DIVYANSH GUPTA

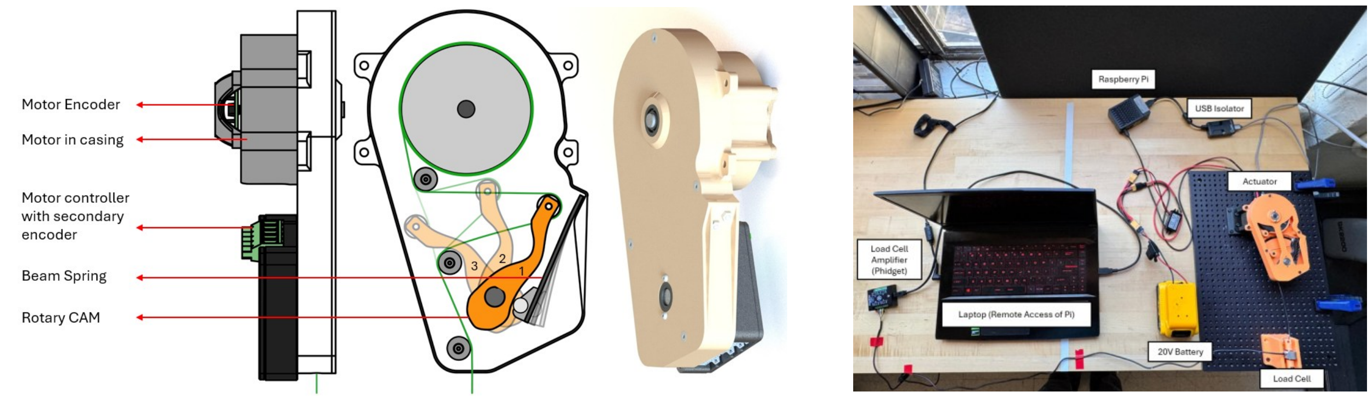
Email: gupta.divy@northeastern.edu | **Phone:** (857) 544-1447 | **Address:** Boston, MA | **Website:** gupta-divy.github.io

Ankle Exoskeleton and Novel Series Elastic Actuator *(Master's Thesis 2022-24)*

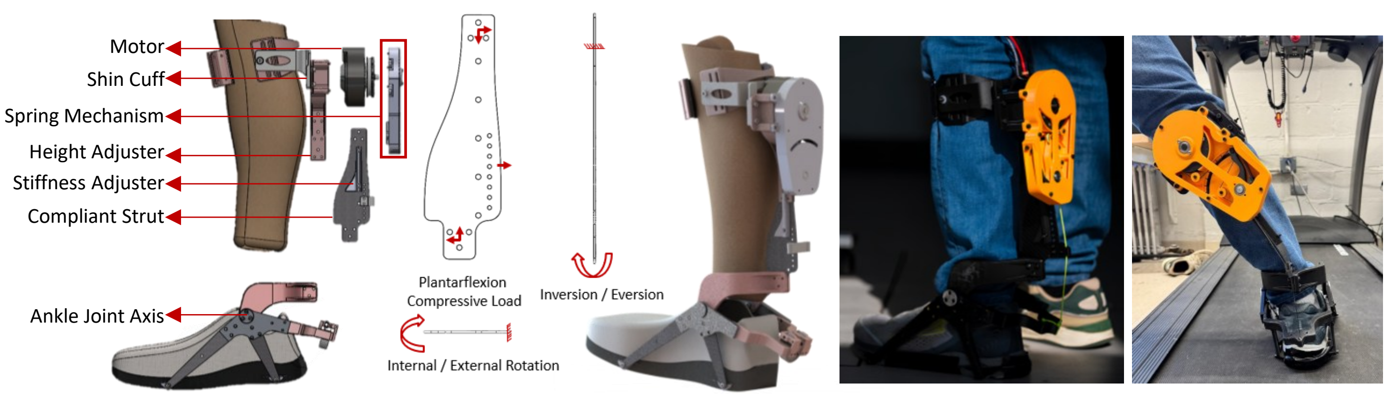
Description: Designed a cable-drive actuator with series elasticity, featuring a CAM pressing against a beam spring to provide mechanically programmable non-linear elasticity. The actuator operates in two distinct configurations:

- *Low Force Mode:* The mechanism remains engaged, adding series elasticity as per CAM profile *(config 1, 2)*
- *High Force Mode:* The mechanism disengages, making the cable-drive stiff (*config 3 in figure 1 schematic*)

Integrated the actuator into an Ankle Exoskeleton, making the exoskeleton lighter and human-centric. The system enables natural motion through passive structural compliance using composite flexures.



