Concept Generation

This section contains the medium and high-fidelity ideas created during the concept generation phase of this project. Concepts one through five are medium fidelity ideas, while concepts six to eight are high-fidelity ideas. The full catalogue of 100 concepts can be seen in Appendix D.

Concept 1.

Based on concept 34 in Appendix D - This concept is a mobile air purifier. The air purifier is mounted to a cart so it can be moved to different locations in the FAMU-FSU College of Engineering. The purifier will contain 3 different filters. The first will be a pre-filter, the second filter is to trap particulates with diameters of 10 microns or larger, the third filter has finest mesh to trap even smaller pathogens. A sketch of the concept can be seen in Figure 3.

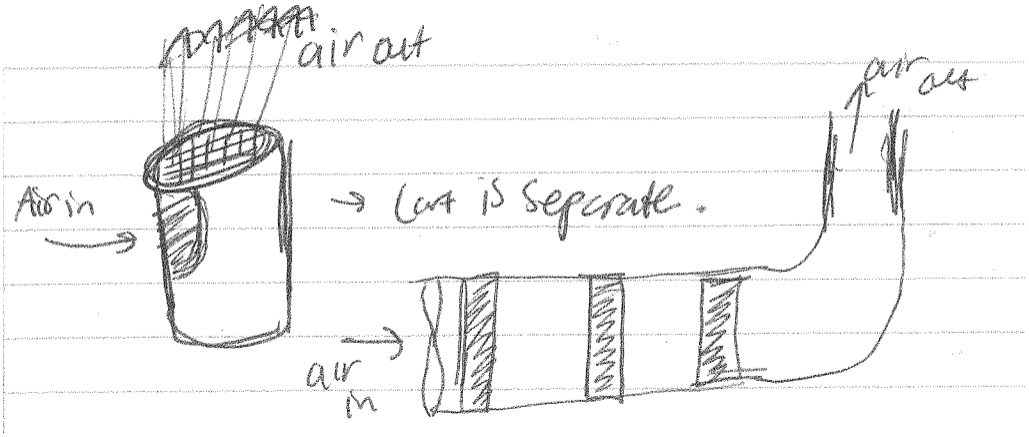

Figure 1. Mobile air purifier

Concept 2.

Based on concept 36 in Appendix D - This concept is a stationary air purifier that is modelled after a tree. It has multiple inlets for air to enter the purifier and filters placed at each inlet. It will be around 5 ft in height and is designed to purify the air in a large room, such as the

atrium in the FAMU-FSU College of Engineering. Since this concept is stationary, it will be powered by mains electricity. A sketch of the concept can be seen in Figure 4.

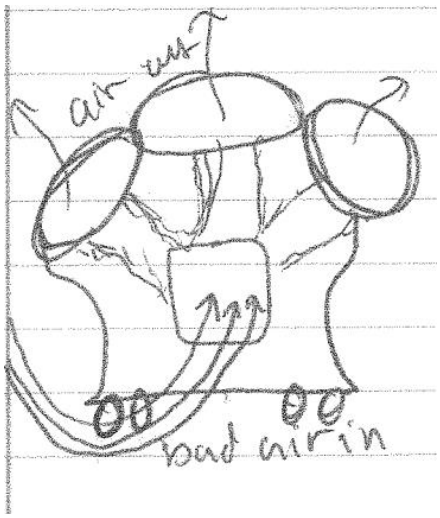

Figure 2. Air Purifier modelled after a tree

Concept 3.

Based on concept 46 in Appendix D - This concept is an air purifier which attracts air through a rotating outer capsule and then uses the air's velocity to push it through multiple filters. The purifier will contain 3 different filters. The first will be a pre-filter, the second will be a sanitizing filter to kill pathogens, and the third filter will have a very fine mesh to trap small particulates and dead pathogens. A sketch of the concept can be seen in Figure 5.

