Lecture 2
Ideas, Ideas, Ideas
Jan 16, 2018

1. Discussion of Previous Projects
2. Some New ideas
3. Choosing your Project
Problems with Problems

Henry Evans Criteria

1. Can it be used everyday?
2. Does it make caregiver’s life easier?
The problems you will see

• Are generally not new
• For previous attempts, why did they fail or..
• Has anything happened that has enabled a new solution?
  – Need
  – Technology
  – Market
  – Distribution
Continuing an “old’ Approach-
Previous students’ work

Advantages
– Can build on established knowledge
– Learning from past attempt(s)
– Problem definition
– Previous people as mentors
– Possible identified customers
– Closer to a product that can be “commercialized”
Continuing an “old’ Approach

Advantages

–Iteration as a path to “wisdom”
Continuing an “old’ Approach

- Challenge: make your “step” of sufficient length
Questions to ask of an “old” approach

• What were the barriers to success?
  – Incorporate into your “problem statement”

• Are they surmountable?

• Can you surmount them?

• You will have to make a “best guess” based on insufficient information
Good News

• All the past two year’s projects were good ones that could be advanced to the next level.

• Time was the major issue!
But, The dumbest thing you can do
But, The dumbest thing you can do

• Bet on a football play on Television
Dumbest thing you can do

- Bet on a football play on Television
Dumbest thing you can do

• Lose
Dumbest thing you can do

• Bet on the instant replay
2017 Project Ideas
Doorbuster 2017

• Automatic Door Opener- Brushless Arduino Powered Doorbuster (opener)
Over Braked
Pressure Sore
Wheelpower
2016 Project Ideas
Stability/Gesture/Gyroscopes

- Device to improve hand stability for handwriting and other daily tasks. Older people and those suffering from motor control functions may use this device to make it easier for them to write or eat.

- Gyroscopic mouse that allows Parkinsons patients to more easily use a mouse. This device provides mechanical feedback and stability.
  - PID loop to make it “smarter”?

- Gyroscopic correction on iPad stylus

- Smart walking stick/crutch

- Walker for stairs
Sight/Google Glass

• Magnify with Google Glass
• Use Google Glass with sight and motion rather than speech
• Eye tracking glasses -> text to speech
  – Look like regular glasses so they don’t stand out
• VR projects (wheelchair training, etc)
• Eyetribe - Improved eye tracking software
• Dissolvable gel contact lenses for people who can’t blink
Wheelchair accessories

- Security pouch
- Pull up a desk/laptop holder
- Head scratching device
- Aid for getting in and out of a manual wheelchair
- Heavy weather conditions wheelchair
- Door opener
- *Clip on cell phone holder
- Luggage or groceries holder
Wheelchair ++

- *Induction based charger*
- New propulsion methods for reduced shoulder pain
- Charging device powered by energy extracted from wheel rotation.
  - The individual could charge electronic devices using power they generate from rotating the wheels of the chair.
- Climbing wheelchair
- Wheelchair control using eye tracking or tongue
Convenience

- Book page turner
- Grip aids
- Aid for standing up out of a chair
- Aid for getting out of wheelchair to Floor (Mark Fugelwand)
- Bed maker
- Drink Sipper
- Mouthguard keyboard interface
- Voice-operated refrigerator
Convenience

• Voice-operated refrigerator

Amazon Alexa Dominates Voice-Command Tech At CES 2017
Others

- Redesigned scooter
  - Better navigation, body suspension, stability
- *Dynamic ulcer-preventing cushion
- Pressure sheet
  - A human sized sheet of some flexible material that monitors pressure over the entire body. Primarily for use in hospital beds. Would need to be accurate on the scale of an inch, and run constantly.
- Improve on human/prosthetic interface
- Wheelchair to car transfer
What Problems were actually worked on?

1. Hemiplegic Wheelchair Steering System
   Team Allez
   Sheila Lo, Stephanie Moon, Auggie Nanz
What Problems were actually worked on last year?

Pressure Release Indication System

Team Sore Losers

SARAH ASANO, MELISSA CRONIN, CHRISTINA MEYER, KEITH RUSSELL
What Problems were actually worked on?

Wheelchair Accessories Kit
Kalyn Chang, Caitlin Chen, Lawrence Lee, Naveen Tadepalli
What Problems were actually worked on last year?

Door Opener for Wheelchair Users

Emma Shupper, Jessica Cheng, and Anvita Mishra
What Problems were actually worked on last year?

