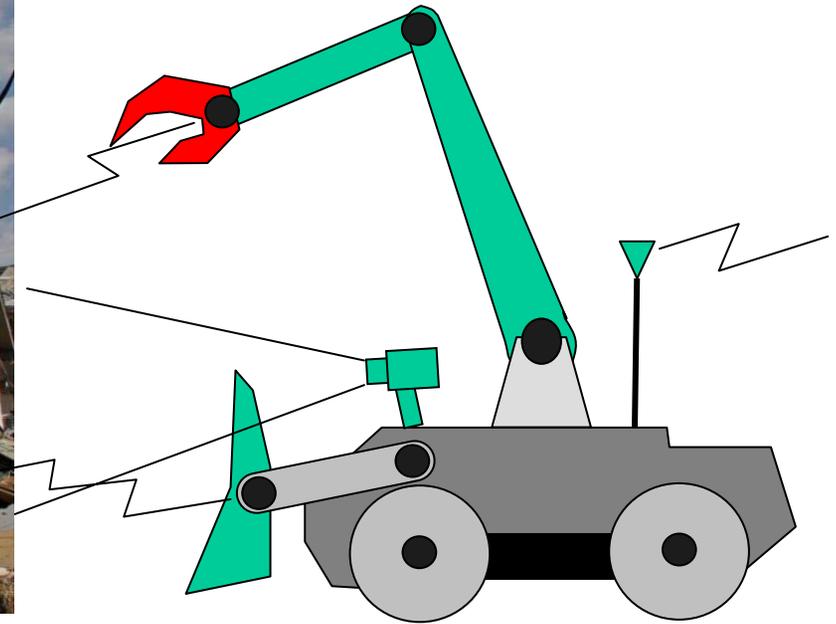


Rescue Robots

2.12 Final Project

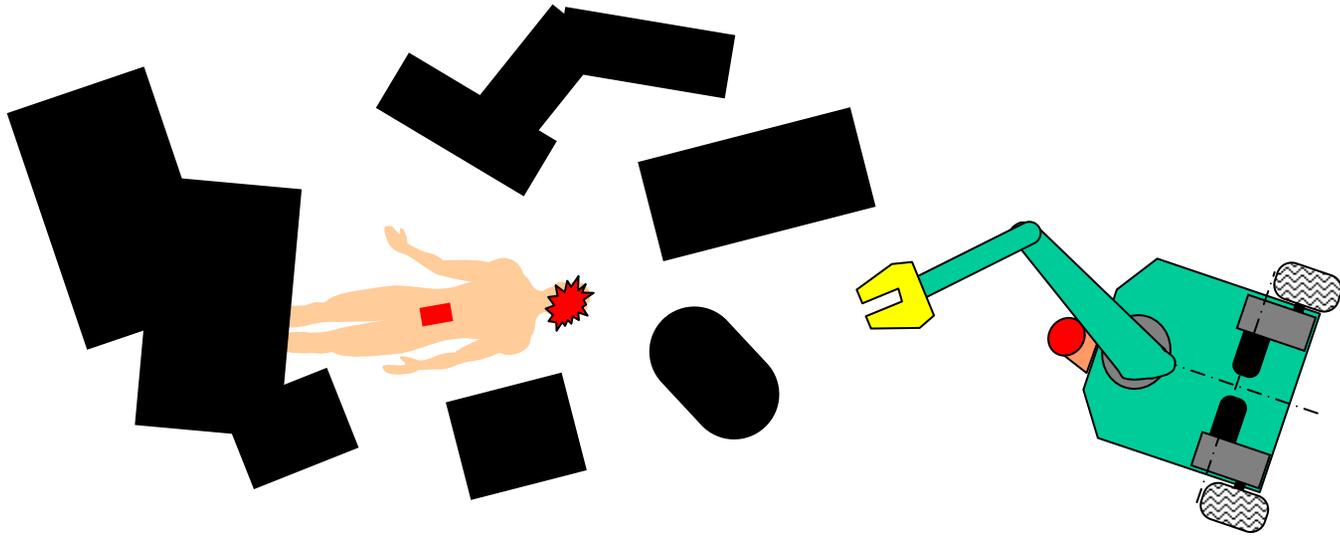


Photo by Robert Kaufmann/FEMA



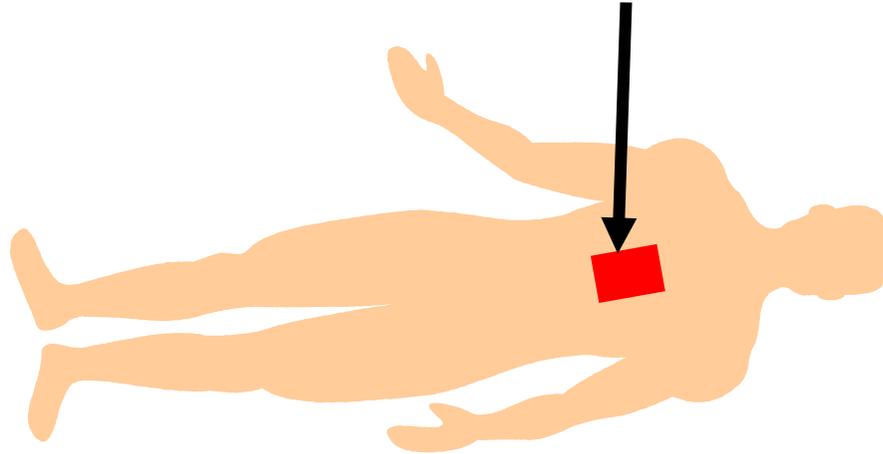
Helping Disaster Casualties

Rescue Scenario



- The location of a casualty is unknown. The rescue robot must be able to find a casualty.
- The casualty is not directly accessible. The rescue robot must remove some wreckage.

