



NANYANG
TECHNOLOGICAL
UNIVERSITY
SINGAPORE

How to Do Research Projects?

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School of Mechanical &
Aerospace Engineering

<http://xieming.robotics.sg>



This presentation is dedicated to ...

- Researchers doing research works
- PhD students doing research works
- MSc students doing research works
- Undergraduate students doing research works



ABOUT NTU



Vision and Mission



A great global university founded on science and technology, nurturing leaders and creating societal impact through interdisciplinary education and research.

Leadership



Professor Ho Teck Hua

President and Distinguished University Professor



Professor Christian Wolfrum

Deputy President and Provost

About NTU

Ranked Among the Best in the World



3rd

Nature Index
Young University Rankings



1st

Times Higher Education
Young University Rankings



3rd

US News and World Report
Best Global Universities in Asia



4th

Times Higher Education
Asia University Rankings



15th

QS World University Rankings



4th

QS Asia University Rankings



27th

US News and World Report
Best Global University Rankings



30th

Times Higher Education
World University Rankings



10th

QS World's Most Photogenic Universities



Ranked Among the Best in the World



15-Year Sustainability Manifesto



Solidifying the University's position as a global leader in sustainability

- NTU's sustainability manifesto goals: carbon neutrality by 2035, halve net energy utilisation and new sustainability courses
- First university in the world to launch a sustainability-linked bond with an Aaa credit rating from Moody's
- Sustainable campus with eight zero-energy buildings, the most amongst organisations in Singapore
- Home to two of Asia's largest wooden buildings, Gaia and The Wave
- Winner of ISCN's Whole Systems Approach Excellence Award in recognition of sustainable practices in the areas of research, education, community engagement, and infrastructure developments

About NTU

Main Campus



200 hectares



State-of-the-art-facilities



25 halls of residence

The NTU Smart Campus is a living testbed of tomorrow's technologies and frequently named among the most beautiful campuses in the world.



Medical Campus



School of Medicine

Learning and research

Sports and recreation

Home to the Lee Kong Chian School of Medicine in Novena, Singapore's healthcare district. The school aims to be a model for innovative medical education and a centre for transformative research.

