

Development of a Smart Walking Cane with Biofeedback



ISABELLE D. PUMFORD^{1,2}, MARCUS J. BAILEY^{1,4} AND PATRICK M. AUBIN^{1,3},

¹RR&D CENTER OF EXCELLENCE, VA PUGET SOUND, SEATTLE, WA,

²COLLEGE OF ENGINEERING AT UNIVERSITY OF ARKANSAS, FAYETTEVILLE, AR

³DEPARTMENT OF MECHANICAL ENGINEERING AND SCHOOL OF MEDICINE⁴, UNIVERSITY OF WASHINGTON, SEATTLE, WA
EMAIL: IDPUMFOR@UARK.EDU

Introduction



- 27 million adults suffer from Osteoarthritis in the United States
- Reducing knee adduction moment, KAM, has been shown to decrease pain and improve function
- Wanted to create a walking aid that encourages increased cane loading and KAM reduction using a vibrotactile biofeedback loop

Device Requirements

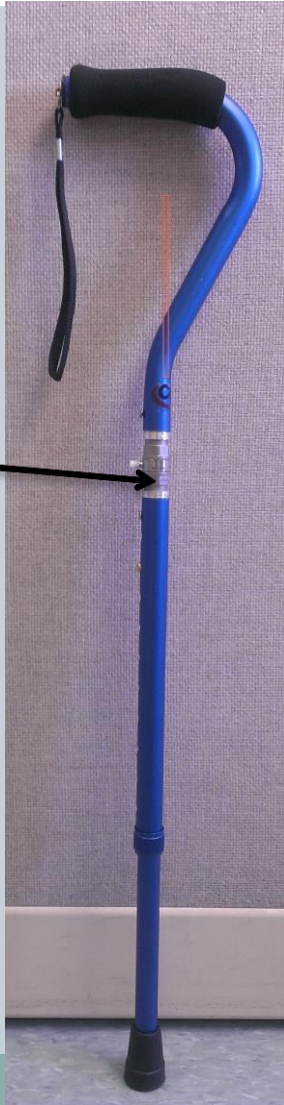


- Provide cane load biofeedback
- Mobile battery operated
- Able to store data
- Person up to 113 kg (250 lbs)
- Able to measure force from 0N to 222N
- Able to record date and time
- Similar weight to conventional cane.
- Able to mechanically withstand up to 222N

Initial Design



Force Link



- Force Link outputs charged based on piezoelectric effect. Displacement results in a charge being created.
- When compressed an Inline Amplifier creates a charge from 0-5V; can detect up to 265N.

Handle holding electronics
bent during testing



Current Design



6mm motor

On and off switch

PBC protects components and allows for sturdy exterior



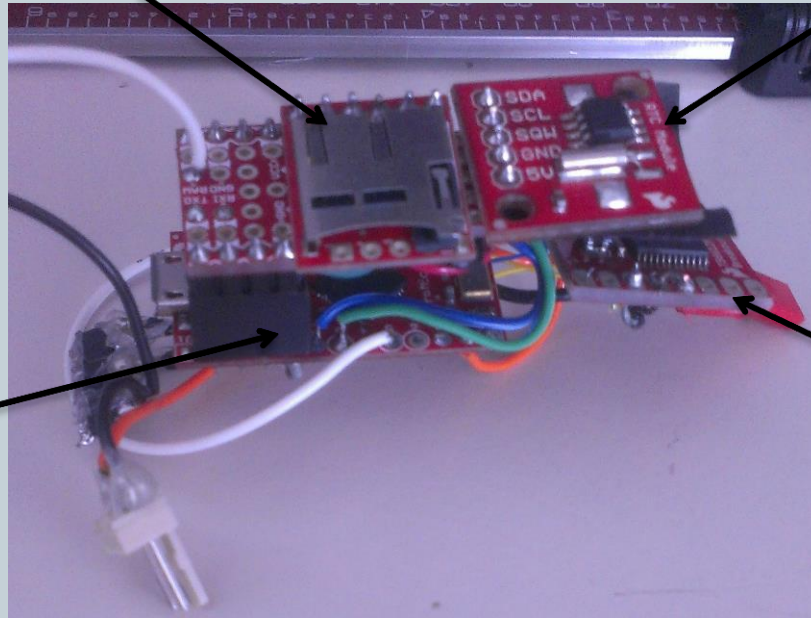
Smart Cane provides biofeedback in the form of a vibration when 20% of user's body weight is loaded