Figures 1 (left to right): Actuator Schematic and CAD, Actuator Prototype on Benchtop Setup



Figures2 (left to right): Exo Schematic, FBD & CAD (v1), Exo Prototype (Isometric and Showing Passive Structural Compliance)

Contributions: Worked end-to-end from concept design to prototype

- Designed CAD (SolidWorks)
- Mechanical Calculations (Kinematics, Cantilever Beam, Buckling, FBD)
- FEA Structure Analysis (Ansys)
- Mathematical Framework and Modeling (MATLAB, Simulink)
- Prototyped (3D Printing, CNC Machining, Soldering, & Circuit Design)
- Control System Design - Cascaded PID with state-machines (Python)
- Hardware: Motor – BLDC Motor (Cubemars T-Motor), Motor Controller – Moteus and Odrive, Computation- RaspberryPi and Jetson Nano, Sensors- Encoders, IMU

Links and Results:

- Patent for Actuator: US 18/911616 (Pending, Submitted October 2024)
- NEU News Coverage of Exoskeleton
- NERC Conference Poster Presentation
- MS Thesis
- GitHub Code HW Support- Moteus, Odrive
- Explored Machine Learning-based control of Exoskeleton Github, Report
- Videos – Actuator, Exoskeleton-v1

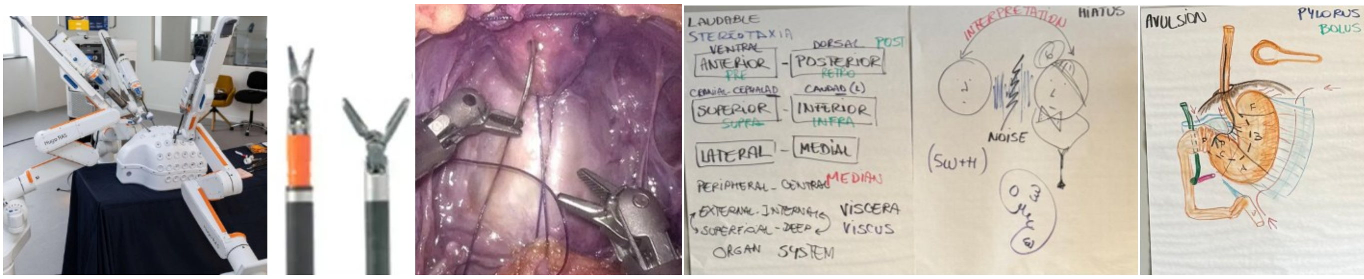
DIVYANSH GUPTA

Email: gupta.divy@northeastern.edu | **Phone:** (857) 544-1447 | **Address:** Boston, MA | **Website:** gupta-divy.github.io

Medtronic – Surgical Robotics

Software Engineer – Controls Intern, Instrument Control (Jan 2024 – Dec 2024)

Descriptions: At Medtronic, I worked on the Wristed Instrument Controls team (Needle Drivers and Shears) for HUGO Robot, enhancing control algorithms and developing support tools to accelerate iterative development



Figures (left to right): HUGO robot, Instruments, Mock Operation Room feed, Clinical Anatomy Training Notes

Contributions: Utilized MATLAB, Simulink, BASH Scripting, Python, QT Py

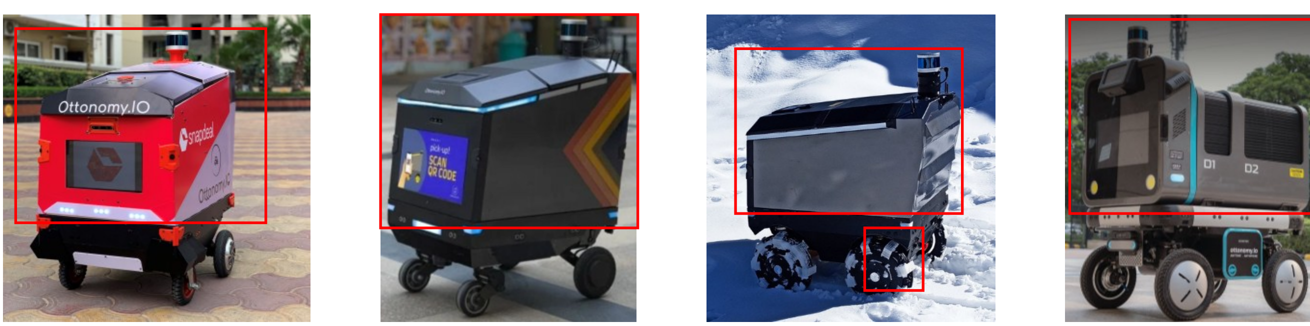
- Built GUIs for real-time data visualization of relevant robot signals
- Automate controller tuning and testing through BASH
- Enabled Hardware in Loop and Software in loop (SIL) simulations
- Designed KPIs to evaluate joint motion control performance and scripts to run parallel pool of simulations

