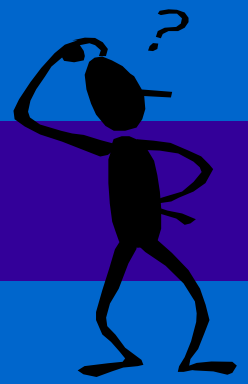
The Cabinet Fit for Everyone

By Rami Guirguis

Today's Cabinets

- Fixed against the wall
- Very sturdy
- Can be custom built to suit personal style

Why do we need a new type of cabinet?



- Virtually impossible for certain people with disabilities to access any part of the cabinet
- To help give people a sense of independence
- To prevent any injuries from failed attempts to reach high levels

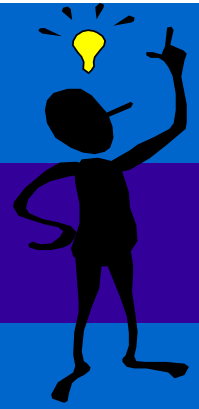
Literature search

- Difference between sitting and standing is about the length of the femur.
- If the average height of a male is 70 inches, then the average length of a femur is about 17.5 inches.
- This means that the height difference that a person in a wheelchair experiences is about 17.5 inches.
- To adjust their upper body to fit everyday devices, they need to be elevated 17.5 inches or have the devices descend 17.5 inches

What do we already know?

- Standard cabinet is 54 inches off the ground
- Standard counters are 36 inches high (18 in)
- Handicapped accessible counters are 34 inches high (20 in)
- Cabinets are no more than 36 inches wide
- 30 inches high
- About 12 inches deep
- Made of 3/4” plywood
- Withstand up to 100 lbs load

Proposed Solution (Goals)



- Build a cabinet with an inside track that is able to move up and down while the outside frame remains fixed to the wall
- Leave the front face of the inside frame open so items can be accessed through cabinet doors.
- Control the movement of the inner frame with a push of a button
- Allow a wheelchair bound person access to the items throughout the cabinet

Specifications

- Raise and lower the inner frame at about 6 inches/second
- Adjust the drive so that the inner frame descends 18-20 inches.
- Be able to support twice the maximum expected weight to be supported (300 lbs)
- Keep the design within given dimensions (30Hx36Wx12D)
- Use a wire rope thickness that can withstand the stress from the weight of the inner frame

Equations

- Weight to be supported: F=2(50 +100)=300 lbs
- RPM of spool for desired speed: W2=(6 in/s)/(pi*1.125)*60= 101.85 rpm
- T2=F(R3)
  - T2 = (300)*(1.125/2 in)
  - T2 = 168.75 in*lbs
- Hp = (T2)*(W2)/(5252)
  - Hp = (168.75 in*lbs)*(101.856 rpm)/(5252*12)
  - Hp = .2727
- MINIMUM Hp needed is .2727

Components Used

- Motor: Standard garage door opener
  - 1/2 Hp of power
  - Worm driven
  - Own control circuit and controllers
  - AC Powered
  - Reversible
  - Small
- Spool: Rear bicycle hub
  - Bearings to reduce friction
  - Mount for gears.
  - Axles can be mounted anywhere
  - Spool diameter = 1.125 in
  - Gear diameter = 1.331 in

