STROKE FEEDBACK SYSTEM

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Client: Dr. Alex Carter

Stroke and Hemiparesis

- Stroke is the 4th most common cause of death in the U.S
- Hemiparesis- weakening or inability to use one side of body (1, 2)
- Caused by lesions in the primary motor cortices
- Inability to perform daily tasks
- Hand function/dexterity is important for normal activities

Neural Pathways

- Hypothesized that brain shuts down ineffective pathways (Liepert 2000)
- Stroke patients often cannot recognize successful movements
- Motor pathway then seems unsuccessful
- Need device to provide feedback for activation of successful motor neuron pathway
- Multimodal sensory feedback is being investigated as an addition to therapy regimen (Huang, 2005 and Lövquist, 2006)

Current Therapeutic Approaches/Exercises

- Constraint-Induced Movement Therapy
- Bobath Concept (Neurodevelopment treatment)
- Music supported therapy

- Sample exercises that target fine motor control
  - Stack pennies.
  - Turn cards over
  - Practice writing.
  - Pinch clothespins
  - Assemble nuts and bolts.
  - String beads.
  - Play checkers.
  - Put together puzzles.
  - Play the piano.
  - Practice typing.

Scope and Goals

- Develop a feedback amplifier for use in rehabilitation
- Sensory feedback should be identifiable by the patient
- Sensory feedback should be multimodal
- System should be accessible across wide range of users
- System should be transportable around hospital or clinic

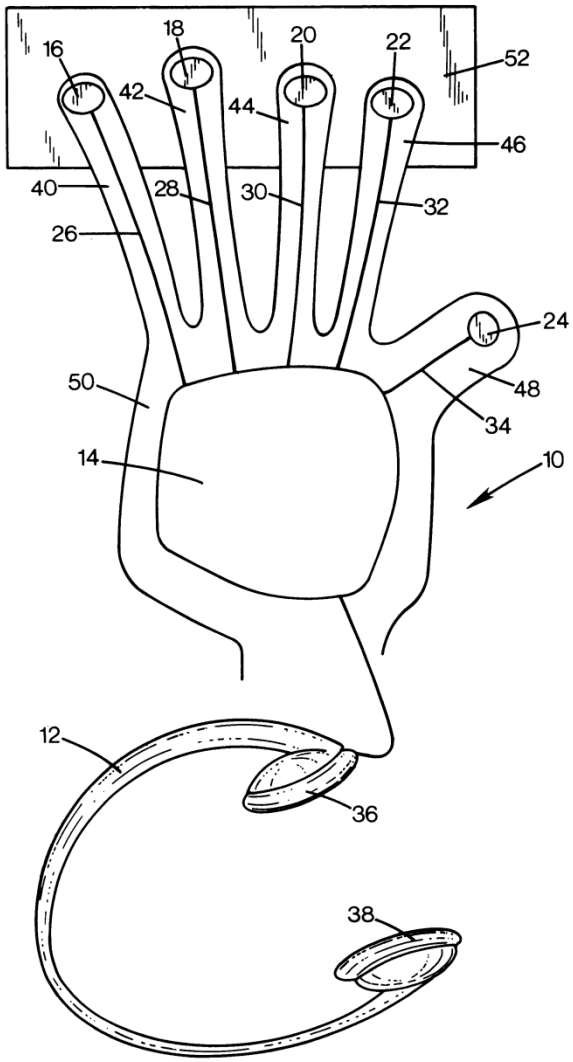
Design Specifications

- Sensory feedback will be in sensible ranges, ex: auditory ~ 60 dB
- At least 2 modes of sensory feedback
- Needs to be usable with hand circumferences between 17 and 25 cm
- System less than 5 kg, with less than 1 kg on the hand
- System needs resolution of 5° on proximal phalange, or distance resolution of $s / r = \theta$, where θ is 5° and *r* is the distance from the metacarpophalangeal joint to the proximal interphalangeal joint.
- Sampling rate: 22 Hz is highest meaningful frequency in finger tapping (Jobbagy, 2005)