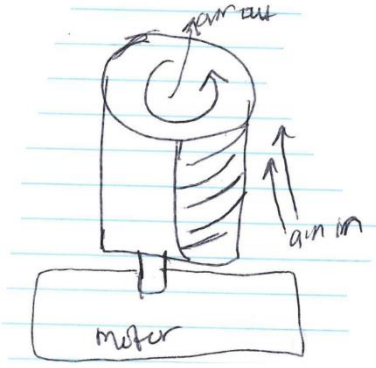

Figure 3. Rotating air purifier

Concept 4.

Based on concept 47 in Appendix D - This concept is a tabletop air purifier that can moved and placed in different parts of a room. The air quality entering the device will be monitored by a series of sensors. These sensors will send signals to external lights indicating the quality of the air passing through. Green lights will indicate good quality air, yellow lights will indicate moderate air quality, and red lights will indicate bad air quality. The device will be powered by an external battery pack so that it does not need to be placed near an outlet. The purifier will consist of multiple filters to filter particulates and pathogens of different types and sizes. A sketch of the concept can be seen in Figure 6.

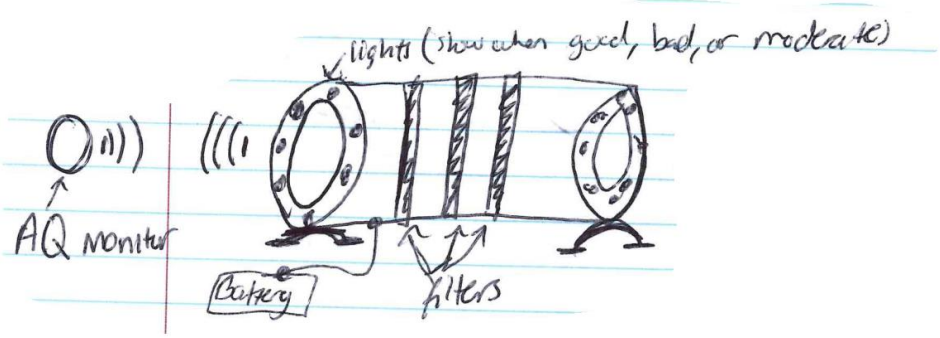

Figure 4. Air purifier with external lights to indicate air quality

Concept 5.

Based on concept 38 in Appendix D - This concept is an air purifier placed on a cart. This will allow the air purifier to be moved and located in different parts of a room. However, the air purifier will be powered by mains electricity, so the cart will need to be placed near an outlet. The purifier will have a mesh grid top, this is where air will be sucked in. The device will contain multiple filters to trap particulates in addition to a UV light that will be used to kill pathogens and sanitize the air. A sketch of the concept can be seen in Figure 7.

Figure 5. Air purifier with UV light and filters

Concept 6.

Based on concept 13 in Appendix D - A single cart containing multiple sensors to measure CO_2, particulates, mold spores, and other gasses. The data gathered by the sensors will be sent to a software program which will store and analyze the information. If air is deemed to be subpar quality by the sensors and software, devices to clean the air will be triggered. For air cleaning purposes, the cart will contain a humidifier and air purifier along with fans to promote air circulation. This cart will be mobile, allowing it to be moved to different locations within the FAMU-FSU College of Engineering to collect data and improve air quality. All devices on the cart will be battery powered. A drawing of this concept can be seen in Figure 8.

