



Special Topics in Design I  
(Prototyping in IOT)  
DSL 810

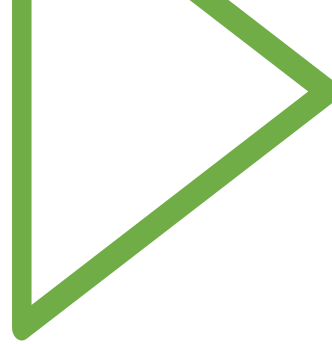
Topic 0  
Overview of the course

Instructor: Jay Dhariwal,  
Asst. Prof., IIT Delhi

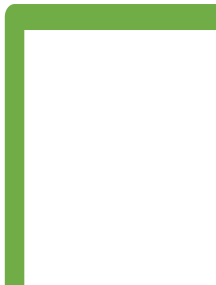
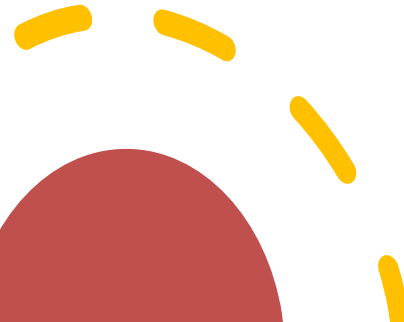
2<sup>nd</sup> January 2020

# Introductions

- Myself
- TA: Gulshan Kumar, PhD student, DoD
- Yourself (google form to know your expectations and skills)

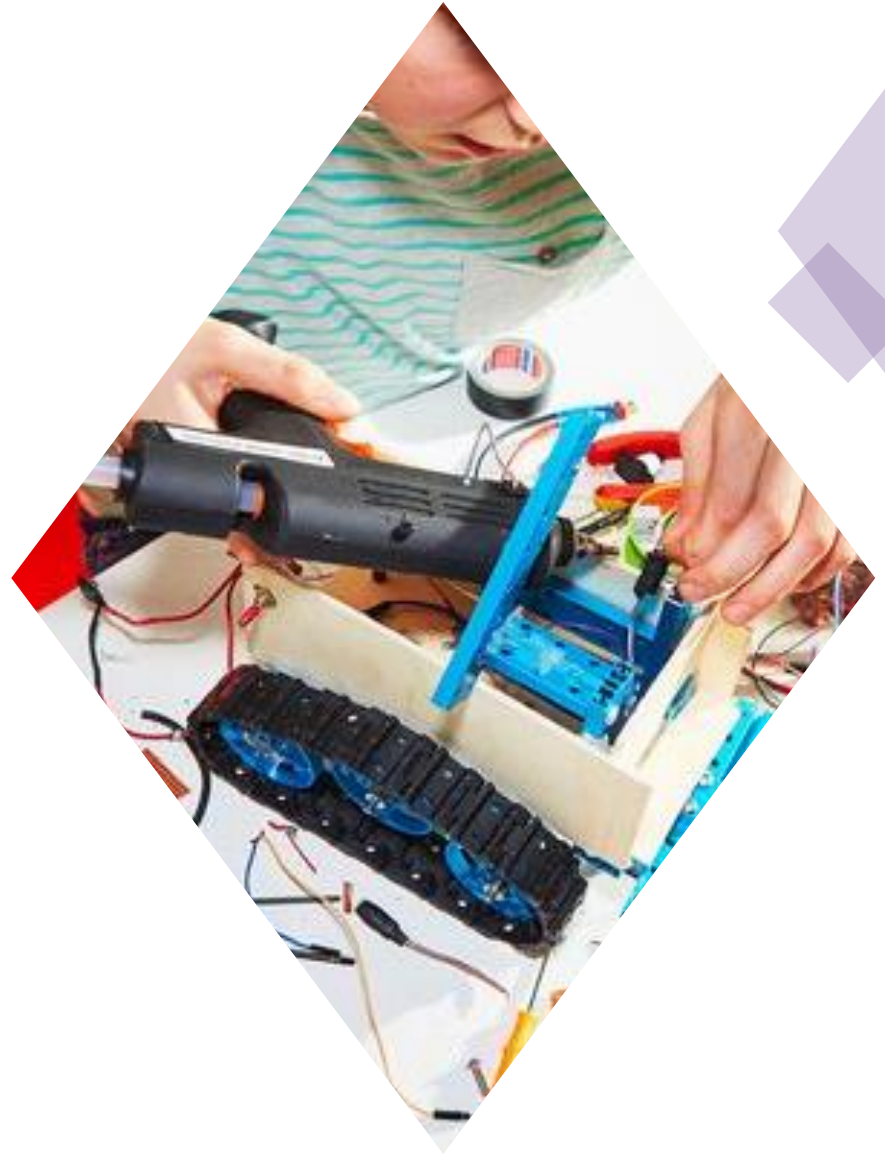


Who Am I?



# What is this course about?

- Hands-on prototyping with electronics (sensors, actuators, etc.). Students would be able to get started with programming microcontrollers (Arduinos, PCB, etc.) and create user interface for their projects (Web, PC, Mobile Apps). Use AI/ML/DS in design process.
- [Course description](#)



# What is this course about?

- [How to Make Almost Anything](#), PF, [Student Projects](#)
- [Fab Academy](#), Cyber physical systems
- [Example](#)
- Design pedagogy of studio based learning, design thinking
- Guide, together
- Peer to peer learning (helping each other, each one with different strengths, very diverse class)
- From “**What** to learn to make?” To “**How** to learn to make?”
- Instructables, DIY sites for making
- Makerspace ([CRF registration](#))
- [Course contents](#)



