# Functional Decomposition

## Introduction

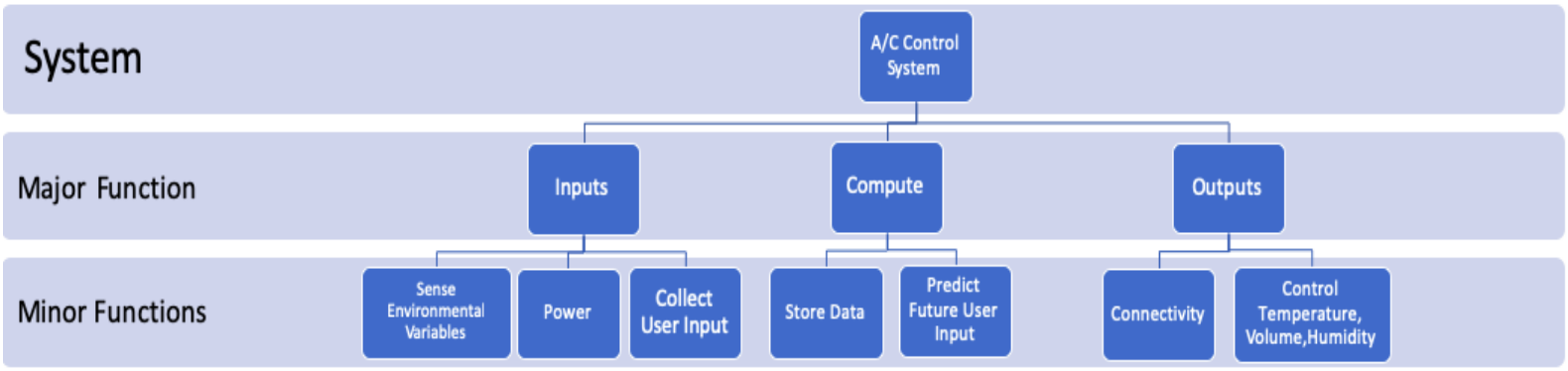
Functional Decomposition is used to break a complex system down into simpler parts. Once these parts are made simpler the work can be divided up within a team to accomplish the creation of the system. The breakdown of the system into subsequent smaller parts was used to create a cross reference table and a hierarchy chart. The components of our system were then discussed and justified.

## Functional Decomposition Reference Table

| System | | | |
|---|---|---|---|
| Function | Compute | Input | Output |
| Sense | | + | |
| Power | | + | |
| Collect User Input | | + | |
| Store Data | + | | |
| Predict Future User Input | + | | |
| Connectivity | | | + |
| Control Temperature | | | + |
| Control Volume | | | + |

| | | | |
|---|---|---|---|
| Control Humidity | | | + |
| Control Pressure | | | + |

## Functional Decomposition Flow Chart




## Explantation of Results

The functional decomposition uses a Hierarchy top down approach to break out the different systems. The system to be produced is an A/C Control system where the major functions were input, output, and compute. The minor inputs were all of the sensors that would go in a space to accurately control the air such as temperature sensors, pressure sensors, humidity sensors, etc. Because the function of this project is to not only control the HVAC system but to be able to set it for individual preference, the solution must also store this data of the individual for future automation. The outputs were the controlled functions in an HVAC such as controlling the volume, the temperature, and relative humidity of the air entering the space. The solution must also be able to compute preferences based on changing outside air conditions.

The data on what needed to be done was gathered by asking individuals questions regarding HVAC systems. From the questions asked, actionable functions were then generated. Basic functions were also generated from typical HVAC control, sensing temperature and relative humidity for example. These are shown on the graphics in the minor functions section.

To create the functional decomposition a list of customer needs was broken into actionable tasks. The tasks were then grouped together. In order to heat or cool a building there are related functions, for instance valves control whether or not water flows the heat exchanger in duct work. So by opening and closing this valve you can vary the heat exchanger properties, to reach a desirable temperature. Functions for computing the air being added to the room and the temperature of the room are related to trending that data to better predict preferences with the time of year. Each of the minor functions represents one portion of the entire control a space needs to be cooled.

## Action and Outcome

For this project, the system has to be able to do these main things; sense the current temperature in a room, be able to accumulate data entered into the thermostat from the user or users, and eventually be able to compile all of that data in order to compute, predict, and generate the preferred temperature of the user based on the data that was accumulated. The current idea of this project is for the device to get to a point where as soon as the user enters the room, the device will be able to perceive who entered and automatically set the thermostat to the user's preferred temperature. If there are multiple users, there will have to be a way for the system to distinguish the different users from each other. However, this part of the system will have to be discussed later.

There will also be additional capabilities to the device such as sensing and controlling humidity and controlling the volume of air in the room. For now, the main functions of the project

can be divided into three main systems; input, compute, and output. For the Input system, the device will sense the temperature and humidity in the room but also sense the user as they enter the room. It will also collect all data entered through the thermostat by the user or others. For the Compute system, the device will carry out trend analysis on the data and attempt to find a trend and designate a preferred temperature for each user. For the Output system, the device will then set the thermostat to the preferred temperature that was computed.

## Connections to Systems and Subsystems

The 3 columns in the functional decomposition comprise of inputs, outputs, and the computation of the data that is received. These functions all have specific subsystems that will need to be implemented in order for the project objectives to be completed.

In order to receive proper inputs, first power is needed in the system. The system will need to be able to sense the environmental variables. These include pressure, temperature, and humidity in the room. This data is needed to compute the volume of the air in the room as well as calculate the specific outputs the system will produce.

Once the data is gathered, there will need to be somewhere to store it. Once it is stored, calculations such as the volume of the air, what the ideal output will be, as well as the ability to predict what the user will prefer in the future. By gathering and storing the data, the system will be able to fulfill the outputs based on the computation that will be implemented.

The outputs of the system will need to control the temperature, volume, and humidity in the room. This will be achieved by taking in the calculations and controlling the current A/C system as needed. Connectivity to the A/C system is needed for this, as the ability for the system to communicate with the A/C unit will provide the unit with the specific measurements to reach the ideal state of the room.

The Input system needs to sense, collect and receive and deliver power to the other systems. Within these functions the sense and collection need to be sent to the Compute system for major usage.

The Compute system needs to store the user input and, if capable, predict future inputs. To be able to do those, the Compute subsystems need to receive variables from the Input sub-systems in order for them to work. As an example, for the prediction of the user input subsystem to work it needs to receive data from the collect sub-system (also inside the Compute system) but also from the Input subsystem sense (and maybe possibly from the collect subsystem).

Finally we have the Output subsystems, these ones are the control, change and connectivity subsystems. These subsystems are in charge of controlling the general output for the whole system. For them to work correctly they need the information from the Input system. However, this data needs to first pass through the Compute system in order to comply with the specifications of the system (basically what the system is expected to do); the control and change subsystems receive information from the storage and predict subsystems, which in turn receive their input from the senses and collect subsystems. The connectivity subsystem is mostly independent from the rest of the subsystems and does not require special inputs from the others but it would probably control the rest of the subsystems if needed.