Hybrid motion/force control of multi-backbone continuum robots

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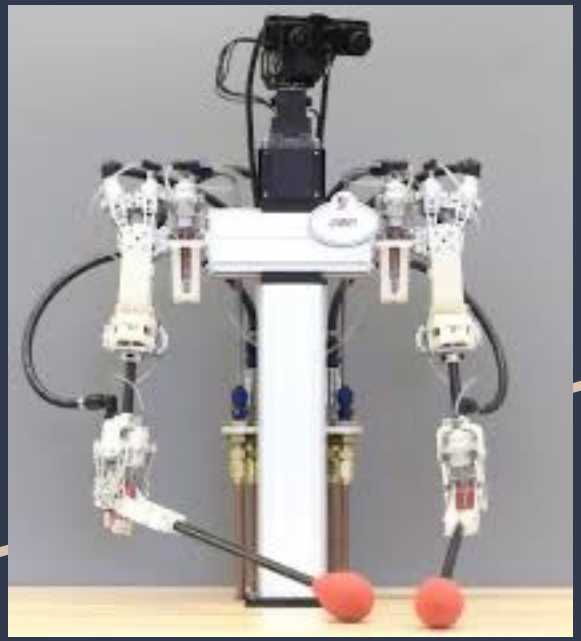
What is it?

- multi-backbone continuum robot which has the ability to move in several axis through rotation and bending mechanisms

- allows to estimate forces and torques at the operational point by monitoring loads along their actuation lines without the need for a dedicated transducer at the operational point

What is the function/purpose?

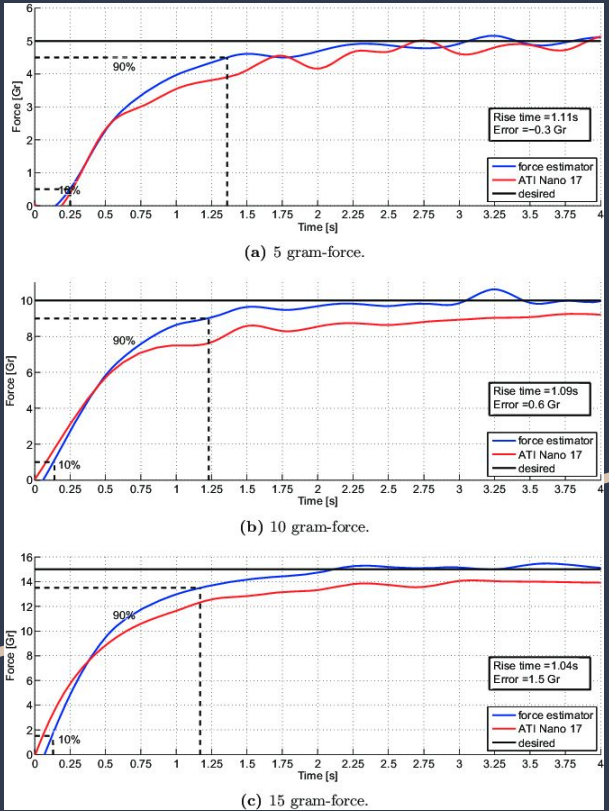


- To advance further the force sensing capabilities of multi-backbone continuum robots so it can be useful in various fields such as robotics and medical fields

- sensing and control of multi-backbone continuum robots in a unified framework for hybrid motion/force control

- To be able to have safe interactions with its environment

Methodology



(a) 5 gram-force.

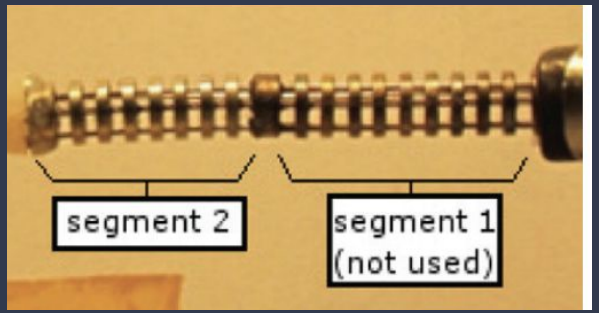
(b) 10 gram-force.