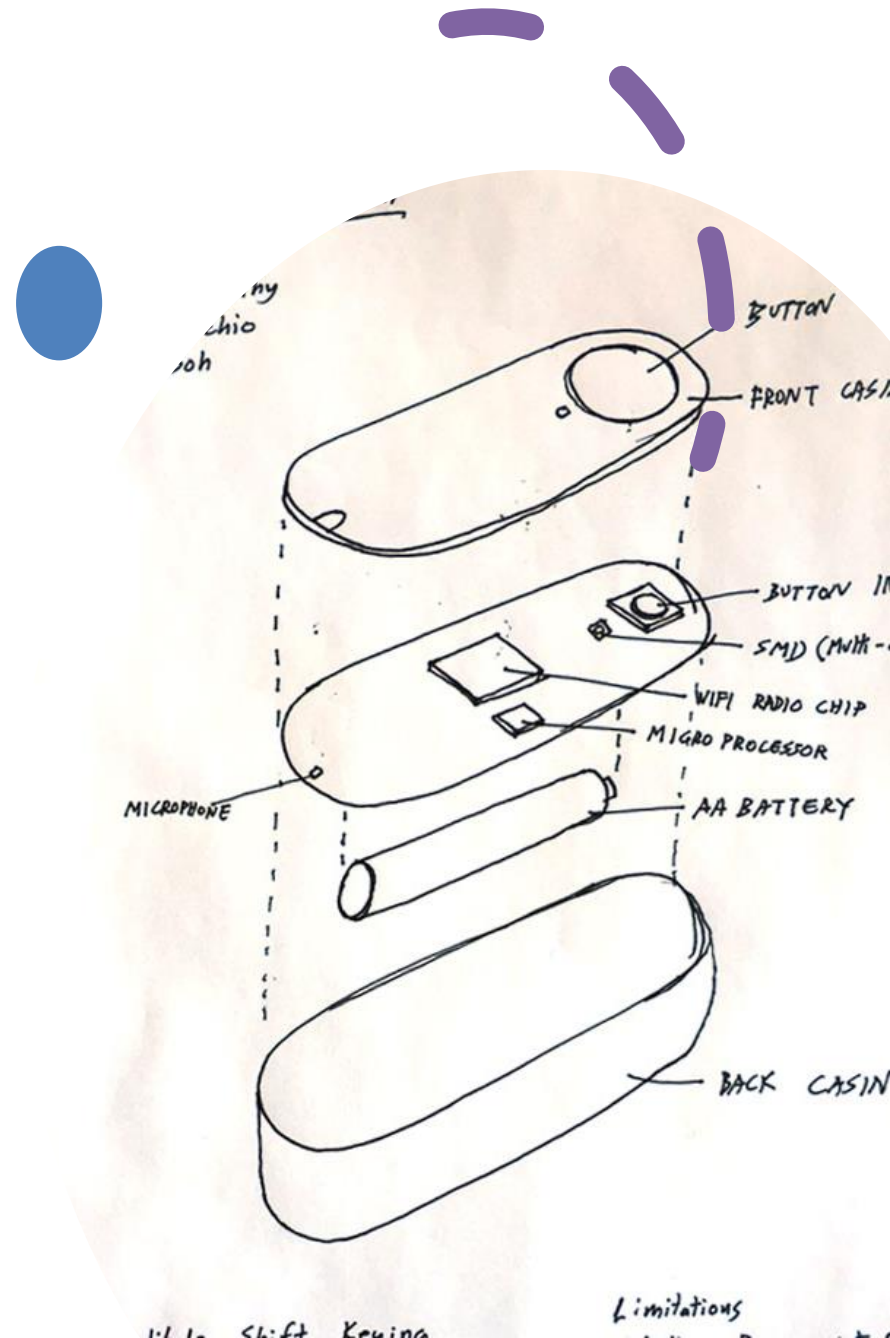
# Website Design for Course Mgmt

- Portfolio, digital repository for others
- [html](#)
- [html, css template provided by us Smart Fan](#)
- [html, css template of your choice Self stabilizing box](#)
- Anything else (Javascript, Markdown, PHP)
- Image compression, Video editing.



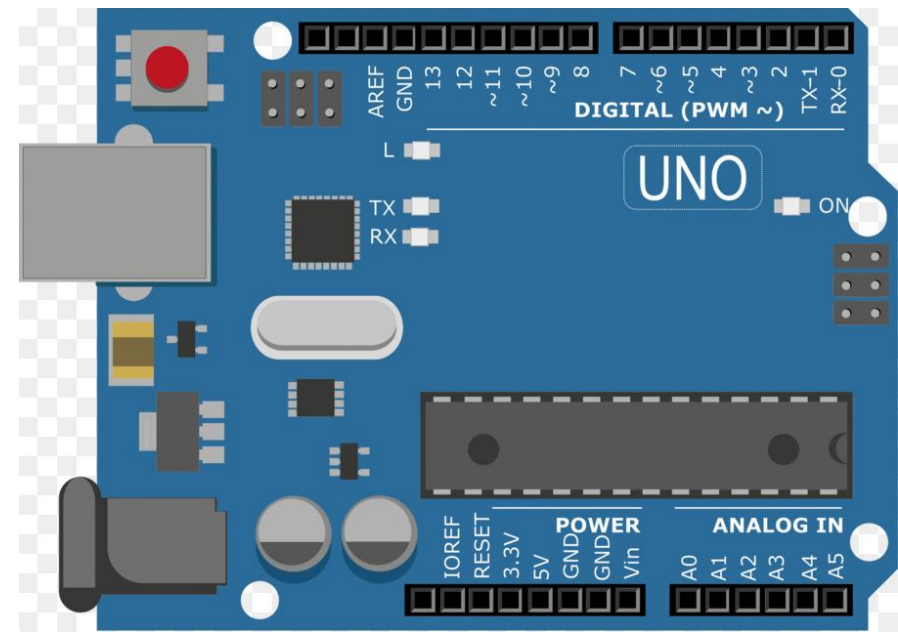
# Project Proposal

- [Sketch your project](#)
- [Follower cart](#)
- [Project examples](#)
- [DIY Cell phone](#)

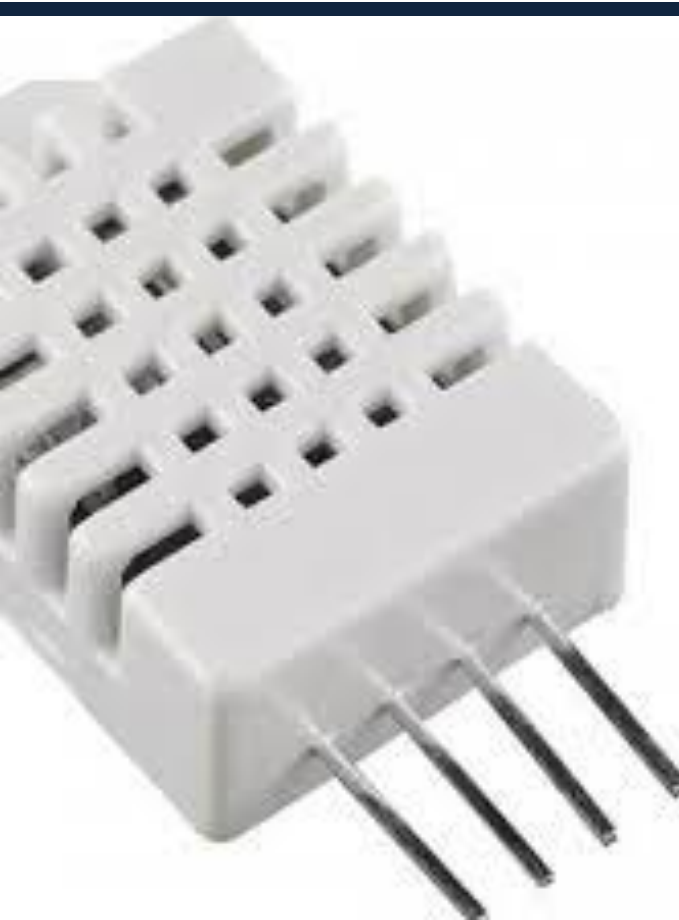


# uC programming

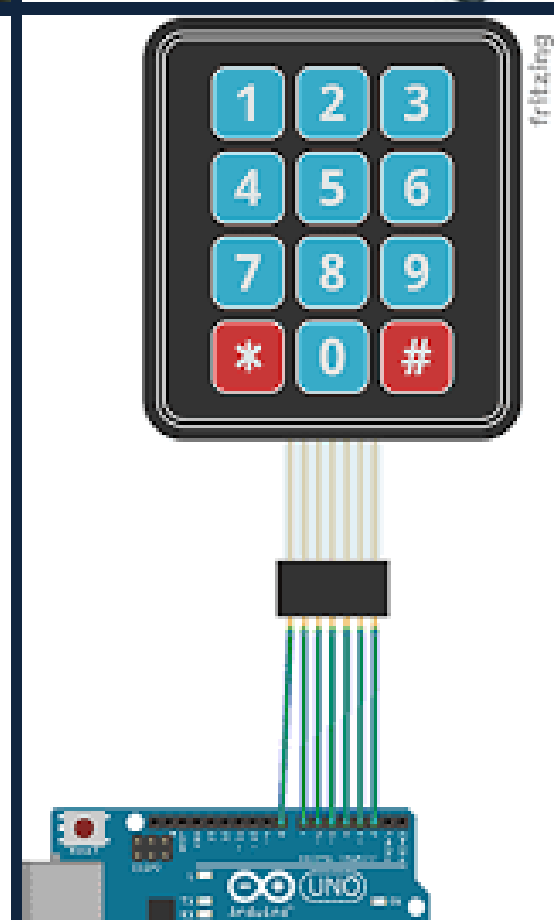
- Programming Languages: C, Python, VB, Processing, MIT App Inventor
- Arduino IDE [name](#) [LED cube](#)
- Raspberry Pi
- AVR series uCs  
(Atmega 328p, [ATtiny44](#))