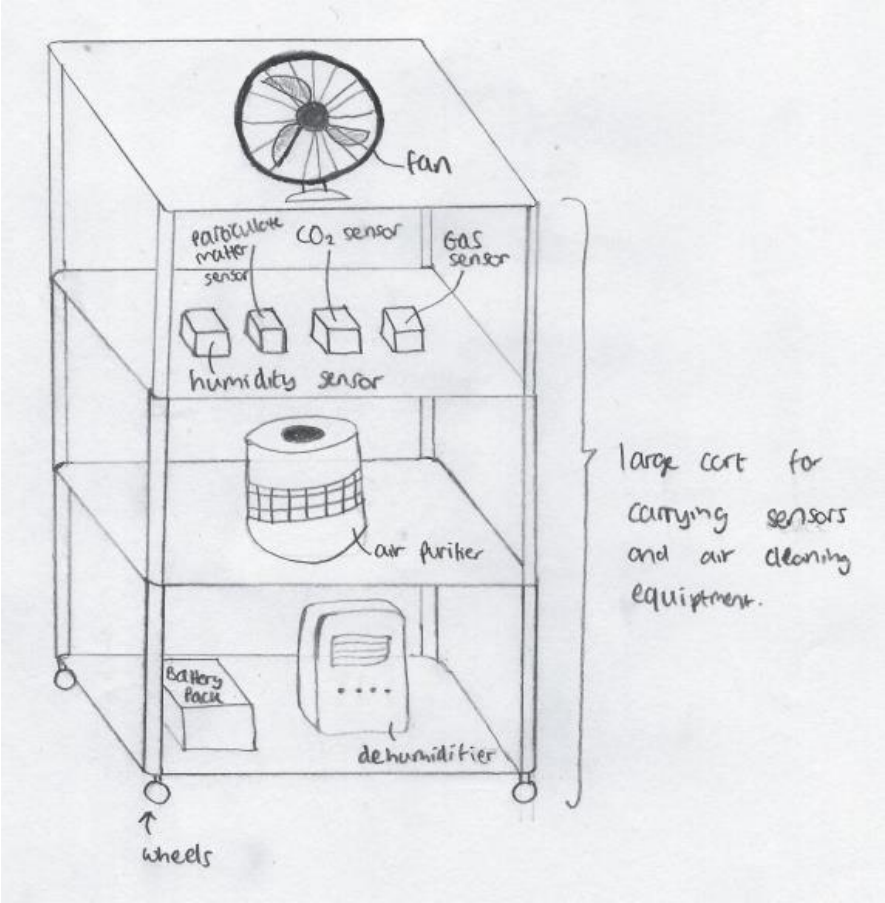

Figure 6. Large, single cart carrying air quality sensors and air cleaning equipment

Concept 7.

Based on concept 14 in Appendix D - This concept is similar to concept 6 above, however, two carts will be used instead of one. Both carts will be relatively small and similar in size so they will be easy to transport. One cart will be used for sensors to monitor and measure the air quality in the room. It will have devices such as CO_2 sensors, humidity sensors, and a particulate matter sensor. The data gathered from these sensors will be sent to a data processing software. If the software flags an area as having poor air quality the second cart will be transported into the clean air in the room. The cleaning equipment will automatically turn off when the air is found to be good quality. The cleaning cart will contain items such as fans,

purifiers, dehumidifiers, air filters, and other sanitizing devices. All devices on both carts will be battery powered. A drawing of this concept can be seen in Figure 9.

