Abstract:

The humidity fan controller functions as a typical bathroom fan with a few extra options for easier use than a typical on/off setup. It has three user settings which allow for fan control. The user can control the fan with a simple on/off toggle or they may allow the fan usage to be dictated by humidity conditions in the room. If the auto option is toggled, the controller will enable the fan at a certain humidity level. The controller will also increase the fan’s speed at higher humidity levels. The fan will remain active until humidity falls below a set level. This allows the user to completely ignore the fan, while reducing damage to the room from high humidity. Proper fan control is important in rooms with high humidity such as bathrooms to prevent mold development, and minimize long term structural damage.

Additionally, the controller’s on setting can be toggled in 15 minute increments up to a maximum of one hour. This allows the fan to be enabled at maximum speed at the user’s discretion, without the need to turn the fan off again. The user may also hold down the on switch for 5-10 seconds to turn on the fan until turned off or switched to automatic. After the timer runs down, the controller switches back to automatic mode.

Project Description:
This fan controller is composed of five major components; the microcontroller, fan relay, LCD screen, control switches, and humidity sensor(s). The resulting system will detect set humidity levels in the room, and if on the auto setting, will enable and adjust the fan’s speed accordingly. The LCD screen will report back time remaining on the “On” feature. The fan can be disabled with the “Off” selection, or will shut down when humidity falls below the enable threshold in automatic mode. The microcontroller for this system will control all aspects of fan control and humidity detection. Additionally, using an internal timer the microcontroller shall keep track of time enabled in the “On” state.

The microcontroller will need to process data from two sources. The control switches and the humidity sensor(s). The input from the control switches supersedes the humidity sensor(s) input. The control options for the user are relatively simple. The user can choose to turn the fan controller off or on. The off option will disable both the fan, and the humidity sensors. The “On” switch enables the fan at the maximum speed setting. Additionally, when the microcontroller receives an “On” input, the internal timer is enabled. When first enabled, the timer will be set to fifteen minutes. Subsequent inputs will add additional increments of fifteen minutes up to one hour maximum. Should the user hold the on switch for a small increment of 5-10 seconds, the timer is cleared and ignored. The fan will remain on until the user indicates a different control mode. The final option the user may choose, and the default setting for the controller, is the automatic mode. This mode enables the humidity sensor(s) and controls the fan based on that input. The humidity sensor(s) now detect humidity levels and report back to the microcontroller.

The fan control simply enables/disables the attached fan. Once the microcontroller determines that the humidity data has reached a set level, the fan is enabled. The LCD screen serves two purposes. It displays time left on the microcontroller’s internal timer in minutes, and displays the controller’s current state.

**Background and Benefits:**

This project was initially planned as a temperature controlled room fan. It was modified upon recommendation to a humidity controlled fan system. This will be much more useful for me personally, as I have a rather enclosed bathroom. However, the project is useful in almost any enclosed room with high humidity. Bathrooms and showers particularly benefit from good airflow. Excess humidity can lead to faster mold development and growth. Mold can lead to unpleasant odors, a disgusting appearance, can irritate those with allergies, and can cause a multitude of health problems such as respiratory issues, burning eyes, and throat and eye irritation. The long term, mold growth can damage parts of the home it has grown on. While it is difficult to control all mold growth, you can greatly reduce its development by reducing moisture and humidity. Properly ventilated rooms suffer much less from mold growth. Small rooms which have a lot of moisture should either be open to the air, or have a proper ventilation system running. Unfortunately, the room that needs a ventilation system running the most is often where we spend the least amount of time in our homes.
My project is attempting to provide a convenient method for a user to vent rooms such as this. By detecting humidity, the fan can vent the excess moisture even if the user leaves. While a user could turn on a simple fan and then leave it on, this is an unneeded waste of power once the room’s humidity has vented.

**Societal and Global impact**

My project benefits the larger consumer populations with easier fan control. Like mentioned before, mold growth can be severely damaging to homes without proper care. Planning for this will save maintenance and repair work for the owner. Additionally, the longer a home lasts, the more it can be resold to others. Thusly, my project helps long term home building and ownership. Finally, mold can easily cause respiratory damage in high concentrations. So my project has some benefit to the health of the owners of the home.

**Competing products:**

There are several similar products that act as bathroom fans that detect humidity. However, it appears that only one company is in this market. You can find different sizes of fan with various features made by Broan or NuTone. These companies are actually merged as Broan-NuTone. So while the fans themselves might be branded differently, they are not directly competing against each other. They run the price range from the cheapest at 150 dollars to up to 350 dollars on the high end.

![BROAN QTRE100S Bathroom Fan](image1)

The model on the left is the BROAN QTRE100S Bathroom Fan. It’s a simple humidity sensing fan that advertises near silent running and no additional features. A big difference between my design and most of this fan series is the fan control is on the fan unit itself. My design is intended to move the control switches/LCD away from the main control unit/fan. Thusly, my controls can be placed in a wall next to the light switch, instead of controlled on the fan casing.

![Broan-NuTone QTXEN110SFLT 110](image2)

This is the highest end of the model fan. The Broan-NuTone QTXEN110SFLT 110 advertises many more features such as a florescent light, night light, a more complex humidity sensor, as well as expanded timer settings from 5-60 minutes of runtime. This model is not controlled on the casing, which allows for flexible installation. This model is closer to my design.
goal, but throws in extra lighting I don’t believe necessary for my project.

**Project Development:**

The project shall be developed primarily in the Western Washington University engineer lab. The lab computers should be able to provide all the needed software and most of the wiring and soldering can be done there as well. Testing for the device will occur in several private residence bathrooms to check the device's sensitivity in various room dimensions. Initial wiring and testing shall be performed on cheap three speed model home fans. Demonstration should be fairly easy in the engineer building near the readily available sink. Either a small enclosed space can be constructed around the sink to mimic a bathroom environment, or a small spray bottle can be used to replicate higher humidity. However, because my project requires moisture, it is best placed away from other sensitive electronic tools and other projects.