At a Glance



35,400 students

24,800 undergraduates

10,600 postgraduates

8,000

faculty, researchers and
staff from 73 countries

300,900 alumni

representing 172 nationalities

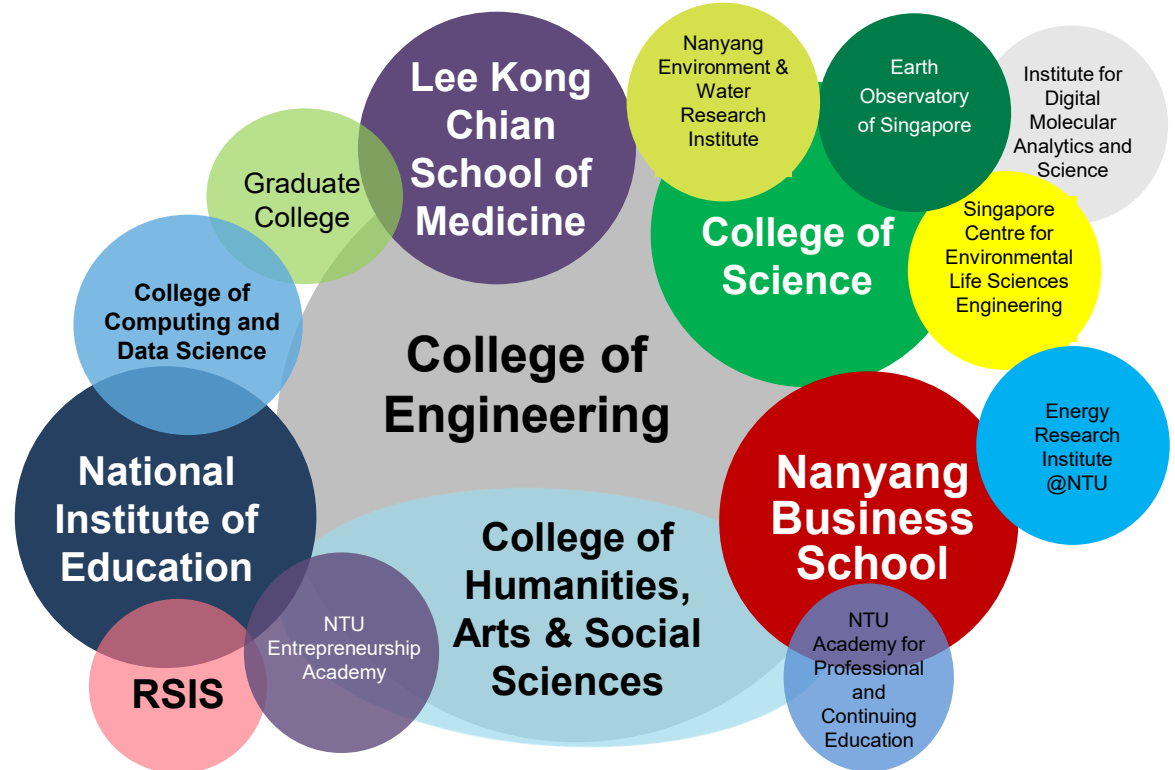
About NTU

At a Glance

6
Colleges

15
Schools

**World-class institutes
& research centres**



NTU Academy for Professional and Continuing Education



- Consolidates continuing education and training capabilities and expertise within the University
- Enriches the lifelong learning experience of adult learners, including the University's alumni, making it easier for them to take charge of their own continuing education
- The FlexiMasters programme for continuing education at the Master's degree level, launched in 2020, has grown to more than 35 curricular offerings from all parts of the University

Global Alliance of Industries @ NTU



- Catalysing new university-industry partnerships through multiple consortia, corporate laboratories, multidisciplinary institutes and technology invention disclosures
- Over 250 industry partners and 20 corporate and joint labs with global entities such as Alibaba, Continental, Hewlett-Packard, Nanofilm Technologies, Rolls-Royce and Schaeffler

About NTU

Top Industry Partners



About NTU

Top Academic Partners



UC Berkeley



Northeastern University



Australian National University



University of British Columbia



Imperial College London



Karolinska Institute



TUM



Seoul National University



Indian Institute of Technology, Madras



University of Toronto



Tsinghua University



University of Pennsylvania



ABOUT YOU



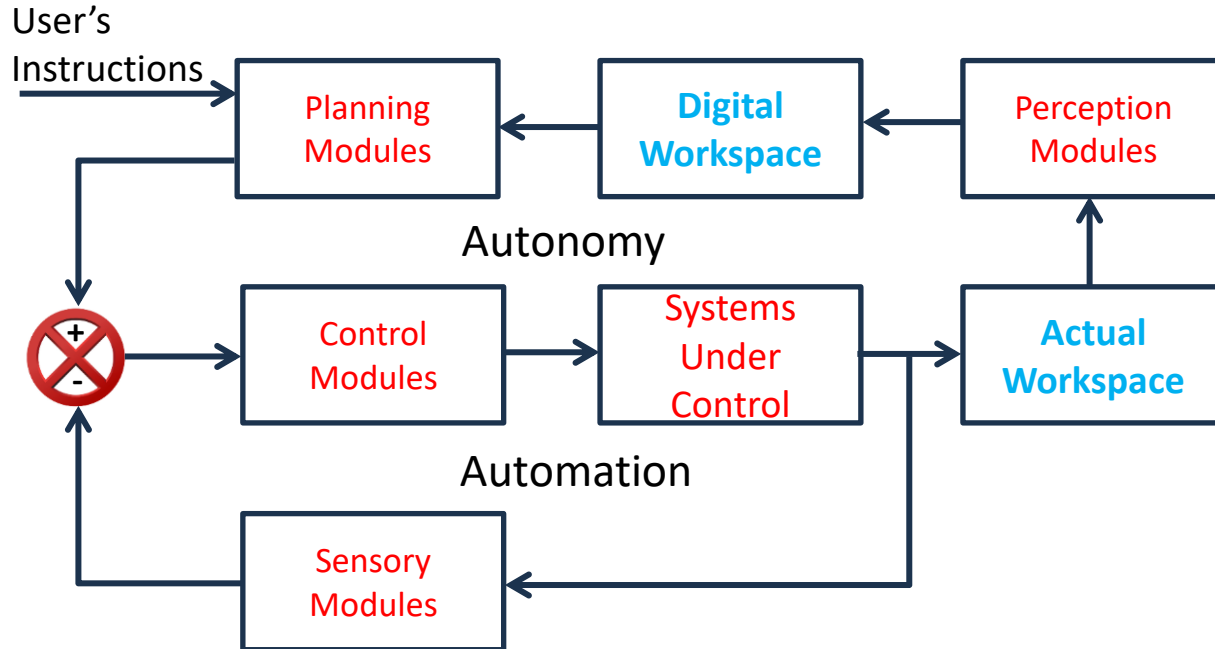
Remember your mission as postgraduates ...

