ADAPTIVE DOOR HANDLE

ETECH 100

This portable door handle will allow people with wrist or hand impingements to easily install an adapter and operate door knobs that they would not be able to do on a daily basis.

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Background:

This could come as a benefit to anyone that has an issue with wrist twisting or difficult movements of the hand and fingers.

Our idea for an assistive technology product is an assistive door handle, a product that can be helpful with someone who has any of the following injuries/disabilities:

- Fractured fingers
- Fractured wrists
- Torn ligaments
- Thumb sprains
- Cartilage tears
- Carpal tunnel
- Wrist sprains
- Or any hand/finger related disability

Here are some references to help make our case:

1) Assistive Technology Australia - Door Handles and Hardware

"Door handles and other door hardware may need to be managed with one hand and or with reduced hand function. Lever handles enable ease of grip and benefit from the assistance of gravity to operate, whereas knobs require fine finger control and good grip." (All, 2015)

2) John Hopkins Medicine- Difficulties of Carpel Tunnel

"The median nerve gives feeling to your thumb, and index, middle and ring fingers. When tissues in the carpal tunnel, such as ligaments and tendons, get swollen or inflamed, they press against the median nerve. That pressure results in the symptoms of carpal tunnel syndrome." (Kieffer, 2015)

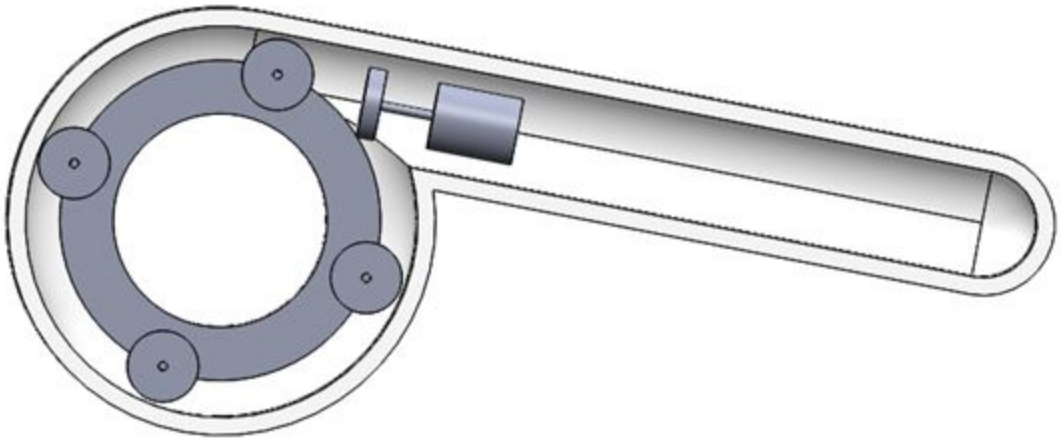
Our group has proposed creating an assistive door handle for people who have arthritis in their hands that makes it difficult to perform tasks with their hands. It seems that arthritis is one of those issues that is hardly addressed in terms of technology that can improve the lives of people affected by it. Arthritis in the hands makes it very difficult to perform everyday tasks such as cooking, writing, and opening doors. To get a better understanding of how it can be

helpful, try this experiment. The assistive door handle is meant to make it so people with severe arthritis can open doors that have door knobs without having to hire someone to replace the knobs, ask someone to open the door for them, or struggle in pain if they live alone. The assistive door knob also provides a means of placing greater torque on the knob to open it without the requirement of increasing effort to open the door. The only thing the user has to do is operate a very small 3-way slide switch that minimizes the movement of the ailing hand while providing the necessary grip and torque to get out the door. If it is used in a nursing home, it makes it that much easier for the caregivers to teach older people with arthritis how to operate the handle since it only has one switch to operate the main parts of the handle that grip the handle as well as a main power switch.