# Input devices



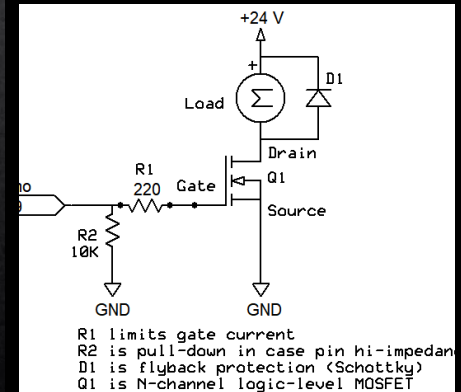
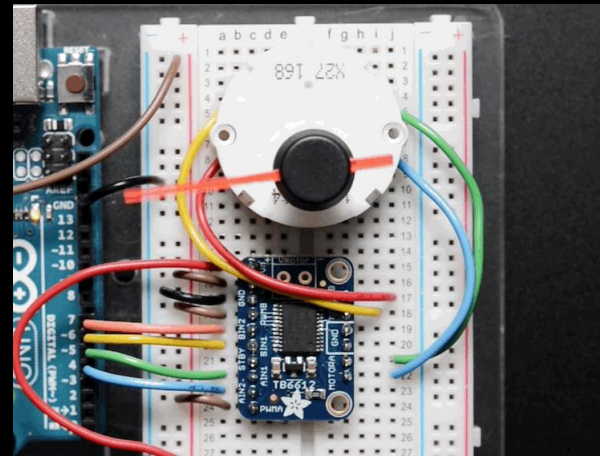
- Sensor features, datasheet
- [T+RH sensor](#), [proximity sensor](#), keypad module with uC
- Sensors in your smart phone (Talk to Me)



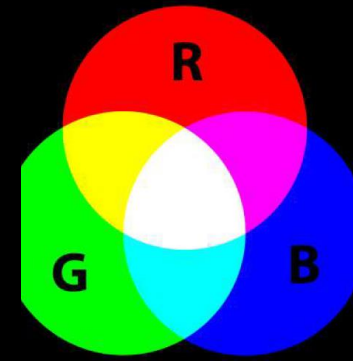
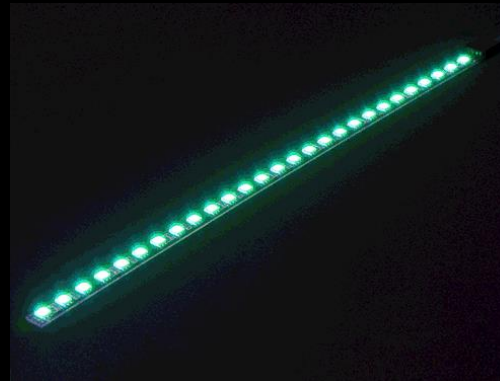


# Output devices

- RGB LEDs, Displays, Speakers, Servo/Stepper Motors, Relays, Dataloggers
- High power electronics
- [Ultrasonic + LED display](#)
- [Pressure sensor + speakers](#)
- [All terrain robot](#)

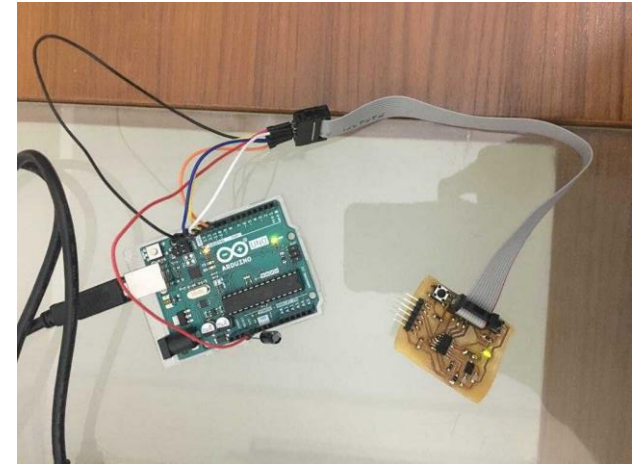


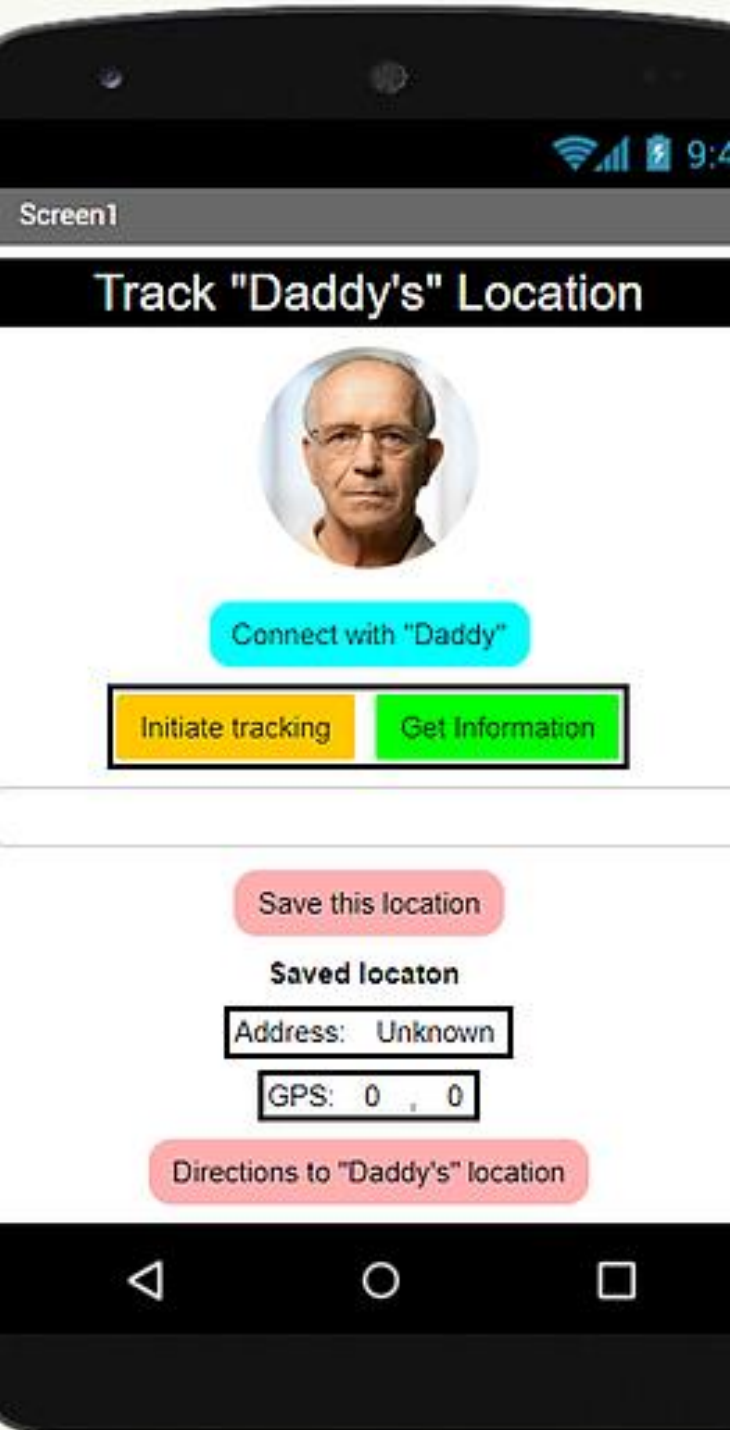
12:30:55 13/03/2015  
Slow 0 Fast 0  
Clock State Sync'd  
16000298Hz GMT+0



