

Pusher Syndrome Assist Device

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Pusher Syndrome

- **Stroke**
 - Age 65+
- **Special case of hemiparesis**
 - Normal stroke patients favor strong side
 - Patients “push” to their weak side
- **Increased complications**
 - Falling risk
 - Increased recovery time

(Karnath et al.)

Pusher Syndrome



(Karnath et al.)

Pusher Syndrome

- Patients have distorted balance
 - Perceive upright at ~18 degrees to their strong side
- Can correctly determine a visual vertical
- Why do patients push to their weak side?

(Karnath et al.)

Pusher Syndrome

- Overcorrection
- Brain realizes that internal balance is off
- Tries to correct in the other direction
- Weakness increases issue

(Karnath et al.)

Current Treatment

1. Visual > Proprioception
2. Give patient visual, vocal, and tactile cues to correct
- 3. Maintain vertical position while doing other activities**

(Karnath et al.)

Need

Maintain vertical position while doing other activities

- A device to provide feedback in the absence of a physical therapist.
- Extend the amount of time spent learning correct orientation

Project Scope

- Wearable device
- Provides feedback past a determined threshold
- Deployable in a physical therapy setting

Design Requirements

- Cost
- Weight
- Ease of Use
- Precision
- Wearable
- Displacement Range
- Real time feedback

Calculations

- Weight
 - Limiting dimension at the 5th percentile
 - 5th percentile for women age 70-74 = 46 kg
 - Comfortable carrying rate: ~5% of body weight
 - $46 \text{ kg} \times 0.05 = 2.3 \text{ kg}$

(Perissinotto et al.; Zingale; Ahlstrom et al.)

Calculations

- Sampling Rate

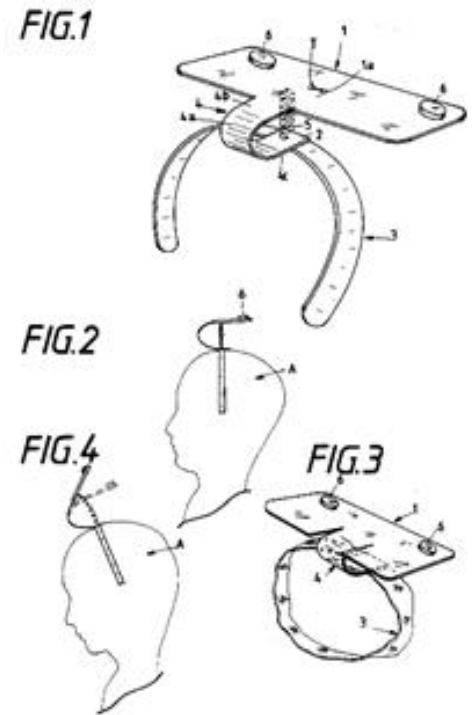
(Feldman et al.)

- Real time feedback
 - Response faster than average reaction time
- Elderly reaction time
 - ~350 ms for tactile, ~300 ms for auditory signals
- Nyquist frequency = $1 / .3 \text{ seconds} = 3.33 \text{ Hz}$
- Sampling Rate = $2 \times \text{Nyquist Frequency}$
- Min. Sampling Rate = $2 \times 3.33 \text{ Hz} = 6.66 \text{ Hz}$

Existing Solutions

Unstably supported plate

- Board flips forward to alert the user
- Pros: Mechanical
- Cons: Awkward, unreliable
- US Patent #5,337,759



Existing Solutions

Sensor belts

- Detects posture through changes in belt
- Produce vibration or audible signal
- Pros: Discreet, adjustable, simple
- Cons: Do not measure lateral flexion
- US Patents: #8,157,752, #5,749,838, #4,938,476, #4,871,998

