Driving Genius: Creativity From Constraints

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C3-006
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Course Description:

What will the world of work look like in 20 years? Is it a world devoid of human interaction, dominated by unmanned autonomous vehicles, operated at peak efficiency by an artificial intelligence supported by machine learning, or is it one in which the relative strengths of human and machine coalesce to bring about an even better result?

This course sits at the forefront of the state-of-the art in technology and design in order to challenge students to be creative in both their application of technology and their design of solutions. In this course, students will explore fundamental building blocks of computer vision, augmented-reality and sensor technology through the lens of human-centered design and real-word business constraints.

Students will work directly with the course partner, Etihad Cargo, to design, develop and test technology-enhanced solutions to real-world business challenges. Students will come away with a much better understanding of not just how to create interactive technology-enhanced prototypes and modern design practices, but also an appreciation for how to propose, enact and manage change across a multi-disciplinary/cultural modern organization.

Specific topics covered will include design thinking, human-computer interaction patterns and exploration of the fundamental buildings blocks of augmented reality applications. Students will become familiar with the Unity game engine, computer vision foundations, augmented reality software development, rapid software prototyping and best practices for researching, designing and analyzing software and hardware products.

Course Hour/Week:	Immersive, 3 weeks experience involving lectures, workshops and significant fieldwork.
Course Credit:	4 credits
Course Category:	Engineering (AD), Interactive Media (AD) Business (NYU Shanghai), Interactive Media Arts (NYU Shanghai)
Core Prerequisite:	None
Lecturer/Lecturers:	Professor Christian Grewell, email: christian@nyu.edu Professor Eliot Gattegno, eliotgattegno@nyu.edu

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Course Structure

The course meets once per day for 3 - 5 hours each session. In general, the session is devoted to a brief discussion of the weekly materials (readings, video, audio), followed by a group critique of the homework due that day, a short lecture and ending with hands-on tech tutorials. The professor will also be available during office hours and by appointment to provide support and guidance to students in the development of their projects.

This is an advanced project-based course, where students will develop small prototypes in the first half of the semester (multiple prototypes each week). Students must come prepared to work and remain focused throughout the entire course. They are also required to complete homework for each and every session without exception.

At the end of this course, students will be able to think critically and wholistically about what makes AR unique as a medium of expression. Students will gain a strong understanding of the power of AR as a storytelling medium and future areas of opportunity. Additionally, the course will introduce students a bevy of complementary state-of-the-art technologies, which when combined with each other will let students create new AR applications at the very fringes of the recently possible.

Course Teaching Objectives: The teaching objectives of the course are:

- To establish an understanding of the fundamental building blocks of augmented reality systems and interfaces.
- To familiarize students with the concepts and practices of technology innovation in the context of a traditional business operating environment.
- To develop an understanding of the role of design and innovation as a collaborative, multi-disciplinary team activity.
- To improve skills of presentation and report writing on technical and feasibility studies.

Course Learning Outcomes: The following learning outcomes are anticipated upon completion of this course. Students will be able to:

- Identify and apply the process of innovation and design within a real-world business context (assessed by homework assignments, final presentation and poster, and fieldwork projects) [(m.1), (m.2), (m.3)].
- Understand the critical role of design-thinking concepts, including user testing in the design and adoption and acceptance of innovative technology products [(c.1), (k.1)] .
- Design, program and deploy augmented reality applications within realistic constraints (assessed by homework assignments, final presentation, and fieldwork projects) [(c.1), (k.1)].
- Work effectively as team members and demonstrate leadership skills (assessed by fieldwork projects) [(d.1), (d.2), (d.3), (l.1), (l.2), (l.3)].
- Communicate effectively (assessed by fieldwork and project reports and presentations) [(g.1), (g.2)].

Text Books:

- Learning OpenCV, Computer Vision with the OpenCV Library, Gary Bradski, Adrian Kaehler, O'Reilly Media, 2015.
- The Spring Book (https://www.dropbox.com/s/xm6svbq5ds58xgq/SPRINT%20kickoff%20slides.pdf?dl=0)

Teaching Method: The teaching method for the course is comprised of fieldwork complemented with rapid prototyping sessions, lectures and programming laboratory workshops. The core of the course will have student teams working directly with industry in order to gain an in-depth understanding of how to design and test their technology solution within a real-world context. Students will be taught the basics buildings blocks of augmented reality applications: world coordinates, gaze, gesture and voice input, spatialized sound and spatial mapping and become

familiar with best-practices for creating augmented reality applications. Each team will be charged to shape and develop their ideas and integrate their solution(s) into a functional prototype. The professors, their assistants and industry representatives will serve as coaches throughout the process and serve as a sounding board.

Course Requirements:

- **Programming Experience:** This course does not require advanced programming experience, but basic experience with 3D graphics and game engines will be very helpful. We will use prototyping techniques such as appropriation of pre-made 3D models in order to streamline the creation process wherever possible.