# Networking and communications

- Wired - SPI, I<sup>2</sup>C
- Wireless – Bluetooth, WiFi
- Weather balloon tracking





# Interface and application programming

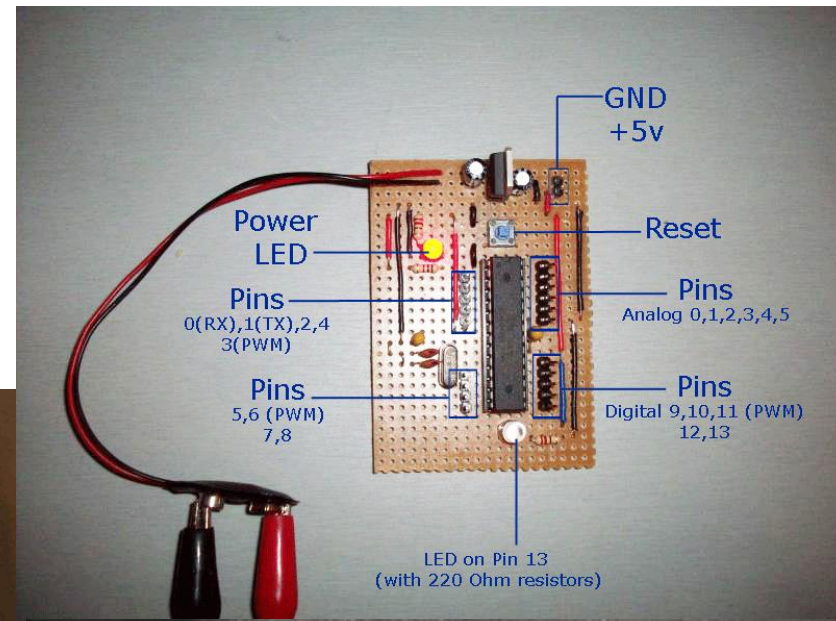
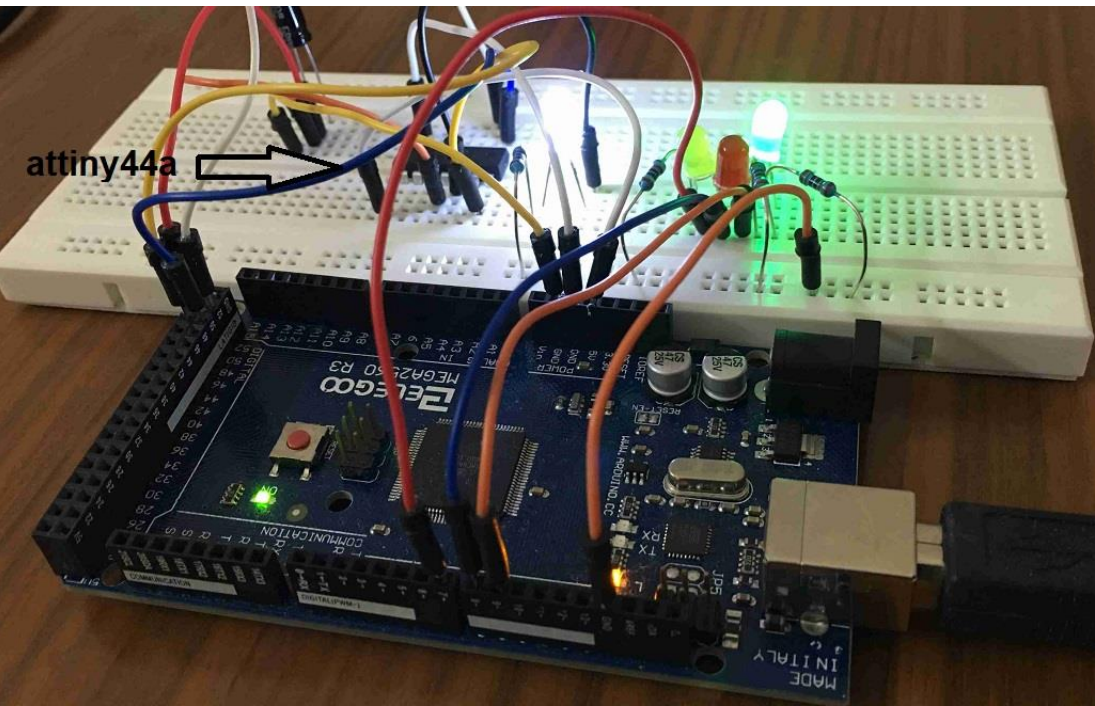
---

- [MIT App Inventor Mobile App Development](#)
- [GPS sensor + Mobile App for Alzheimer's patients](#)
- [Processing UI](#) [Music Visualizer](#) [Motion Graphics](#)



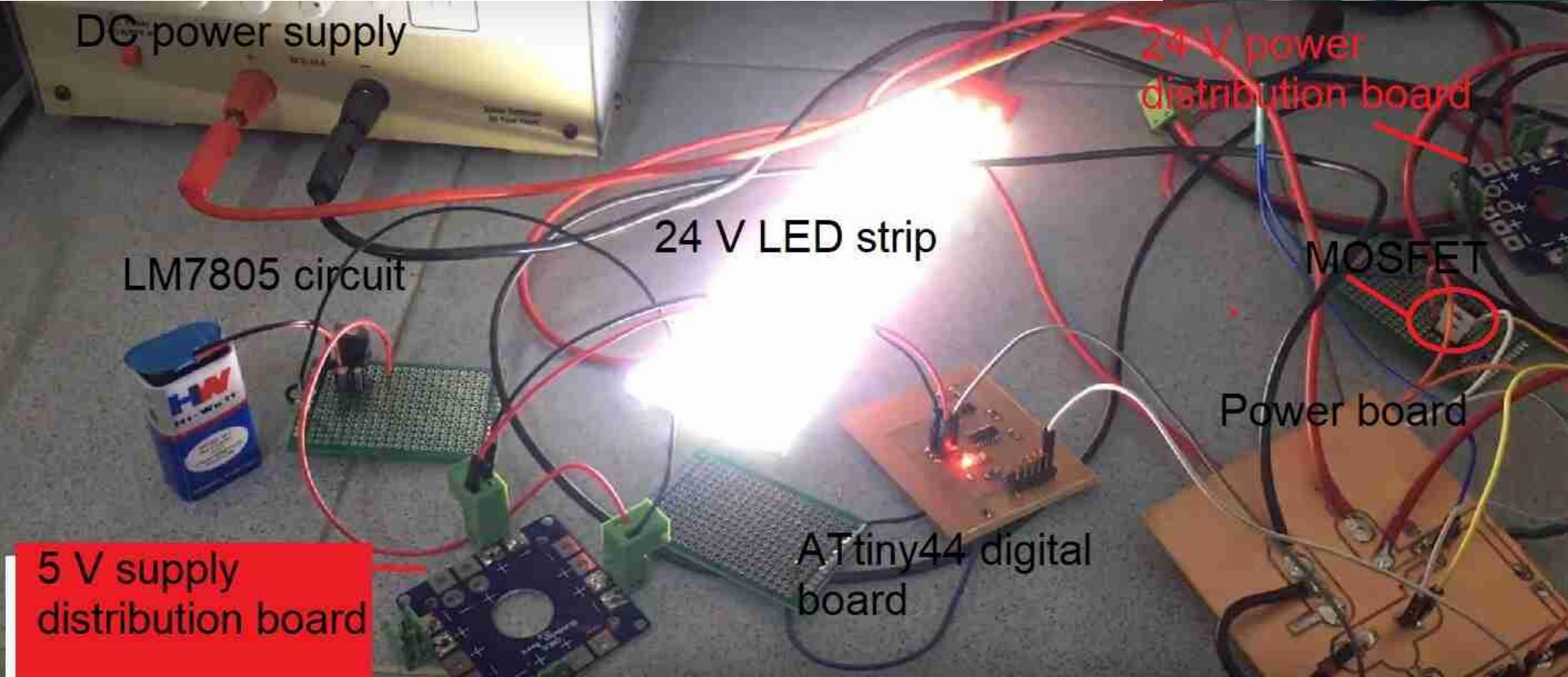
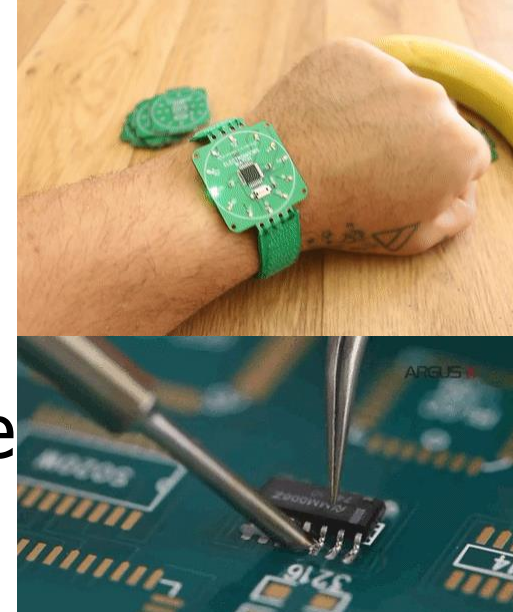
# uC programming 2