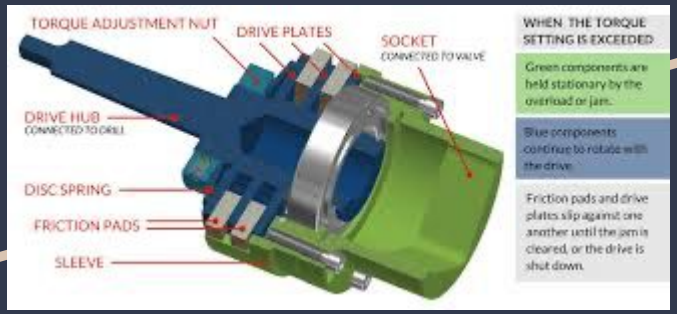
(c) 15 gram-force.

- framework is based on a kinetostatic modeling of the multi-backbone continuum robot with, a simplified model for online estimate of the manipulator's compliance, and a new strategy for merging force and motion control laws in the configuration space of the manipulator

- successful and safe interaction with the environment which required robotic manipulators to control motions and forces at their operational point while complying with contact and motion constraints

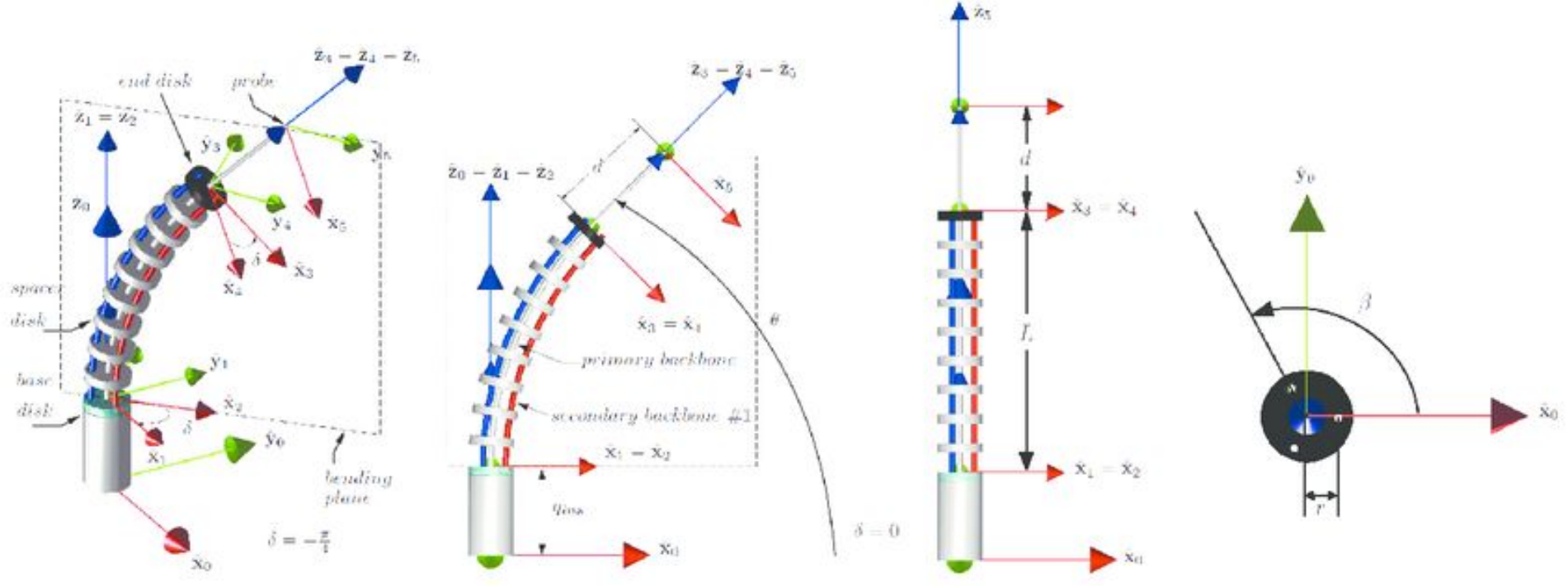
Capabilities



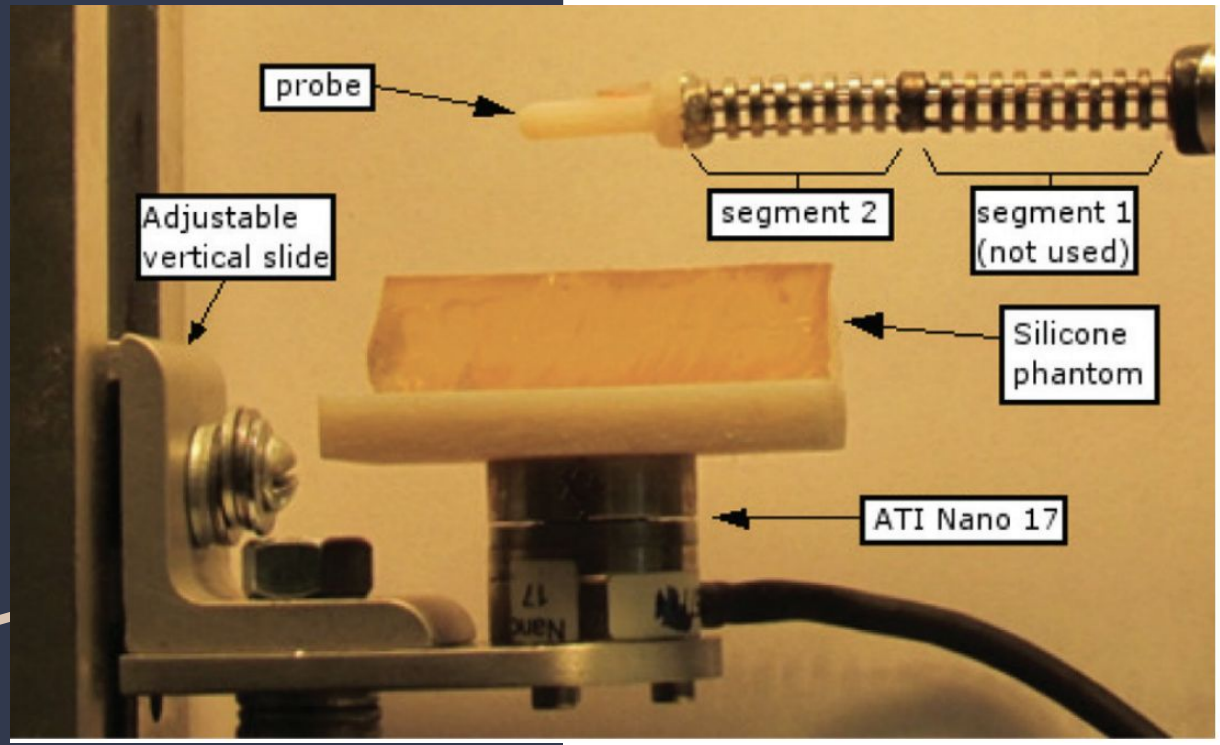


- the segment has three push-pull backbones that allows for bending its end disk in space
- Had several actuators in which it can rotate and the x, y, and z axis to make specific movements that humans can make
- first segment isn’t used and is stiff due to equilibrium configurations and because it’s connected to the base
- measure friction using tactile sensor which uses piezoresistive beams for detections

