



WORKSHOP 4: DESIGNING NOVEL ROBOTIC SYSTEMS

Nicholas HO, PhD
Institute of System Science, NUS

- Introduction
- Summary of topics covered
- Novel methodologies



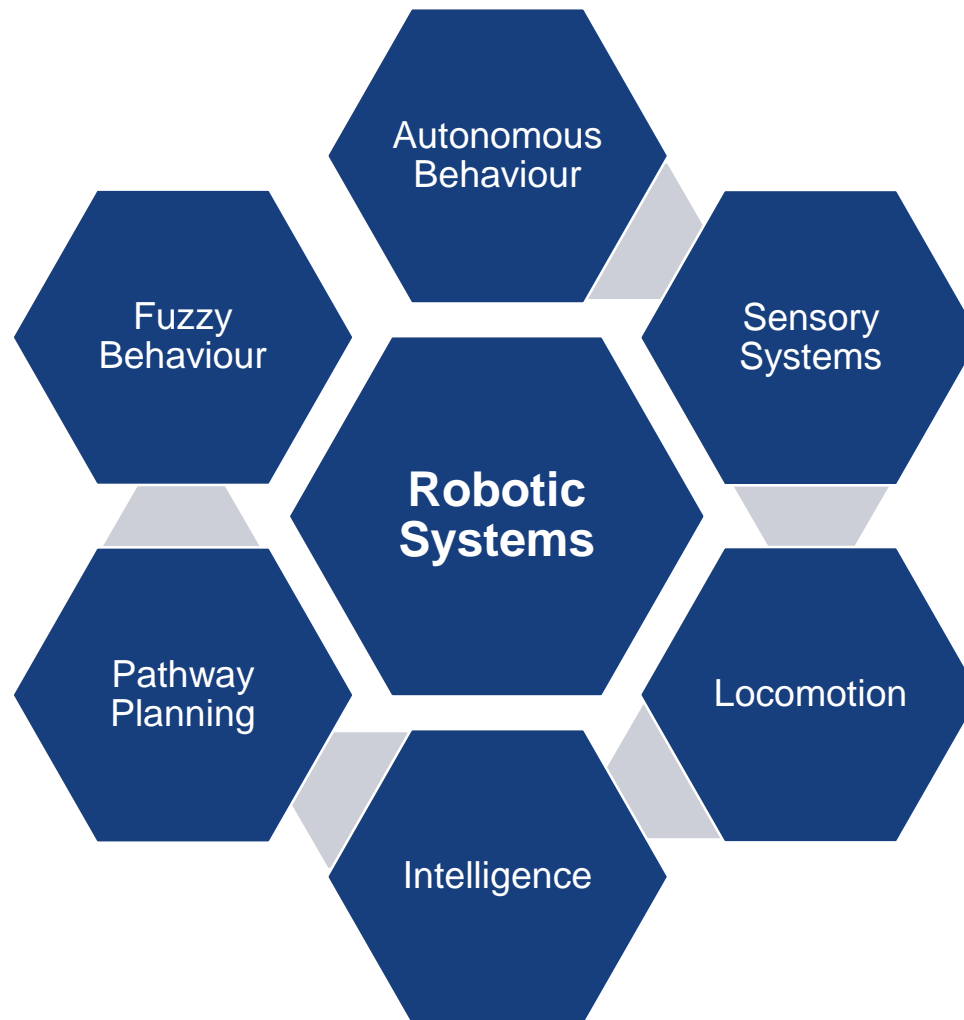
Introduction



- This workshop is to train and teach participants to implement and design robotic systems for real world applications
- RBS professionals need to identify proper pain points to tackle to ensure success



