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Automated Oscillating Fan

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Automated Oscillating Fan using Microcontroller

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Introduction

This paper describes an automated oscillating fan which incorporated temperature sensors to inform the fan motor on when to turn on its propeller and a servo motor to position the fan motor in the direction of the highest temperature. The circuit developed is not supposed to activate the fan motor unless a temperature sensor registers a temperature of greater than certain degrees Fahrenheit and be able to determine the area of greatest temperature rise. For instance, if sensors one, two, and three all had same temperature reading, then the micro controller should be able to conclude that the best position would be in the middle which in this case would be sensor 2. This design utilizes both analog and digital components.

Motivation of this Project

The motivation of this project was simply to challenge students learning and applied techniques in the microcontroller course. The life cycle of any built-in prototype starts from brainstorming, schematic design phase, implementation of prototype, programming and then measuring the results. A similar example was illustrated where a light turns on automatically between a high, low, and turn off based on the level of photons in the area. Another example was the usage of flame sensor for the automated car headlights that can also turn on and off a fog light depending on other factors such as refraction of light. This design is a very simplistic approach to the concept with much room to grow; however, that is what a prototype means by definition: a simplified approach to a concept to prove its validity; and then move on with further improvements.

Parts List and Prototype

The core components in this project are temperature sensors, a fan and a servo motor; they are put together in such a way that they inform the fan when to turn on and in what direction to face when sending the air flow. Doing so, the intended result is to circulate, and possibly cool, the stall overheated air in said direction in hopes of easing some of the discomfort created by the airspace. All of the components used in this design are Arduino compatible and intended to do specific jobs, for example the servo motor is only intended to rotate in a circular motion (either clockwise or counter clockwise) and the fan is only commanded to turn on rotating its propeller blades in one direction or turn off stopping the rotation of its propeller blades. Through the combination of all these components being told what to do and when to do it by a Microcontroller, the outcome is an achievable feat. Aside from the electronic components, the device is constructed on a wooden frame with screws and adhesives applied where needed. Figure 1 shows parts needed and prototyping process.