Bending/Rotating Mechanism



General Design



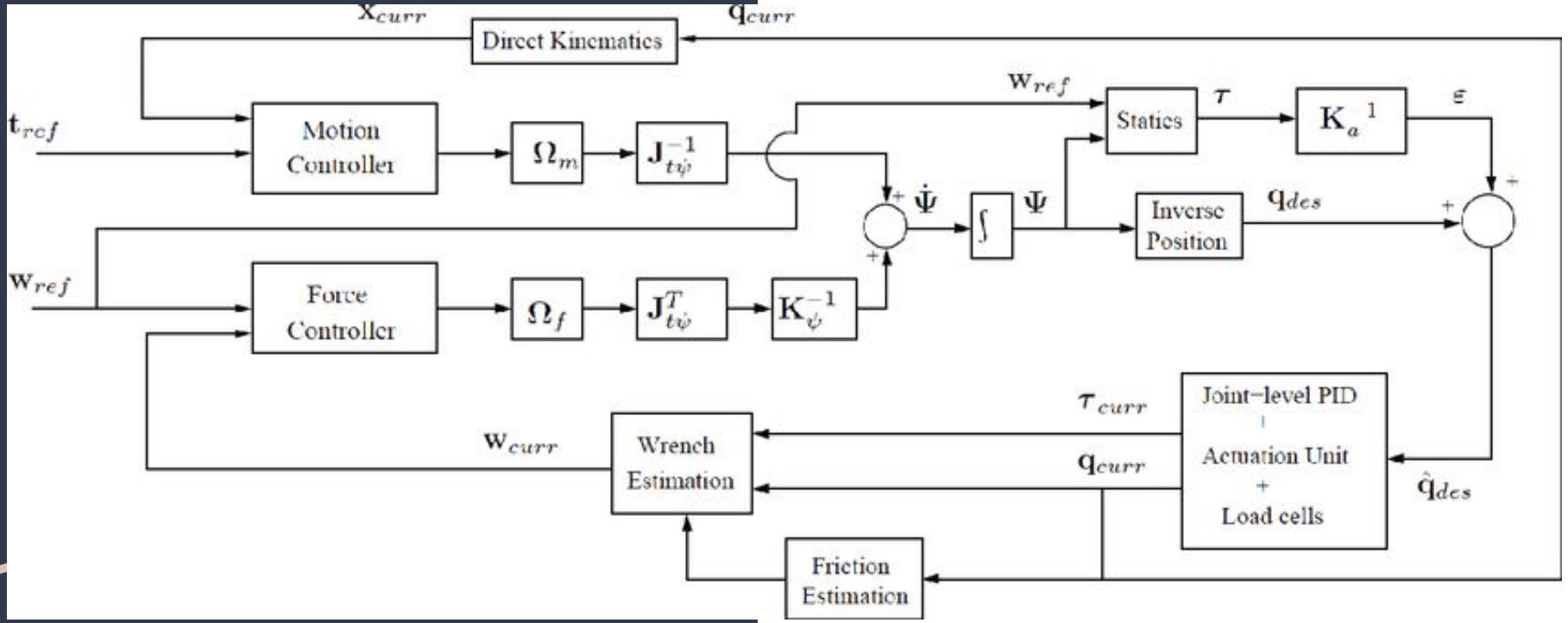
Project Feature

- it has several bending and rotating mechanisms which can help it make precise movements in relation to its environment

