iFlow

**Senior Design Team Contract**

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# Intent

The following contract was written and agreed upon by Derrick Adkins, Daniel Newell, Cole Pownell, and Payton Turnbow. The contract provides expectations, objectives, and results for developing the Wi-Fi-Controlled Air Duct Damper.

The contract is effective for all team members participating in IT 5001/5002 through the 2023-2024 academic year.

**Senior Design Team Contract**

**2023-2024**

# **Project Name:**

iFlow

# Project Summary:

The project aims to develop a WiFi controlled air duct damper that allows users to control the flow of air in their home or office using a mobile device or computer. The air duct damper will be designed to fit into existing ductwork and will work with a range of HVAC systems.

The WiFi controlled air duct damper will be equipped with a small motor that allows the damper to open and close based on the user's commands. The motor will be controlled using a microcontroller that receives commands over WiFi. The microcontroller will be programmed to respond to commands from a mobile app or web interface that allows the user to adjust the airflow in different parts of the building.

The mobile app will be designed to be intuitive and easy to use, with clear controls that allow the user to adjust the airflow in real-time. The app will also provide feedback on the current airflow and the status of the damper, allowing the user to monitor the system's performance.

The WiFi controlled air duct damper will be powered by an external power supply, which will be connected to a standard electrical outlet. The damper will be designed to be energy-efficient, with low power consumption when in standby mode.

The project will be developed using high-quality components, with a focus on reliability and durability. The system will be designed to withstand the harsh conditions inside an air duct and will be tested to ensure that it meets industry standards for safety and performance.

In summary, the WiFi controlled air duct damper project aims to provide an easy-to-use, energy-efficient solution for controlling the flow of air in homes and offices. The system will be designed to be reliable, durable, and safe, with a focus on meeting the needs of the modern user who expects seamless control over their environment.

# Problem Statement:

The HVAC system accounts for a significant portion of energy usage, consuming 46% of the average U.S. home's energy (Direct Energy, 2023). According to the U.S. Energy Information Administration's 2020 Residential Energy Consumption Survey, 88% of U.S. households utilize some form of air conditioning (U.S. Energy Information Administration, 2022). The same survey revealed that two-thirds of these households primarily rely on central AC or a central heat pump as their main cooling equipment (U.S. Energy Information Administration, 2022). Interestingly, regional variations exist; for instance, 92% of households in the Midwest and 93% in the South use air conditioning, compared to only 73% in the West (U.S. Energy Information Administration, 2022). When it comes to the types of residences, 90% of single-family detached homes have air conditioning, whereas the rate drops to 80% and 85% for apartments in smaller and larger buildings, respectively (U.S. Energy Information Administration, 2022).

Traditional air duct dampers are particularly challenging to adjust due to issues of accessibility and time consumption. Often located in hard-to-reach areas like attics or crawl spaces, these dampers require significant effort just to access them for adjustments. Even when reached, the settings are frequently difficult to see, necessitating additional tools and lighting. Furthermore, achieving the optimal airflow balance is a time-consuming process, involving multiple adjustments and a considerable amount of trial and error. These challenges not only make the task cumbersome but can also result in temperature imbalances and wasted energy. The problem is more significant for individuals living or working in buildings with many rooms, where the HVAC system cannot distribute the air evenly.

The WiFi controlled air duct damper proposes a solution to the problem. The damper's wireless control capabilities will enable individuals to adjust the airflow in different parts of their home or office with ease. This technology will allow for a more even distribution of airflow, reducing energy wastage and temperature imbalances.

If the problem is not solved, individuals will continue to experience discomfort, wasted energy, and increased energy bills. The problem is taking place in homes and offices with traditional air conditioning systems, where the ducts are often challenging to access, and manual adjustments are required.

The problem needs to be fixed as soon as possible to address the challenges faced by individuals and businesses concerning temperature regulation and energy efficiency. The WiFi controlled air duct damper is a step towards solving the problem and will help to improve energy efficiency in homes and offices.

In conclusion, the WiFi controlled air duct damper project aims to solve the problem of inefficient distribution of airflow in homes and offices. The proposed solution will enable individuals to adjust the airflow in different parts of their home or office wirelessly, reducing energy wastage and temperature imbalances.

# Solution:

To address the problem of inefficient distribution of airflow in homes and offices, our proposed solution is a WiFi controlled air duct damper that will allow users to adjust the airflow in different parts of their home or office wirelessly.

Our approach to solving this problem involves designing and developing a WiFi controlled damper that is easy to install, energy-efficient, and compatible with a range of HVAC systems. The damper will be equipped with sensors that provide real-time feedback on the airflow and status of the system, enabling users to monitor and optimize their energy usage.

To ensure that our solution is effective, we will conduct extensive testing and evaluation of the WiFi controlled air duct damper in different environments, taking into account factors such as building size, ductwork design, and HVAC system compatibility.