- Atmega328p, ATtiny44
- Soldering
- Protoboard



# PCB design & fabrication

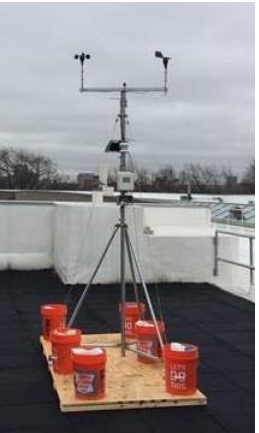
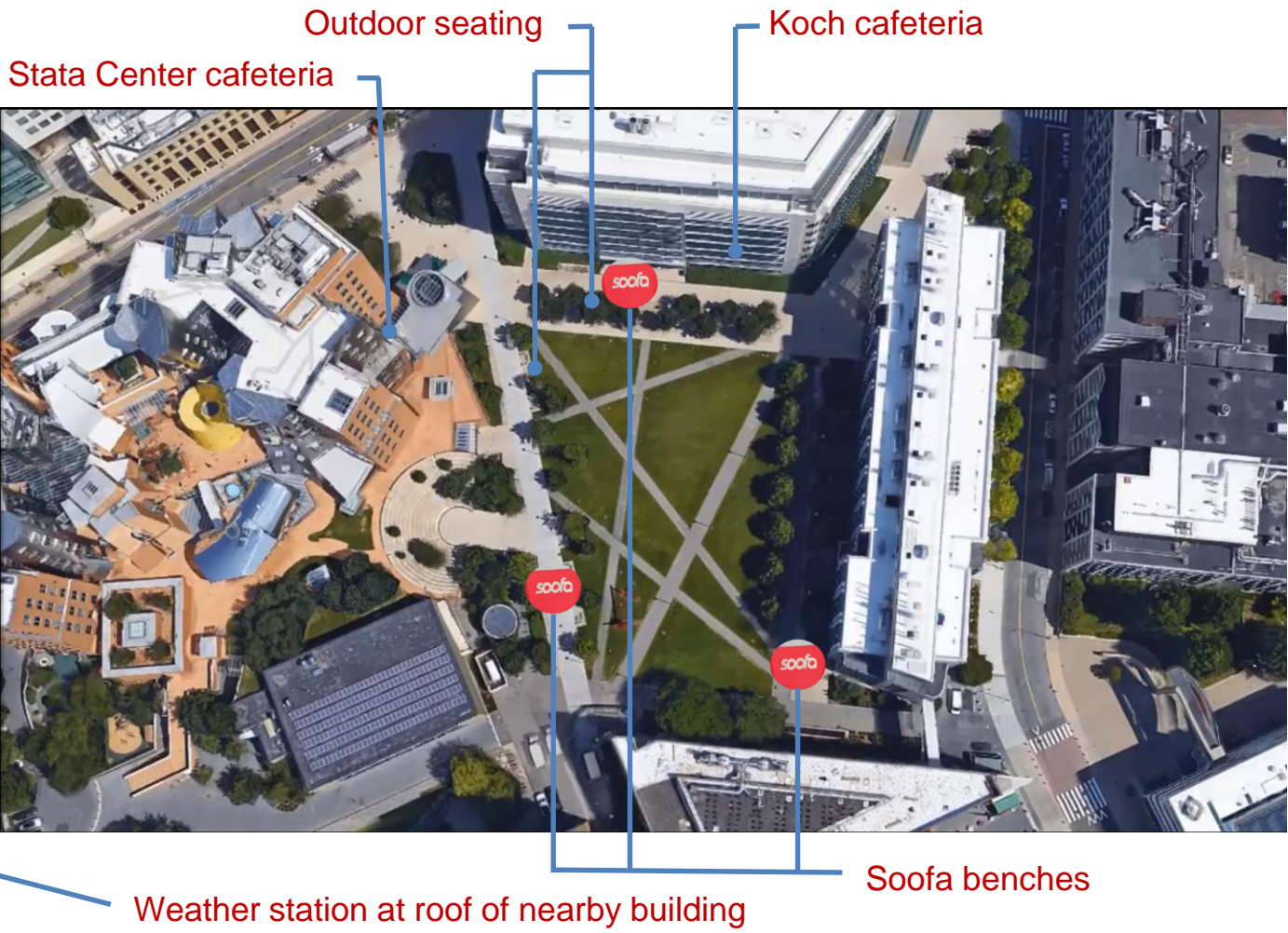
- [Procedure](#) for PCB design, Eagle, Kicad
- PCB milling, Outsourcing to board house
- [Electric bike controller](#)



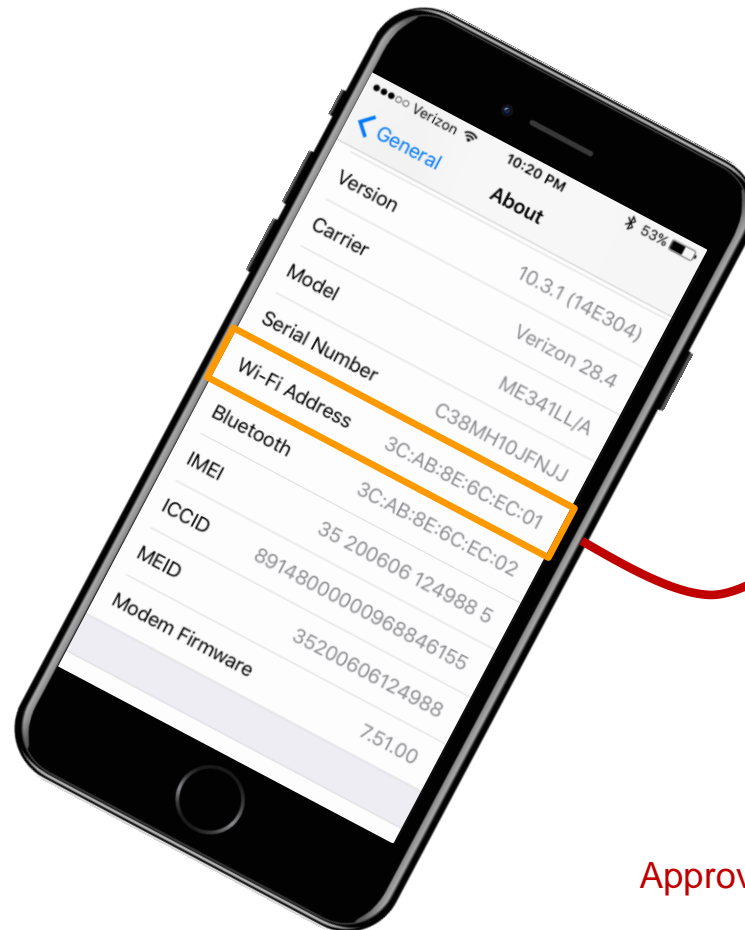
# Big Data Analytics: Design of Outdoor Public Spaces



