**Comfort Control**

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. These early ventilation systems included man powered fans used by early Egyptians and a furnace powered system called a hypocaust used by the Romans [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 with a design that used an ice water saturated rag instead of blocks of ice and could lower a room's temperature by twenty degrees; however, this design 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. Carrier’s design was based on the mechanical refrigerator and could control humidity in an area by pumping air through water filled coils [2]. His design could even adjust humidity to a desired level [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 time a unit stays on and efficient units that require less energy to operate. To further increase efficiency in cooling and heating, current designs are placing focus on the direction of airflow to better cool and heat entire household.

Comfort Control will incorporate the newest technology to create a more efficient HVAC system for households. The design will include a smart thermostat that 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 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. Currently there are a few smart HVAC products in the market. However, some of the products target only one component of the HVAC system. One such product is Nest, a smart thermostat that can control a HVAC system via a smartphone app or thermostat interface that retails around $250 [4]. Keen Smart Vents, another similar product that only targets airflow, retails for around $85 dollars per vent [5]. Currently one of most similar products to Comfort Control is Ecovent Systems which costs around $200 per room [6]. Comfort Control will be able to control the entirety of the HVAC system from the thermostats to the vents, and will retail for around $175 per room.

Furthermore, smart thermostats have been calculated to save enough money to essentially pay for themselves 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 leave the rest to the product. Very little maintenance and human interaction will be needed. The 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 providing comfort in every room

The Comfort Control design consists of three main components: a main hub 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 that will enable user control from anywhere with an internet connection, 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.

Comfort Control will also have advantage of being fully integrable into a building’s HVAC system. The main hub will easily replace the homeowner’s existing central thermostat. Also, the local thermostats can easily be mounted near or directly in a power socket, allowing for greater user control over the system. The vents will take the place of existing vents in the ceiling, walls, etc. A simple setup procedure will be required for initial setup, but following the setup will allow little to no maintenance to use Comfort Control.

**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. By implementing Comfort Control into a home, homeowners will be able to impact the environment in a positive way by using less energy. This would also allow the homeowner to use the money they save from energy costs in other markets, which could have a positive impact on the economy as a whole. 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. Continued implementation of Comfort Control in homes and residential buildings will stimulate the smart HVAC market, leading to more smart HVAC technology which in turn will lead to a more environmentally friendly homes. Furthermore,   
Comfort Control could lead to smart HVAC control systems becoming a staple in the future of home designs.

**References**

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