Power Wheelchair Independent Charging

Team Induction Boyz

Morgan Hill, Thomas Peterson, Omer Subasi
What Problems were actually worked on last year?

Writing Aid for Tremors - Team Shakeless
Hannah Walsh
Wheelchair e-Brake

Having good wheel locks for a manual wheelchair is important for a user that does not have full upper body strength to utilize during transfers (e.g. medium function quadriplegic, cerebral palsy, MS, ALS, elderly, etc.). Aside from wheel locks there is the concern of being able to brake your wheelchair with different surfaces.

For example, an individual may want to use a public restroom and transfer onto toilet. The floor may have recently been mopped with soap and has retained a slippery, almost oily surface. Someone transferring back into their wheelchair off of the toilet may not have sufficient triceps to lift their body up and over and because of this the force exerted from their arms isn’t down, but more to the side. This force coupled with a slippery surface causes the wheelchair to push away from the toilet. The exact same issue can happen with a transfer to/from a shower chair/bench, a car, onto a coach, into bed, etc. As a quadriplegic, I personally have fallen out of my chair numerous times due to different surfaces that did not grip my chair, outside of having good wheel locks.

For a manual wheelchair user with inflatable tires, the air pressure as well as the wheel locks need to be maintained at all times. If air pressure is not maintained the wheel locks will prove ineffective and transferring will be severely impaired and dangerous. This is another reason why having a backup braking system would make sense if you need to have your air pressure and/or wheel locks adjusted, but you don’t have anyone around to help in the near future. Similar to what we have in our vehicles, you could look at this design concept as an emergency brake for your wheelchair.

The brake would be designed to be manual as well as electronic (optional) to engage. A rude way of describing the concept would be a plunger that mounts on your backrest rigidizer bar (see picture below) with the large suction cup at the bottom and an additional rubber pad with teeth sitting inside of the suction cup as a secondary brake option. The top portion would have two angled rubber coated levers that would allow you to push down easily with your hand or elbow to engage the brake and also easy to push the levers up to disengage the brake. You would engage the suction cup for surfaces that are flat and engage the other internal rubber pad with teeth to handle surfaces that aren’t flat.

This should be designed to mount easily on the backrest rigidizer bar with simple bracket housing. The electronic engagement component may be more difficult to manage for the build, but the switch should be mounted on the front of the wheelchair near the wheel locks or underneath the seat sling. This type of product would be adaptable to walkers, rollators, etc. and is commercially viable.
2. Intelligent Wheelchair Lighting

When you are motoring in your wheelchair at night it is important to not only see where you are going, but to be visible to others. And it’s pretty cool to have some colorful lights glowing from underneath your wheelchair. Currently, there are a few companies in the marketplace that produce an LED light system with a controller that can be mounted with Velcro and/or tie downs to your wheelchair.

This is a fun and useful system, but it can cost roughly $200 and it is more of a permanent option. For a manual wheelchair user, there are limited places to mount the controller where you can access it, which is an issue when trying to turn it on/off, control settings and to be able to recharge the batteries. This in turn limits the level of independence for the individual who intends to utilize such a device.

I envision making a multicolored LED light that attaches to your wheelchair tubing in the front where the housing can rotate around the tubing 360 degrees and can rotate in space 360 degrees. It would have different programs to accommodate fast/slow blinking, higher brightness and a dusk-to-dawn feature for night time. With the multicolored lights and flexible positioning it would not only be aesthetically pleasing, but it would allow for visibility in dark places for not only the user, but for those around you in vehicles, on bikes, etc.

One of the key attributes for this product would be to have control from your smart phone. This would require designing an app for the light that would allow you to control and customize the lights to fit your needs. Aside from the typical programming needs made easier by the smart phone controls, maybe you want to disable the dusk-to-dawn feature, but you want the lights to turn on at a certain time in the morning to blink like an alarm clock or as a reminder. Having Bluetooth technology would be ideal, but if you could connect your smart phone to communicate with the device that would work as well.

The light could be sold as is with a manual button for off/on/program and/or sold with the app and connectivity technology. There are numerous portable bike light options that would give you great ideas for the wheelchair. The main idea is creating an affordable lighting option that someone with a disability can control independently and use for not only aesthetics, but for safety.
3. Transfer positioning strap

When performing a transfer, whether the individual is doing the transfer independently or with the help of a caretaker, positioning of your lower limbs is extremely important. When someone is paralyzed from the chest down, without any support from positioning of the lower limbs, an assisted transfer can be similar to lifting a giant bag of sand from the top...it just doesn’t work well. I say this because over the years people have tried to pick me up underneath my shoulders without listening to my direction and without the legs properly in place, they struggle every time. I am fortunate that with my current level of spasticity (involuntary muscle contraction), I can position my legs in such a way that when I transfer my legs work for me and not against me.