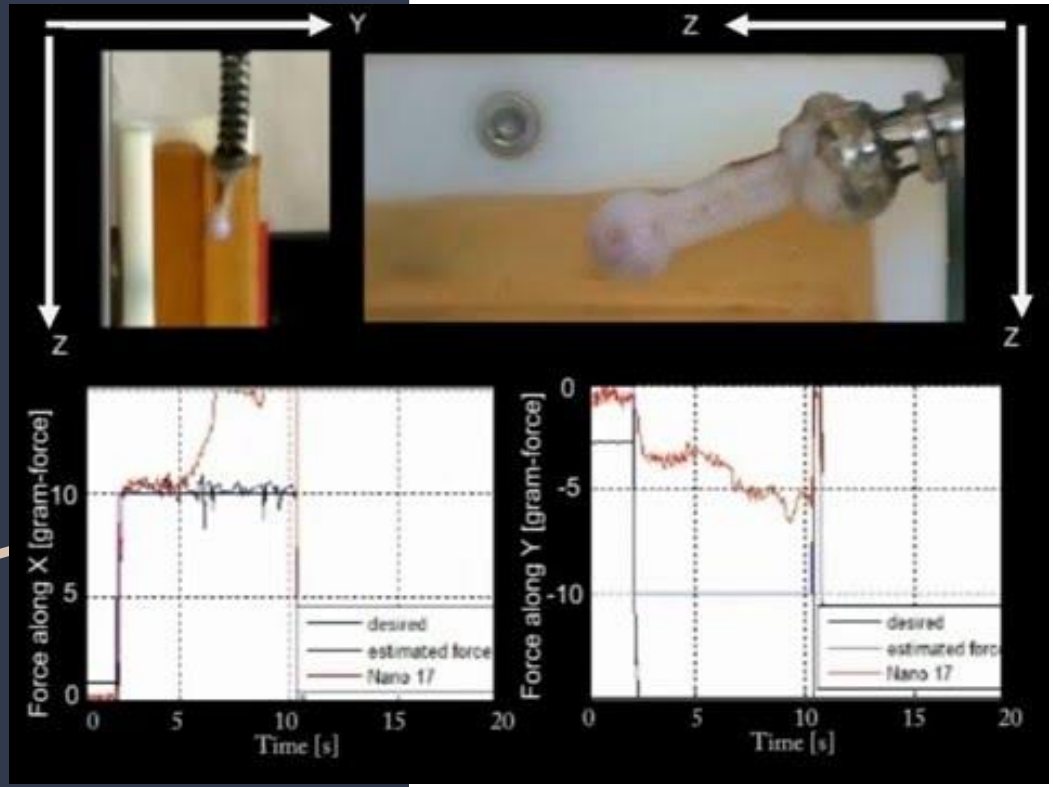
- this is unique because it can help set up future applications for this actuation such as surgery and artificial machines

Control System

- Closed loop system which gets feedback from sensors



Example at work



Improvements

- use this device for surgery in the future because it omits the factor of human error
- Make the base be able to rotate and move to give the robot further accessibility
- replace the head with other sensors to give it a more useful job

Challenges With Case Study

- Tedious getting specific information such as the material used to build the device and the process in which they conducted research

- To interpret some information as there were several new and complex topics

Sources

https://journals.sagepub.com/doi/10.1177/0278364915584806

https://www.researchgate.net/publication/282061704_Hybrid_motionforce_control_of_multi-backbone_continuum_robots

Kneepad Wearable For Football

Problem

- knee injuries are one of the most common and long-lasting injuries in sports
- current knee pads aren’t as protective as they can be and not very durable
- Not comfortable due to heavy padding
- limits athletic ability

Function/Purpose

- this knee pad will inflate prior to impact to ensure the knee is protected and is safe from injury
- contains a radar gun which gives live data in the form of velocity of incoming players
- will inflate with nitrogen gas and will travel through and air tube embedded in the airbag

Materials

- the knee pad is made from mostly from polyester

- Inflatable pad is made from nylon so it’s very durable and won’t rip easily(same as airbag)