Other Learnings: Participated in clinical human anatomy training and NPI brainstorming sessions. Also, attended Mock OR sessions learning to translate doctors feedback, needs and use cases to engineering requirements

Ottonomy Inc. - Autonomous Delivery Robot

Robotics Engineer – Mechanical Engineer (Mar 2021 – May 2022)

Description: At Ottonomy Inc., an early-stage startup founded in 2021, I was one of the first two mechanical engineers working on an autonomous mobile robot for last-mile delivery. I had the unique opportunity to contribute across the first 4 iterations of the robot, working end-to-end—from concept development to deployment—while also translating business and customer needs into engineering design requirements



Figures (left to right): Different versions of robot – 2021 V0, 2021 Indoor V1, 2022 Outdoor (snow-testing), 2022

Contributions: As one of the two mechanical engineers on the team, I was responsible for the design, manufacturing, and assembly of the robot's upper body *(highlighted in figure with red border),* including:

- Sheet metal body covers for structural integrity and aesthetics, along with engineering drawings with GD&T
- Electro-mechanical mountings
- IP54-rated sensor enclosures for IMU, GPS, LiDAR, and cameras
- Cargo space design translating the voice of customer into it
- Prototyped concept attachments enabling snow-traversal *(figure 3)* & automated cargo for item detection

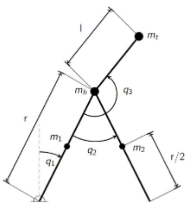
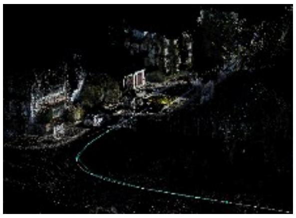
Key Achievements: Co-filed a patent for the robot design alongside the company's co-founders

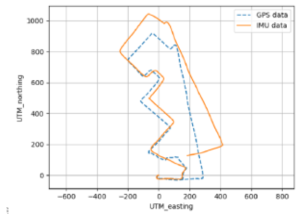
DIVYANSH GUPTA

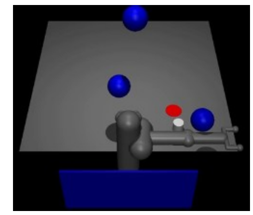
Email: gupta.divy@northeastern.edu | **Phone:** (857) 544-1447 | **Address:** Boston, MA | **Website:** gupta-divy.github.io

Course Projects - Northeastern University *(Sept 2022 – Dec 2023)*

Description: Course projects snippets for Reinforcement learning, Legged Robotics and Robot Sensing and Navigation for Autonomous Vehicles – where I learned concepts around Robot modeling, controls, & perception



Figures: 3 Link Planar robot, RTABMap results, Camera Frame with OpenCV, GPS vs IMU based mapping, MuJoCo env

Contributions: Utilized Robot Modeling, Python, ROS, OpenCV, MuJoCo and PyTorch

- Modeled a 3-link planar bipedal robot using forward kinematics and lagrangian mechanics (Link)
- Applied and tuned V SLAM (RTABMap) on KITTI Dataset and used YOLO-v5 for road sign detection (Link)
- Wrote drivers for IMU, GPS and used sensor fusion for dead reckoning (Link)
- Updated Pusher-v2 environment with dynamic obstacles and new reward function with MuJoCo (Link)

Indian Institute of Science UTSAAH Lab – Insulin Pump *(May 2019 – July 2019)*

Description: At UTSAAH Lab, I worked on an insulin pump designing a novel transmission mechanism that uses Ratchet Pawl configuration driven by eccentric shaft rotating driven shaft by half teeth to achieve 1:64 gear ratio