You will notice from the pictures below that in an assisted transfer situation the knees of the patient are squeezed together between the legs of the caretaker in order to stabilize the lower extremities. This helps make the transfer smoother when pivoting a patient from one location to the other. Typically a gate belt is used to help guide the patient and weight towards the caretaker to accomplish the transfer with limited strain and/or potential injury.

The product design to assist with transfers is essentially a positioning strap for your legs which forces your knees together, yet would allow the knees and legs to move slightly in all directions to accommodate the shifting of your weight and body. Essentially, a strap that mimics how your legs and knees are positioned as illustrated.
Problems with Problems

1. Problem understood?
Problems with Problems

2. Importance/Impact?
Problems with Problems

3. Doable in 2 quarters?
Problems with Problems

1. Prior work?
Problems with Problems

1. Time for *Full* Implementation?
Problems with Problems

Are the problems vague?

How well did previous attempts work?

What would satisfy you?
A New Project

• Life is often learning when to “kill” stuff
  – Good not to beat a dead horse
• Can apply a totally different approach to an old problem
• Problems themselves change as the world changes
Remember

• We want the project to be do-able in two quarters
• We want *something* to demonstrate at end of Quarter 1
• Can be Phase 1
• Concept of Minimally Viable Product
Minimally Viable Product

• In product development, the Minimum Viable Product (MVP) is a product with just enough features to gather validated learning about the product and its continued development.
Iteration

- We will learn together in this class
- Pivots, Restarts are fine
- Sometimes assumptions do not withstand research
- *Put in the form of hypotheses which can change with time and more information*
Falls, a big, mechanically under-addressed problem

Focus Group
Falls, a big, mechanically under-addressed problem

Falls Are Serious and Costly (CDC)

• 1 in 5 falls causes a serious injury, e.g. broken bones or head injury.
• 2.8 million older people per year go to emergency rooms for fall injuries.
• 800,000 patients a year hospitalizations
• 300,000 older people are hospitalized for hip fractures.
• Falls are the most common cause of traumatic brain injuries
• Direct medical costs for fall injuries $31 billion annually.

https://www.cdc.gov/homeandrecreationalalssafety/falls/adultfalls.html
Falls, a big, mechanically under-addressed problem

Falls Are Serious and Costly (CDC)

• Many people who fall, even if they’re not injured, become afraid of falling.

• Fear may cause a person to cut down on their everyday activities.

• When a person is less active, they become weaker and this increases their chances of falling.11

https://www.cdc.gov/homeandrecreationalsafty/falls/adultfalls.html
Falls have complex causes

- Most associated with one or more identifiable risk factors (e.g. weakness, unsteady gait, confusion and certain medications)
- Attention can significantly reduce rates of falling.
- Requires systematic assessment and interventions, exercise programmes and environmental-inspection and hazard-reduction
- Challenging because of the complex nature of falls.

Laurence Z. Rubenstein  UCLA School of Medicine and Geriatric Research Education and Clinical Care
Some solutions

Fall Detection Devices
Some solutions

Landing Strip
Some solutions

Grab Rails
Some solutions

Walkers
Some solutions

Caltech/Art Center/Rancho Crutches (2015)
Jacqueline Bae, James Blackwood, Shalini Majumdar, Harrison Miller
More past projects
Access to Accessories (2015)

Derek Kearney, Richie Hernandez, Alejandro Sanchez, Tara Sowirajan
Some solutions

Wheelchair Add-on for one-arm drive (2015)

Catherine Pavlov, Harry Golash, Tatiana Roy, Teo Wilkining
Some solutions

Umbrella (2015)

Austin Mayron, Kyung Keon Park, Melissa Wang, Vivia Liu,
Some solutions

Customizable Sleeve for Amputee (2015)

Justin Nam, Philip An, Wilton Liano
Some solutions

Pressure Ulcer Prevention Sensor System (2015)

Parul Pubbi, Sherri Chen, Amir Poorheravi
Some solutions

Trace: Eye Tracking Keyboard (2015)

Sadaf Amouzegar
OK Let’s begin the selection process

• Everyone
  – 1. write down the three most interesting ideas which intrigue you.
  – Tell us the ideas
  – Discuss with others your ideas
  – After talking with each person
    • Write down your three ideas again