- Air tube will be made from nylon as well to ensure the air stays in the pipe

System input and outputs

- radar gun will detect how fat an incoming player is coming

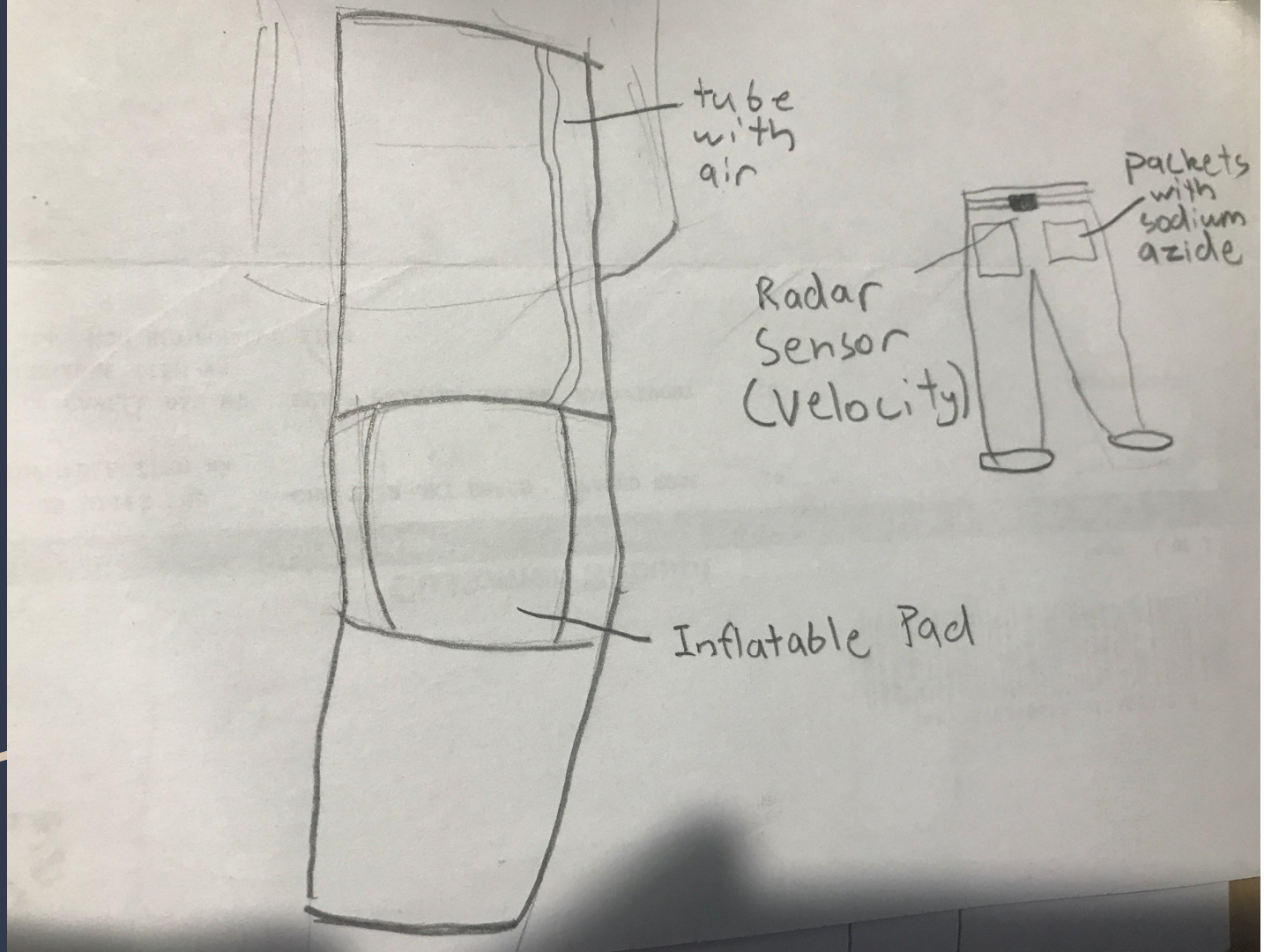
- contains packet filled with sodium azide when released will turn into nitrogen gas through a chemical reaction