- You are here to grow your knowledge and skills so as to be able to design **machines** with **controllable behaviors** and hopefully in some **intelligent ways**.



How to fulfill your mission?

- To apply learnt knowledge and skills into the implementation of the following universal blueprint underlying all the intelligent machines or systems.

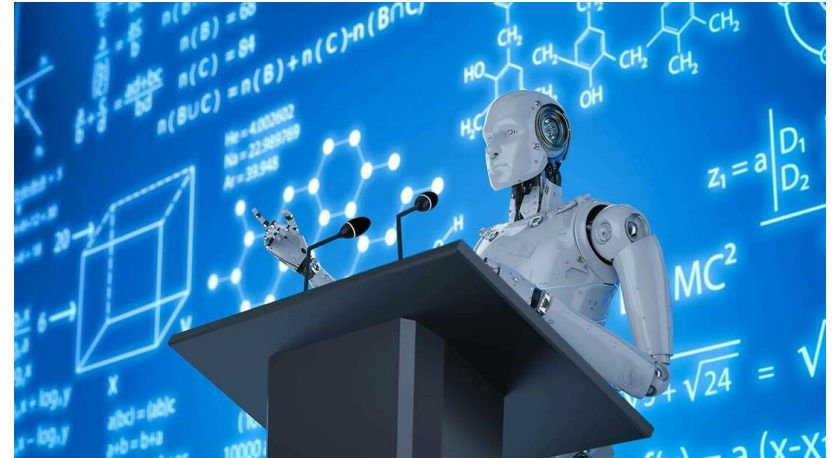


ABOUT ME



My role is to help you ...

- To be motivated
- To be purposeful
- To be resourceful
- To be skillful
- To sharpen your mind





Professor Xie Ming has been:

- Dean/Professor, School of Electrical Engineering and Control Science, Nanjing Tech University, China.
- Guest Professor, Huazhong University of Science and Technology, China.

Professor Xie Ming is now:

- President, Robotics Society of Singapore
- Editor-in-Chief, International Journal of Humanoid Robotics.
- Associate Professor, Nanyang Technological University, Singapore.

Professor Xie Ming has published:

- Three books in English
- Two edited books in English
- Two books in Chinese
- Over 40 International Journal Papers
- Over 100 International Conference Papers

Professor Xie Ming has received many awards and over 10 granted patents.