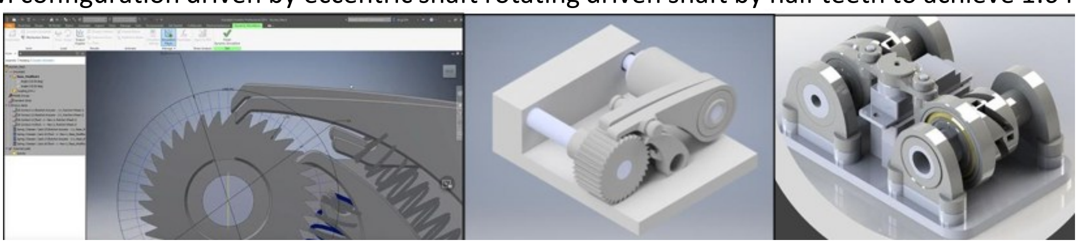


Figure 1 (left to right): double ratchet pawl mechanism (inventor simulation), CAD, Forward-Backward Switching Mechanism

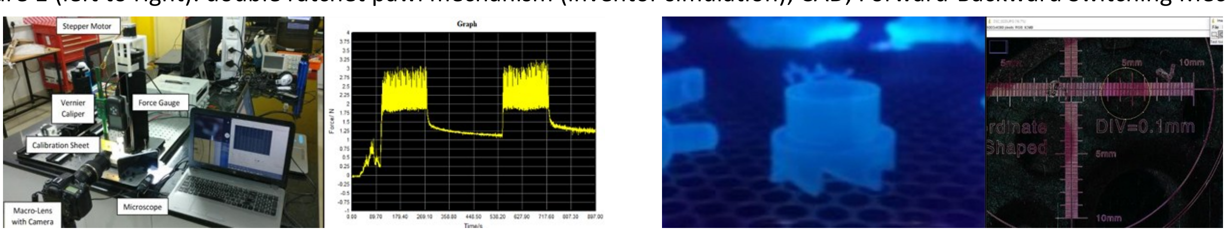
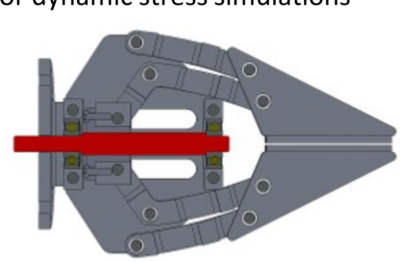
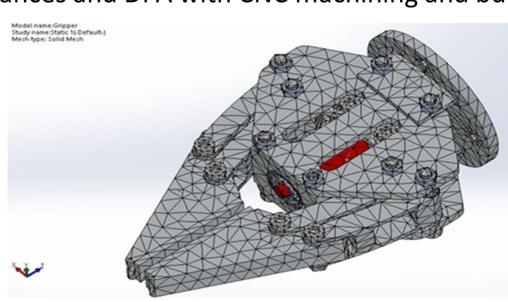
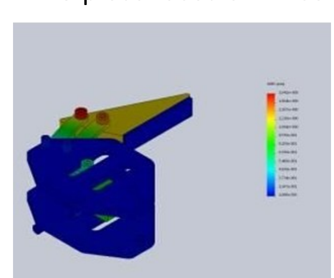


Figure 2 (left to right): Subcutaneous Injection force dynamics validation, Environment led deformation analysis of SLA prints

Contributions: Designed CAD model, prototyped utilizing SLA 3D Printing, used Autodesk Inventor for Motion Simulation, Image processing for Detecting environment led deformations of materials, and mathematically Modelling subcutaneous injection dynamics which were experimentally validated as in *figure 2 setup*

Hitech Robotics Systemz – Insulin Pump *(May 2018 – July 2018)*

Description: Designed a parallel jaw gripper, did motor-sizing based on technical specifications for the gripper. Collaborated with machinists for tolerances and DFA with CNC machining and built a DEMO piece. Used Simwise 4D for dynamic stress simulations

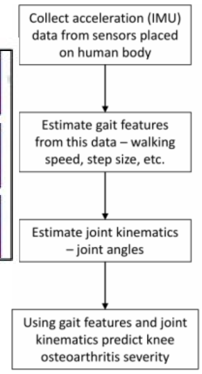




DIVYANSH GUPTA

Email: gupta.divy@northeastern.edu | **Phone:** (857) 544-1447 | **Address:** Boston, MA | **Website:** gupta-divy.github.io