We will also provide comprehensive user documentation and support to ensure that users can easily install and operate the WiFi controlled damper. This will include user manuals, video tutorials, and customer support services.

Overall, our solution to the problem of inefficient distribution of airflow in homes and offices involves developing and implementing a state-of-the-art technology that will improve energy efficiency, reduce temperature imbalances, and provide users with greater control over their HVAC systems.

# Contact Information:

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| --- | --- | --- | --- |
| **Team Member** | **Degree + Track** | **Email** | **Phone Number** |
| Derrick Adkins | BSIT – Software Dev | adkinsdk@mail.uc.edu | 937-903-1098 |
| Daniel Newell | BSIT – Game Dev, BSCyber | newelldb@mail.uc.edu | 440-567-4142 |
| Cole Pownell | BSIT – Software Dev | pownelcg@mail.uc.edu | 513-605-0460 |
| Payton Turnbow | BSIT – Software Dev | turnbopd@mail.uc.edu | 513-680-3429 |

# Project Source:

The project was conceived by Derrick Adkins, who was inspired by the inefficiencies of traditional air duct dampers and the need for a more energy-efficient and user-friendly solution. The idea came to him as he was researching HVAC systems and their impact on energy consumption.

Derrick Adkins conducted the requirements analysis for the project. He researched the current market for air duct dampers, identified the limitations and shortcomings of existing solutions, and determined the key requirements for the WiFi controlled air duct damper.

The project team formed through a combination of in-class collaboration and online forums for the class. Derrick Adkins worked with classmates and online peers to share ideas, collaborate on design and development, and provide feedback on the project's progress.

# Project Objectives/Goals:

The project aims to develop and implement a WiFi-controlled air duct damper for HVAC systems, enabling wireless airflow adjustments, improving energy efficiency, user control, and system performance. The project's success will be measured by reduced energy consumption, enhanced user comfort, and increased HVAC system efficiency, ultimately contributing to environmental sustainability.

* Develop and implement a WiFi-controlled air duct damper that allows users to adjust the airflow wirelessly.
* Enable more efficient energy consumption by reducing energy wastage and temperature imbalances.
* Improve user control over HVAC systems and reduce the need for manual adjustments.
* Provide real-time feedback on airflow and system status to users.
* Optimize HVAC system performance and energy efficiency with automated adjustments.
* Design a solution that is compatible with a range of HVAC systems and easy to install.
* Conduct extensive testing and evaluation of the WiFi controlled air duct damper in various environments.
* Create comprehensive user documentation and support materials, including user manuals, video tutorials, and customer support services.
* Evaluate the potential impact of the WiFi controlled air duct damper on energy consumption, user comfort, and overall system performance.
* Establish partnerships with HVAC contractors and distributors to promote the adoption of the WiFi controlled air duct damper.
* Measure the success of the project by tracking the number of installations, user feedback, and energy savings achieved.
* By achieving these project objectives and goals, the WiFi controlled air duct damper can potentially have the following measurable outcomes:
* Reduced energy consumption and cost savings for users.
* Improved user comfort and indoor air quality.
* Increased HVAC system efficiency and reduced wear and tear.
* Increased user control and convenience.
* Improved environmental sustainability by reducing energy waste.

# Team Members and Responsibilities:

Project Manager: Derrick Adkins

* Developing a project plan that includes timelines, milestones, and deliverables
* Assigning tasks to team members and monitoring their progress
* Ensuring that the project stays within budget and meets deadlines
* Communicating regularly with team members to provide project updates and address any concerns or issues
* Managing project risks and developing contingency plans
* Motivating and managing team members to ensure that they are productive and working effectively
* Facilitating meetings and ensuring that everyone is on the same page
* Ensuring that all project documentation is accurate and up to date
* Seeking out opportunities to improve the project management process and implementing changes as necessary

Software Developer: Daniel Newell

* Develop and implement the back-end of the mobile application
* Test the mobile application to ensure it works properly
* Ensure the mobile application is user-friendly and easy to use
* Collaborate with developers within the team to standardize communication protocols between system components

Hardware Developer: Cole Pownell

* Develop and create comprehensive circuit designs that meet project specifications
* Conduct testing of the circuit to ensure its functionality and compliance with safety standards
* Design and develop printed circuit board (PCB) layouts
* Design a safe and secure enclosure to encompass the hardware components

Graphic Designer: Payton Turnbow

* Develop and implement the front-end of the web application
* Develop and implement the front-end of the mobile application
* Produce icons and graphics as needed for system components
* Create promotional content that represents the features, benefits, and unique selling points of the product

# Project Scope:

Our team will develop and implement a WiFi-controlled air duct damper that allows users to adjust airflow wirelessly and optimizes HVAC system performance. The scope of the project includes the following:

1. Research and analysis:

* Conduct market research and analysis to identify user needs, industry trends, and competitive landscape.
* Conduct a technical feasibility study to evaluate the potential for developing a WiFi-controlled air duct damper.