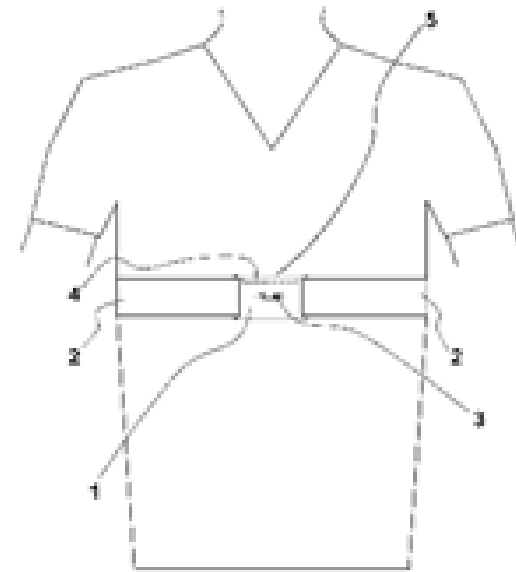


Fig. 3

Existing Solutions

Posture vest

- Physically inhibits movement
- Pros: Actively encourages posture
- Cons: Can be uncomfortable, restraining, does not address underlying cause
- US Patent #: 7,901,371



FIG. 1

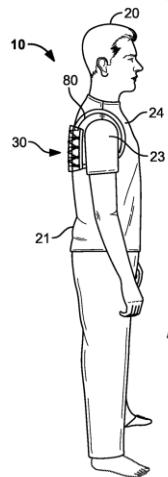


FIG. 2

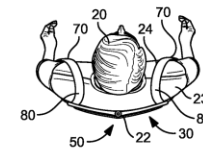


FIG. 3

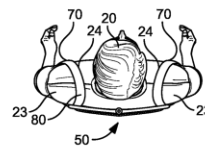
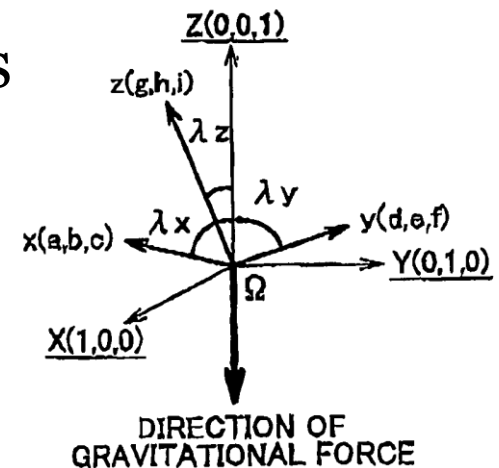
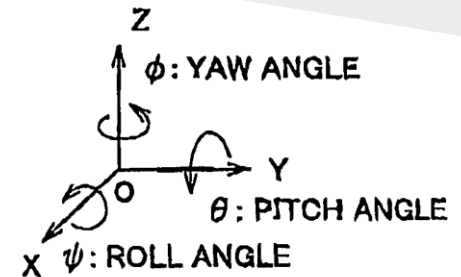