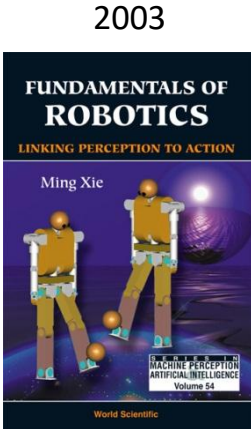
Ming XIE

Associate Professor (1999 - present)
<http://personal.ntu.edu.sg/mmxie>



1984: B.Eng (China)
1986: Msc (France)
1989: Ph.D (France)

Recipient of Chinese Government's Overseas Scholarship (1984 - 1989)



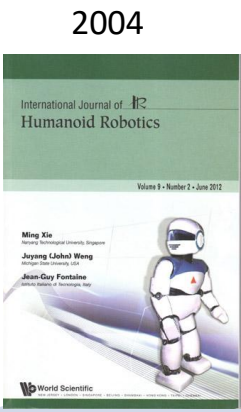
Knowledge Innovation



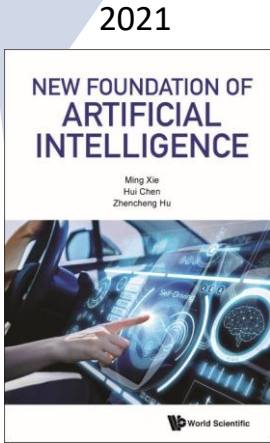
Product Innovation (Robot Driver)
Technology Innovation (Robot Worker)

Teaching Portfolio

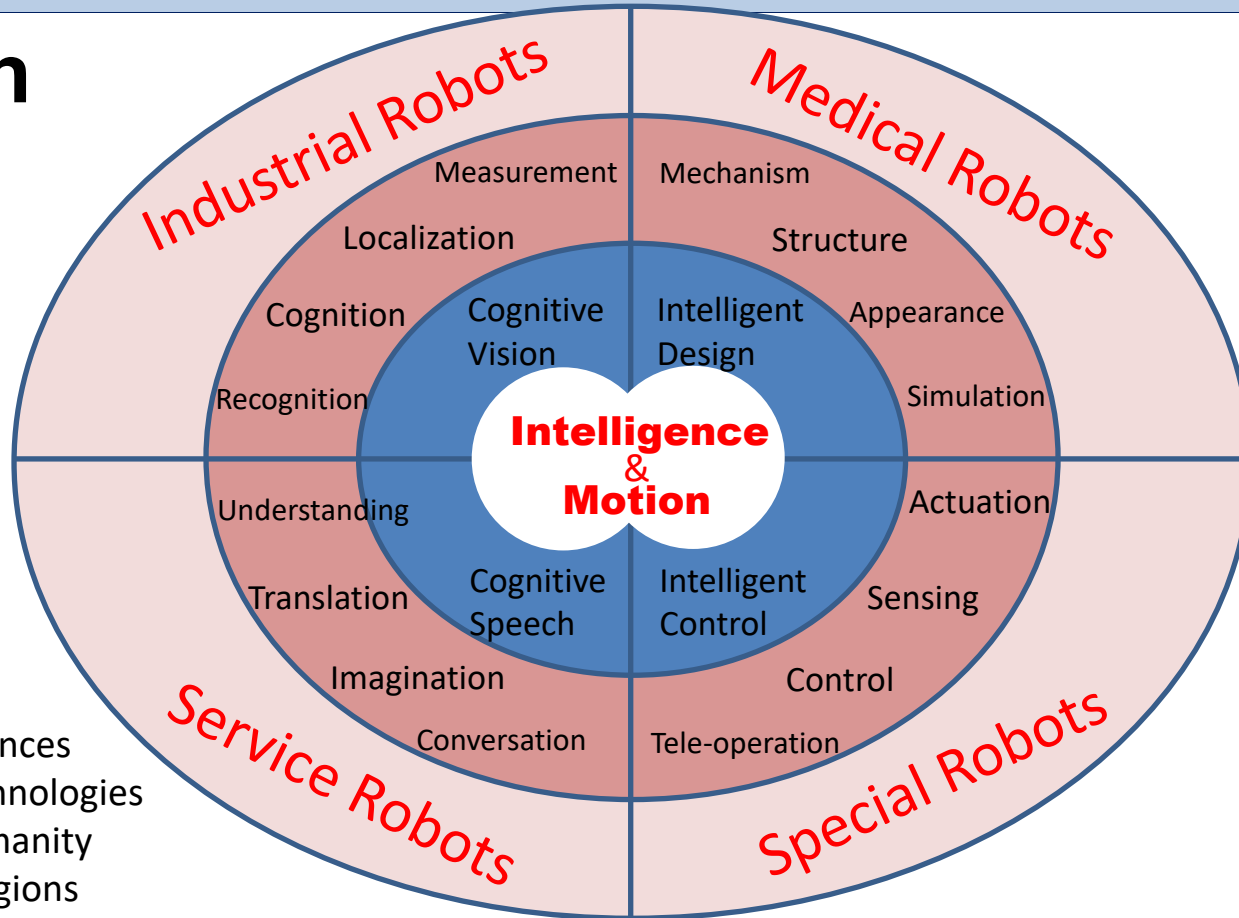
1. Sensors
2. Robotics
3. Microprocessors
4. Machine Intelligence