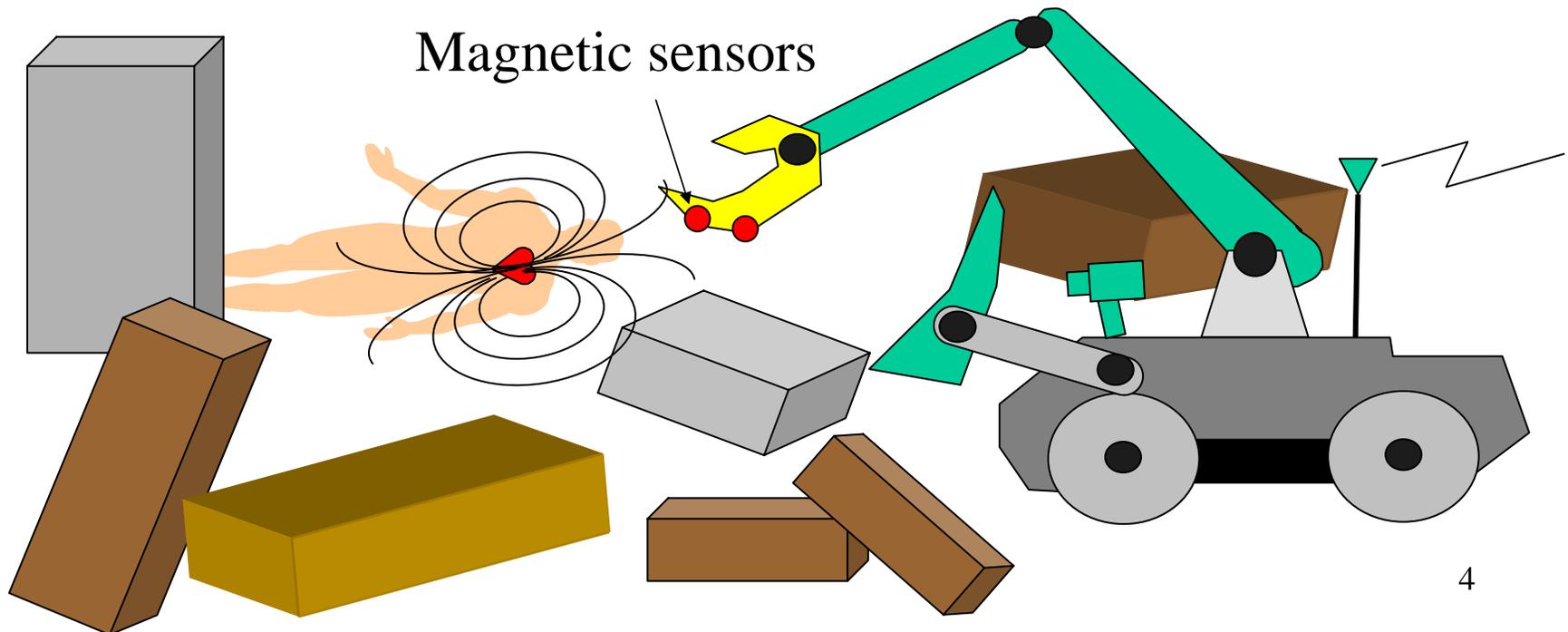
A magnet is imbedded in the body



- Detection using magnetic proximity sensors
 - The same lead sensor as the one used for the de-mining robot
- Grasp with a solenoid
 - End effector design

Search Method 1.

- The rescue robot has magnetic sensors at the end effector.
- The disaster site is probed with the magnetic sensors by moving the end effector.
- Wreckage/obstacles must be pushed or grabbed by the robot to find a way for accessing a casualty.