Reinhart C., Dhariwal J. and Gero K., 'Biometeorological indices explain outside dwelling patterns based on Wi-Fi data in support of sustainable urban planning', *Building and Environment*, 126, 2017, 422–430. 14



# Privacy in the Modern Age



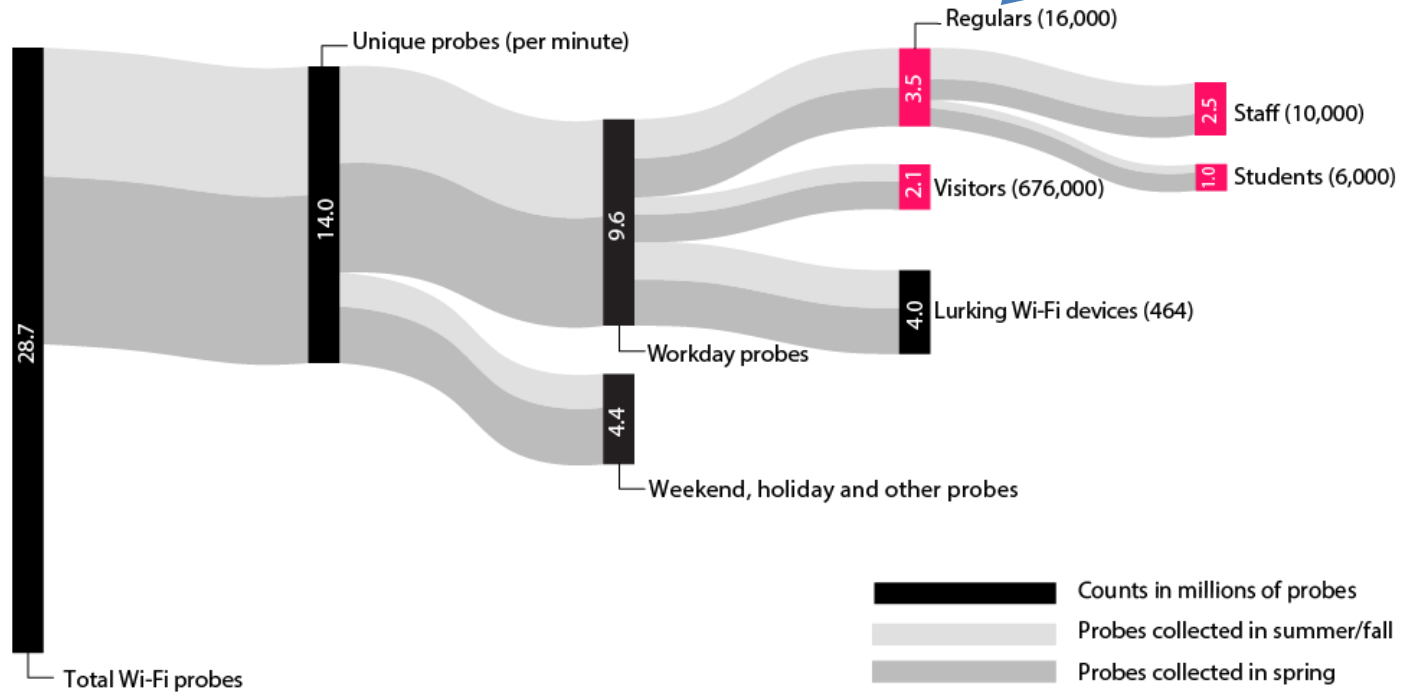
Encrypted ID device ID

Approvals from COUHES at MIT

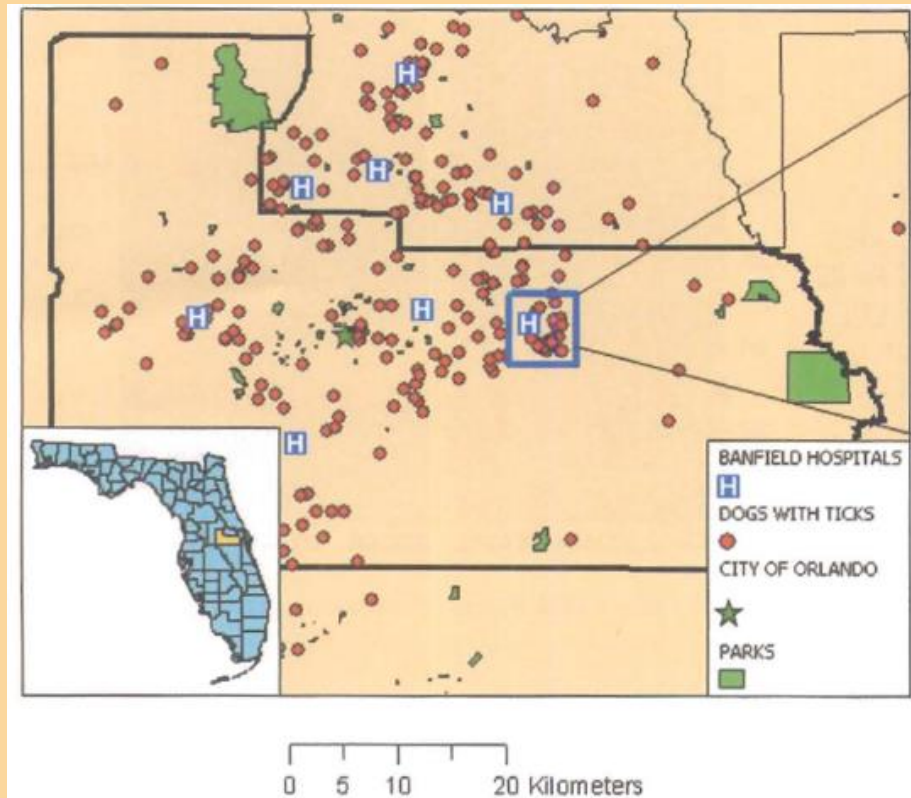


# Results from July 2016 – May 2017

400 times more longitudinal subjects than any study in the past



# Introduction to Data Science



- Big Data from MIT North Court study
- SAS data warehouse inventory management
- Spatio-temporal clusters for early epidemic detection
- [Marta González - Mobile Data for Urban Transformation](#)
- Handling data from sensors, smart phones in MATLAB

Understanding congested travel in urban areas [Serdar Çolak](#), [Antonio Lima](#) & [Marta C. González](#) [Nature Communications](#) volume 7, Article number: 10793 (2016)

## Train

Collect examples of what you want the computer to recognise

Train

## Learn & Test

Use the examples to train the computer to recognise text

Learn & Test

## Make

Use the machine learning model you've trained to make a game or app, in Scratch or in Python

Make

# Introduction to AI/ML

- [Google's AI AlphaGo Is Beating Humanity At Its Own Games](#)
- [Elon Musk on AI](#)
- Eric Schimdt: AI assisted health care, Self driving cars
- Vinod Khosla: [Generative Design](#)
- Machine learning – Smart fan, Smart light
- [Machine learning for optimization](#)
- Seminars from Experts

# Why this course?

Prof Neil Gershenfeld: Personal Fabricator

Students in his course: Express yourself through prototyping

The way I see this: Important for indigenous design and manufacturing,  
One science, Science for impact.