$$Rate_{Nyq} = 2 f_{\max}$$

  - Sampling at 100 Hz would be optimal to reduce error, enhance resolution

Existing Solutions

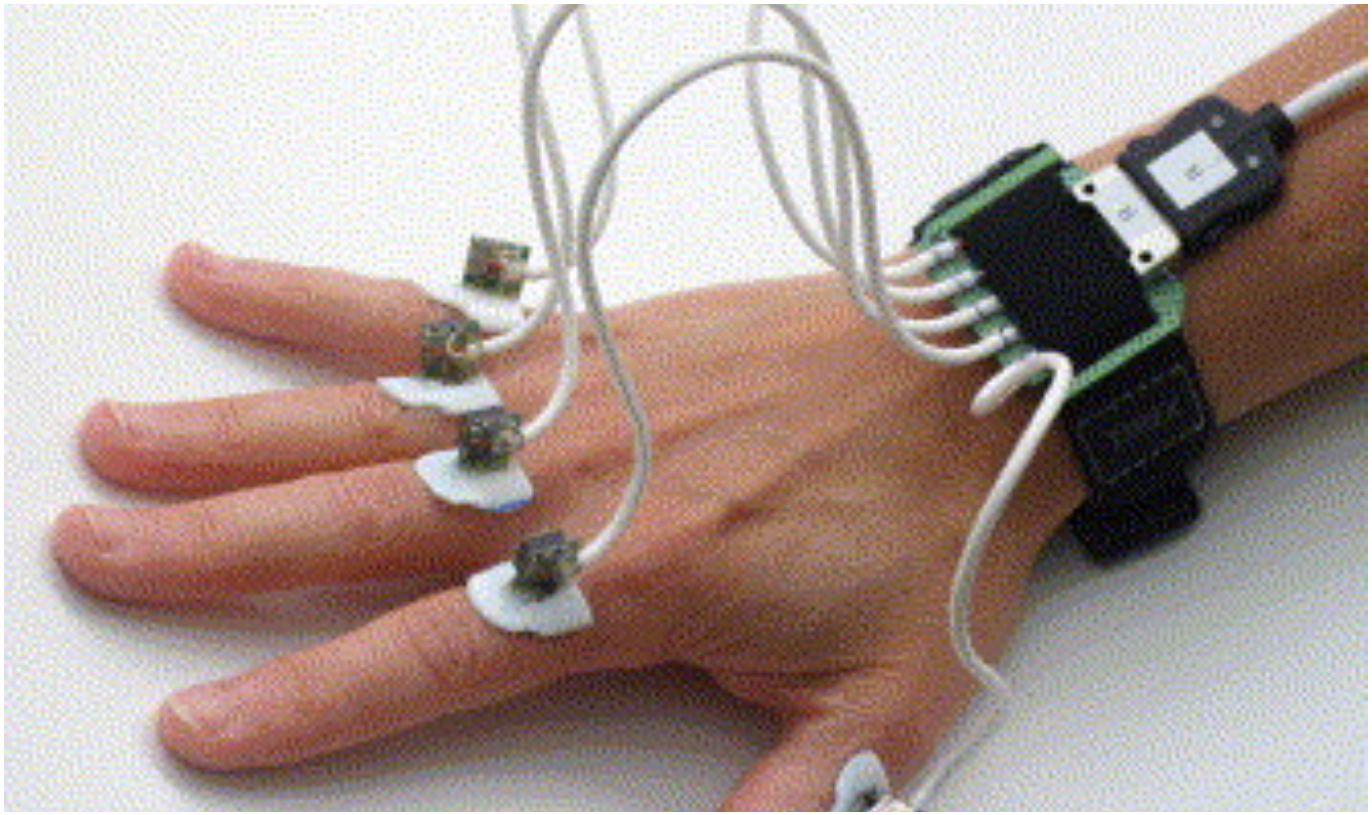


16	100%	0%
18	75	25
20	50	50
22	25	75
24	0	100

US 6,589,287

Citation here should be (Last Name Year)

