Future of Robotics

Statement of Work

EDSGN 100: Intro. to Engineering Design
Fall 2019 Client-Driven Design Project

Project Objective

Identify opportunities for the use of robots to positively impact society, thereby improving our lives, within the next ten years.

Project background

Every day we hear stories about new robotic systems, whether it be Handle (Figure 1), a mobile robot designed for logistics (i.e., moving boxes); Spot (Figure 2), capable of animal-like movement; PackBot (Figure 3) to support police operations; robotic pets to support dementia patients; or robots for industrial or construction applications; and the list goes on and on! Future applications are nearly limitless. But with expected advantages of these systems also come potential challenges like ethical dilemmas and the displacement of workers.

Figure 1. HANDLE™ logistics robot from BostonDynamics[1]

Figure 2. SPOT® nimble robot from BostonDynamics[2]

Figure 3. FLIR PackBot by Endeavor Robotics (now FLIR)[3]

Considering potential future applications and challenges, reflect on the technological advances, societal acceptance, and policies and supporting systems needed to enable the increased use of robots to better our lives.

Sponsor Background

Texas Instruments' semiconductor technologies and their people are changing the world. TI engineers, manufactures, tests, and sells analog and embedded semiconductor chips—key ingredients in things you experience every day. From connected cars to intelligent homes, from self-monitoring health devices to automated factories, TI's technologies add intelligence to electronic systems—making them safer, smarter, more connected, and more efficient. Their history is engrained in their name: Texas Instruments. They were founded in 1930 as an oil and gas exploration company—established with a Texas-born determination to ask, "What if?"—and to answer with ideas that open new markets and avenues of innovation. Over the years, as markets and industries have changed, they have reengineered their company time and time again to grow and thrive. And along the way, their core values of integrity, innovation, and commitment have remained the same.

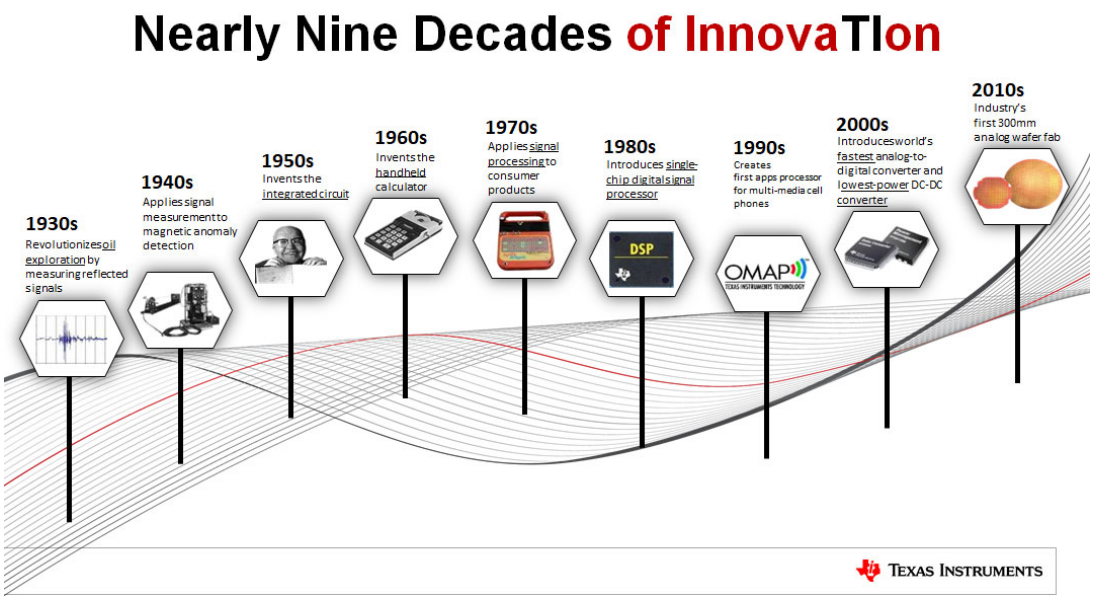
Companies in every market continue to add more electronics to make their products smarter, safer, more efficient, and more connected. TI's breakthroughs in analog and embedded processing semiconductors help companies create innovative, differentiated applications. Their technologies are at work in every type of electronic system in markets that include: Industrial, Automotive, Personal electronics, Communications equipment, and

[1] https://www.bostondynamics.com/handle

[2] https://www.bostondynamics.com/spot

[3] https://www.flir.com/products/packbot/

Enterprise systems. TI is a global Fortune 500 technology company with more than 30,000 employees, nearly 100,000 products, and more than 40,000 patents.