Social Service

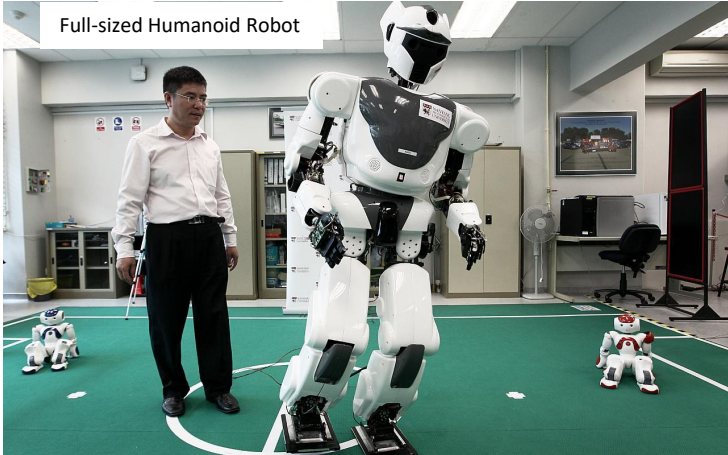


Research

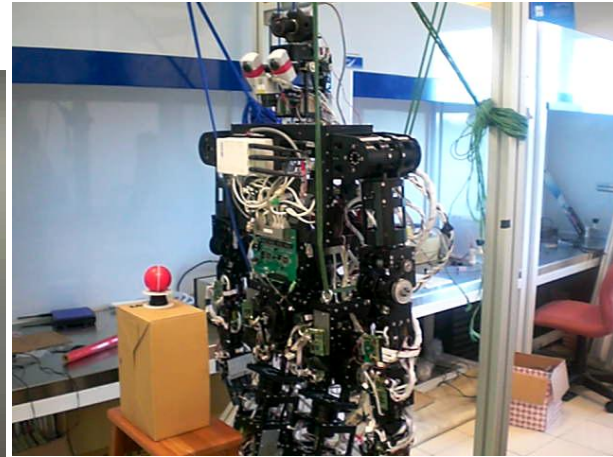
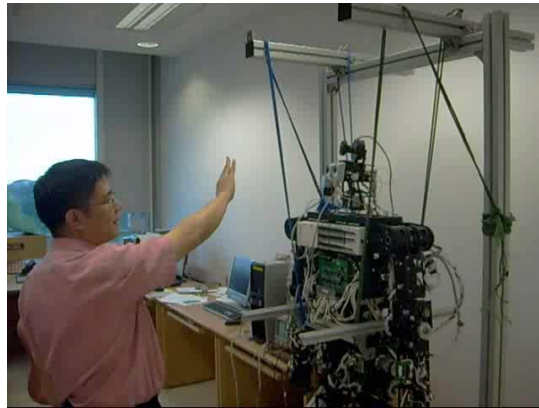