Wearable Device for Knee Osteoarthritis Detection *(Dec 2019 – May 2020)*

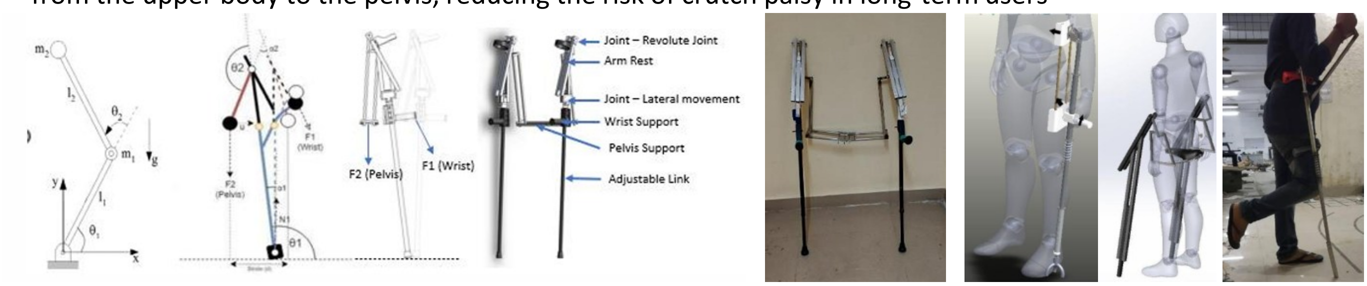
Description: Inspired by the need to have a low-cost diagnostic device to detect knee osteoarthritis severity progression in elderly (for my father), I took this project for my bachelor thesis project during COVID times [(Link)]



Figures (left to right): CAD of device, circuit design prototype, MATLAB based GUI, GaitPy algo layout for detecting gait features, and flow chart showing approach for severity detection

Redesigned crutches *(2018-2019)*

Description: Redesigned crutches by reimagining it as a double inverted pendulum model to redistribute load from the upper body to the pelvis, reducing the risk of crutch palsy in long-term users



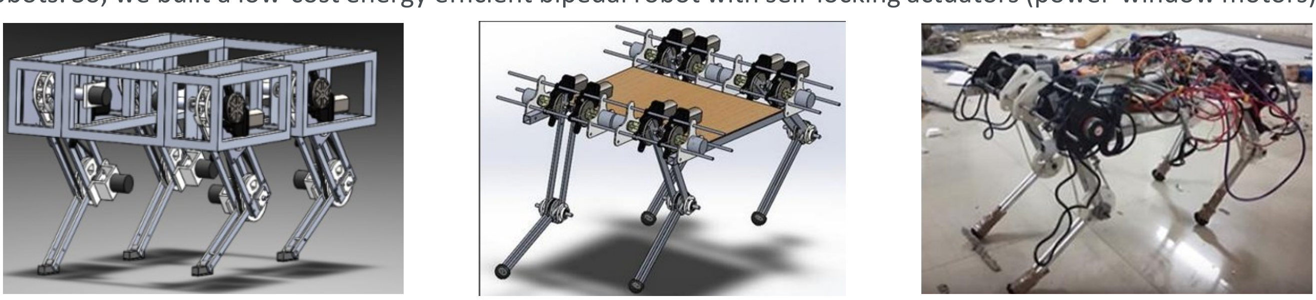
Figures (left to right): double inverted pendulum and reimagined crutch schematic, CAD & Prototype, Initial Ideations

Contributions: Designed CAD model, prototyped utilizing 3D Printing, ANSYS for structural analysis, and used MATLAB SimScape to model & analyze dynamics of crutch movement for tuning structure design parameters

Links and Results: Won 2nd Prize for Biomedical Innovation Challenge by BETIC, Video, Read More

Chitrak – Quadraped Robot *(2018 –2019)*

Description: Imagine yourself standing for 1hr, your legs will start hurting gradually. Though theoretically you are not moving but to maintain your stance your muscles are actively working. Similar thing happens with legged robots. So, we built a low-cost energy efficient bipedal robot with self-locking actuators (power-window motors)



Figures (left to right): Initial design , second design lighter in weight, and prototype with all onboard electronics

Contributions: Designed CAD model, prototyped utilizing 3D Printing, and used MATLAB for parametrizing foot trajectory using Bezier Curves and then used convex optimization (fmincon) for trajectory generation

Links and Results: Selected among top 5 innovations for 2018 by student-led group, Video, Read More