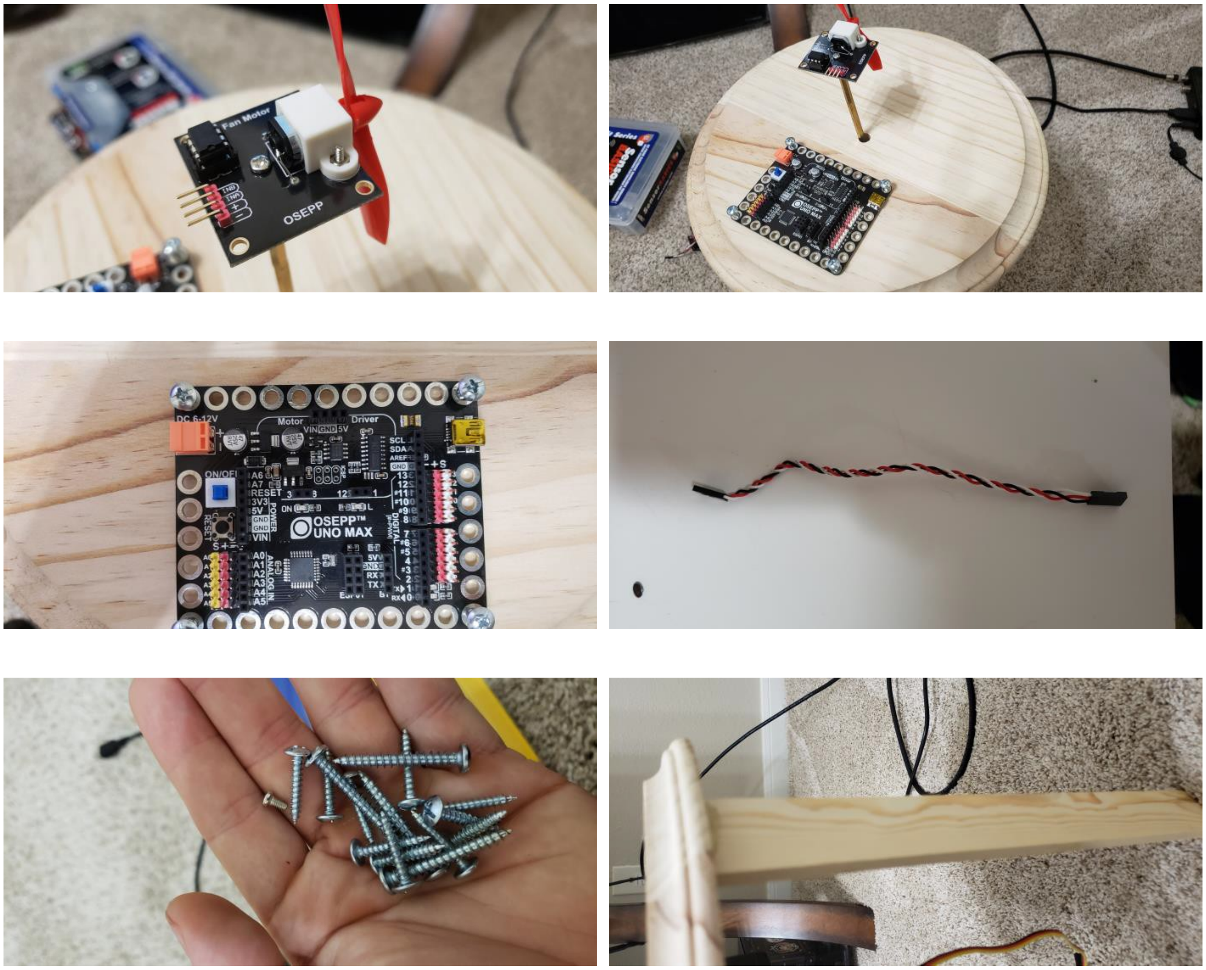
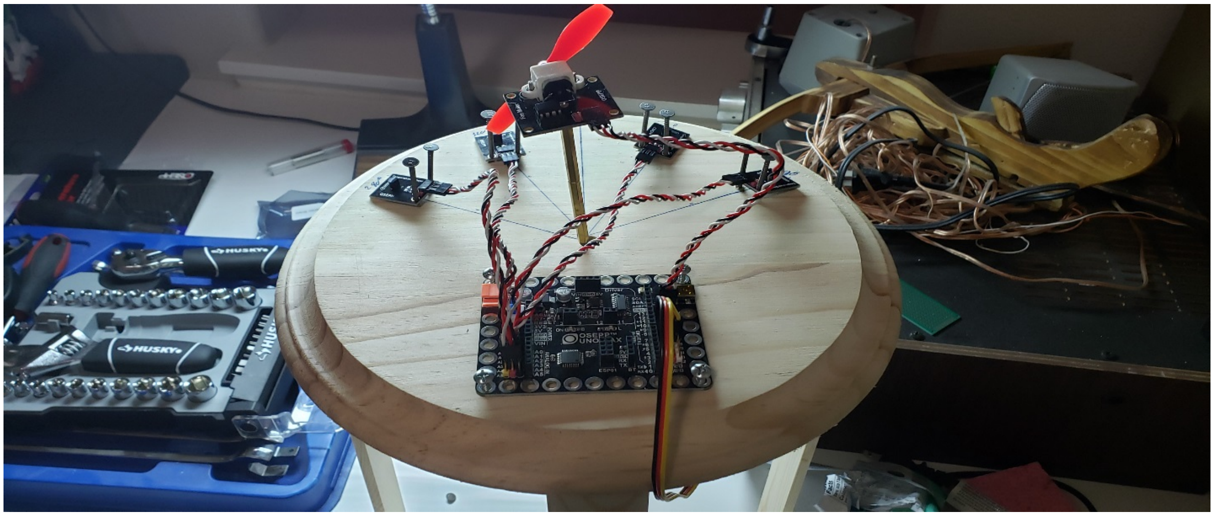


Figure 1: Components used to build the prototype

The main components for the built prototype are self-explanatory. Temperature sensors read/measure the outside ambient room temperature. The fan motor operates the propeller which acts as the cooling agent sending air flow through the area of greatest temperature. The servo motor rotates the pillar that the fan motor is attached to the top of in order to direct the fan motor in the appropriate direction. The jumper wires attach all temperature sensors and the fan motor to the UNO MAX microcontroller board. The metal octagonal cylinders are connected through a cut apart wood screw that is also used as a turning shaft for the servo motor. This in turn is attached on its opposing side to the fan motor with the only used circuit screw. The servo motor is screwed to the wooden housing on the underside of the base (the circular piece of wood) with the turning shaft poking out through a hole in the center of the base to have the fan motors propeller blades safely above all wires and electric components. All temperature sensors and the microcontroller board itself are screwed in place to keep them from shifting their wires around to again keep them away from the fan motors propeller blades. Finally, the structure is held up in the air by four wooden legs to keep the servo motor from taking any of the weight of the device thus not receiving any internal damage which may lead to it grinding through its rotation under strain. The legs were attached by first etching or burning out indentations in the underside of the base to provide more



(a)

(b)

Figure 2: Final prototype

surface area for the adhesive bonding agent to apply to; essentially establishing greater bite to secure the legs to the base. Figure 2 shows the final prototype.

This built prototype has great versatility and a wide range of applications that it can be applied to. Anywhere a traditional oscillating fan can be used this would operate more efficiently such as a cubical office to keep the user of the office space cool or the main frame of their computer cooler in hopes of not overheating; the driver's area of a mass transportation bus, such a school bus so they don't have to worry about positioning the fan or turning it off if it starts to cool down from the sun hiding behind clouds or from rain; any non- air condition regulated environment such as housing on the west coast side of America.

