

Abstract

Multiple Sclerosis (MS) is a degenerative condition caused by destruction of myelin sheath of neuronal axons, resulting in decreased function. Our client has MS and requires his iPhone during driving. Currently it is in the center of the steering wheel but turns as the wheel is rotated. A device is required to keep the iPhone upright and maintain its position.

Background

- MS: inflammatory disease affecting Central Nervous System (CNS)
- Healthy neurons: insulated by myelin sheath
 - Propagate electrical signals
- MS: immune system attacks the myelin sheath
 - Signal damping
 - Decreased propagation speed
 - Neuronal degradation
- Common symptoms:
 - Muscle weakness
 - Disorientation
 - Decreased memory
- Client requires iPhone to be in center of steering wheel
 - Optimal position
 - Navigation
 - Reminders
- Current products not designed for placement on steering wheel
 - Prices range between \$5.00-\$60.00

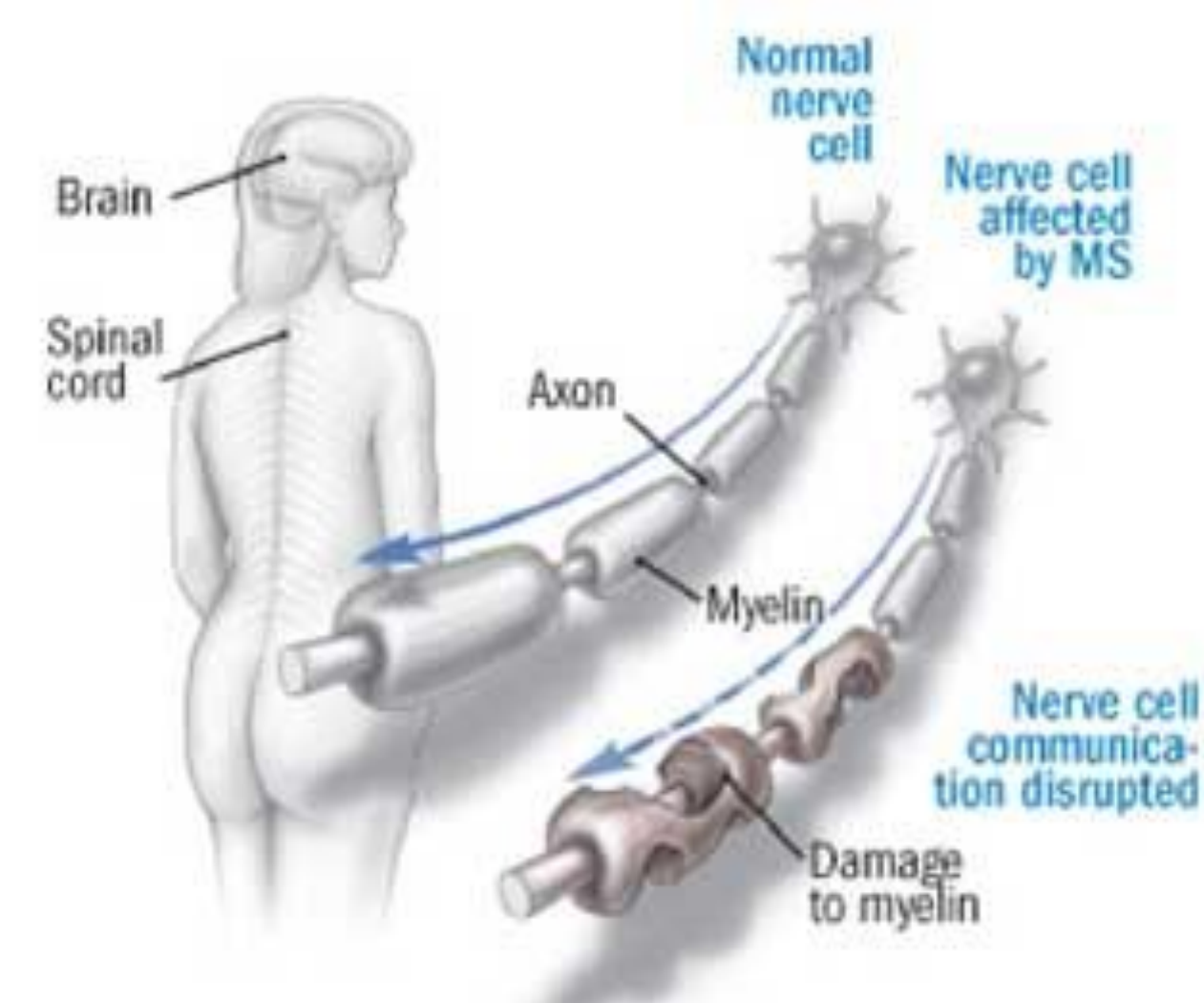


Figure 1: MS degrades myelin sheath in neurons



Figure 2: Current position of iPhone

Design Requirements

- Securely attach iPhone to center of steering wheel
 - Elevation and distance
- Remain upright
- Cannot obstruct airbag deployment
- Versatile to different phone and car models
- \$300 budget

