

ME 133

Lecture 1

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1/10/23

- (1) syllabus
  - (2) Informal polls
  - (3) What is mechatronics?
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How many have used arduinos? 10 -

How many have 3D printed? 3/4

How many have programmed in 'c'? 15

# What is Mechatronics?

Chapter 1

"mechanics"

"electronics"

Control system



(digital)  
computer  
system



Mechatronics



electrical  
system



Mechanical systems

mechatronics : integration of mechanical & electrical components through a digital control architecture  
MPCU (microcontroller) CPU

# Mechatronic System Components

effects or senses environment

translates sensor signals to usable signals for Controller

Mechanical system

<u>Actuators</u>	<u>Sensor</u>
<ul style="list-style-type: none"><li>• motor</li><li>• solenoid</li><li>• hydraulics</li></ul>	<ul style="list-style-type: none"><li>• temperature</li><li>• pressure</li><li>• moisture</li></ul>

Input Signal Processing

- A/D converter
- FFT
- filters

Output Signal Processing

- D/A converter
- PWM
- amplifier

Digital Controller

- algorithm
- micro CPU
- timing

User Interface

<u>Inputs</u>	<u>Outputs</u>
<ul style="list-style-type: none"><li>• touchscreen</li><li>• keyboard</li><li>• button</li></ul>	<ul style="list-style-type: none"><li>• LCD</li><li>• LED</li><li>• sound</li><li>• screen</li><li>• haptics</li></ul>

translates controller into into the actuator's "language"

determines what to do

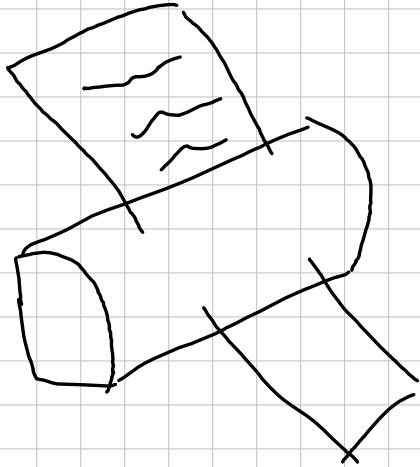
allows users to input & display info.

## Main Focus:

- ① circuits (digital & analog) for signal processing
- ② tools for analysis & reasoning about mechatronic systems

EX. 1

# Ink Jet Printer



## Actuators :

motors

- move print head
- move paper

pump (piston)

- pushes ink

heater

- heat ink

Sensors : infrared sensor

→ ink level

''

''

→ paper in tray

temperature sensor

→ heat of the ink

Signal Processing : paper jam

→ detect high torque

image → bit map (01001)

x 3 Red  
Blue  
Green

bitmap → print head location.

surge protection processing

filters for the sensor  
↓  
amplifiers

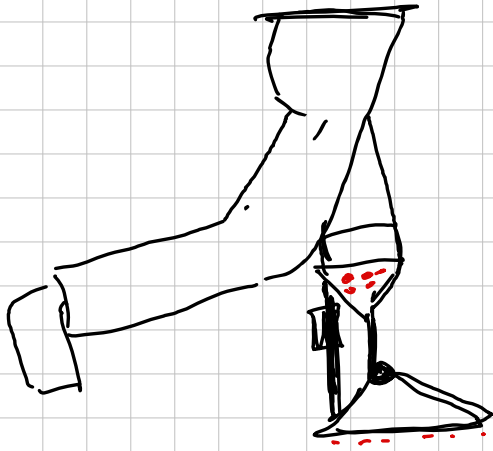
## Digital Controller :

- send motor commands
- maintain queue
- file system
- mix ratio of colors

## User Interface :

- abort button
- LCD screen
- beep
- buttons
- LEDs

## Ex. 2 Lower-limb active prosthesis



Actuators: DC motor (passive spring)  
piston  
Haptics → user feedback

Sensors: pressure  
FSR (force sensitive Resistor)

- Angle
- Encoder
  - IMU (inertial measurement unit)
    - 3-axis accelerometer
    - 3-axis gyroscope
    - 3-axis magnetometer
  - EMG (electromyography)
    - sense muscle activation



## Signal Processing :

EMG → filter

A/D converts

Motor drives

·  
·  
·  
·

## Digital Control :

torque control → current command

machine learning

fault detection

## User Interface :

· LED

· voice command.

· iPhone APP

What is an arduino?

- micro controller
- open source
- program with 'C-like'
- large community: tons tutorials

Lab kits:

- Arduino + basic components
- you need to download IDE

integrated development env...

## Lab Organization:

- 2 groups
- TA provide summary / background  
→ there to help!!

{ → Group 1: 2pm - 3:20  
Group 2: 3:30pm - 4:50