Working Principle

The Microcontroller acts as the brain taking in information from its surrounding sensory components and translating that data to input commands that are sent to the more mechanical components informing them on what to do. In the case of this device the sensory components are the temperature sensors which read the surrounding air in their immediate environment, which is are in proximity of one or two inches, and then send back a voltage signal to the Microcontroller. This voltage signal is then converted through mathematical equations in the programming side of the device into a readable temperature, in this case Fahrenheit. The temperature is used as a reference point to inform the fan on when to turn on.

In other words, if the temperature that is read is over or equal to a stated threshold value, for example 80 degrees Fahrenheit, then the fan turns on and once the temperature drops back down below the threshold value, the fan turns off. The temperature sensor that registers a temperature above the threshold tells the servo motor which direction to point the fan in before turning on as there is more than one temperature sensor in order to utilize the servo motor and cover more surface area then a simple stationary fan. The servo motor is a timed circulation type of motor as opposed to a directional motor so it is told by the Microcontroller, again in the Arduino programming, which direction to rotate in and for how long to rotate in that direction before stopping to reach its designated position. Then it reverses those commands to bring the fan back to its original point of origin when the temperature falls back below the threshold value.

If one temperature sensor exceeds the threshold value, then the fan is directed directly over it if two temperature sensors exceed the threshold value, then the fan is directed to a position in between those two sensors and so on. If the two outer most temperature sensors or all four of the temperature sensors exceed the threshold value then the servo motor is commanded to swing the fan from one outer end to the other outer end of the temperature sensors ranges while it is rotating its propeller blades turning off after a set amount of time. The procedure is repeated until the temperatures from all the sensors drops below the threshold value.

Future Goal and Discussion

We utilized three basic components to make a more sophisticated and elaborate device that is still easy to understand and a great concept to start showing our experience with Microcontroller based devices. The design has lots of room to grow it can have a more enclosed housing design with a compressor and evaporator to produce conditioned air along with an exhaust vent to remove the heat from the cooled down air for a more effective result of reducing a heated environment as well as a much larger fan to cover more surface area and thus become more efficient as well. To do all this it would require being upgraded to more industrial grade components then microcontroller components can provide; but that would also allow it to become marketable and open to commercial use and sale. For this, it would have to be patented and copyrighted which would be the next step before implementing these new improvements. Also, along the same lines of thought it would need a whole new housing design that is more structurally sound, most likely made of some form of plastic material. All of these advancements would cost a good deal more than the original product here which was around one hundred dollars for everything(though components were bought in kits so most likely cheaper per part directly); but on a mass production line buying components in bulk always helps to reduce the price of a product and allows for a more

Table 1: Bill of Materials

Part	Description	Vendor	Price	QTY	EXT
Uno Max OSEPP Microcontroller	Microcontroller used to interpret all I/O signals	Fry's electronics	$24.95	1	**$24.95**
OSEPP Metal Gear Digital Servo Motor	Device used to rotate in commanded direction	Fry's electronics	$29.99	1	**$29.99**
OSEEP Temperature sensor	Device used to monitor fluctuations in temperature	Fry's electronics	$11.99	4	**$47.96**
OSEEP Motorized Fan	Device which turns on rotating a propeller	Fry's electronics	$15.99	1	**$15.99**
Craft wood	Used as legs for structural housing	Michaels	$6.99	4	**$27.96**
Wooden clock face	Used for holding all device components together	Michaels	$15.99	1	**$15.99**
Gorilla glue	Used to secure craft wood to clock face	Home depot	$4.99	1	**$4.99**
Wood screws	Used to secure components to main housing (gathered in home)	N/A	N/A	12	**N/A**
				TOTAL	**$167.83**

economical price range with the added benefits of A/C as well as a dual servo to angle in all directions rather than just left and right and greater range of temperature monitoring for the sake of being able to be more accurate, perhaps an infrared sensor. Table 1 shows the bill of material for this project.

Also, as far as upgrades go, of course adding a compressor to condition the air would be a highly expected choice as mentioned above; however, this would restrict its usage on the west coast of America and any other section of the world with air pollution regulations. Using a Bluetooth connection to connect multiple fans in one room to keep a room cool as a whole would be very beneficial in areas like California if you had sensitive and expensive equipment in a place in your home and were worried about it receiving damage from overheating or excessive heat from the surrounding environment. Adding additional servo motors for longitudinal as well as lateral directions would help point the fans propeller blades more precisely in the specified direction, such as directing the fan motor up or down as well as left or right. With Bluetooth it could even connect to other devices to adjust its temperature controls or to simply turn it on or off to conserve your electric bill or its own self supplied battery power source. Some of these options would just be parts added to the base product at a user's discretion but in order to use them to their fullest one more important part must be incorporated and that would be a hard drive, after all if a user was to tamper with the source code and not know how to correct what they changed there is a strong chance the device may no longer operate the way it was originally intended to and the base source code is quite long.

References

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[3] 101 Sensor Basics (Book style), 2017, pp. 71.