Functional Decomposition

The subsequent functional decomposition deconstructs the processes needed to improve the air quality of indoor hotspots. Firstly, the systems, or major functions, needed for the project were identified. Those systems were then broken down to find the minor functions of each system. Using this method to break down the large system into smaller subsystems makes the project more manageable. Moreover, a functional decomposition can encourage innovative design by identifying ways that different subsystems overlap and can potentially be connected. While a functional decomposition does not generate a design for a project, it can be used to reveal the systems necessary in potential designs.

Most of the data used to create this functional decomposition was gathered during a virtual meeting with our sponsor, Honeywell. We asked a series of questions to help define the scope of the project and interpreted our sponsor's responses to find any engineering requirements or specifications. This information can be found in the customer needs table shown in Table 1 in the customer needs document. We also made some assumptions about the project on topics where the sponsor was not able to provide any information. The functional decomposition for this project is based on the interpreted needs data from the sponsor and our assumptions.

The functional decomposition was gathered by identifying the physical actions needed to address the sponsor's problem; the air quality of indoor public spaces, such as stadium bathrooms, is often subpar and needs to be improved. The first system we identified was improve air composition. To meet the sponsor's requirement of improving air quality, the composition of the air would need to be enhanced. This relates to removing pollutants in the air such as dust, viruses, and bacteria. The next system identified was ventilate room; the project must ensure that there is airflow around the room. The relationship between these major functions is clear, both

are related to the experience of the user. However, we also realized that another system is needed to control these major functions and the control system was added. This system is responsible for sensing when the air needs to be cleaned or circulated and executing the necessary actions to make it happen.

Figure 1 is a functional decomposition flowchart. The boxes on the second tier of the chart, shown in blue, indicate systems in the project. The boxes branching down from the systems, shown in green, indicate functions belonging to each system.

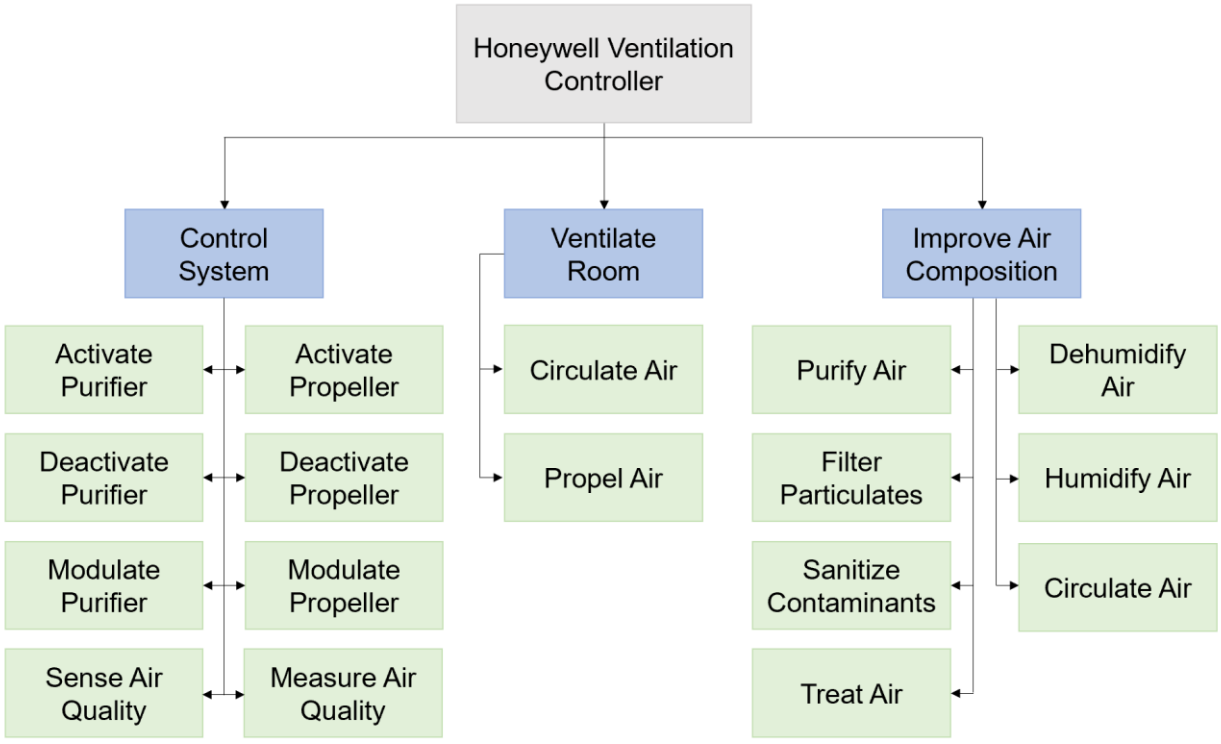

Figure 1. Functional Decomposition Flowchart Chart

Table 2 is a functional decomposition cross-reference table for our project. The major functions of the system are shown horizontally along the top while the minor functions are

shown down the left-hand side vertically. Table 2 was created based on the flowchart shown in Figure 1. An ‘x’ in a box in the table represents a function belonging to a system in the project.

Table 2. Functional decomposition cross-reference table

	Major functions		
Minor functions	Control System	Ventilate Room	Improve Air Composition
Sense Air Quality	x		
Measure Air Quality	x		
Activate Propeller	x		
Deactivate Propeller	x		
Modulate Propeller	x		
Activate Purifier	x		
Deactivate Purifier	x		
Modulate Purifier	x		
Propel Air		x	
Circulate Air		x	x
Purify Air			x
Treat Air			x
Filter Particulates			x
Dehumidify Air			x
Humidify Air			x
Sanitize Contaminants			x
Total	8	2	7

The systems of the device can be ranked by the number of functions which they connect to because a system cannot operate without all its functions. The control system, which is connected to seven functions, is the most important, since every major system relies on the control system to tell it when it should be enabled, and at what level they should be running. The purification system, which is connected to six functions, is the next highest priority system of the device, as it is the system that undergoes the processes by which the air quality will be improved. The system with the lowest priority is the ventilation system, which is connected to only two functions. This system’s only purpose is to circulate air through the purification system, which,

while critical to device functionality, is a problem solved by an off the shelf component that likely already exists in locations where the device needs to be installed.

As seen in Table 1, a single function can span multiple systems; the circulate air function spans both the ventilate room and improve air composition systems, thus the air circulation necessary for dehumidification can be accomplished through the same system. Through this, both dehumidification and ventilation can occur without creating a redundant circulation system that only works for one of the two functions. There are also integrations that can be done but are not represented in Figure 1 and Table 1, because they are prerequisites for some functionality, but not necessarily a part of the system. Most notably, the entire purification subsystem requires the ventilation system to propel air through it and circulate the now purified air back into the room. Similarly, the control system activates, deactivates, and modulates the subsystems of both the ventilation and air quality improvement systems.

This functional decomposition has highlighted the physical actions the project needs to carry out to be successful. Using sensors, it will be able to identify when the location is a hotspot. The system will then be activated and will modulate the air in the bathroom. It will ventilate the air by propelling and circulating the contaminated air out of the bathroom. It will also improve the overall air quality by dehumidifying and purifying the air inside the hotspot. The air will be purified by sanitizing and filtering the infected air. Once the system has cleared the air it will automatically deactivate. This product will make going to the bathroom at a stadium a cleaner and overall better experience.