IIT Delhi (Institute of Eminence)

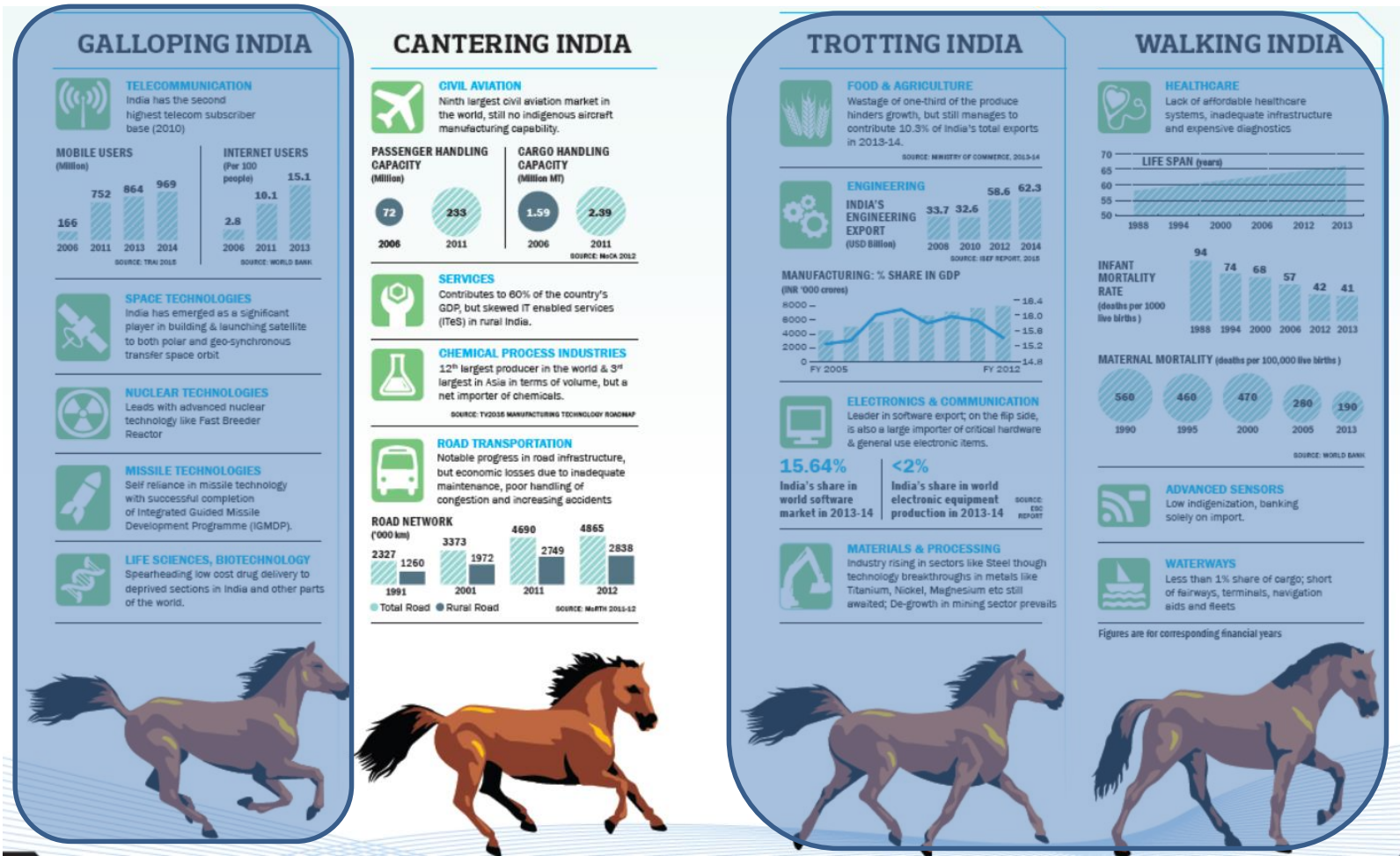
I came, I saw, I conquered.

-Julius Caesar



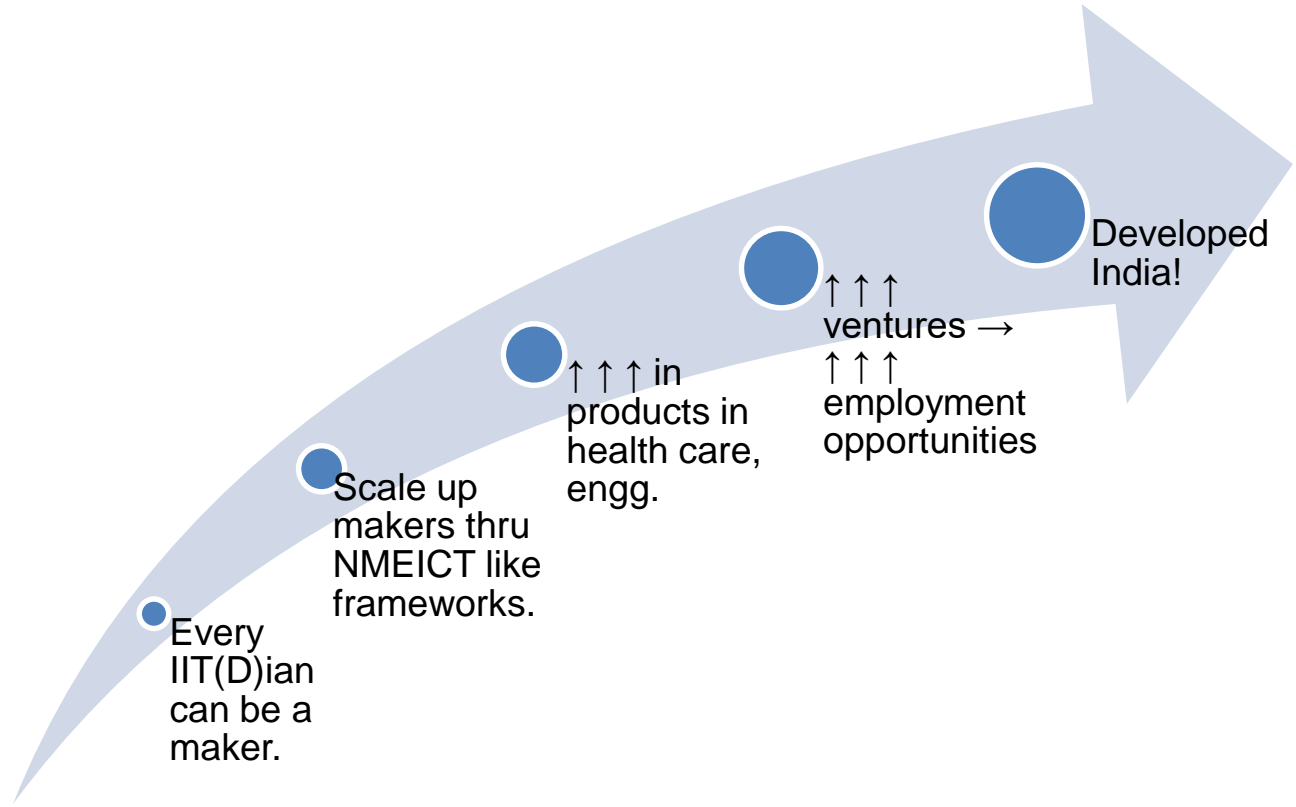
Students of IIT Delhi

I ideate, I make, I venture.