Existing Solutions



Schaechter 2006

Existing Solutions

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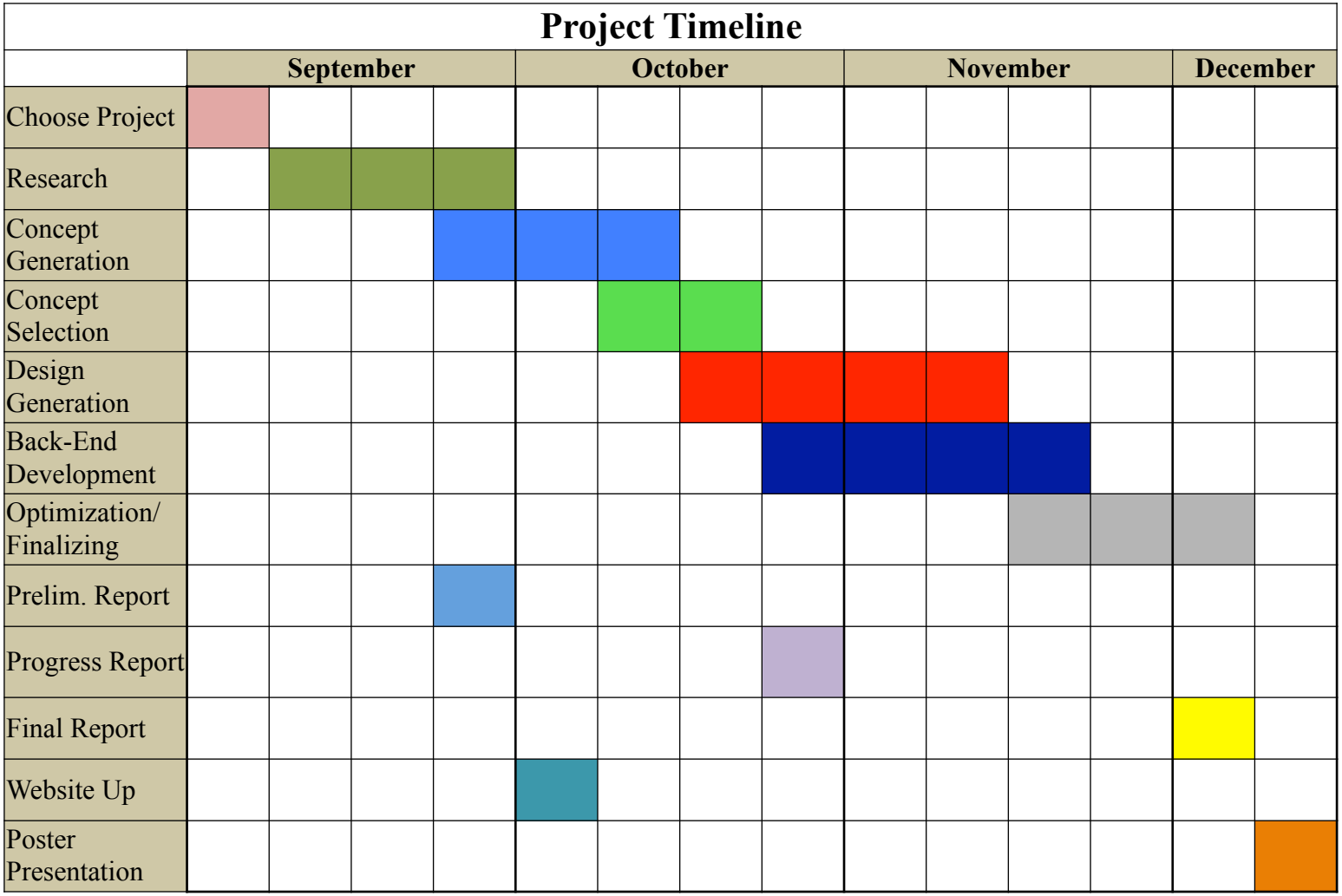
Citation here should be
(Last name Year)

Design Schedule



Team Organization

- Andrew
  - designSAFE
  - Progress report
  - Cost analysis
  - Back end interface
- Brandon
  - Final report
  - Website
  - Back end interface
- Ben
  - CAD
  - Materials acquisition
  - Software
  - Front end interface
- All
  - Client interaction
  - Patient observation
  - Idea generation

Questions?

References

1. http://www.stroke.org/site/PageNavigator/HOME
2. http://www.stroke-rehab.com/hand-exercises.html
3. Liepert, Joachim, et al. "Treatment-induced cortical reorganization after stroke in humans." *Stroke* 31.6 (2000): 1210-1216.
4. Huang, He, et al. "Interactive multimodal biofeedback for task-oriented neural rehabilitation." *Engineering in Medicine and Biology Society, 2005. IEEE-EMBS 2005. 27th Annual International Conference of the*. IEEE, 2005.
5. Lövquist, E., and U. Dreifaldt. "The design of a haptic exercise for post-stroke arm rehabilitation." *Proc. 6th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies, Esbjerg, Denmark, September*. 2006.
6. Jobbágy, Ákos, et al. "Analysis of finger-tapping movement." *Journal of neuroscience methods* 141.1 (2005): 29-39.