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Safewalk

Abstract

Each year, millions of adults aged 65 and older fall, causing injuries such as hip fractures and head trauma. This equates to about one out of every three adults aged 65 and older falling at least once per year. One of the benefits of using a walker is to help prevent these injuries. However, walkers do not prevent all accidents, and can even cause some. The Centers for Disease Control and Prevention (CDC) states that 47,000 elderly people are injured per year from cane or walker-related falls, and about 87% of the elderly falls are walker-related. In addition to causing falls, walkers also limit the mobility of the user. These issues inspired our idea of building a walker that could solve them. The two main goals of this project were to prevent falls and provide more mobility than the traditional walker.

The walker uses copper pipes and copper fittings, such as 90 degree elbows and tees, to make up the frame. The walker also uses a tilt sensor connected to a microcontroller, which detects when the walker is falling and triggers a motor to rotate the arm out, which prevents the walker from falling. The walker uses omni wheels, which can roll forward, backward, and sideways, to provide mobility

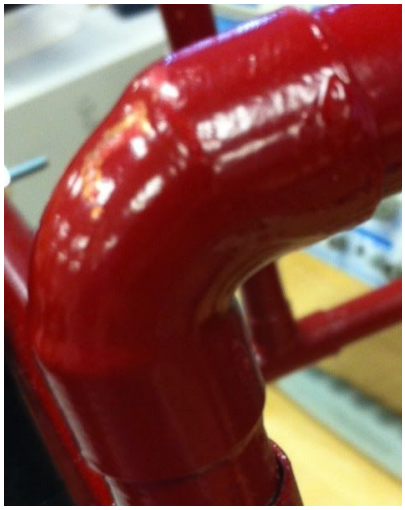
In conclusion, the walker's purpose is to assist the elderly in their mobility issues, as well as help prevent falls among them. These problems have been solved in our walker through the use of omni wheels and a tilt sensor.

Materials

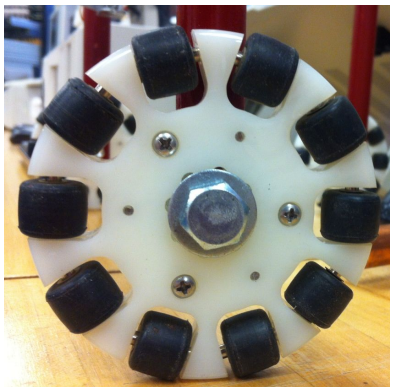
- 15 feet copper pipe ½ inch diameter

- 10 ½" T connectors

- 4 ½" 90-degree elbows

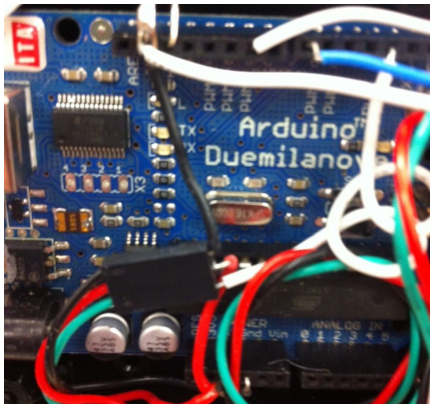


- 4 3” omni wheels

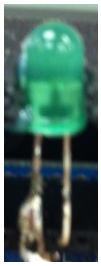


- 1 servo or any other rotating motor

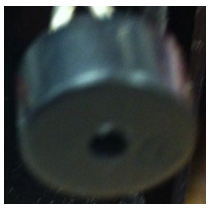
- 1 Arduino Microcontroller



- 1 LED

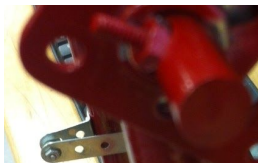


- 1 Buzzer



- 1 box to hold the Arduino, LED, and Buzzer

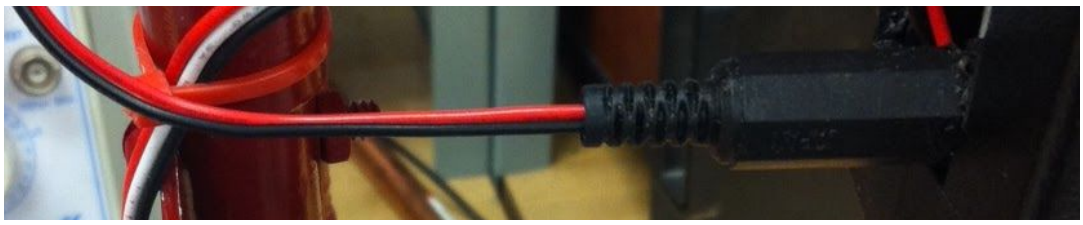
- 1 metal rod less than ½ inch diameter



- 6 zip ties

- 1 9 volt battery

- 1 9V battery to Arduino connecting wire



- 23 bolts and nuts

- 9 washers

- 2 triangular metal plates

- 1 rectangular metal plate

- 1 9V battery box/connector

Step 1 - Cutting the Copper Pipe

Using preferably a pipe cutter, and if not a hack saw, measure the copper pipe to the specified lengths below. Remember to measure twice and cut once to ensure accuracy. After cutting each piece, take a maker and write the part number on pipe. the part numbers will allow for the pieces to be put together and soldered properly.