Summary of Topics Covered





Novel methodologies



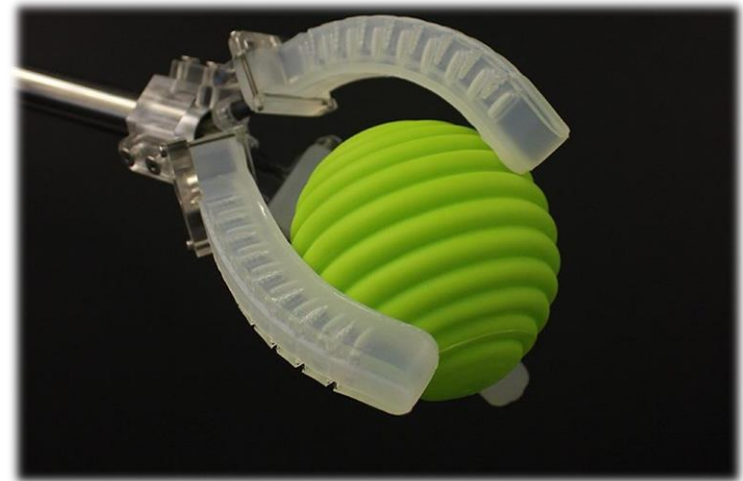
Soft Robotics

- To achieve **high compliance and nature-like movement**
- Use of **pneumatics, electric field, thermal, inflatables, elastic materials**
- Applications: Medical, Massage, Assistive device, Space exploration

Video Link:

<https://www.youtube.com/watch?v=X0XGu-re7mak>

<https://www.youtube.com/watch?v=N28bttqLoZE>



<https://www.therobotreport.com/97810-2/>



Novel methodologies



Soft Robotics Example 1:



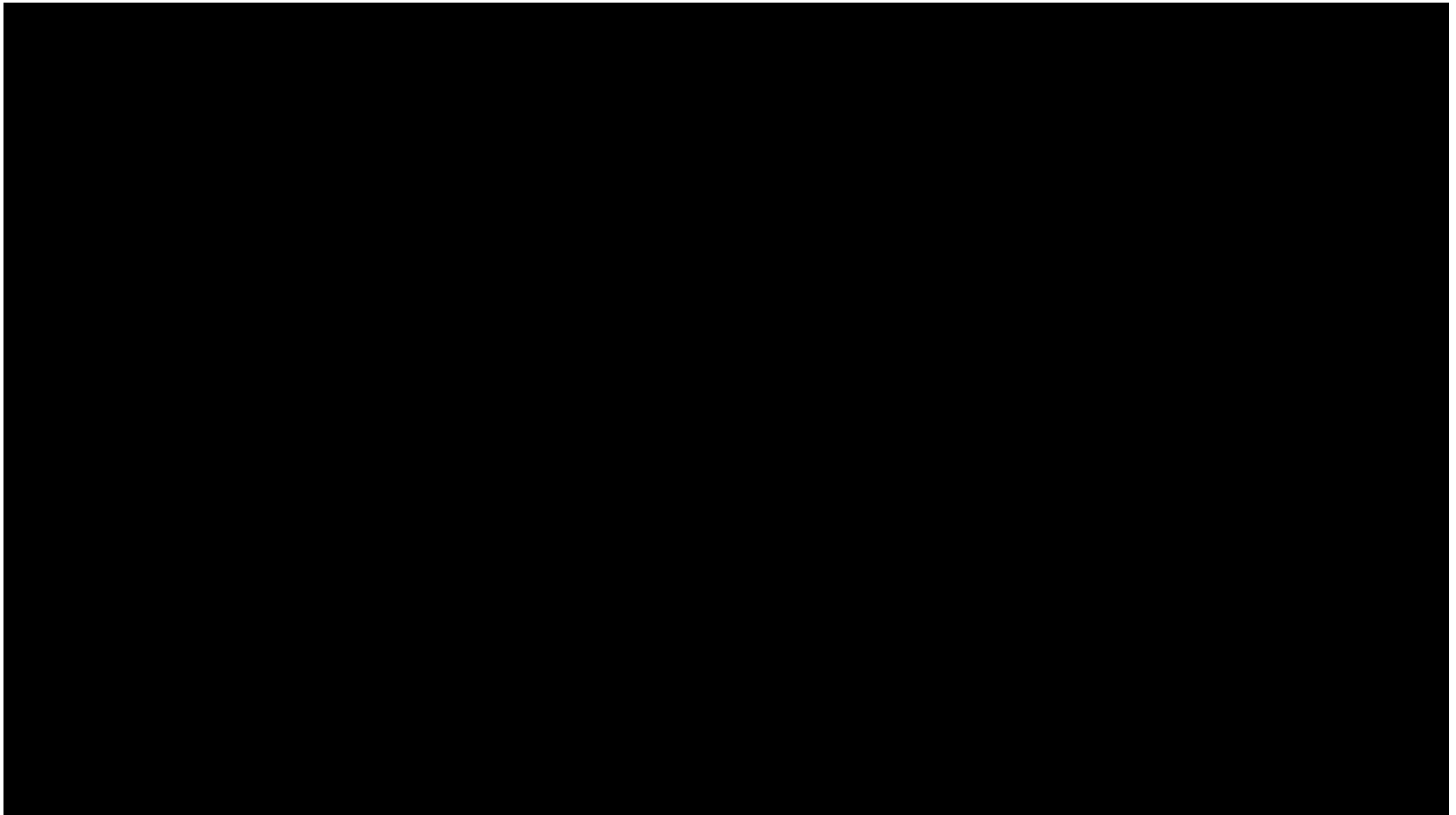
<https://www.youtube.com/watch?v=X0XGure7mak>



