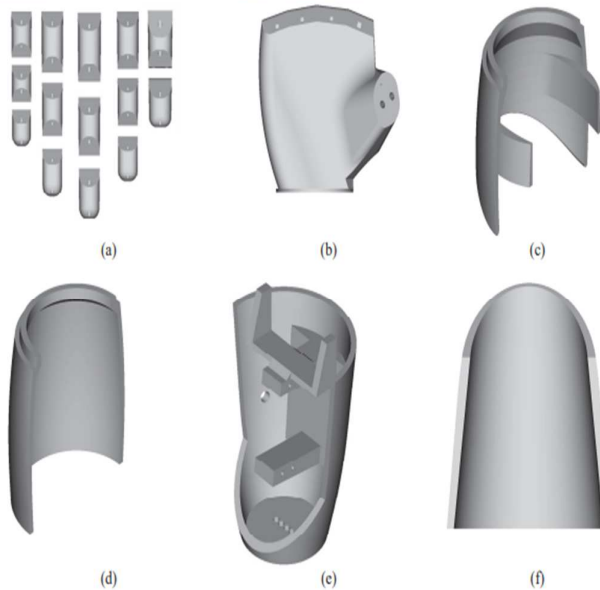
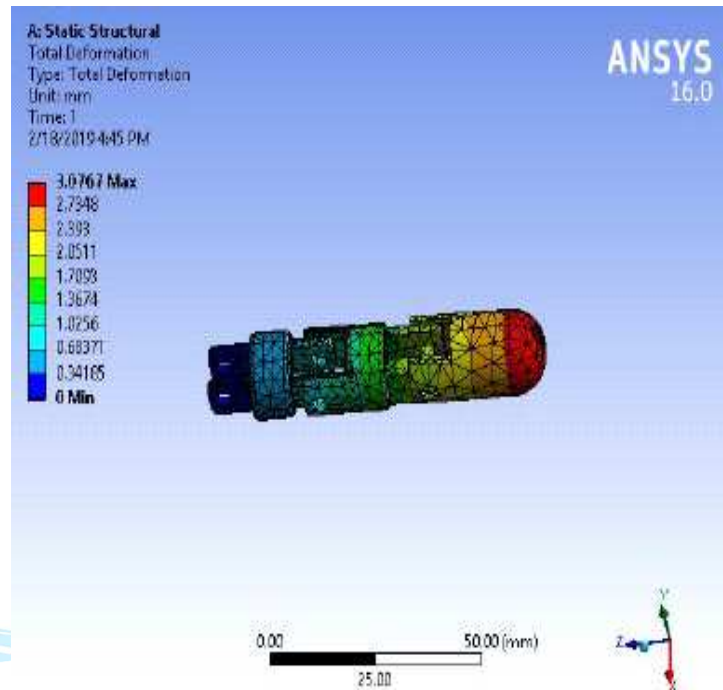
3. Method

Voice Sensor Prosthesis Control: Prosthetic arm/hand can be controlled by user in the form of voice commands. Microphone is used to record the voice commands. The embedded system is connected to microphone. Voice commands are converted into text using Flutter app with the help of (controller) and with the pre-recorded commands this text is compare. There is a continue feedback goes to the embedded system regarding the current position of servo motors.

Purpose is to send the voice signals to servo motors. This obtained by using a Bluetooth module.

Voice control method works with the Flutter app assistant feature and signal are sent to Arduino through HC-06 Bluetooth module. Arduino contains the program for the signal processing and according to this program the servo motors rotates. The rotation of these servo motors causes the movement of hand (open and close). The model of this 3d printed robotic hand is made on SOLIDWORKS 2017 and the analysis is done using ANSYS printed by slicer.

Different parts of 3D printing design of limb



Sr.No	Parts of 3D Printing	Time	Weight of pieces in grams
1	Fingers	3 hours	50
2	Palm of hand	6 hours	110
3	Wrist part lower	5 hours	70
4	Wrist part upper	5 hours	65

Voice control: Flutter app feature of transcription is used. When the user speaks the word, it is transcribed then this transcription is used to control servo motors according to the

Voice control method works with the Flutter app feature and signal are sent to Arduino through HC-05 Bluetooth module. Arduino contains the program for the signal processing and according to this program the servo motors rotates. The rotation of these servo motors causes the movement of hand (grasp or release).