Project Description

Robots are often tasked with jobs that are considered "dirty, dull, and dangerous" (the "Three Ds"). Ultimately, your design team should choose one (or a combination) of these categories and develop a concept for the use of robots in an identified market space.

First, your team will explore robotics as a system of inputs and outputs using the Texas Instruments Robotics System Learning Kit (TI-RSLK). Each team will be tasked with building the robot and completing simple tasks. Then, your team will be challenged to design a robotics system appropriate for a given market space.

Specifically, your team will (1) explore possible markets for robots (e.g., elder care, robotic construction, meal delivery, package delivery, hazardous environments, co-robots, stock-taking (e.g., Simbe), vacuuming, etc.); (2) identify one or more of interest, researching what has been done in addition to identifying gaps in the market; (3) design and model the robotic system that addresses a specific design opportunity in that market space; and (4) evaluate your design. Throughout the process, your team will need to validate assumptions and explore the larger system to justify your design decisions.

Markets that your team considers may fall into three categories: (1) new markets (nothing exists; ask yourself: what would you like a robot to do to improve your life or the lives of those around you?); (2) emerging markets (consider barriers to acceptance and entry into market, initial responses); and (3) mature markets (e.g., robotic car assembly).

While researching market spaces and designing your robotic system, your team should explore the following concepts to understand the larger system into which these robots would integrate and operate:

- What is your team's definition of a robot?
- The fundamental canon of engineering is to "hold paramount the health, safety, and welfare of the public." With that in mind, what does it mean to "improve" society and our lives?

- What are some of the ethical implications involving robots? These can be explored, for example, by examining Asimov's "Three Laws of Robotics", self-driving cars dilemmas, displacement of workers, liabilities, and hazardous work.
- What is the public perception of robots, which may vary in different countries and cultures? For example, consider Japan and the concept of the "Uncanny Valley".
- Explore economics surrounding their use and the potential inequity of risk/benefit.

Project entries in one (or more) of these three categories (the "Three Ds") should first include background research into technologies being deployed today. The project team should then describe modification(s) to an existing feature/function or creation of a new technology or application for the robot of the future.

Within the scope of this design project, your work will involve the following

1. Identify a category and opportunity
2. Demonstrate your concept or a sub-system of your concept through a functioning robot or subsystem
3. Examine your opportunity as a system and examine all inputs and outputs.
    a. Create a systems diagram
    b. Create an example of the user experience (i.e., Concept of Operations) for your opportunity
    c. Discuss a life-cycle assessment for the opportunity or system you propose
4. Demonstrate how the system would be deployed and how the user and other stakeholders will be affected by your design choices.
5. Examine and discuss important aspects of your system through analysis of relevant concepts affecting feasibility and adoption, such as: regulations; ethical considerations; cultural, security, and privacy issues; issues around market entry; and general perceptions of robots.
6. Demonstrate that your design is economically viable (i.e., affordable) by proposing and supporting the approximate cost of your design.

Project Deliverables

Note: Your instructor will clarify expectations for these deliverables and respective due dates.

- Technical report containing the following elements
    - Rationale for the selection of the opportunity
    - Description of alternative concepts and their evaluation
    - Systems diagram
    - Concept of Operations
    - Life-cycle analysis
    - Assessment of important aspects of your system for feasibility and adoption
    - Economic viability of the system
- Model or prototype of the robotic system, demonstrating how the end user will interact with the overall system

Additional Resources

- EDSGN 100 Project Website: https://sites.psu.edu/engineeringdesignproject/first-year-engineering-design/current-project/
- TI website: http://www.ti.com/
- TI-RSLK website: https://university.ti.com/en/faculty/ti-robotics-system-learning-kit/ti-robotics-system-learning-kit