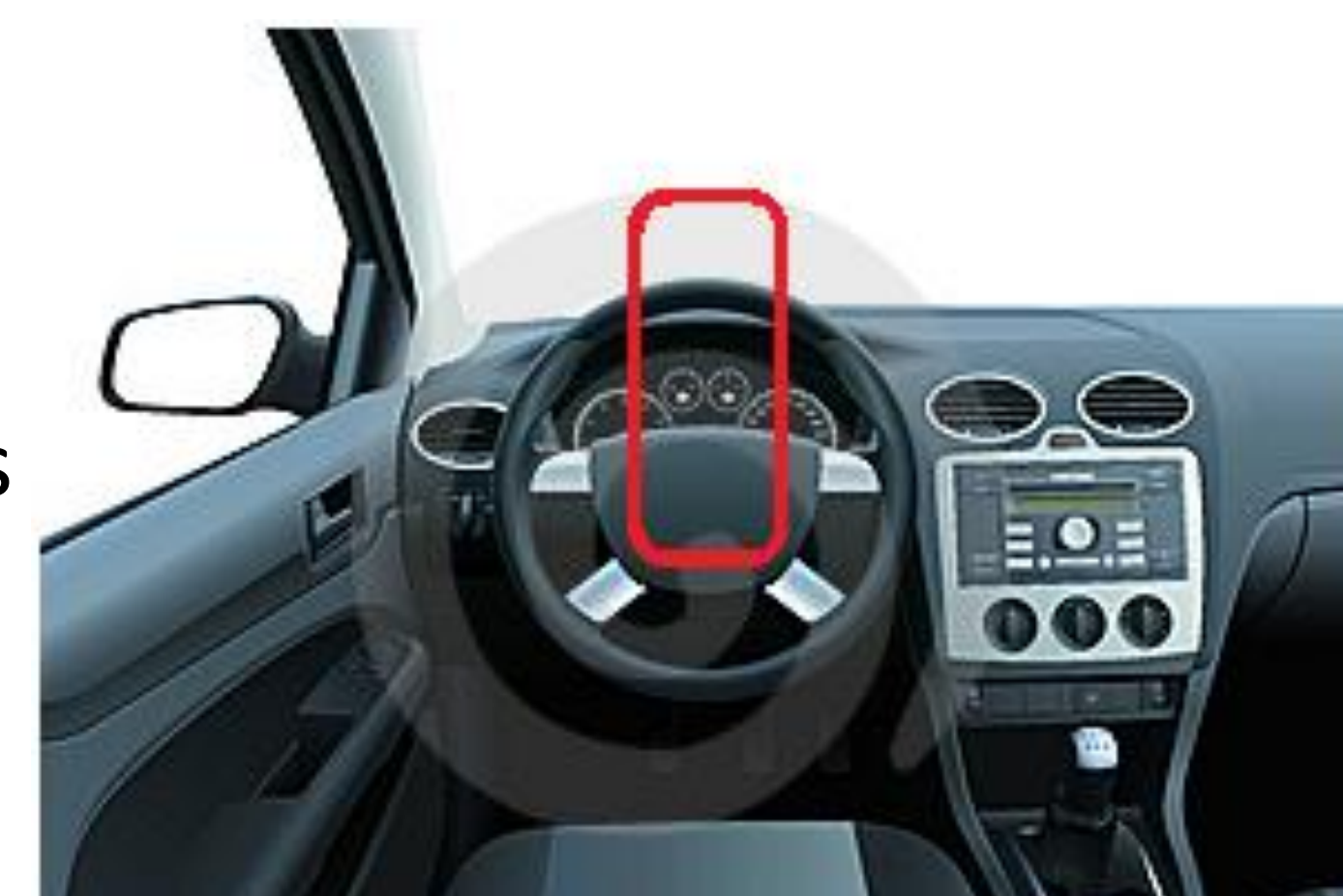


Figure 3: Ideal elevation

Final Design

Our final design comprises the following:

- Solid backing
- Stepper motor
- iPhone cover
- Velcro straps

Features:

- Stepper motor allows iPhone to rotate freely
- Weights on bottom of iPhone maintain its vertical position
- Attached to steering wheel via velcro straps
 - Riveted at top of board
 - Velcro at bottom of board
 - Allow device to be pushed aside by airbag
- Optimal position and distance

Prototype Creation

Solid backing and stepper motor:

- CD-ROM drive donated by UW-Madison Mechanical Engineering Department
- Stepping motor including CD interface extracted
- Plexiglas front plate glued to stepper motor
 - Weights glued to bottom
- Plexiglas back plate screwed to stepper motor