- Sciences
- Technologies
- Humanity
- Religions



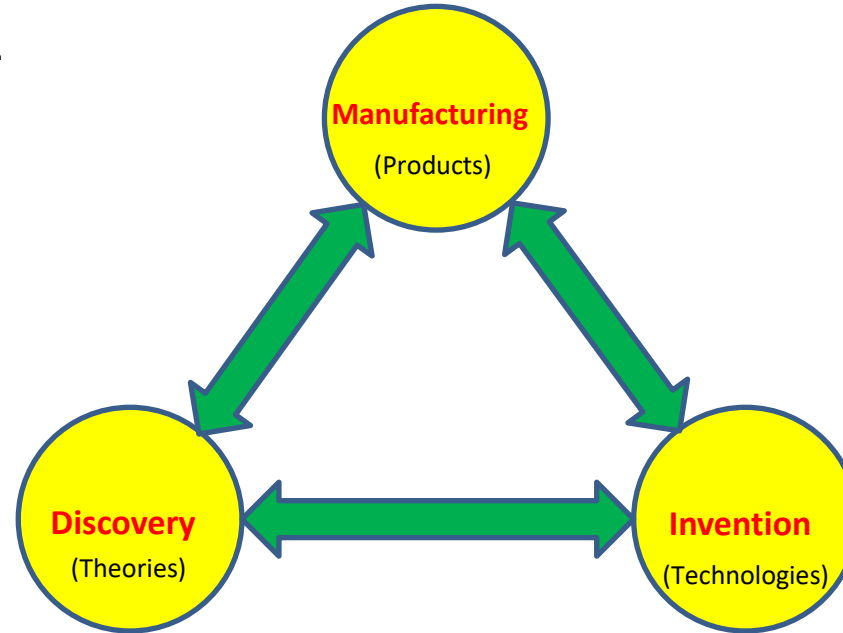


Robots with Intelligence Inside ...



How to understand and improve the world?

- Research comes first.
- What is research? What are the 1,2,3 of research?
- Research has one objective which is to create values by finding better ways of solving problems.
- Research is not to create results by applying solutions.



Two Driving Forces of Research

1. Scientific Problems
2. Social Needs



1. Creation of New Theories
2. Creation of New Technologies
3. Creation of New Products

Outline of Today's Talk

- What is research?
- Research Procedure
- Examples of Research Topics
- Layout of Research Thesis
- Layout of Conference/Journal Paper
- Why to Do Literature Survey?



WHAT IS RESEARCH?



Difference between Engineers and Researchers

Role of Engineers

- Given a problem, work out a **workable** solution.

Role of Researchers

- Given a problem, work out a **better** solution.
- Standing on the shoulders of giants!



What is research?

Basic Research

- Given a fundamental problem in science and engineering, find out better theoretical results

Applied Research

- Given a popular need in industry and society, find out better technological solutions.



RESEARCH PROCEDURE



Research Procedure

1. Choose a research topics (i.e. a **problem** or a **need**).
2. Survey existing solutions to the chosen problem or need.
3. Formulate the details of your innovative (i.e. **better**) solution to the chose problem or need.
4. Implement your innovative solution.
5. Test and experiment with your version of implementation.
6. Analyze results of your experiments.
7. Explain the observations from your experiments.
8. Write research report.
9. Publish conference or journal paper.



EXAMPLES OF RESEARCH TOPICS









[About](#)

[Programs](#)

[Resources](#)

[Get Involved](#)

[Stories](#)