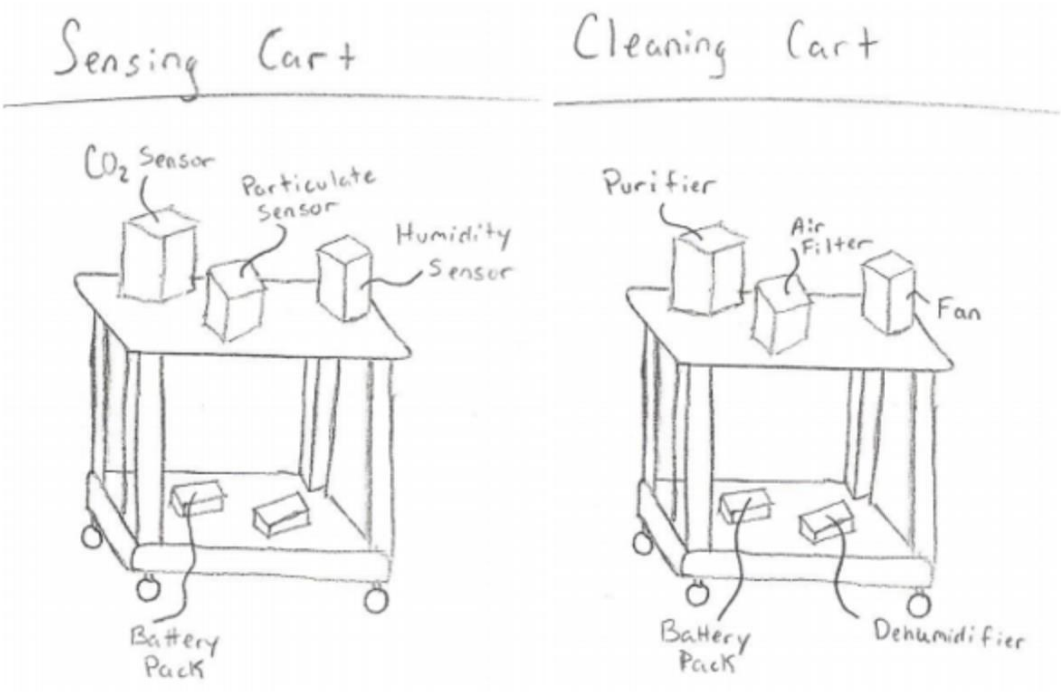

Figure 7. Two carts, one containing air quality sensors, and the other containing sir cleaning equipment

Concept 8.

Based on concept 48 in Appendix D - Humidity, particulate matter, and CO_2 sensors will be mounted on the walls around the FAMU-FSU College of Engineering. A humidifier, dehumidifier, set of three particulate filters, and a UV sanitization system will be attached to the existing vents, and paired with their nearest sensor. When the sensors detect that the air quality has become poor, the corresponding system in all nearby vents will be enabled to return air quality to optimal levels. Once the air has returned to optimal levels, the cleaning equipment will switch off. A drawing of this concept can be seen in Figure 10.