Novel methodologies



Soft Robotics Example 2:



<https://www.youtube.com/watch?v=N28bttqLoZE>

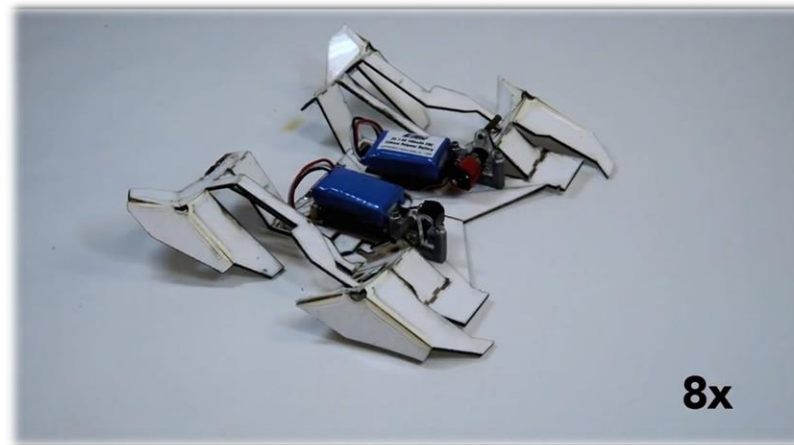


Novel methodologies



Shape Shifting/Self Assembly Robots

- **Assemble and morph by itself**
- Can change from **2D to 3D**
- Based on principles of origami and other mechanisms
- Applications: Space, Military