1. Design and development:

* Develop the WiFi-controlled air duct damper hardware and software.
* Conduct extensive testing and evaluation of the WiFi-controlled air duct damper in various environments.
* Optimize the system's user interface and user experience to improve usability and user control.
* Create comprehensive user documentation and support materials, including user manuals, video tutorials, and customer support services.

1. Implementation and deployment:

* Develop an installation guide to ensure proper installation of the WiFi-controlled air duct damper.
* Work with HVAC contractors and distributors to promote the adoption of the WiFi-controlled air duct damper.
* Provide ongoing technical support and maintenance to ensure the system operates at peak performance.

The solution will include the following features and functionality:

* WiFi-enabled air duct damper with motorized controls.
* Mobile application for iOS and Android devices to control the air duct damper wirelessly.
* Automated adjustment of airflow based on real-time feedback from temperature sensors.
* Customizable scheduling and settings for personalized user control.
* Real-time feedback on airflow and system status to users.

The goal of the project is to develop a cost-effective, energy-efficient, and user-friendly solution for optimizing HVAC system performance and reducing energy consumption.

# Quick Project Timeline:

| **Task #** | **Task Name** | **Duration** | **Start Date** | **End Date** |
| --- | --- | --- | --- | --- |
| 1 | Research and Analysis | 4 weeks | 8/21/2023 | 9/17/2023 |
| 2 | Design and Development | 12 weeks | 9/16/2023 | 12/9/2023 |
| 3 | Testing and Evaluation | 8 weeks | 1/8/2024 | 3/4/2024 |
| 4 | Documentation and Support | 2 weeks | 3/5/2024 | 3/18/2024 |
| 5 | Installation Guide | 2 weeks | 3/19/2024 | 4/1/2024 |
| 6 | Promotion and Deployment | 4 weeks | 4/2/2024 | 4/25/2024 |

# Technologies Used:

For the development and implementation of the WiFi controlled air duct damper, we plan to use the following technologies:

* Microcontroller: We will use a microcontroller to control the damper's movement and to receive and process commands from the WiFi module.
* WiFi module: A WiFi module will be used to enable wireless communication between the damper and the user's smartphone or other devices.
* Mobile application: We will develop a mobile application for users to control the damper. The app will communicate with the WiFi module and allow users to adjust the damper's position.
* Cloud storage: To store the user's preferences and settings, we will use cloud storage. This will enable users to access their preferences and settings from anywhere and on any device.
* PCB design software: We will use PCB design software to design and layout the circuit board for the damper's microcontroller and WiFi module.

# Ethical and Legal Considerations:

As we develop and implement the WiFi controlled air duct damper, we must consider several ethical considerations to ensure that our project is responsible, safe, and beneficial to society. Some of the ethical dilemmas and considerations we need to keep in mind include:

* Privacy: We need to ensure that the user's data, preferences, and settings are kept private and secure. We will use encryption and other security measures to safeguard their information.
* Safety: We need to ensure that the WiFi controlled air duct damper is safe to use and does not pose any risks to users' health or property. We will conduct thorough testing and ensure that the damper meets all relevant safety standards.
* Accessibility: We need to ensure that the WiFi controlled air duct damper is accessible to all users, regardless of their physical abilities. We will ensure that the app and damper are designed with accessibility in mind.
* Environmental impact: We need to consider the environmental impact of our project, particularly in terms of energy consumption. We will ensure that the damper is energy-efficient and has a minimal carbon footprint.

To address these ethical considerations, we will apply the following strategies:

* Conduct regular risk assessments to identify any potential ethical concerns and develop strategies to address them.
* Incorporate ethical considerations into the design process and ensure that the project is aligned with our values and principles.
* Consult with stakeholders and experts to ensure that we are addressing ethical concerns appropriately.
* Develop clear guidelines and policies for data privacy, security, and other ethical considerations.

# Team Rules:

1. All team members will communicate respectfully with one another, acknowledging diverse perspectives and ideas. Any disrespectful behavior will not be tolerated.
2. Team members will be punctual for all scheduled meetings and complete assigned tasks on time.
3. If a team member needs assistance or is struggling with a task, they will reach out to the team for help.
4. Team members will be responsible for keeping accurate records of their work and progress.
5. Any changes to the project plan must be discussed and approved by the Project Manager.
6. Confidential information and data will be kept secure and shared only with team members who have a need to know.
7. All team members will give credit where credit is due and acknowledge sources appropriately.
8. In case of a conflict or disagreement, team members will work towards a resolution through open communication and compromise.
9. All team members will comply with ethical standards and guidelines related to the project.

# Team Signatures:

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Derrick Adkins Daniel Newell**

Project Manager Software Developer

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Cole Pownell Payton Turnbow**

Hardware Developer Graphic Designer

**Project Advisor Signature:**

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Rebekah Michael**

Instructor

# References

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