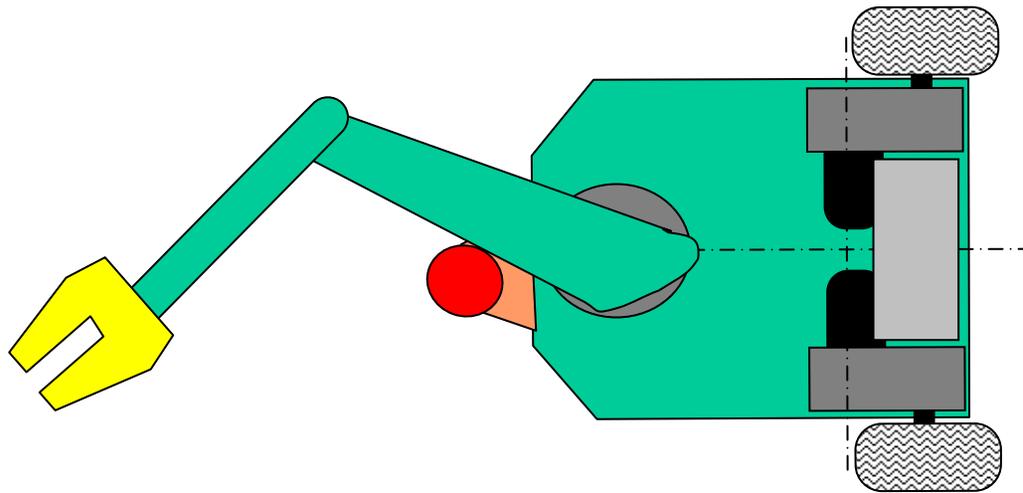


Project Teams

- Four project teams will be formed.
 - Team 1 : Thursday 12 - 2
 - Team 2 : Thursday 3-5
 - Team 3 : Friday 12 - 2
 - Team 4 : Friday 3-5
- Each project team will be divided into three sub-groups:
 - Mobile platform design and control
 - End effector, arm, and manipulation
 - Sensing and navigation

Mobile platform design and control

- Chassis for mounting motors, drives, an arm, batteries, and controllers
- Layout design and system integration