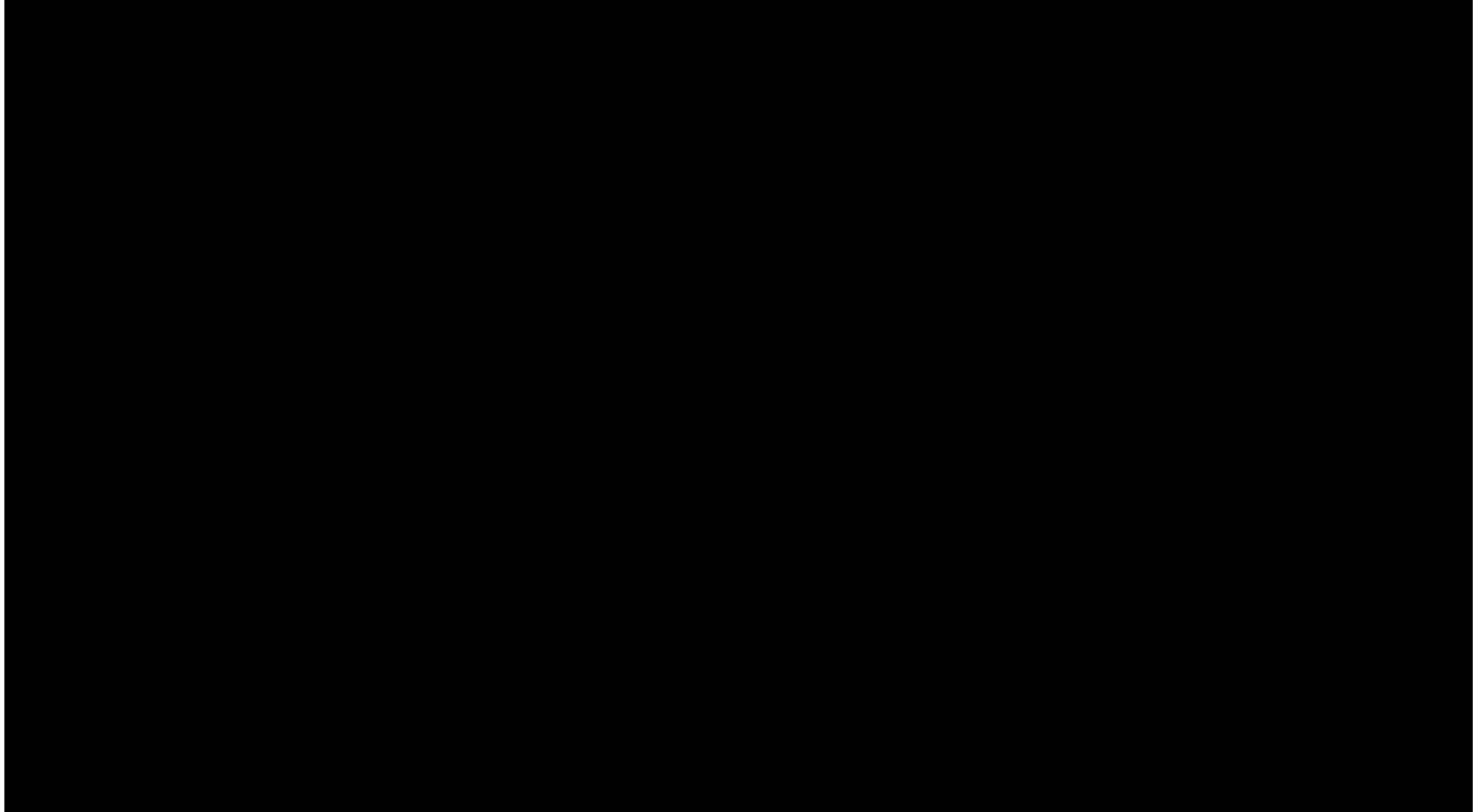
<https://www.youtube.com/watch?v=9M1zNIVGrjM>