Main Frame:

1. 4 x 8 ¼”
2. 4 x 6 ¾”
3. 2 x 4 ⅞”
4. 8 x 2 13/16”
5. 2 x 1 ¼”
6. 1 x 9”

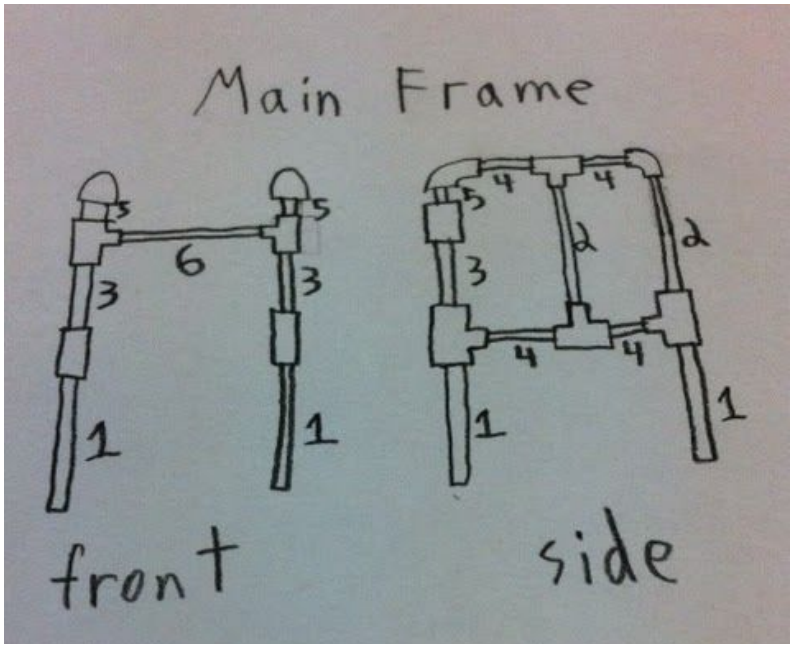
Anti-Fall Arm:

7. 2 x 9”
8. 2 x 8 ½”

Step 2 - Soldering

Find a room with proper ventilation. Prior to soldering, sand the ends of each pipe that need to be soldered. This will create a tighter connection when the parts are soldered together. Next, apply Flux to the ends of the pipe that are to be soldered. The Flux sucks the solder into the joint to create a strong connection. Using a vise, clamp the two parts of the joint that are to be soldered together. Heat the pipe with a blowtorch and and apply the solder thoroughly to the joint. The solder will melt on contact with the pipe. Solder the frame in accord with the picture below:

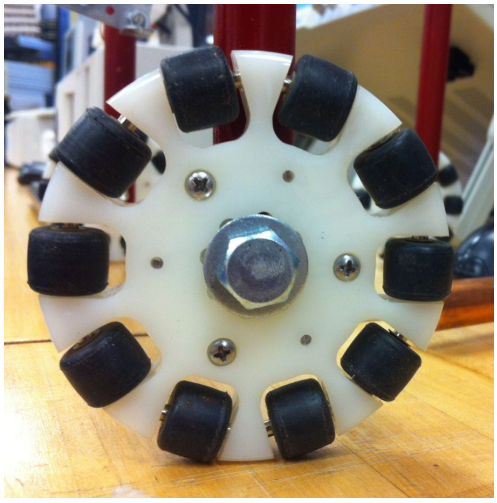
Main Frame:



Anti-Fall Arm:

Step 3 - Attaching the Omni-Wheels

Drill a hole with the same diameter as your bolt about ¼” from the bottom of each leg of the walker for the omni-wheels. Use a nut and a washer on either side of the wheel to bolt the omni-wheels to the outside of the legs. Once complete, it should look like this:



Step 4 - Attaching the Anti-Fall Arm

Once both the main frame and the Anti-Fall Arm are soldered, the next step is to attach them together. The first step in this process is to insert the metal rod inside the pipe labeled 8. The purpose of this is that it makes it easier to attach to the triangular plates. However, before

inserting the rod, drill two holes approximately half an inch away from each edge of the rod so that a screw can later be placed in the hole.Once this is complete, attach the two triangular metal plates to the main frame by drilling two holes in the frame where the plates can be attached with a nut and bolt. The holes should be drilled about a half inch below the tee connector on the pipes labeled 3. Once the triangular plates are attached, it should look like this:

Step 5 - Attaching the Motor to Main Frame

First, drill a hole in the left leg 1 (left when looking at the front of the walker) so that a screw can be inserted. It should be about ¼" below the lower tee connector on that arm. Line up a square metal plate with the hole already drilled, and drill a second hole based on the openings in the metal plate. Bolt the plate onto the leg. Next, use two screws to bolt the servo onto the metal plate. The servo's blades should be be parallel the the metal plate. This assembly should look like this:

Step 6 - Connecting the Servo to the Anti-Fall Arm

Drill a hole into the left arm 7 (left when looking at the front of the walker). Bolt a 1” ‘L’ shaped metal plate to the arm. On the same metal plate, in a hole ¾” from the arm, bolt another 4 ½” metal plate to the right side (from the front of the walker) of the 1” plate, with a ¼” spacer in between. They should be parallel to one another.

Then, at the end of the 4 ½” plate, bolt the a second L-shaped plate on the left side of the 4 ½” plate with the bent part of the L below the 4 ½” plate. Finally, on the same joint, bolt a 2 ½” plate, whose other end is bolted to one arm of the servo.

From left to right on the three-part joint, it should go L, 4 ½” plate, then 2 ½” plate. The picture below shows this completed step.

Step 7 - The Box

A box will be mounted on part 6 (the bar going across the main frame). The box contains an Arduino controller, tilt sensor, buzzer, and LED. Drill two holes aligned in the middle of the box horizontally about 2” apart. Drill two similarly sized and spaced holes in the middle of part 6. Bolt the box to part 6 and make sure to put the bolt in through the box first. Next, glue the back of the Arduino controller to the the side of the box bolted to the main frame. Make sure that port for the power supply is on the left side (from the front view) of the walker, on the same side as the servo. Drill a hole on the top side of the box and glue the LED so that it is sticking out the box and can be seen. Next, position and glue the tilt sensor slightly tilted forward so that the sensor goes off right after the walker starts to tilt. This may take some trial and error. After, drill a hole on the front side of the box, for the sound of the buzzer to come out. Glue the buzzer to the inside front part of the box and align the speaker on the buzzer with the hole previously drilled. Then cut a 1 ½” by 1” square from the left side of the box so that the power cord can connect to the microcontroller and this will also leave room for the wires connected to the servo. Connect all wires to the Arduino controller following the code.

Step 8 - Power and Wiring

Once the box is attached, get a 9 volt battery box. Plug in the cord to the Arduino through the hole previously cut. Use two zip ties to secure the battery box to the underside of part 4 on the side of the servo.

The wires that come out of the servo will be too short to reach the Arduino in the box. Use three different wires about 12 - 15” to connect each of the three wires from the servo to the Arduino. After soldering the wires together to make three longer ones, use heatshrink to cover the open wires. Cut the heatshrink long enough to cover the open wires, position the tube over the open wires, then apply heat to the material to make it shrink over the soldering joint. This can be done with a soldering iron, heat gun, or a lighter. Connect the three wires to the correct ports on the Arduino controller, following the instruction of the code. Finally, use zip ties to secure the wires to the frame of the walker.

Final Step - Uploading the Code

Upload the following code to the Arduino:

```
//safewalk code; extends emergency kickout to prevent walker from tilting over
//using a tilt sensor, servo, arduino Micro controller.
//
#include <Servo.h>
Servo kickout;
int tonePin = 7;          // speaker connected to pin 7
int ledPin = 13;          // Connect LED to pin 13
int switcher = 3;                 // Connect Tilt sensor to Pin 3
void setup()
{
pinMode(tonePin,OUTPUT);
```

```
pinMode(ledPin, OUTPUT);     // Set digital pin 13 to output mode
pinMode(switcher,INPUT);      // Set digital pin 3 to input mode
}
void loop()
{
  digitalWrite(ledPin, HIGH); //FLASH LED
  if(digitalRead(switcher)==HIGH) //Read sensor value
            {
  digitalWrite(ledPin, HIGH); //Turn on LED when the sensor is tilted
  kickout.attach(9);
  kickout.write(60);
  tone(tonePin, 200000, 200);// Turns on Primer sound
  tone(tonePin, 5000, 200);// Turns on 2nd sound
  }
  else
  {
  kickout.attach(9);
  kickout.write(180);
  digitalWrite(ledPin, LOW);     // Turn off LED when the sensor is not triggered
  noTone(tonePin);
  }

  }
```

Final Product




Safewalk in Action
https://www.youtube.com/watch?v=0U4NmUzq9Cc&feature=youtu.be