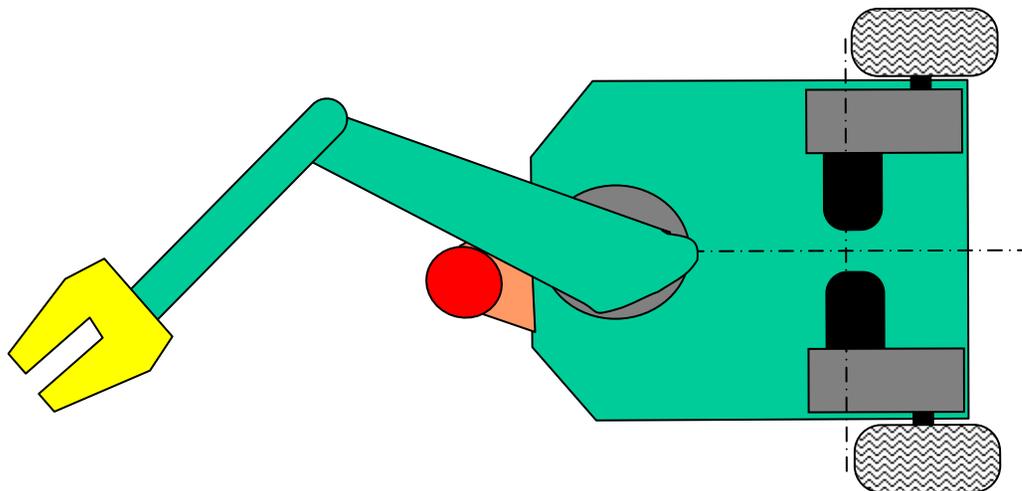


End Effector, Arm, and Manipulation

- End effector design
 - Grasp: Solenoids
 - Magnetic sensors
- Control
 - Closed-loop control
 - Arm trajectory generation and
 - Search control

Sensing and Navigation

- Dead reckoning using optical shaft encoders.
- An optical beacon (North Star) based navigation
- Navigation route generation and path planning



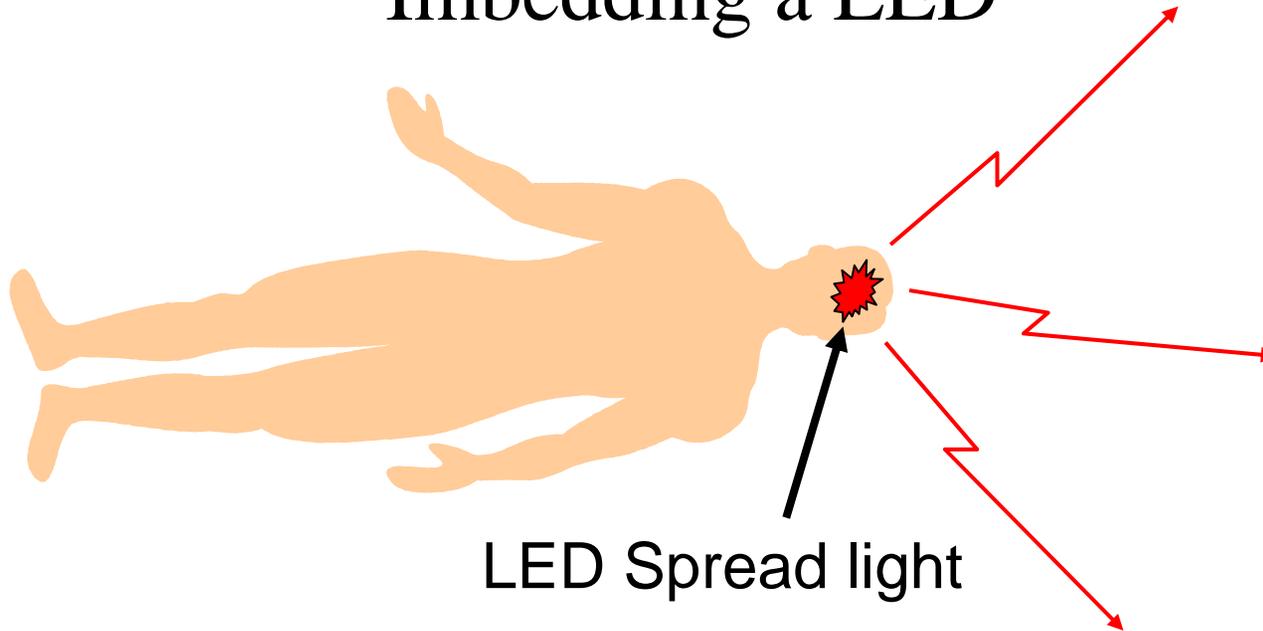
Schedule and Milestones

- Week 1: 11/4,5
 - Group strategy brainstorming
 - Forming subgroups
- Week 2: Idle, Veterans Day Holiday
 - 11/9(W) Game plan presentation
 - 11/10(Th) Game plan due
- Week 3: 11/18, 19
 - Machining and hardware fabrication
- Thanksgiving Holiday
- Week 4: 12/1,2
 - Assembly and check
- Week 5: 12/8,9
 - Programming and tuning
- Week 6: 12/12 (Monday, Final check) and 12/14 Presentation