There are two other door handle attachments that are currently in the market right now, and that would include the Door Knob Grip Assistant and the Lever Adaptor.The Door Knob Grip Assistant does help make opening doors a little easier, just because the gripping is a lot nicer. It is also very easy to attach, with just using warm water and putting it over the door knob. It is also a little more flexible on the variety of door knobs it can go on. This item will last a long time and stay on the door knob. It is also one of the economically cheaper items on the market right now. Some would say the look appeal looks a little nicer than the bulky handles that you could get instead. This item is useful, yet it is still limited to the population it can help. Compared to the other door knob attachments, people who use this one will still need better motor control in order to open it. It also a one-time attachment. This means you can use it on one door knob and if you remove it, it no longer has any use.

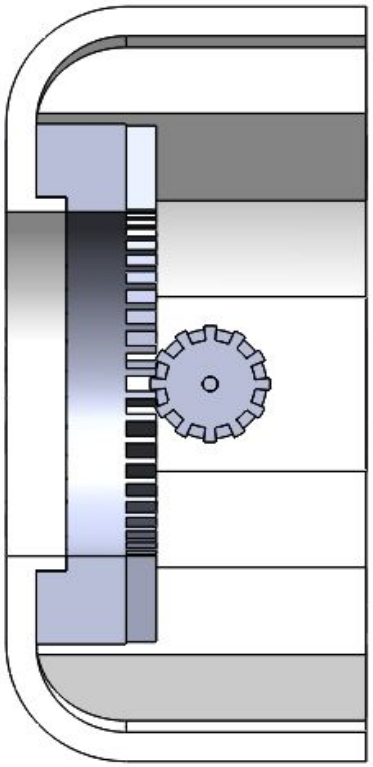
The Lever Adapter makes it easier for all sorts of people to open doors. You don't really need to grip the door handle, since the lever makes it easier to just push down. You do need to screw it in, so it will be very long lasting. It is a lot easier to attach, instead of replacing the door handle all-together. This is an attachment that's more complicated in attaching, since screws and such is involved. This also limits where you can use it, for example you wouldn't want to use it in public places like one's workplace or hotel. It's also limited in what door knobs it can be attached to.

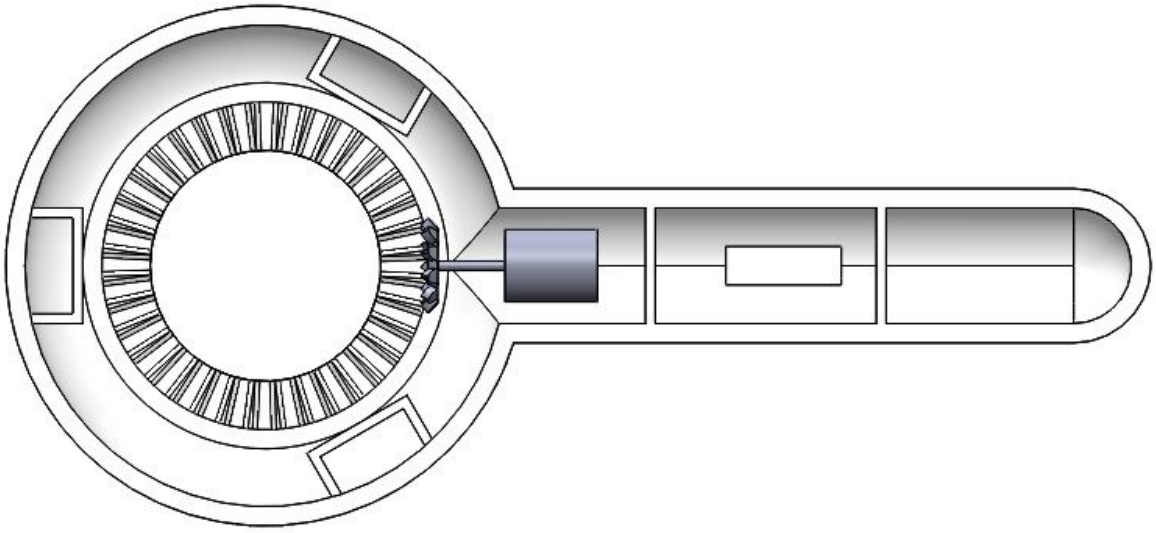
Original Design of Door Knob Adapter:



So how does the assistive door handle work? The battery powers a small processing board that operates a chucking mechanism that grips the door handle when a switch is triggered. When the switch is triggered to the on position, the processor board turns the motor to tighten the chuck with four rubber grips on a rack gear attached to a short series of gears. To make sure the chuck grips the knob hard enough without damaging the motor, a force sensitive resistor will be connected to the processor. When the resistor reaches a certain resistance, the board will cut power to the motor, leaving the handle attached to the knob. After the door is opened, the switch is pressed in the opposite direction until the handle is able to come off the knob with little effort. To ensure the power switch isn't left on, a little 1.8mm LED will be connected in parallel with the main power wires.

Changes Made To The Initial Design:

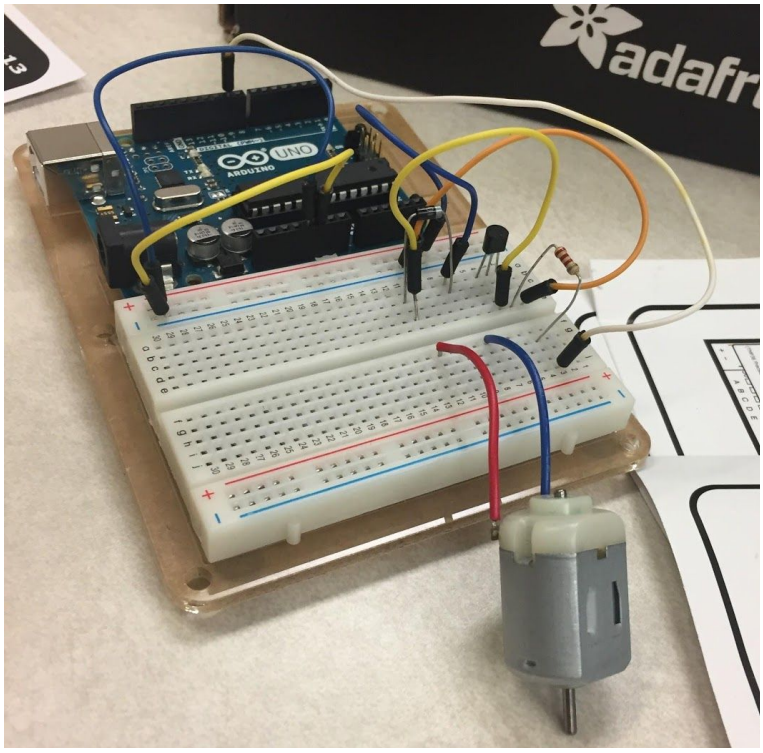


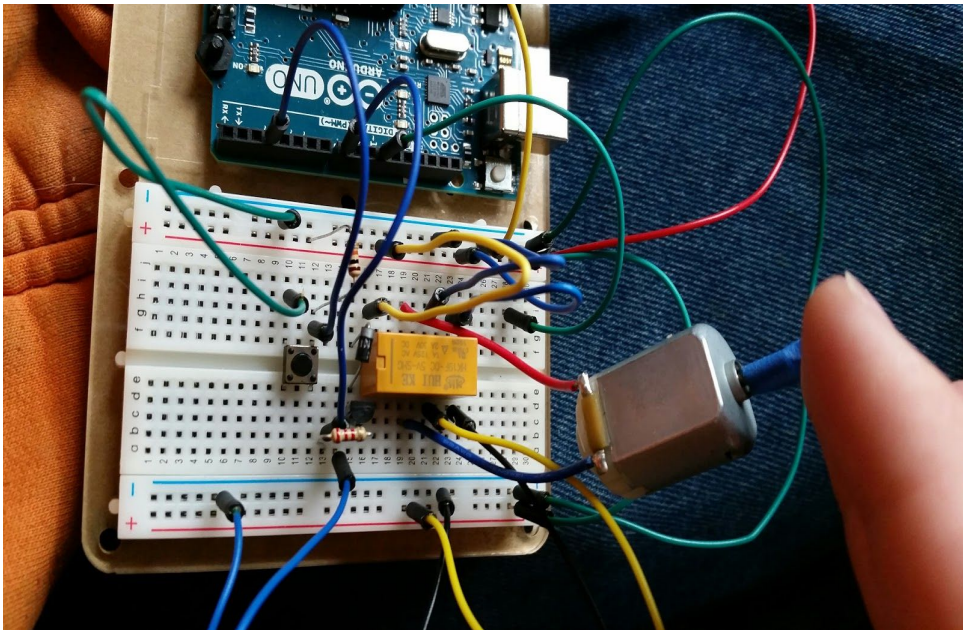


There were some improvements made in the design as we continued our project. For the lever of the handle attachment, we relocated it from the top of the main gear to the center of it so they can connect better. This will make the system more stable. It will also make the door handle more neutral. Since the handle will be attached to both sides of the door, the neutrality is important.The gear train went through several ideas from worm gears to bevel gears. The final solution was to go with bevel gears attached to the motor to ensure that it would mesh better during use and hopefully be less prone to slipping. It was also finally decided that the main gear for turning the whole gear train would not be beveled like the gear attached to the motor. The improved gripping the gears got, brought the potential of it falling apart a lot lower. We are no longer using a 3-way switch or a mini-Arduino board, just because of the accessibility of resources we have. This just means the prototype will have the circuit board and batteries sticking it out of it.

Circuit:

Our circuit was constructed following the lab example of Circuit 07.. With the exception of the force resistive sensor, we were able to use the majority of the logic that we wrote in class.