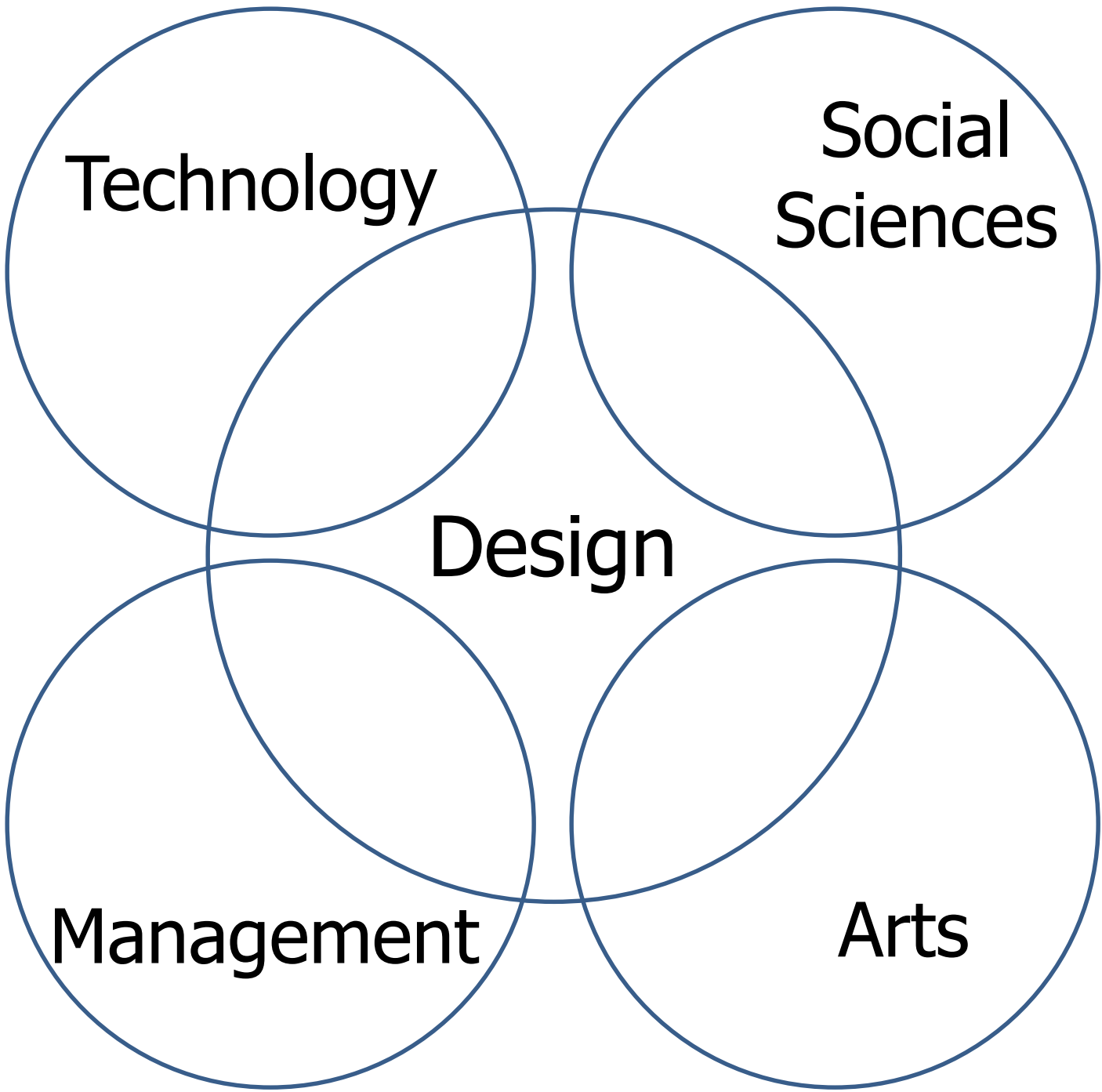


Source: Technology Vision 2035, TIFAC, Govt. of India, 2015

# ↑ ↑ ↑ Indigenous design and manufacturing is the need of the hour

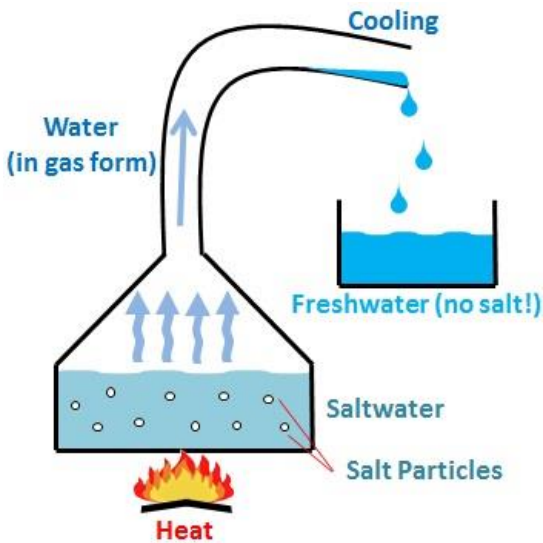


One science, science for impact



Anti-disciplinary

First principles method



Water filter – plant xylem

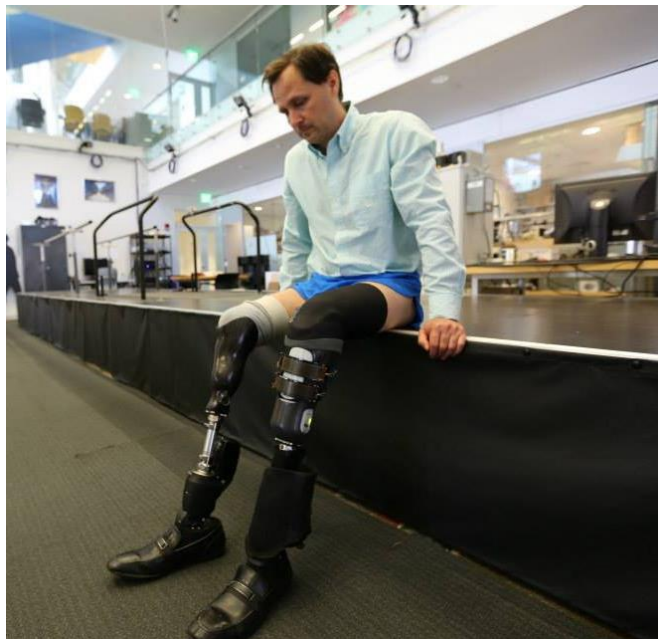
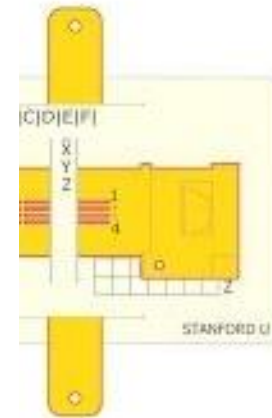


Waste-water treatment

Biology, Chemical engineering, Mechanical engineering, Nano-technology

Examples of One Science: SOLVE water





Science for impact

# Logistics

- [Grading](#)
- WhatsApp group
- [Course Website](#),  
Slides
- Windows OS (Mac?)
- Laptop access?

Class schedule

Project Development

Student Pages

Teaching Assistants

[Autumn 2019](#)