Program

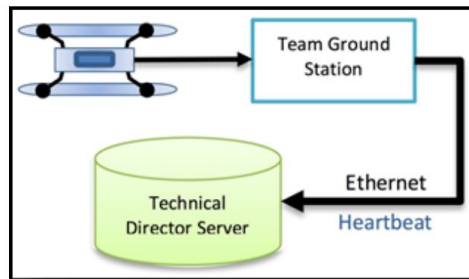
RobotX Challenge 2022

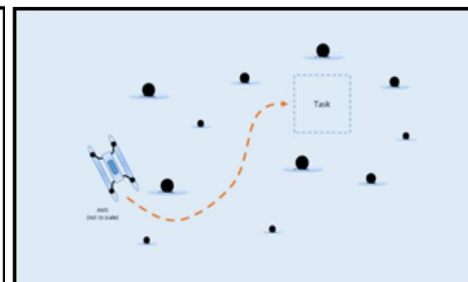
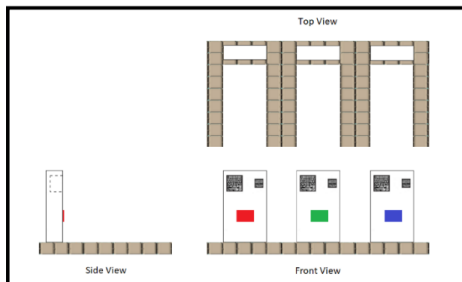
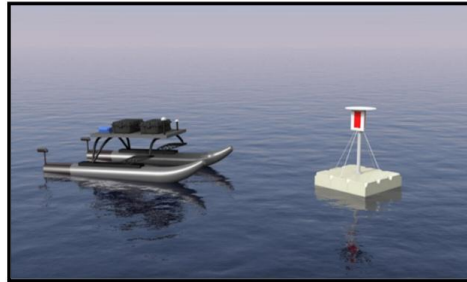
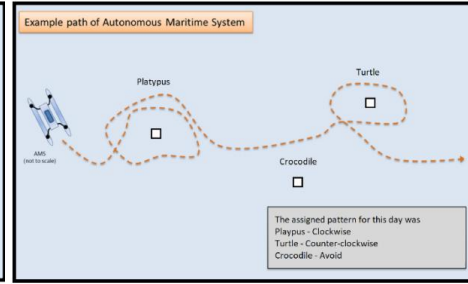
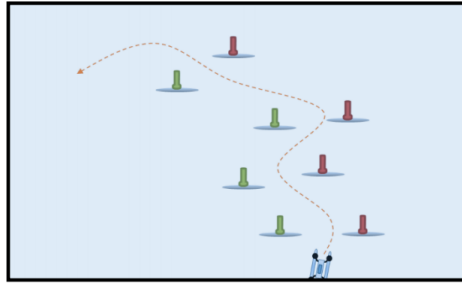
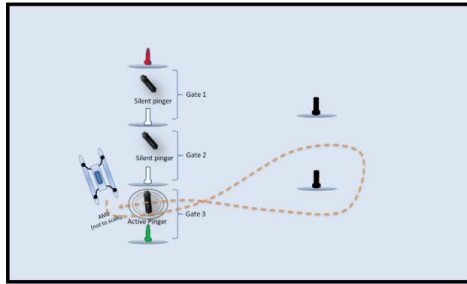


The Challenge

The Maritime RobotX Challenge is an international, university-level competition designed to broaden students' exposure to autonomy and robotic technologies in the maritime environment.

[Discover the Challenge →](#)

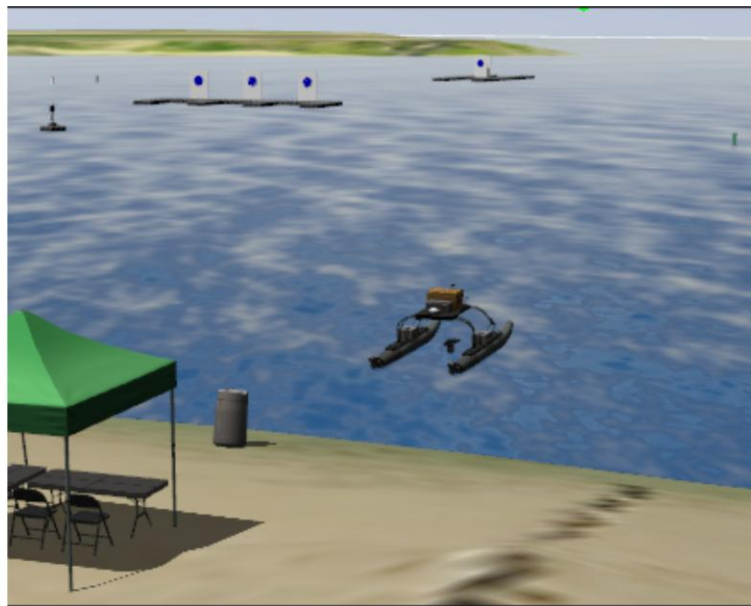
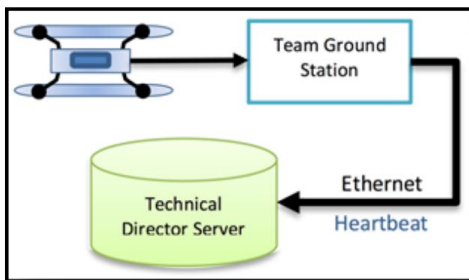




