Target Catalog

Table 1 shows the different functions from the flow chart from section 1.3.1. It also adds some more functions that are considered to be important to consider when building the device. The most critical functions are indicated with an asterisk next to its name (*).

Table 1
Function targets and metrics

Function	Target	Metric
Sense Environmental Variables*	0 - 110°F -17 - 43°C 20 - 90%	Temperature (°F) Temperature (°C) Relative Humidity (%)
Energy	Battery life longer than 1 year	Electric Charge (mAh)
Collect User Input*	Allow only human inputs	User Feedback
Store Data	Be able to store the user input data to about 500GB	Storage Capacity (GB)
Predict Future User Input*	Set a temperature from user based on past behavior	User Feedback
Connectivity	Achieve a short connection timeout. Less than 50 ms	Time (ms)
Control Temperature*	59 - 85°F 15 - 30°C	Temperature (°F) Temperature (°C)
Control Volume *	Size of an average room	Volume (m3)
Control Humidity*	30 to 70% (ideally 50 to 60%)	Relative Humidity (%)

Setup Time (Temperature)	Reach optimize temperature within 1-20 min	Time (min)
Maneuverability of the system	Device size less than 0.2m3	Volume (m3)
Easy to use	User friendly device for all ages	User Feedback
Satisfaction*	Have the user be satisfied with the temperature	User Feedback

Method of Validation

Control Temperature: This is one of the important functions that needs special care, the whole project success is determined by the performance of this function. Its target needs to be met within a margin of error of at most 1%. To validate this, test measurements with the prototype will be held to know how close to the desired temperature it can get.

Sense Temperature: Sensing the environment temperature helps the system in predicting future user preferences, but it can also help in conserving energy consumption. Multiple sensors can be used to account for this and to validate them it has to be tested with the control temperature environment.

Setup Time: The system needs to be tested on how long it takes for the room to reach the preferred temperature. For that the system units need to be timed at different times of the day, locations, and different ambient temperatures. The target time should not go over the maximum estimated time unless otherwise specified or if the system fails at some point.

Maneuverability of System: The device use for input should be small enough so it does not become a bother to the user's space, but still big enough so almost anyone could be able to

use it. To validate the target the design of the device needs to be presented to different possible users while complying with the target metric.

Connectivity of the system: The system needs to be connected to the internet for two major reasons, for one it allows the storage target to be easier to comply with; the other one is because it could allow the user to access the system remotely and check its status or set up a new temperature. The validation comes from the type of connection used, whether wireless or not, in either case the delay in the connection to the system should be as close to zero as possible.

Energy Consumption: The system needs energy to work, a battery can provide this energy but it needs to be as big as the system requires. The only actions that require energy will be the inputs to the device and the transfer of data therefore the consumption should be miniscule. The validation of the targets comes from heavy testing the different batteries and extrapolating an estimation of its lifespan.

Storing Information: All the information the user inputs need to be stored in a secure location for other functions to make use of them. The larger the capacity the better for more precise control but it also increases the memory size. Either physical or cloud base memory works. Validation comes from inserting information at a high volume and checking the stored location to see if all information was received correctly.

Predict user input: A Machine learning algorithm that helps the system in setting up a temperature based on previous inputs stored. To validate this, during the temperature control testing there will be multiple inputted temperatures and we will see if the device correctly assigns the right preferred temperature based on the guidelines that we will set.

User Input Collection: The device receives the user inputs and then sends that information over to the storage device for later use. The device will need to let users not only input their preferred temperature but also should store that information. This be validated by the predict user input target. If that target is validated it means the user input collection target is also validated.

Easy to use: this is a commodity part of the system which needs to be as user friendly as possible. In other words, it would need to be able to be used by people that do not possess a very good knowledge of the internal workings of the system. The system will be built with this in mind and then make other people run a few tests to identify possible problems. Hence, this will have to be validated directly by the user.

Satisfaction: This is the most important function of the current project. The system needs to comply with the user input and try to achieve the best possible temperature according to the inputs. The validation comes from how well received the product is, and it can also be tested during the easy to use test (see how well the system responds to the user input and how well the user accepts the device). Again, this will have to be validated directly by the user.

Derivation of Targets/Metrics

Sense Temperature: The range for this was determined based on the temperature of the places people live all around the world. From the exceedingly cold temperatures of Canada to the extreme heat of the Middle East, it was determined that the device should be able to sense temperature of this specific range. Places like Antarctica weren't really considered because it didn't line with our primary and secondary market.

Control Temperature: As a critical function, the range of the temperature for this is crucial. After researching AC units, it was determined that most AC units operated between these specific temperatures. Even though there might be extreme users who might prefer colder or hotter than the range provides, they will probably be few and far between.

Set-up Time: The time is will take the system to reach the optimal temperature of the user is relatively important. It needs to be in a short enough time as to not irritate the user but long enough that the sudden change in temperature doesn't cause major discomfort to the user. For example, if a user prefers rather cold temperature and another user favors hotter temperature, if the first user leaves and the second user enter the temperature should not automatically change to the second user's preference. The range of this time was determined to be from 1 minute to 20 minutes.

Storing Information: Depending on where the device is used, from a large office space with multiple users to a small house with few users, there will need to be a wide range of inputed data that will need to be stored and calculated. 500GB should be enough.

Connectivity of the system: It would be extremely beneficial and useful if this system was able to be wireless connected. It isn't a required for this project but just an extra

Energy Consumption: The energy consumption of the system is defined by the components and parts of the device that are required.

Maneuverability of System: The device will be the size of a standard thermostat.

Collect User Input, Predict User Input, Easy to Use and Satisfaction: These functions have metric stated as "User Feedback". This will be defined as scale-based survey from 1 to 5 or

1 to 10. The users will then note in the scale how they feel with respect to the device in each category.

Discussion of Measurement

Most of the metrics needed for this project require certain measurements, and to do that there needs to be a way to measure different conditions. To sense the surrounding environment there are industry standard sensors. Room temperature is monitored with a room temperature sensor, humidity is measured using a relative humidity (RH) sensor. Energy can be monitored in multiple ways, using a current sensor is one. Using the IoT, data will be stored in the internet cloud as will user inputs. Predicting future user input will be computed using software and a controller. The temperature will be controlled by a damper system varying the amount of air entering a room as well as the volume of air. The humidity will be controlled with a heat exchanger driving the air temperature down decreasing the RH. The setup time, and maneuverability of the system will be designed around the environment. The customer satisfaction will be measured by the amount of changes made to the system, the less user input the happier the customer is staying.

Critical Targets/Metrics

For this project, the critical functions that the device will need to do are Sense Environmental Variables, Collect User Input, Predict Future User Input, and Control Temperature, which should all lead to User Satisfaction. These functions can be seen with an asterisk next to them in Table 1. The device's ability to sense variables such as temperature and humidity is important because that is one of the basic functions of a thermostat. It needs to be able to sense the current state of the room to determine whether a change is needed or not.

Collecting user input is vital because that is how the device will be able to predict user preferences, and predicting future user input is the key function that will separate out device with other similar devices that are on the market. Finally, controlling the temperature, humidity, volume of air is another basic function of AC units.