Voice Control Method

Flutter app /cell phone is used for voice control. Flutter app scribes the word which someone speaks. This transcription is used to control the prosthetic hand. When a person speaks “OPEN” the transcription of word is fed into Arduino through HC-05 Bluetooth module which is further used for the closing of hand. Similarly, when a person speaks “CLOSE” the hand opens.

HC-05 Bluetooth Module

HC-05 Bluetooth module is used by android app to transmit transcribed word to Arduino.

Performance and trial of prosthetic limb:

The weight of this prosthetic hand is 678 grams. This can hold weight up to 3 Kgs. We had undergone trials of picking up different things in daily routine. It can pick up light and big objects in size like apple, bottle, and Mobile phone etc.

But it cannot perform precise functions like holding spoon and fork.

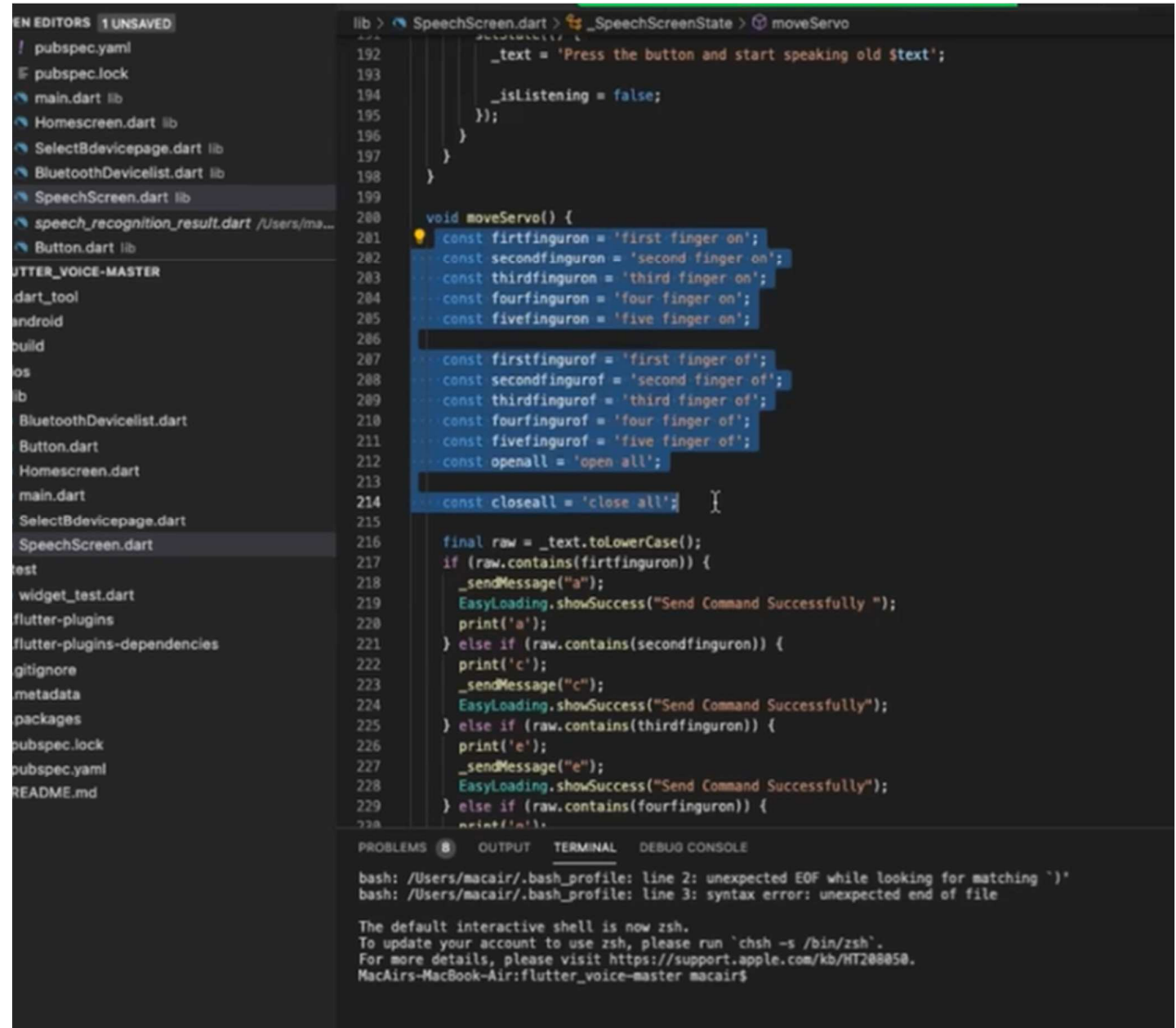
This developing of prosthetic hand can be very much helpful to amputee to perform daily tasks