Electronics



Open logger for SD card

Real Time Clock (RTC)



Promicro Controller

Motor Controller

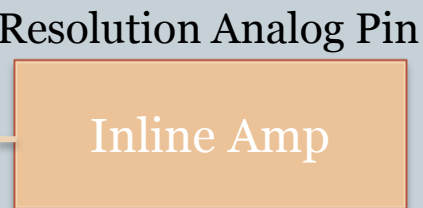
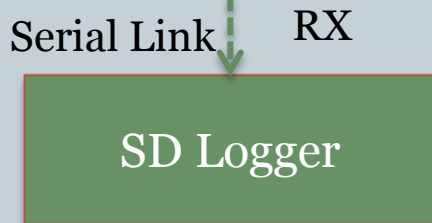
- Promicro controls computerized system
- Open logger allows data to be stored on SD card
- Real Time Clock records actual time and date for record keeping
- Motor controller controls vibrating motor

Electronic Communication



Pulse Width Modulation (PWM)

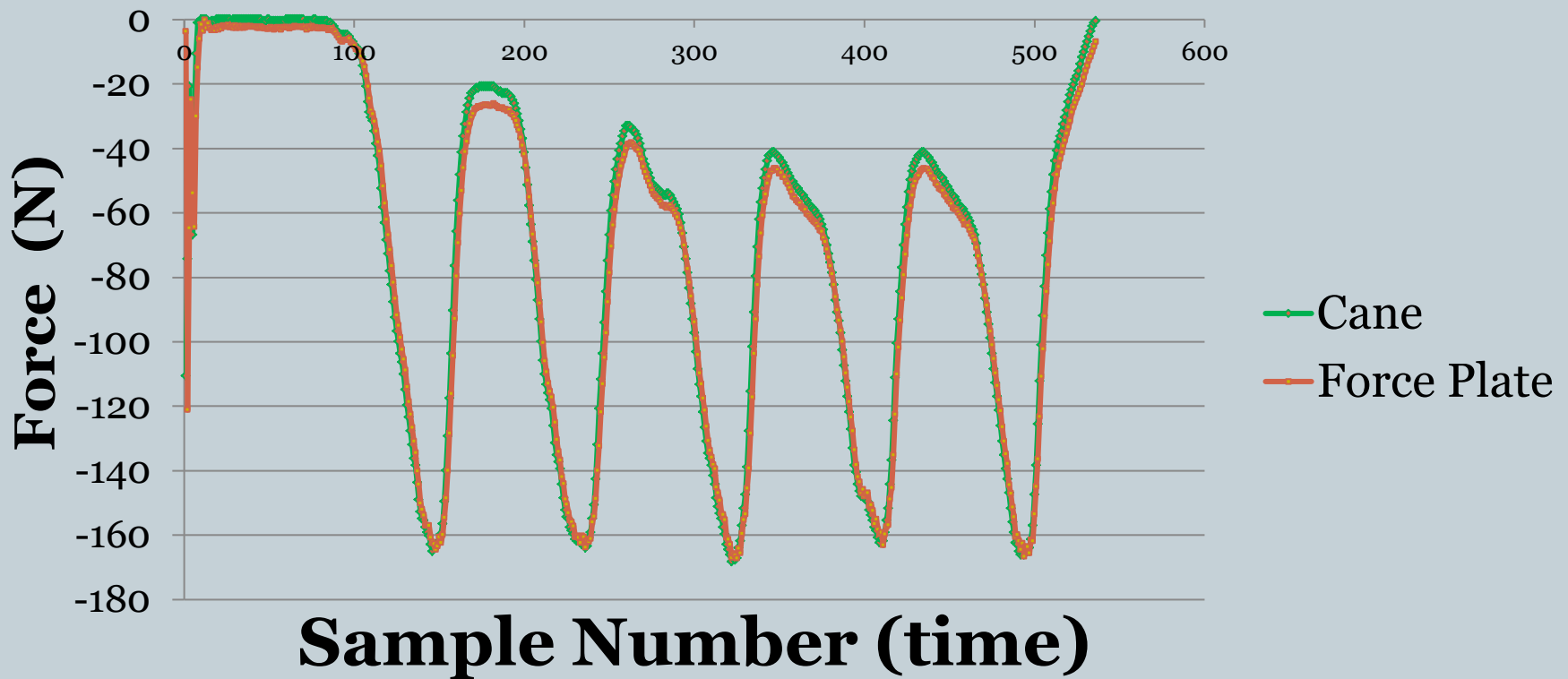
Inter-Integrated Circuit (I²C)