FIG. 4

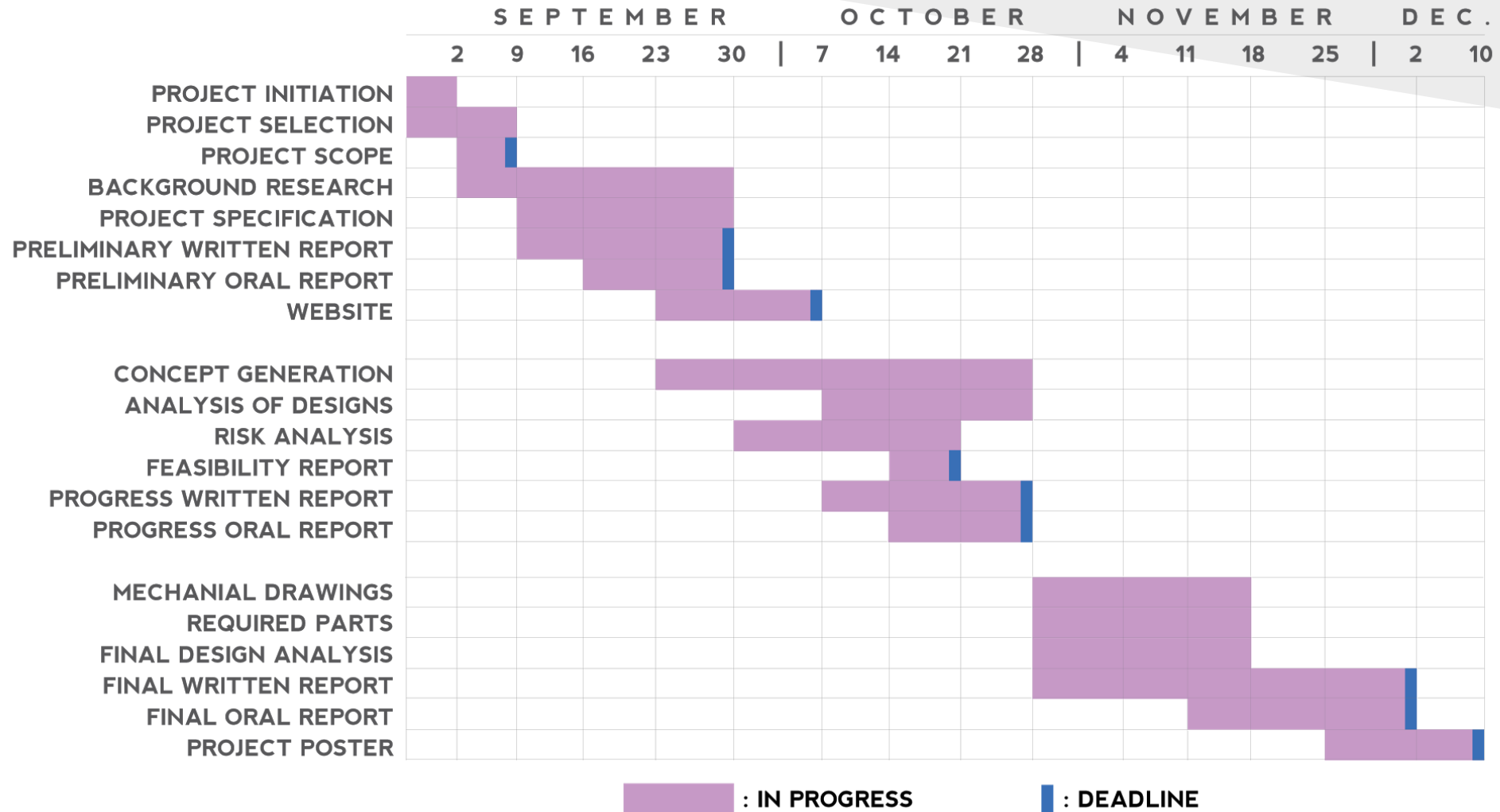
Existing Solutions

Accelerometers/Gyroscopes

- Calculate angles based off of the force of gravity/angular rotation
- Pros: Robust, accurate measurements
- Cons: Drift, cost, more complex
- US Patent #: 7,949,487



Design Schedule



Member Responsibilities

	JAKE	DAVID	PAT
IDEA GENERATION			
DEVICE COMPONENTS			
SENSOR/INTERNAL COMPONENTS			
FEEDBACK SYSTEM			
USER INTERFACE			
INTERFACE DESIGN			
WEARABLE COMPONENT			
MATHEMATICAL CALCULATIONS			
RESEARCH			
FEASIBILITY			
LITERATURE SEARCH			
EXISTING PRODUCTS			
PRICES + QUOTES			
RISK ASSESSMENT			
WEBSITE			
CLIENT INTERACTION			
PRESENTATIONS			
PRELIMINARY			
PROGRESS			
FINAL			
REPORTS			
INITIALIZING			
EDITING			
FIGURES AND SKETCHES			
SCHEDULING			
INTELLECTUAL PROPERTY			

Questions?

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