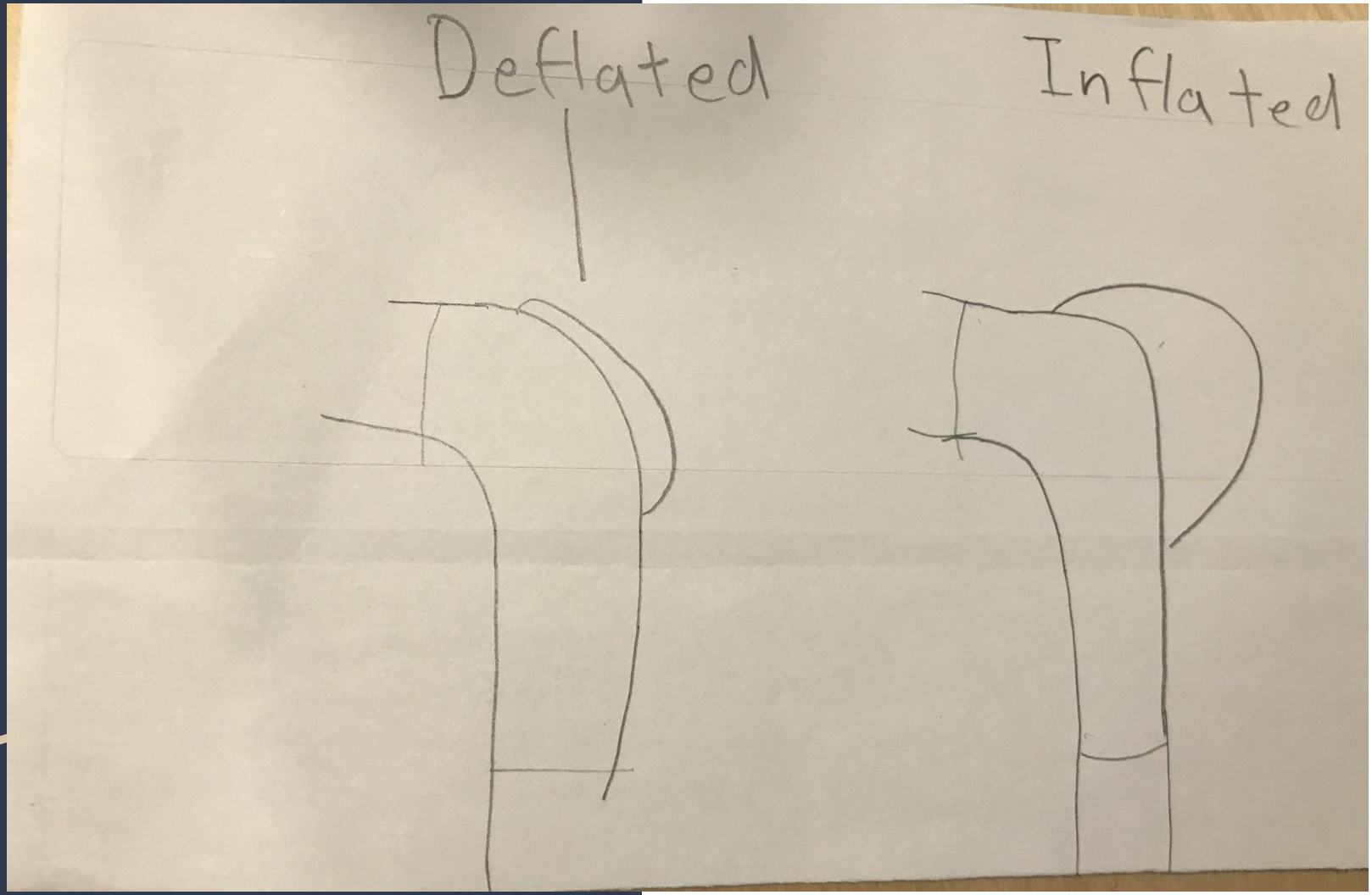
- the air will go through the tube and into the inflatable pad