Must	Should	Would be nice
	TBA	

Search Method 2

Imbedding a LED



- Long range search for the body
- Modulated LED spread light, 600~800 nm
- Partially visible

Vision-based Sensors: Hardware

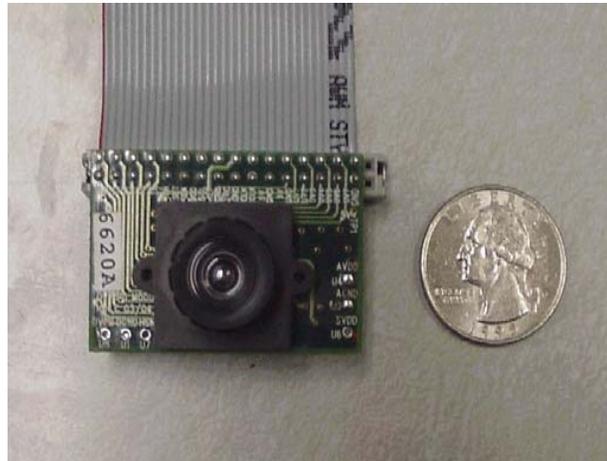
Photos of hardware removed for copyright reasons.

2048 x 2028 CCD array

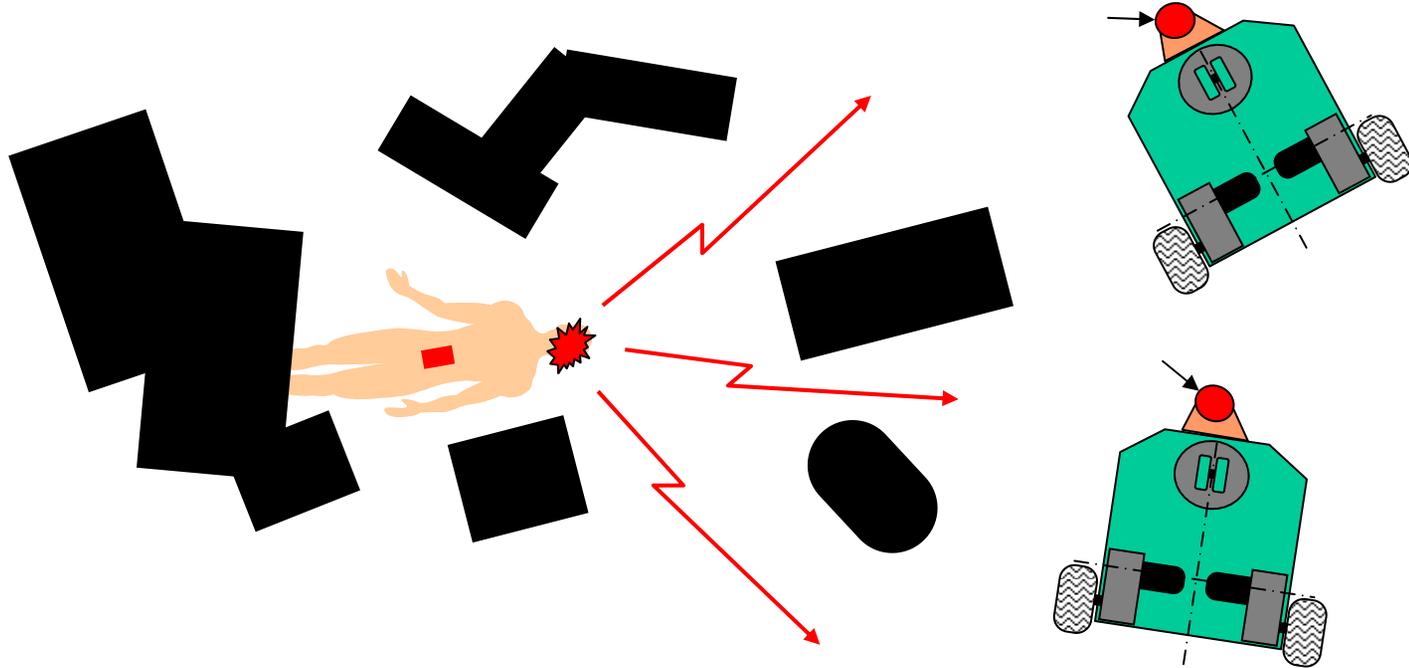
Orangemicro iBOT Firewire webcam

Sony DFW-X700 color machine vision camera

Canon IXUS 300 digital camera



Searching for a casualty

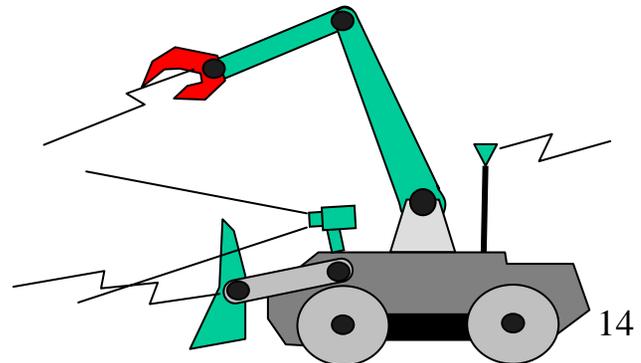


- The rescue robot has to go around the disaster site to search for a casualty
- With a set of photo detectors, the rescue robot can detect the modulated LED light and determine the direction of a casualty.
- To determine the position of the detected casualty based on triangulation, the robot has to obtain the direction of the LED light at two different locations.