Novel methodologies



Self Assembly Robots



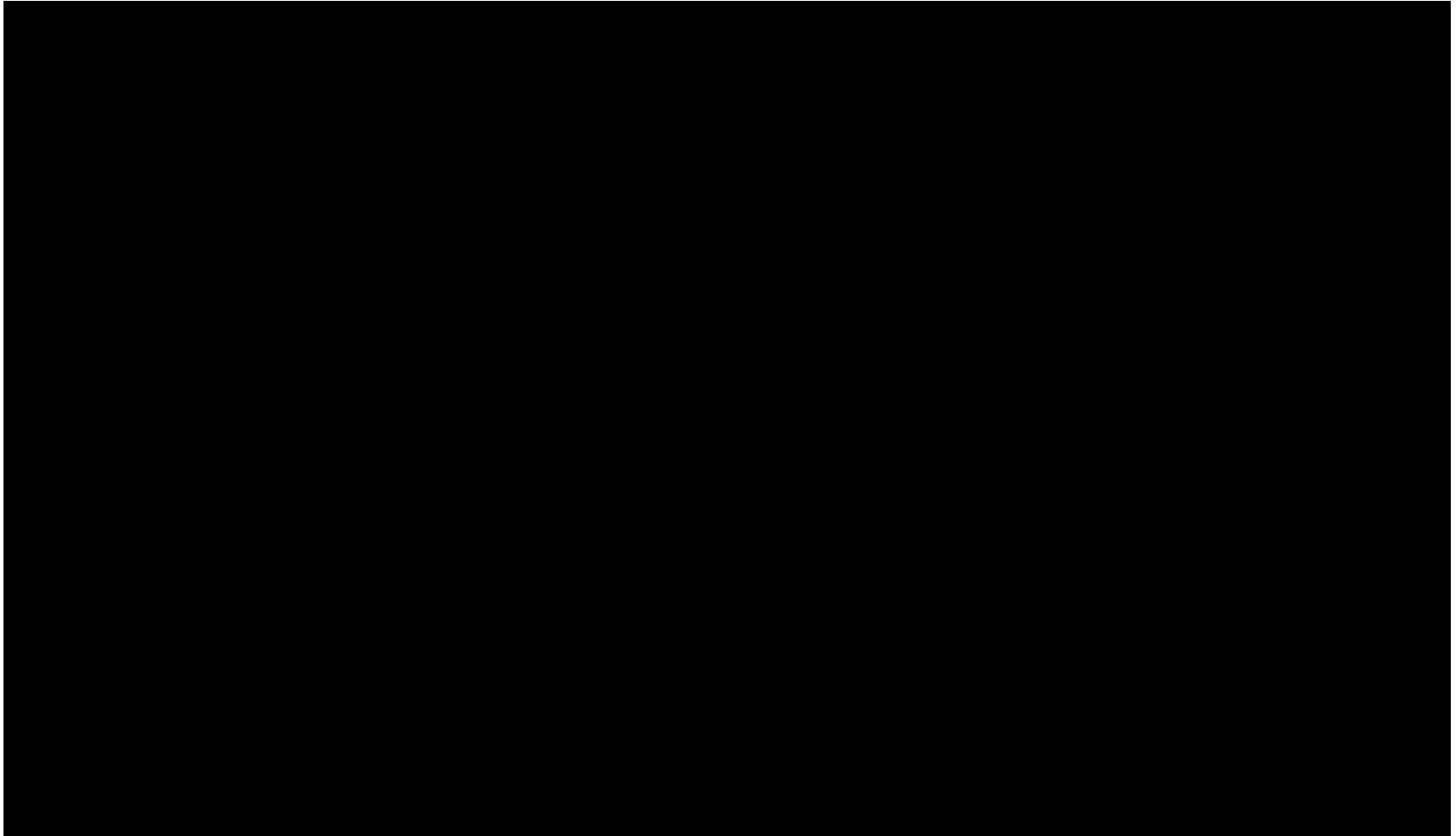
<https://www.youtube.com/watch?v=9M1zNIVGrjM>



Novel methodologies



Shape Shifting Robots



<https://www.youtube.com/watch?v=Pfo233eN3HE>



Novel methodologies



Telerobot

- Based on a **Master and Slave** approach
- Algorithms may assist pilots to better control the robotic limbs
- Applications: Surgery, Manufacturing, Space, Military... etc.



<https://www.youtube.com/watch?v=3rZYn62Old8>



Novel methodologies



Telerobot (Shadow Hand) Example:



<https://www.youtube.com/watch?v=3rZYn62Old8>



Identifying Use-cases



Look for:

- **Daily pain issues** (no pain, no interest)
- **Revenue generating or manpower saving or cost saving** opportunities

After identifying, ask yourself these questions:

- Can the problem be solved with other cheaper alternatives than using robots?
- Will robotics result in cost or manpower savings in the long run?
- Will it infringe any patents or company IT policy or ethical policies?
- Will it cause inconvenience in any way?
- Is it cheap to try out ?



