

# **1. Problem Statement**

## **1.1 Histories and Background**

Heating Ventilation and Air Conditioning (HVAC) systems have become an essential component of modern households. Ventilation systems have been used since the 1000s-1400s [1]. One of the first documented cooling apparatuses was created by Dr. John Gorrie in the 1830s. This simple design implemented a fan blowing on ice to cool a hospital [2]. Dr. Gorrie's design was emulated by Naval engineers in 1881 and could lower a room's temperature by twenty degrees but would use up to half a million pounds of ice in two months [2].

Since the 1800s, HVAC system technology has advanced. One of the first modern HVAC systems was invented in 1902 by Willis Haviland Carrier; it was based off of the mechanical refrigerator [2, 3]. As HVAC systems have become an integral part of households and energy consumption has risen, it has become increasingly important to create an energy efficient system. Integrating smart technology into the HVAC system is one solution, such as programmable thermostats to reduce the amount of time the unit stays on and efficient units that require less energy to operate. To further increase efficiency in cooling and heating, an improvement is to look at the vents and how to utilize them.

Comfort Control will incorporate the newest technology in order to create a more efficient HVAC system for households. The design will include a smart thermostat which will monitor and control each room's temperature via local temperature probes and automated vents. The system will have the ability to be controlled on a user defined schedule in order to minimize energy consumption, while allowing for maximum comfort.

## **1.2 Market and Competitive Product Analysis**

Comfort Control will be best utilized by modern households and small commercial buildings that are focused on maximized comfort and minimized energy usage. Unlike popular smart thermostats such as, LG Smart AC and Nest, that can only be programmed to schedule when the HVAC unit turns on and what temperatures to use throughout the day, the Comfort Control system will also control air flow to different rooms of the building using motorized vents [4,5] There are a few designs similar to Comfort Control such as EcoVent [6]. However, Comfort Control will have the edge financially over such products, due to its simple design. Also, smart thermostats have been calculated to pay themselves off after only two years, and with the additional efficiency that the Comfort Control system can bring, that time can be lowered [7]. Comfort Control will be fully automated, allowing users to input their desired settings and let the system go to work. Very little maintenance and human interaction will be needed. This simplicity of the design should appeal to modern consumers, thus making Comfort Control a competitive product in the smart HVAC market.

### **1.3 Concise Problem Statement**

Most modern HVAC systems have the disadvantage of being controlled by a centrally located thermostat, which can cause undesired temperatures in adjacent rooms. Comfort Control will solve this problem by allowing user control of each room, thus eliminating the problem of undesired room temperatures being present.

The Comfort Control design consists of three main components. There will be a main hub microcontroller controlled thermostat, local temperature sensors, and automated vents.

The communication between components will be accomplished with a combination of hardwired and wireless connections. The local temperature probes will monitor the temperature in individual rooms, and relay that information to the main hub. The main hub will decipher the data and decide which vents to open and close based on the user-defined settings in each room. The design will also make use of a mobile device application which will enable user control on the go, as well as allow the user to create a scheduled variation of temperatures across the home. The combination of these components will allow Comfort Control to be a competitively efficient system, while maintaining comfort in the home.

### **1.4 Implications of Success**

A successful Comfort Control product will not only create a more energy efficient home, but also create a household with maximum personalized comfort. Use of Comfort Control and other products similar to it would create a “greener” society, while also decreasing the financial strain on consumers from energy costs. A successful product could also stimulate the smart thermostat market, which in turn would make way for more smart HVAC systems. Another minor benefit of the Comfort Control design is the comfortable atmosphere that would be provided to a household. A more comfortable household could lead to a better social atmosphere in the home, which could also benefit families. Furthermore; Comfort Control could make way for smart HVAC control systems becoming a staple in the future of home designs.

## Work Cited

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