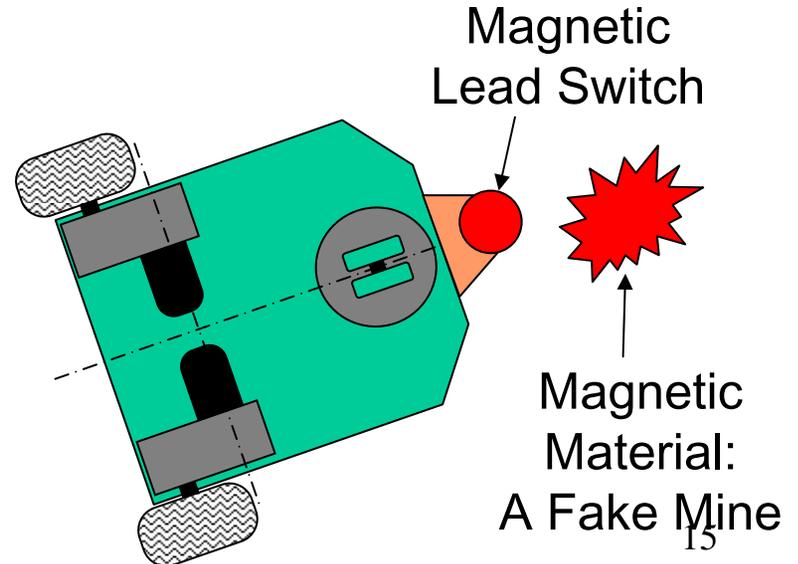
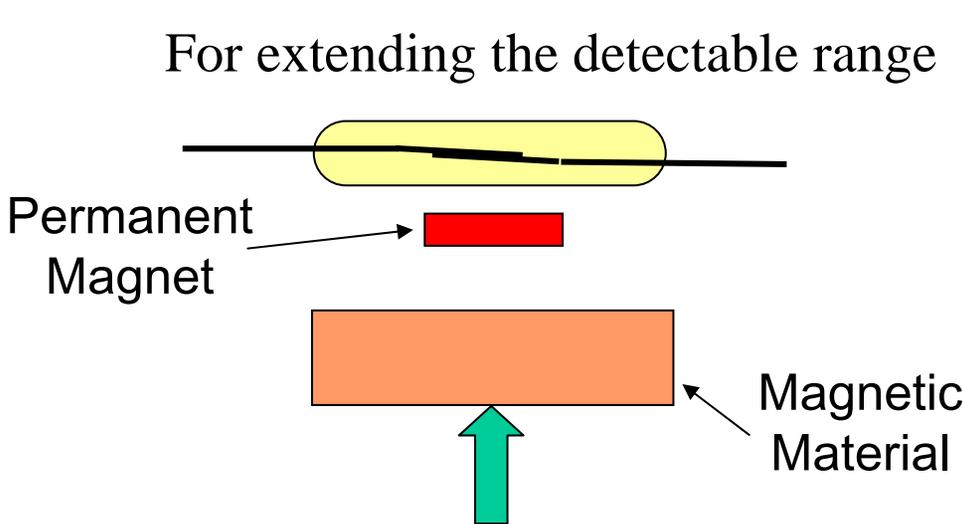
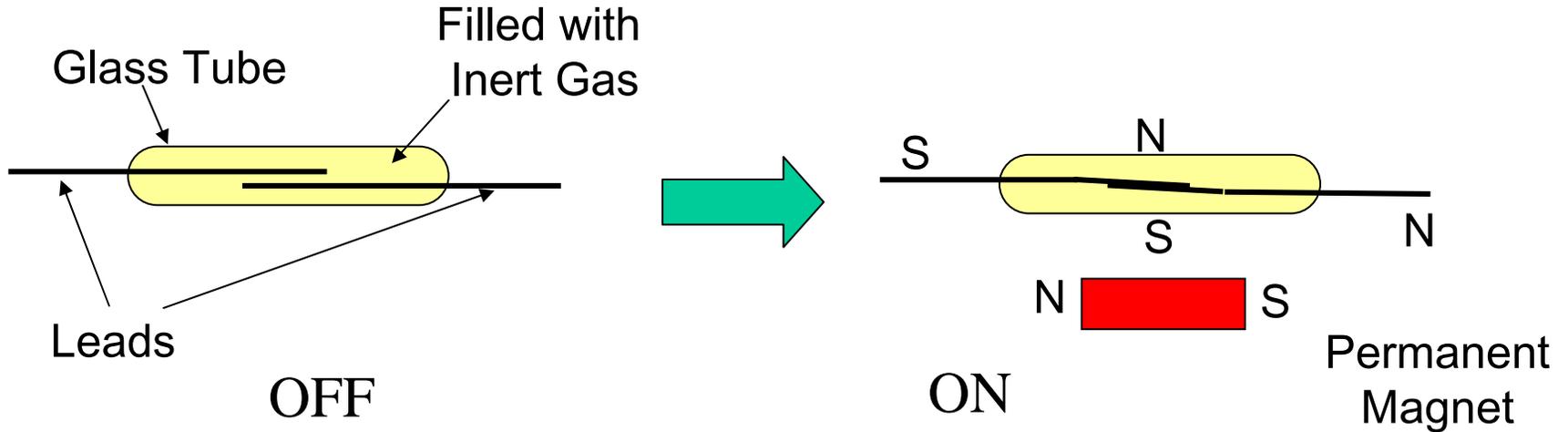
Robot system development

- Strategy
 - Algorithm
 - Sensor selection
 - End effector design
 - Programming
 - Control tuning
- Modality
 - Range
 - Accuracy
 - Sampling rate
 - Complexity/Cost