The Virtual Competition

The Virtual RobotX (VRX) competition challenges student teams to develop innovative solutions in a simulated environment. These solutions can be integrated onto a WAM-V RobotX platform.

[Discover Virtual RobotX →](#)



Examples of Research Topics

1. Toward Cognitive Vision
2. Toward Robot's Self-Intelligence (AI 3.0)
3. One-to-Many Machine Translation
4. Toward Human-Like Binocular Vision
5. Development of Cognitively-Intelligent Robots



Toward Cognitive Vision

- Human vision is cognitive in nature.
- Human vision is able to transform physical quantities into conceptual quantities in human languages.
- The aim of this project is to develop scientific principles which will enable vision systems to have human-like cognitive capabilities.
- The key tasks include:
 - 1) study of conventional vision systems,
 - 2) study of human-like visual perception,
 - 3) development of principles for machines to cognize colors, shapes, objects, faces, etc.



One-to-Many Machine Translation

- Human beings are able to learn any human language and to undertake one-to-many translation of learnt languages.
- The aim of this project is to develop principles which will enable machines to have similar capabilities of undertaking one-to-many translation of human languages.
- The key tasks include:
 - 1). study of speech recognition,
 - 2. study of speech understanding,
 - 3. study of machine translation,
 - 4) development of one-to-many translation of human languages by machines, etc.



OUTLINE OF PRESENTATION



Outline of Presentation

1. Motivations of Research
 - Users? Users' Needs? Intended Outcome?
2. Problem Statement
3. Literature Survey
 - Existing Theories/Technologies? Existing Works?
4. Proposed Better Solution
5. Detail of Implementation
6. Experimental Results and Analysis
7. Conclusions



LAYOUT OF RESEARCH REPORT



Layout of Research Thesis

1. Cover page
2. Summary
3. Acknowledge
4. Table of Contents
5. Chapter 1 Motivations of Research
6. Chapter 2 Problem Statement
7. Chapter 3 Literature Survey
8. Chapter 4 Proposed Better Solution
9. Chapter 5 Detail of Implementation
10. Chapter 6 Experimental Results and Analysis
11. Chapter 7 Conclusions
12. List of References



LAYOUT OF CONFERENCE OR JOURNAL PAPER



Layout of Conference or Journal Paper

1. Title
2. List of Authors and Their Affiliations
3. Abstract
4. Introduction (why to do this research)
5. Problem Statement (what is the problem under investigation)
6. Literature Survey (what have been done by others)
7. Details of Proposed Better Solution
8. Short Description of Implementation
9. Details of Experiments and Results
10. Conclusions
11. List of References



WHY TO DO LITERATURE SURVEY?



Why to Do Literature Survey?

- It is compulsory that you have to come out a workable solution.
- It is compulsory that you have to come out a **better solution**.
- The best way for you to come out a workable and better solution is to stand on the shoulder of a **giant** in the field of your research project.
- Hence, literature survey is for you to know:
 - Who are the giants in your field of research?
 - What have been done by the identified giants?
 - What is the proposed solution to your research project, which is better than the existing solutions published by your giants?



Thank You for Listening!

“Ask not what your country can do for you – ask what you can do for your country,” - John F. Kennedy

“Do not think that you are needy – think that you are needed in the world”, - Manis Friedman

“Study will make you knowledgeable, resourceful, and hence more needed”, - Xie Ming



Welcome to visit: xieming.robotics.sg

ENJOY DOING YOUR RESEARCH PROJECT!