- **Device Requirements:** We will be publishing applications for mobile devices. It's highly advisable that you have an Android or iOS mobile device. A PC or Mac is also required to complete the majority of the course assignments. The Hololens module will require a PC in order to develop experiences. The instructors have set up and configured 4 PCs available in the classroom that are open to students in the course.

Grading Components:

TBD

Course Schedule

Week 1: Course Introduction, Overview of Augmented Reality Technologies, Technical Toolkit Workshops
The first week of the course begins with the standard course introduction and syllabus overview, followed by exercises designed to help students become familiar with problem-solving approaches, complex project management and systems design topics as well as helping students become comfortable communicating complex engineering problems and solutions to a diverse set of stakeholders. The remainder of the week will involve lectures and hands-on technical workshops designed to help students engineer prototypes at the forefront of today's technological frontier.

Week 2 + 3: Challenge + Design Sprint
The second and third week of the course will introduce students to the design sprint process and begin a series of 5 design sprints where students will work directly with business unit teams, while designing and prototyping potential solutions.

Week 4: Technical Prototyping + User Testing + Presentation
Week 4 will introduce students to systems engineering topics, quality assurance system design and challenge students to complete their technical prototype and return to the client site for further testing and measurement and documentation culminating with final solution presentations on the last day of the course,

Relationship to Outcomes

	Shared Engineering Outcomes	Program Specific Criteria

	(1)	(2)	(3)	(4)	(5)	CivE	CmpE	ElecE	MechE	GenE
Lectures	X	X			X	X	X	X		X
Labs	X	X		X	X	X	X	X		X
Fieldwork	X	X	X	X	X	X	X			X

	Student Learning Outcomes												
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
Lectures			X				X			X	X		X
Labs	X	X	X	X	X		X			X	X		X
Fieldwork		X		X	X		X	X		X	X	X	X

Shared Engineering Outcomes:

(1) Apply techniques in the practice of leadership and innovation [(l), (m)];
(2) Identify social, economic, ethical and other factors that shape engineering solutions and incorporate them in conjunction with engineering principles in problem solving and designing systems, components, or processes to meet desired needs within realistic constraints [(a), (c), (e), (f), (h)];
(3) Recognize and respond respectfully to cultural concerns and differences when solving problems both physical and ethical [(a), (e), (f), (h)];
(4) Exhibit guidance and organizational effectiveness in multidisciplinary teams as a participant and a leader [(d), (l)];
(5) Demonstrate competence in writing and speaking effectively, and in communicating significant technical information in a clear and concise manner [(g)].

Program Specific Criteria:

- **CivE:** Civil Engineering graduates will be able to work professionally in four of the technical areas of the civil engineering discipline (structural, geotechnical, transportation, and environmental), design systems, components, and processes in more than one civil engineering context, and apply the principles of project management.
- **CompE:** Computer Engineering graduates will be able to analyze and design complex computing and network devices and systems containing hardware and software components.
- **ElecE:** Electrical Engineering graduates will be able to analyze and design complex electrical, electronic, and communication devices and systems.
- **MechE:** Mechanical Engineering graduates will be able to analyze and design systems, components, and processes, and work professionally in both thermal and mechanical systems areas.
- **GenE:** General Engineering graduates will be able to analyze and design devices and systems in an interdisciplinary engineering area related to: Biomedical and Health Systems; Information, Communication, and Electronic Systems; or Urban Systems.

Student Learning Outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

(l) an ability to apply leadership skills including project and risk management and decision making

(m) an ability to apply innovation skills

Assessment Plan for [COURSE #]: Applications in Mediated Reality

Performance Indicators	Assessment Tools		
	Project Presentation	Poster	Final Project - Augmented Reality Application
(c.1) Design a system/process to meet desired needs within realistic constraints. *The students will be tasked with conceptualizing and programming innovative augmented reality application to assist cargo handlers*			**X**
(d.1) Fulfill individual duties			X
(d.2) Contribute to the team effort.			X
(d.3) Consider viewpoints of team members.			X
(g.1) Demonstrate effective written communication of information, concepts and ideas. *Deliver a multimedia project presentation and poster describing the AR system and its value to the business.*		X	
(g.2) Demonstrate effective oral presentation of information, concepts and ideas. *Deliver a team presentation at the end of the course.*	X		
(k.1) Acquire skills using modern tools necessary for engineering practice. *Ability to understand and employ modern software engineering practices and programming to create an augmented reality computer application.*			X
(l.1) Apply principles of project management. *Students are expected to use standard project management techniques with special emphasis on user feedback.*			X
(l.2) Apply techniques of risk assessment in decision making. *Ability to identify and manage risks associated with the design, development and deployment of the application.*			X
(l.3) Demonstrate effective decision making within contextual constraints *The students will demonstrate the ability to conceptualize the abstract concept and convert it into a tangible deliverable within tight time and budget constraints*			X
(m.1) Frame a problem creatively	X	X	X

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(m.2) Leverage state-of-the-art technology. *Students incorporate modern augmented reality headsets, sensors and software to create a state-of-the-art AR application.*			X
(m.3) Optimize value proposition *Maximize the value of the application to the business, and the acceptance of the technology to the end user.*			X