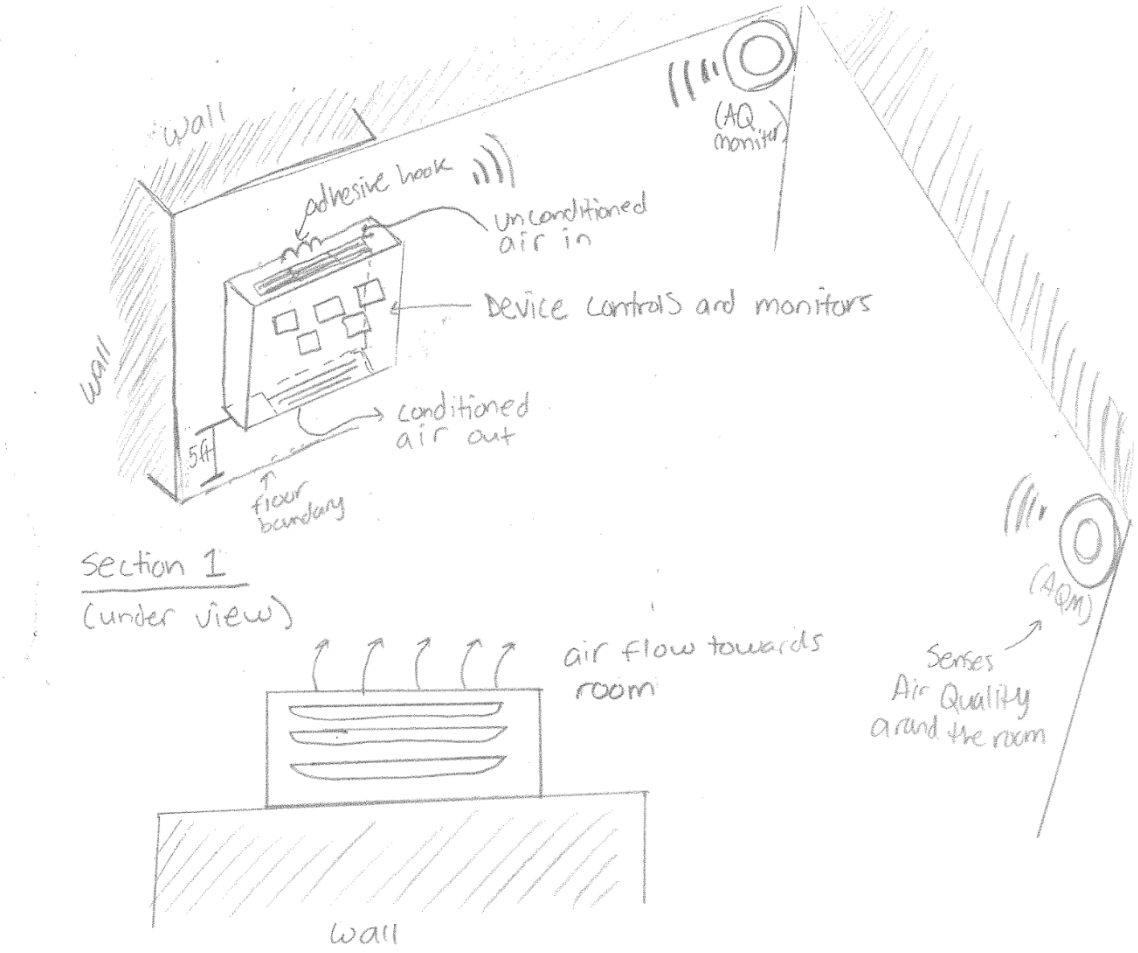

Figure 8. Sensors and cleaning equipment attached to existing infrastructure around room

Appendix A: 100 Concepts

This Appendix contains a catalogue of 100 design concepts created during the concept generation phase of the project. The concepts are split into sections depending on which concept generation tool or method was used. The methods are shown in the headings of each section. Medium and high-fidelity concepts can be seen in section 1.6 of this report.

Brainstorming

1. Fill the room with plants, use sensors to monitor air quality
2. Fill room with water, now there is no air quality to deal with
3. Make everyone wear very high-quality masks all the time so they have good air quality no matter what the quality of the room is
4. Every night, completely suck all the air from the college of engineering and replace it with new clean air
5. Ban people from the college of engineering so the air quality is no longer an issue
6. Add more windows to the college for greater airflow
7. Place a canary in the college, if the canary gets sick or dies, the air quality of the room is unsafe
8. Constantly purify the air in the room to ensure it can't reach unhealthy levels
9. Constantly vent air out of rooms where that pass a certain occupancy threshold
10. Evacuate rooms with poor air quality and wait until it reaches normal levels
11. Bring air in from unoccupied rooms when air quality becomes poor
12. Count number of people entering a room and enable cleaning system when it reaches a threshold
13. A single cart containing sensors to measure air quality, and air purifiers, dehumidifiers, and fans to improve the air quality. All devices will be battery powered
14. Once cart containing sensors to measure air quality and a second cart containing cleaning devices, such as air purifiers, fans, and dehumidifiers
15. Raise temperature in the room to sanitize the air
16. To monitor air quality, survey people and see if they think the air quality is bad
17. BYOO (bring your own oxygen). The room is a complete vacuum, so it is literally impossible to have bad air.
18. Design & create a simple HVAC system and add onto the existing system
19. Add small fans blowing towards a cart containing cleaning equipment for increased air circulation & sensibility
20. A moving cart containing cleaning with a designed pathway. Adding small motors & sensors for stopping & pathway
21. A cart with a pressure system added to increase circulation
22. Open door and place a cart containing cleaning equipment beside the entrance point. This would add a pathway for circulation in a positive or negative air-filled room