System input and outputs

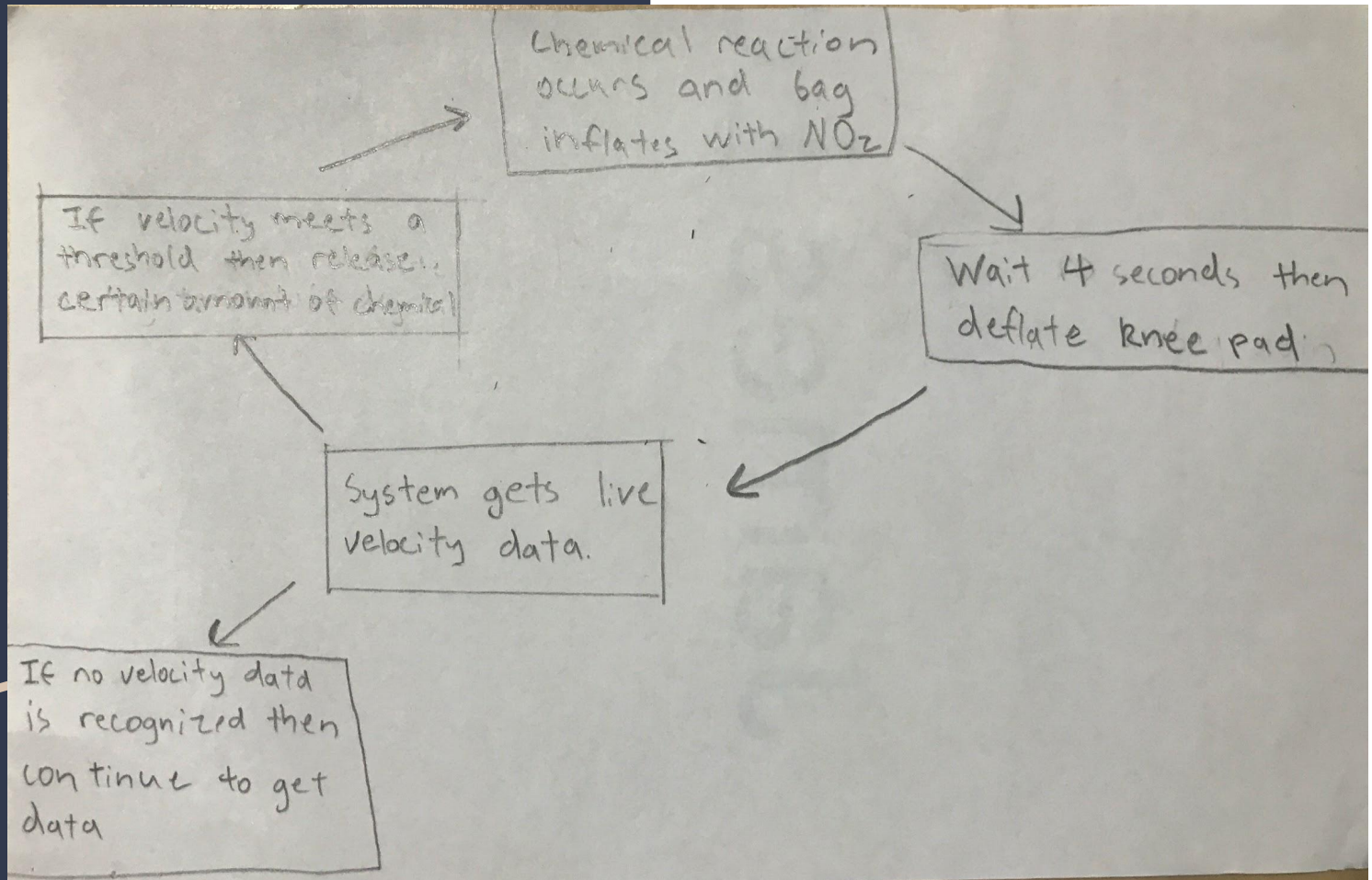
- the live data will be sent to the cloud application where the program is and it will return the velocity value

- Based on the value the airbag will inflate to a certain degree therefore preventing any knee injury


tube with air
Inflatable Pad
packets with sodium azide
Radar Sensor (Velocity)


Deflated
Inflated

Control System



Thank you for listening!