Robotics Blueprint and Implementation Plan



Design

- What is its purpose?
And design/constraint factors to consider?
- What is the technical requirement?
- Info about required hardware and software components?
- Components integration plan and tools?
- Robotic flow process (see next slide)

Production

- Assembly requirement and process?
- Diagnosing of issues during prototyping or production

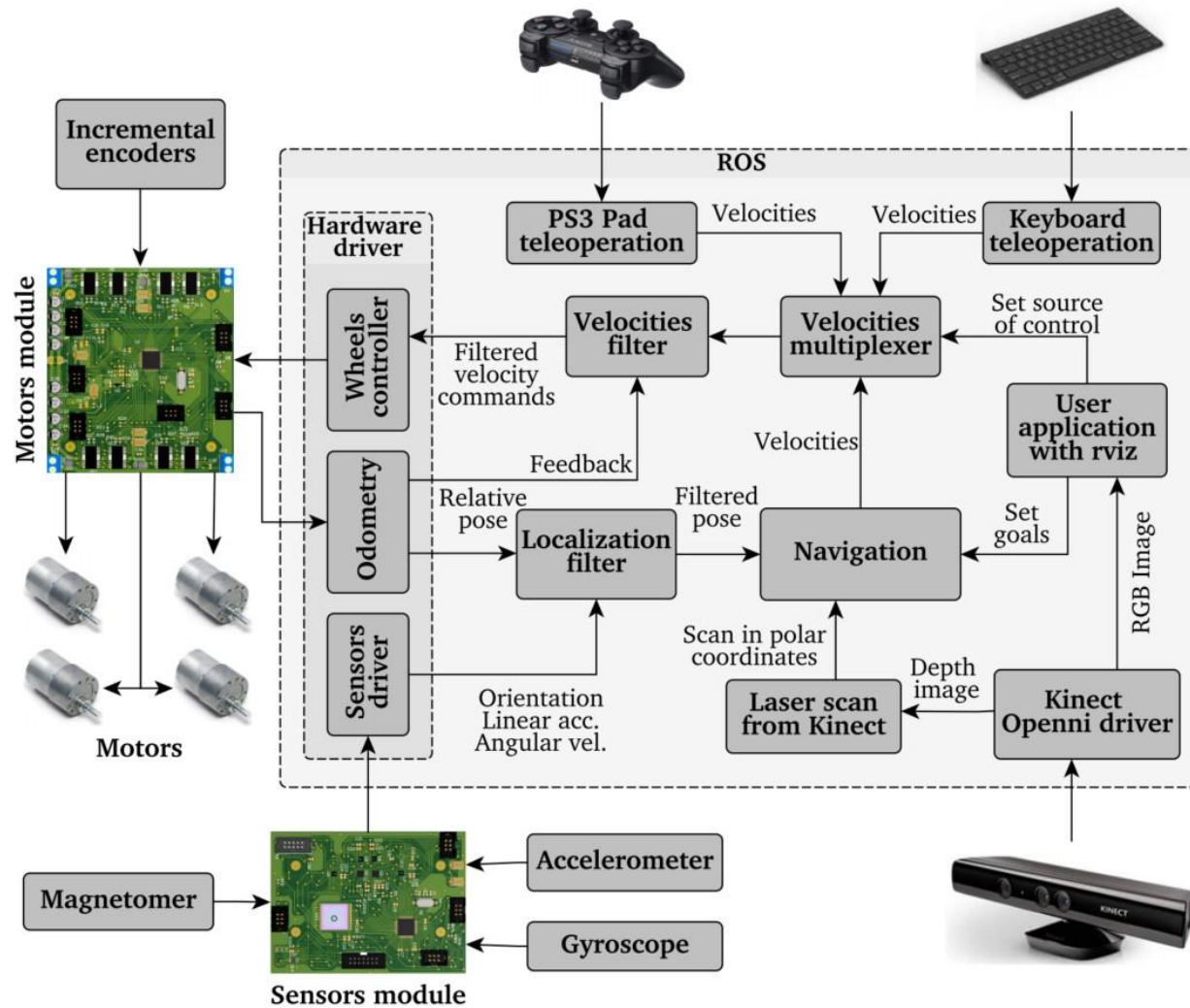
Service

- Maintenance requirement and monitoring?
- Reliability issues and Mitigation Plan?
- Safety and Security Risk and Mitigation Plan?