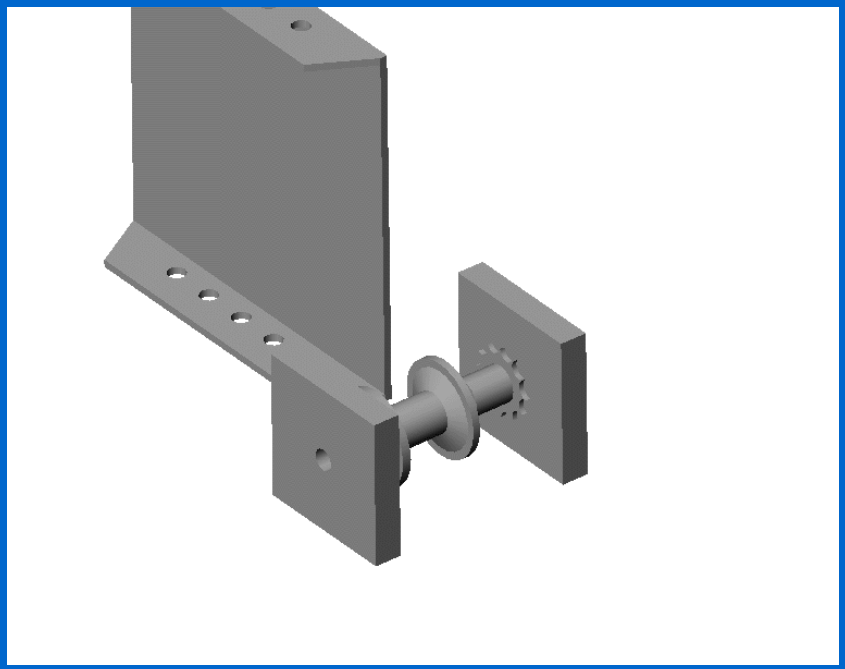
Equations

- Power provided: 1/2 Hp
- Motor speed measured: W1=108.52 rpm
- Hp = T1 * rpm /63024
  - 1/2 = T1 * (108.52 rpm) /63024
  - T1= 290.37 in*lbs
- (pi)*(D1)*(W1) = (pi)*(D2)*(W2)
  - (1.25 in)*(108.52 rpm) = (D2 in)*(101.85 rpm)
  - D2 = 1.331 in
- HP = (T1)*(W1)/(63024) = (T2)*(W2)/(63024)
  - (290.37 in*lbs)*(108.52 rpm)=T2 *(101.85rpm)
  - T2= 309.38 in*lbs

Equations (cont)

- T2 = 309.38 in*lbs
- T2=F(R3)
  - 309.2504 in*lbs = (F)*(1.125/2 in)
  - F = 549 lbs
- Maximum load is 549 lbs