Force Measurement Validation



Force Measured by Cane and Force Plate

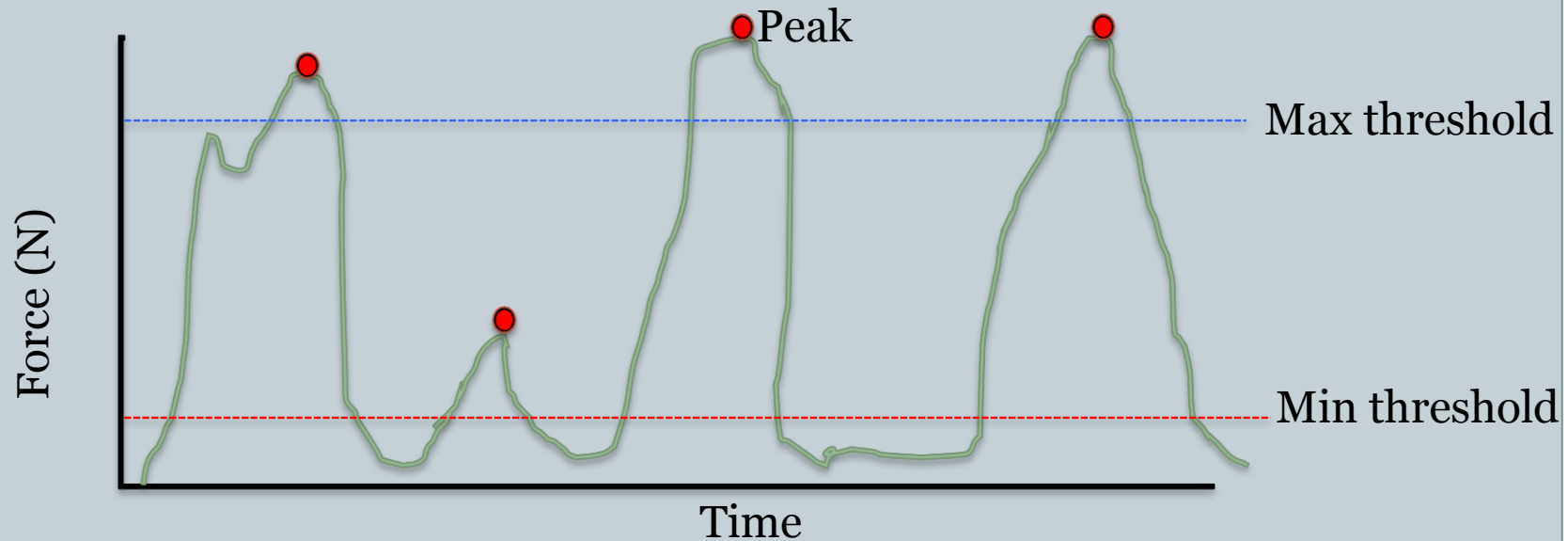


RMS Error ± 2.5 N

Arduino Software



- Records force
- Records peaks
- Turns motor on and off
- Loop repeats every 20 milliseconds, 50 hertz



Conclusion



Requirement	Smart Cane
Provide cane load biofeedback	Vibrotactile feedback loop
Mobile battery operated	Untethered and uses Li-ion batteries
Able to store data	Data logger uses SD card
Person up to 113 kg (250 lbs)	Yes
Able to measure force from 0N to 222N	Up to 265N
Able to record date and time	Uses RTC for real time and date
Similar weight to conventional cane.	About 2 kg of weight added
Able to mechanically withstand up to 222N	New PBC model is able

Acknowledgements and Questions



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