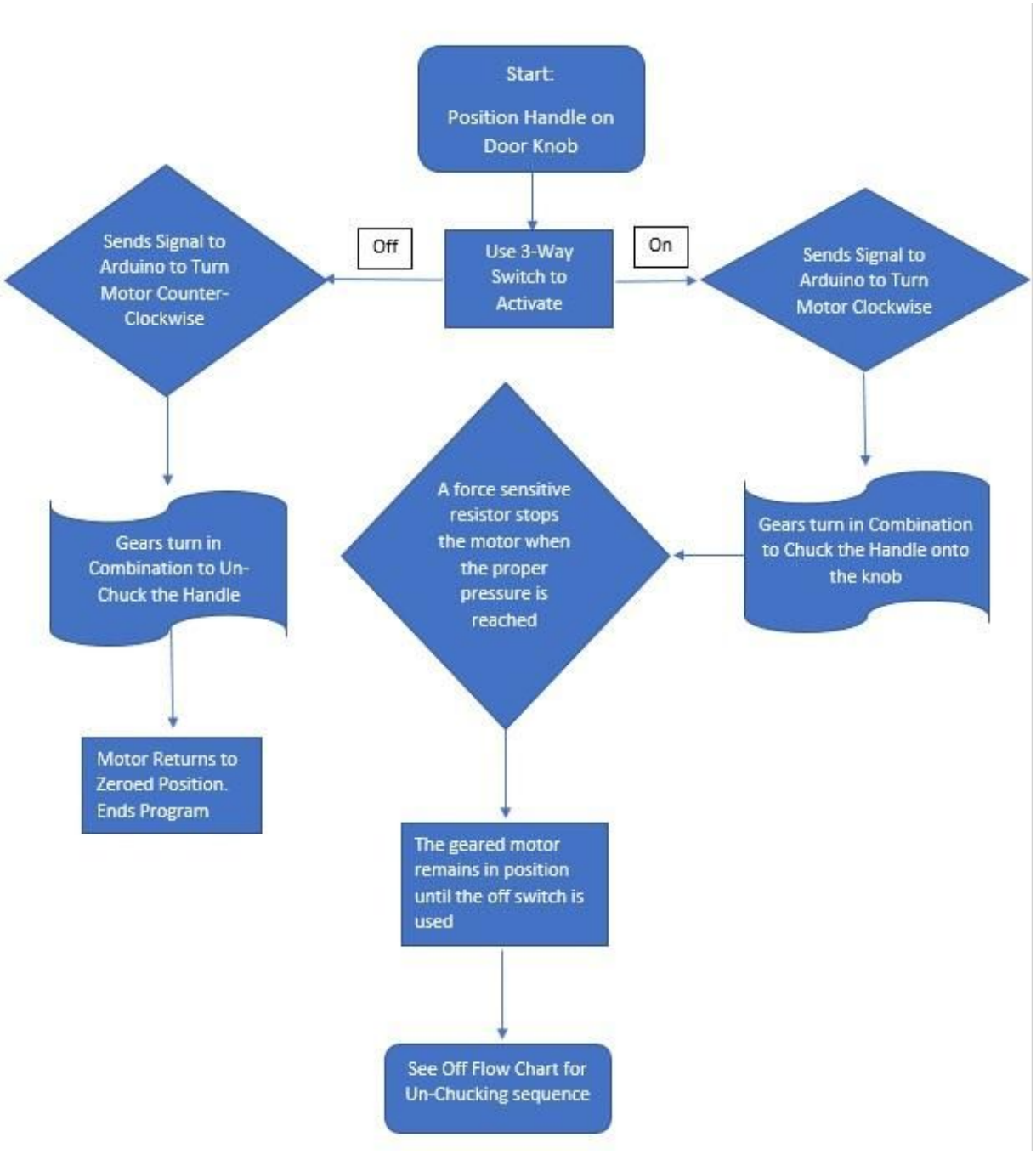


Physical Construction:

The physical construction of a lot of the parts were created using a 3-D printer. The printer uses a spool of ABS plastic. The outer edges of each part has 3 walls of plastic (6 total). The infill varied, depending on the part, from 20%-40%. From left to right, the first pocket contains where our motor will mount. The second pocket is where our switch will be mounted so that the unit can operate. The last pocket is the power supply from which the motor and circuit board will run. All of the gears were also created with the 3-D printer.

Code Logic:

Our code logic follows the following flow chart:



The code has one modification in the loop from what is in the book. You can see the difference in the appendix where the code is stated. The circuit uses only one push button in the experimental photo that will be replaced with a slide switch to change motor direction. Finally, a momentary switch will be wired up in series with the output to the motor from the relay to act as the on/off button for the motor on