Focus



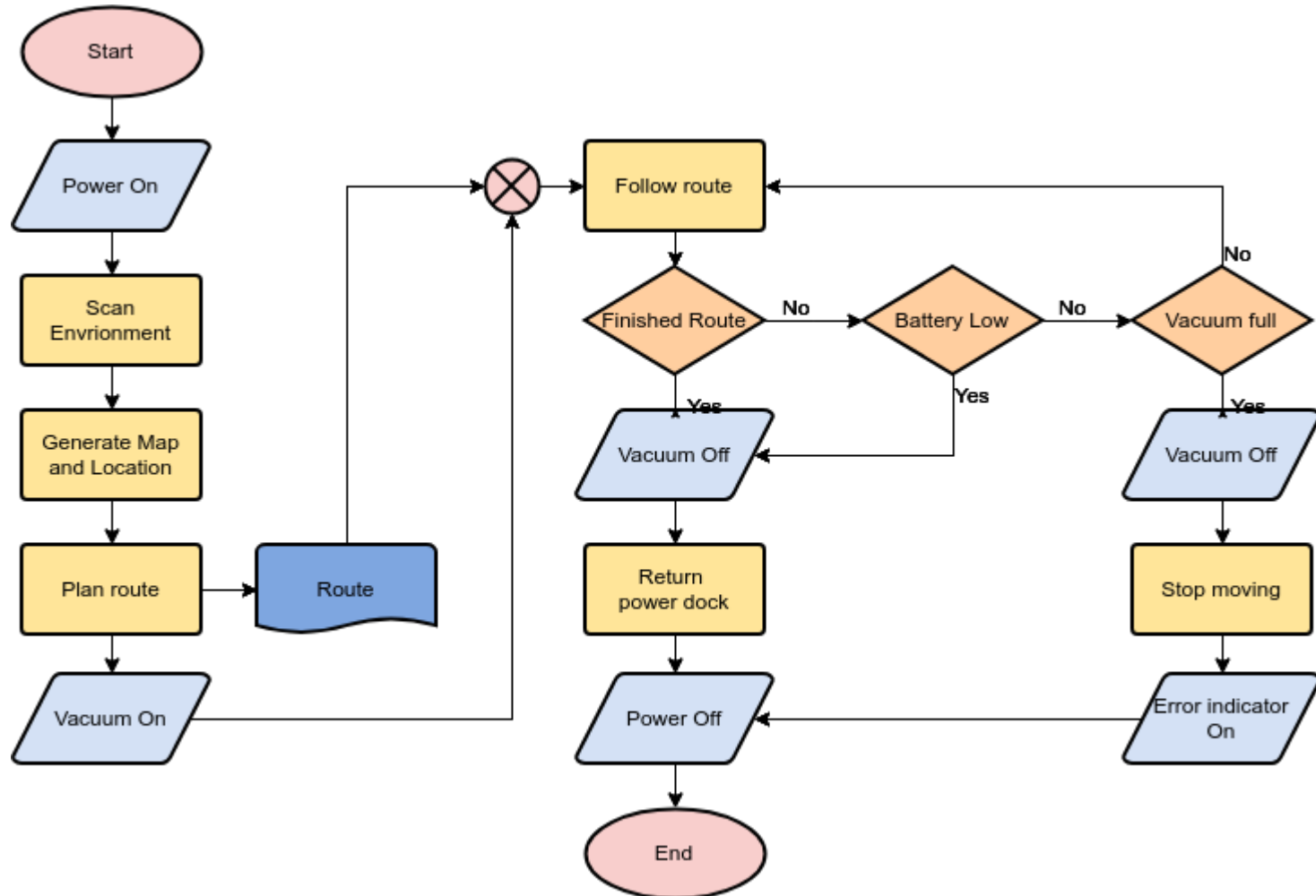
Example of Robotic flow process



- Various critical components:**
1. Sensors
 2. Variable derived
 3. Processing
 4. Sub-Components
 5. Decisions
 6. Actuation/Action



Example of Robotic flow process





Homework



- **Prepare a real robotics implementation plan** specific to your work place or identified use-case
- Include all the points discussed in the previous few slides
- **To be presented and submitted on the 5th day**
- **5~10 minutes presentation** (10 slides or less) and 5 minutes Q&A per person
- Have more graphics/charts/figures than wordy
- PowerPoint-based
 - Use template provided



End of Workshop 4