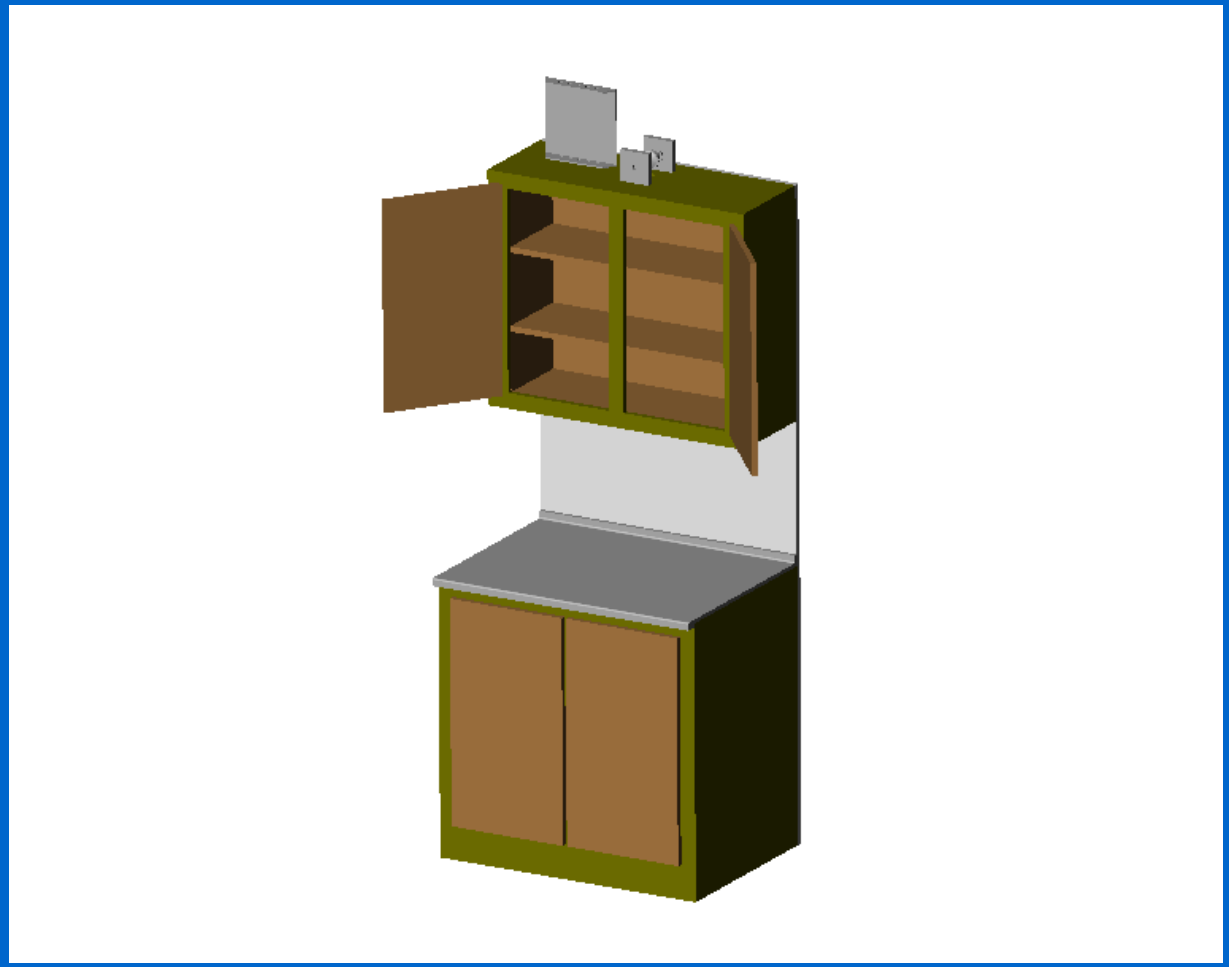
Motor and Spool



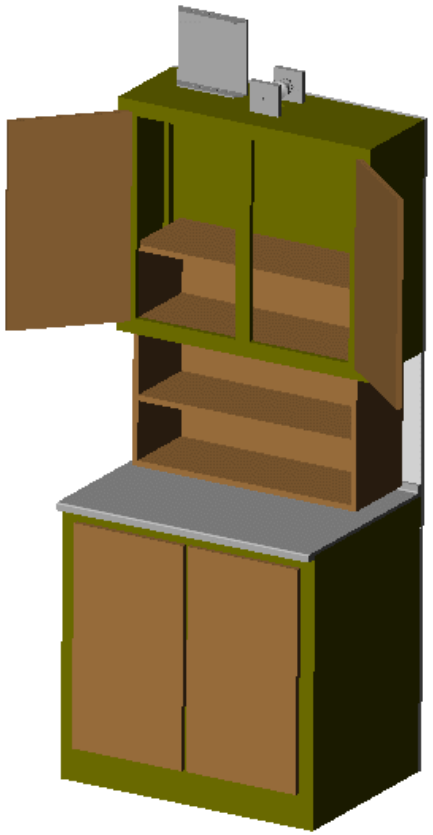
Unused Space

So after assembling everything together, what does it look like?

Model (opened)



Inner Track Down



Improvements made

- Access to shelves improved by 18 inches
- Items remain accessible in up position
- Motor was hidden in compartment
- Controls are easily operated by everyone
- Maintained original look of shelf - keeps kitchen looking nice

Bill Of Materials

- Approximately 200 dollars worth of alterations were made to convert cabinet
- 1 motor, wire rope, chain - $130
- 3/4” plywood - $60
- Spool - Donated (about $10-15)
- Hardware supplies - $10

References

- Norton, Machine Design: An Integrated Apporach
- Enderle J., Blanchard S., Bronzino J., Introduction to Biomedical Engineering

Any Questions?