the clamp. Lastly, the part of the code that says that when input pin 2 is on, to turn on power for the ledPin is what makes the direction control possible as pressing the switch overrides that part of the code.

References:

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Appendix:

Code for Door Adapter

```
int ledPin=8;
int inputPin1=3;
int inputPin2=2;
int value=0;

void setup() {
 Serial.begin(9600);
 pinMode(ledPin, OUTPUT);
 pinMode(inputPin1, INPUT);
 pinMode(inputPin2, INPUT);
}

void loop() {
{if (digitalRead(inputPin1)==HIGH) ←- This is the part that is different from the code in the book.
{digitalWrite(ledPin,LOW);}
else if (digitalRead(inputPin2)==LOW){digitalWrite(ledPin,HIGH);}
}
}
```

Original Code from Book

```
int ledPin=8;
int inputPin1=3;
int inputPin2=2;
int value=0;

void setup() {
 Serial.begin(9600);
 pinMode(ledPin, OUTPUT);
 pinMode(inputPin1, INPUT);
 pinMode(inputPin2, INPUT);
```

```
}

void loop() {
{if (digitalRead(inputPin1)==LOW)
{digitalWrite(ledPin,LOW);}
else if (digitalRead(inputPin2)==LOW){digitalWrite(ledPin,HIGH);}
}
}
```