23. Adding a small black light or lights near device to get a better visual of particulate motion during circulation
24. Add Clorox wipes to filter/filters to better “clean” air during filtration.
25. Add rectangular vents for exit points in air circulation on device. A rectangular jet causes a shear layer also known as a “mixing layer” with air flow
26. Spray cleaning spray into the air, this will help “clean” air and the spray can be manual or automatic
27. Add sensors to 4 corners of the room and place a cleaning cart in the center of the room to get a room size analysis on air quality
28. Place a cleaning cart next to room air duct to better assist room with air purification
29. Add phone charging ports to cart for improved personal interaction with device.
30. Add silent alarm whenever there is a dangerous number of particulates or chemicals in the air
31. Our project can be compared to a velocity flow field inside a room. Our device is trying to create a pressure difference to pull particulates in and circulate clean air out
32. Device can take a finite element method approach. The cart will be placed in multiple positions while measuring variables. A 3D model can be made based on the data collected in different spots for the cart.
33. Add fake plants and signs saying “Good Air Quality” to trick people into thinking the air is cleaner
34. L-shaped air purifier on a cart. Incoming air passes through 3 filters, air is directed upwards at exit
35. Variation of idea 32 with one of the filters toward the end of the outlet. The last filter will catch excess particles from the bend of the L
36. A stationary air purifier that looks like a tree; takes air in from below to be filtered out through branch-like outputs; large.
37. Variation of idea 34 with a small output of air which would be useful for smaller areas
38. Air purifier with a mesh grid at the top, contains filters and a UV light to purify air
39. Air purifier with 2 filters, for areas clean of large matter; Has cooling coils
40. Purifier with exhaust air that is aimed towards existing vents in room
41. Purifier with 2 fans, inner fan redirects the flow of air in system; lightweight as possible for small rooms
42. A wireless network air purifier; Can be mobile and accessed through an app
43. Triangular prism shaped air purifier with mobile network function
44. Air purifier is decorated with fake plants to trick people into thinking the air is being naturally cleaned
45. Variation of idea 44, with sensors on top, under the fake garden to hide controls.
46. Air purifier with rotary functions to capture and release air all around
47. Air purifier with lights to indicate air quality, sensors connect wirelessly to lights
48. Air purifier, dehumidifier, and sensors that are mounted to walls and, vents, and existing HVAC infrastructure.

Biomimicry

The natural organisms used for each idea is shown at the beginning of the concept

49. Deer Alert System – The system gathers information similar to how a deer uses its keen senses. The device with alert the area when something is wrong just like a deer does.
50. Elephant Cleaning System – When the room is determined to be not clean and unhealthy the device will spray the room with sanitizer like an elephant sprays water to clean itself.
51. Honeybee Cleaning – The device will contain thousands of tiny robots and will release them to clean the air.
52. Hawk/Eagle Monitor and Alert – The device will monitor the air with devices that can see and hear very well and will make a screeching noise when it notices that something is wrong with the air in the room.
53. Scavenger System – the system will scavenge the room to clean up after people have left it dirty and unclean
54. Oyster Sanitation System – When the door is opened to the room and the device has detected a guest the device will begin a sanitation cycle that sprays the entire room, much like oysters do to clean the water around them.
55. Cat Cleaning System – This system will be set on a timer and the device will clean the room in increments throughout the day similar to how cats clean themselves periodically throughout the day.
56. Polar Bear System – In order to combat the growth of bacteria and viruses the system will start a cooling cycle when the temperature is too high like how a polar bear is able to regulate their body temperature.
57. Bottom Feeder Cleaning – Similar to how some fish feed on the bottom of an aquarium to clean it the device will constantly sweep the room to ensure that it is clean.
58. Bird Nest Cleaning – The device will fly around the room destroying viruses and picking up anything that is unsanitary much like a bird carries away the baby bird's poop and cleans the nest.
59. Hippo Bath – At night the room will be sealed off and completely flooded to clean the room
60. Rain Shower – Similar to how rain cleanses the air in nature the buildings sprinklers will be turned on and cleanse the dirty room.
61. Tornado System – Much like how a tornado destroys things, the system will contain a giant fan to blow through the room to push out the bad air and destroy the bad pathogens.
62. Human Breathing – The device with act similar to the way a human breathes by intaking air that is currently in the room. It will sense and filter the air then release the bad air outside through a vent and will keep the good air circulating through the room.