Level of different environment condition		Level(db.)
1	Whispered voices	20-30
2	Urban Area	40-60
3	Average conversation	60-65
4	Low traffic street	60-80

Hard ware coding

```
if (value == "Open"){
    for (pos = 180; pos >=0; pos -= 1) {
        b.write(pos);
        delay(5);
    }
    for (pos = 180; pos >=0; pos -= 1) {
        a.write(pos);
        delay(15);
    }
    for (pos =80; pos >=0; pos -= 1) {
        c.write(pos);
        delay(5);
    }
}
if (value == "close"){
    for (pos = 0; pos <= 180; pos += 1) {
        // from 0 degrees to 180 degrees
        a.write(pos);
        delay(15);
        // tell servo to go to position in variable 'pos'
        //wait 15ms
    }
    for (pos = 0; pos <= 180; pos += 1) {
        b.write(pos);
        delay(15);
        // waits 15ms
    }
    for (pos = 0; pos <=80; pos+= 1) {
        c.write(pos);
        delay(5);
    }
}
```


Voice control: Flutter app Commands



```
lib > SpeechScreen.dart > _SpeechScreenState > moveServo
212     _text = 'Press the button and start speaking old $text';
213     _islistening = false;
214   });
215 }
216 }
217
218 void moveServo() {
219   const firtfinguron = 'first finger on';
220   const secondfinguron = 'second finger on';
221   const thirdfinguron = 'third finger on';
222   const fourfinguron = 'four finger on';
223   const fivefinguron = 'five finger on';
224
225   const firstfingurof = 'first finger of';
226   const secondfingurof = 'second finger of';
227   const thirdfingurof = 'third finger of';
228   const fourfingurof = 'four finger of';
229   const fivefingurof = 'five finger of';
230   const openall = 'open all';
231   const closeall = 'close all';
232
233   final raw = _text.toLowerCase();
234   if (raw.contains(firtfinguron)) {
235     _sendMessage("a");
236     EasyLoading.showSuccess("Send Command Successfully ");
237     print('a');
238   } else if (raw.contains(secondfinguron)) {
239     print('c');
240     _sendMessage("c");
241     EasyLoading.showSuccess("Send Command Successfully");
242   } else if (raw.contains(thirdfinguron)) {
243     print('e');
244     _sendMessage("e");
245     EasyLoading.showSuccess("Send Command Successfully");
246   } else if (raw.contains(fourfinguron)) {
247     print('n');
248   }
249 }
```

PROBLEMS OUTPUT TERMINAL DEBUG CONSOLE

```
bash: /Users/macair/.bash_profile: line 2: unexpected EOF while looking for matching `)'
bash: /Users/macair/.bash_profile: line 3: syntax error: unexpected end of file

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
MacAirs-MacBook-Air:flutter_voice-master macair$
```

4. Applicability and Commercialization Potential

The initial goal of this project is to make a cost effective and domestically applicable prosthetic hand. The working on 3D printed prosthesis is done very rapidly in the world and many advancements have been made in this field. At this point, we would like to reiterate the advantages of our voice-controlled prosthetic hand design in comparison with the EMG interpretation-based hand prostheses that are widely available on the market today. As there is no pain or fatigue involved during its use, our design is extremely comfortable and easy to use. All the user needs to do is to utter the voice command associated with the desired task. As such, there is no risk of doing a wrong or unintended operation. If the uttered voice command is not recognized by the controller due to noise problems, for instance, the prosthetic hand will simply perform no action.

Further advantages of our approach can be summarized as:

- 1) simple to use and so that its more energy efficient.
- 2) It has simple fitting of the hand, as there is no need to place EMG electrodes on the skin.
- 3) No need to train the user, allowing for a faster adaption time.

Other considerations taken during the design process were to design a hand that resembles the human hand; the size should be similar and light, not too bulky, and the overall cost should be low. The prosthetic arm is tested on different weights and respective response time. Response time is time taken to pick the weight from one fix position and place it to another fixed position, Further; the recognition success rate for different voice commands is calculated at different environments. Afterwards, it is concluded that 88.8% of success rate can be achieved in noiseless environment through this system. Working non-arm patients in service sector such as patient who has no arm can observe the system which should be monitored and if necessary he/she can stop the system with the “stop the system” command.



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