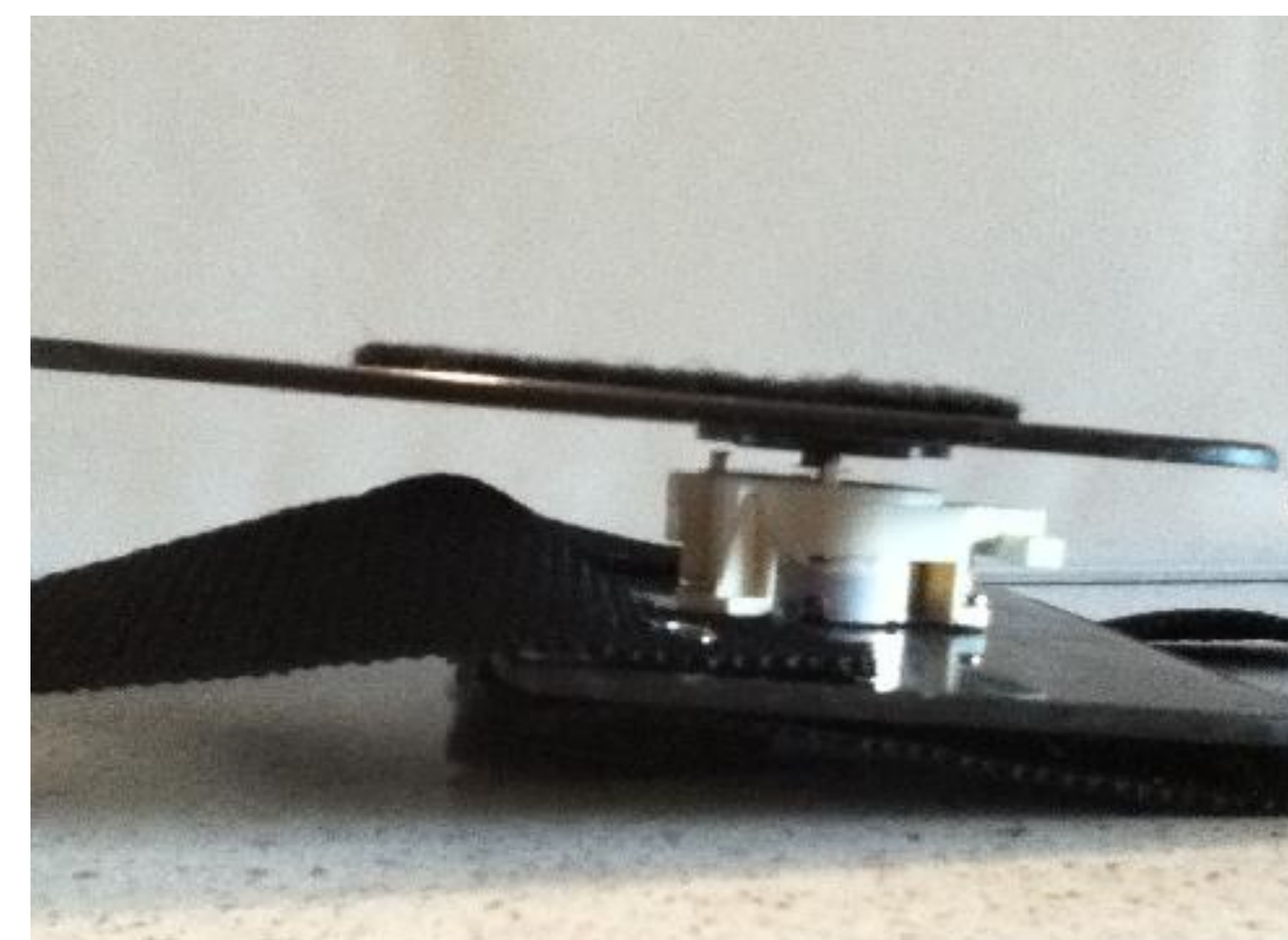


Figure 4: Side view of prototype

iPhone cover and straps:

- iPhone cover attached to front plate using velcro
 - Adjustable
- Nylon straps riveted to back plate
- Device attached to steering wheel using velcro
 - Removable and customizable

Testing

Client opinion:

- Prototypes evaluated by client
 - Average prototype score: 9.8

Driving:

- Device maintained vertical position
- Angle of deflection did not exceed 25°
- Little or no swinging

Strength of straps:

- Compare methods of attaching straps to solid backing
- Force required to induce failure measured
 - Nylon straps riveted to board: 264N (average)
 - Nylon straps glued to board: 88.5N
- Force required for device to remain attached during airbag deployment
 - 422N (calculated)



Figure 5: Client trying out the prototype

Budget

- Total spent: \$47.31 (2 prototypes)
- Marginal Cost (per device): \$113.96
- Materials: \$23.96
 - Stepper motor, nylon and velcro straps, rivets, plexiglas
- Labor: \$90.00
 - Inclusive of overhead costs and wages
 - Estimated 3 hours at hourly salary of \$30 per hour

Future Work

- Design and implement stronger method to attach straps to board
 - Mountaineering-stitched straps looped through slits
- Simulate airbag deployment using LSDYNA software
- Modify design to accommodate different phone and car models

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