Forced Analogy

The analogy used for each idea is shown at the beginning of the concept

63. Projector - Use a UV light to kill pathogens and clean air
64. Projector - Use a projector light in a dark room to see areas where there is the most visible contamination in a room
65. Ceiling fan - Use large fans to blow air towards vents/UV lights for sanitation

66. Thermostat - Cleaning devise should have sensors to count the amount of people in a room, when a critical amount of people has been identified, the devise will switch off
67. Thermostat - The devise should automatically switch on, but have an emergency stop button so it can be turned off in the case of a malfunction
68. Classroom - Our project relates to a closed-circuit system with air flow continuously circulating through room
69. Wind Tunnel - Air circulating device can be compared to a wind tunnel due to changes in pressure and air circulation
70. Analogue to Digital Sensor - Our device can be compared to a data acquisition software that takes real world physics and converts variables into a digital value

Crap Shoot

71. Go-Kart engines are used to power the device
72. A priest blesses the air at the college, making it holy
73. Students are given rocking chairs to sit on, the kinetic energy they produce from rocking is used to power the device
74. The devise will be powered by solar panels
75. Have a vacuum running all the times to suck particulates and debris out of the air

Anti-problem

76. Use filters to remove solid particulates from the air
77. Require people to be tested for COVID-19 and other common airborne diseases before they can enter college
78. Require people to walk through spray-down sanitation tents and wear hypoallergenic suits before they can enter the college to reduce the introduction of pathogens and other contaminants in the college

Morphological Chart

The following ideas came from the morphological chart shown below

Ventilation	**Control System**	**Sanitize**	**Humidity Control**
Fan	Phone App	Sprayer	Dehumidifier
Vent	Computer Program	Filters	Water Fan
	Buttons	Diffuser	Heat Lamp
		UV Light	

79. Ventilate using a fan, control the system using a phone app, sanitize using a sprayer, and control the humidity using a dehumidifier.
80. Ventilate using a fan, control the system using a computer, sanitize using sprayer, and control humidity using a dehumidifier.
81. Ventilate using a fan, control the system using buttons, sanitize using a sprayer, and control the humidity using a dehumidifier.
82. Ventilate using a vent, control the system using a phone app, sanitize using a sprayer, and control the humidity using a dehumidifier.
83. Ventilate using a vent, control the system using a computer, sanitize using sprayer, and control humidity using a dehumidifier.
84. Ventilate using a vent, control the system using buttons, sanitize using a sprayer, and control the humidity using a dehumidifier.
85. Ventilate using a fan, control the system using a phone app, sanitize using filters, and control the humidity using a dehumidifier.
86. Ventilate using a fan, control the system using a phone app, sanitize using diffusers, and control the humidity using a dehumidifier.
87. Ventilate using a fan, control the system using a phone app, sanitize using a UV light, and control the humidity using a dehumidifier.
88. Ventilate using a vent, control the system using a phone app, sanitize using filters, and control the humidity using a dehumidifier.
89. Ventilate using a vent, control the system using a phone app, sanitize using diffusers, and control the humidity using a dehumidifier.
90. Ventilate using a vent, control the system using a phone app, sanitize using UV light, and control the humidity using a dehumidifier.
91. Ventilate using a fan, control the system using a computer, sanitize using filters, and control the humidity using a dehumidifier.
92. Ventilate using a fan, control the system using a computer, sanitize using diffusers, and control the humidity using a dehumidifier.
93. Ventilate using a fan, control the system using a computer, sanitize using a UV light, and control the humidity using a dehumidifier.
94. Ventilate using a fan, control the system using buttons, sanitize using filters, and control the humidity using a dehumidifier.
95. Ventilate using a fan, control the system using buttons, sanitize using diffusers, and control the humidity using a dehumidifier.
96. Ventilate using a fan, control the system using buttons, sanitize using a UV light, and control the humidity using a dehumidifier.
97. Ventilate using a vent, control the system using a phone app, sanitize using diffusers, and control the humidity using a water fan.
98. Ventilate using a vent, control the system using a phone app, sanitize using a UV light, and control the humidity using a heat lamp.
99. Ventilate using a fan, control the system using a phone app, sanitize using diffusers, and control the humidity using a water fan.

100. Ventilate using a fan, control the system using a phone app, sanitize using a UV light, and control the humidity using a heat lamp.