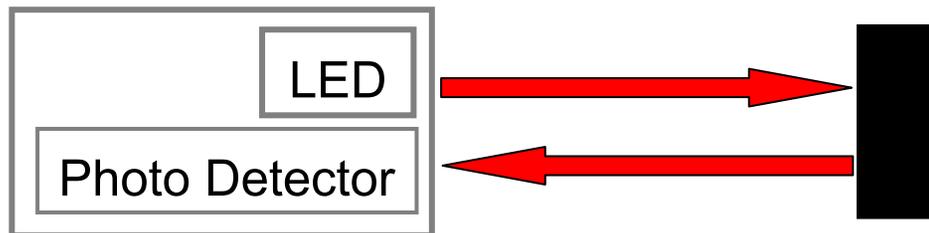
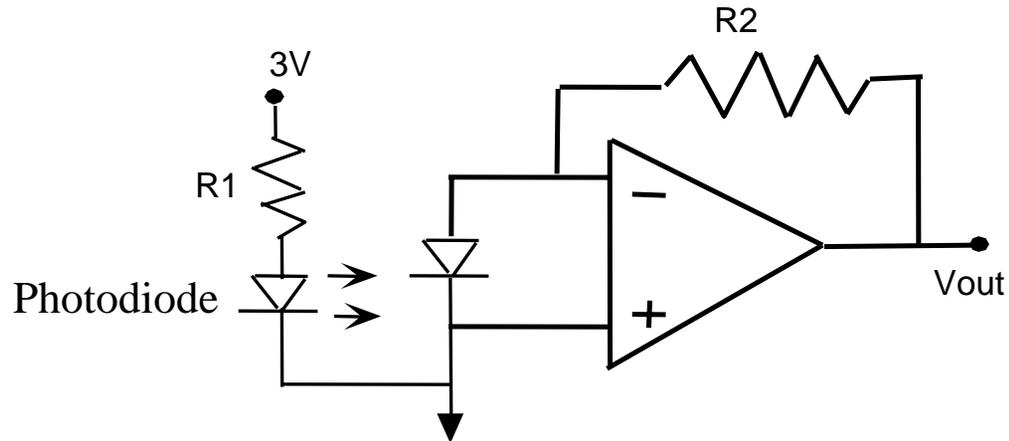
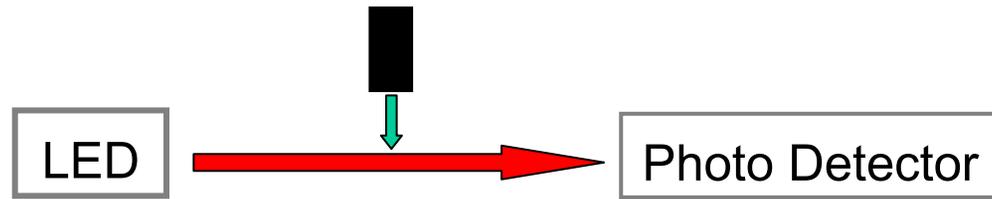
Hero/Heroine Robot



Magnetic Lead Switches

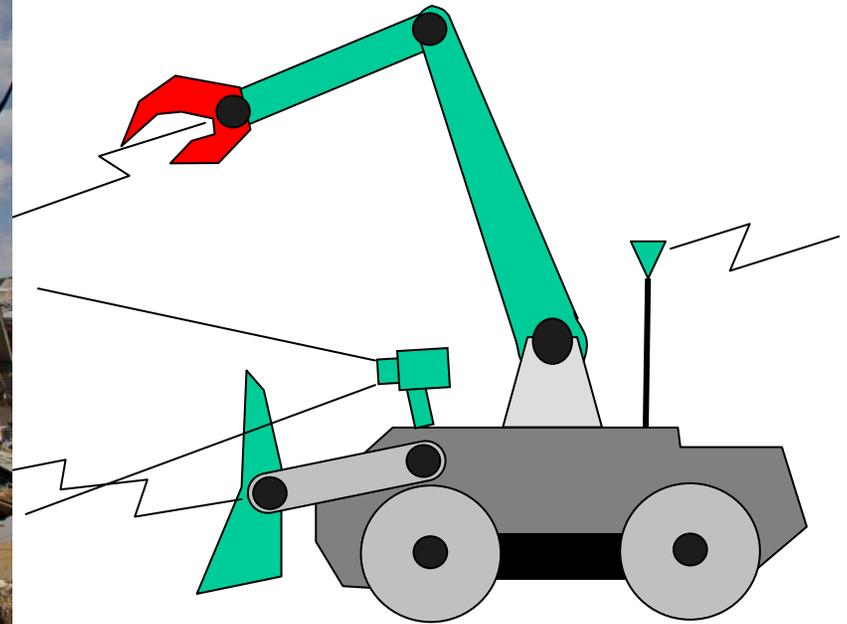


Optical Proximity Sensors

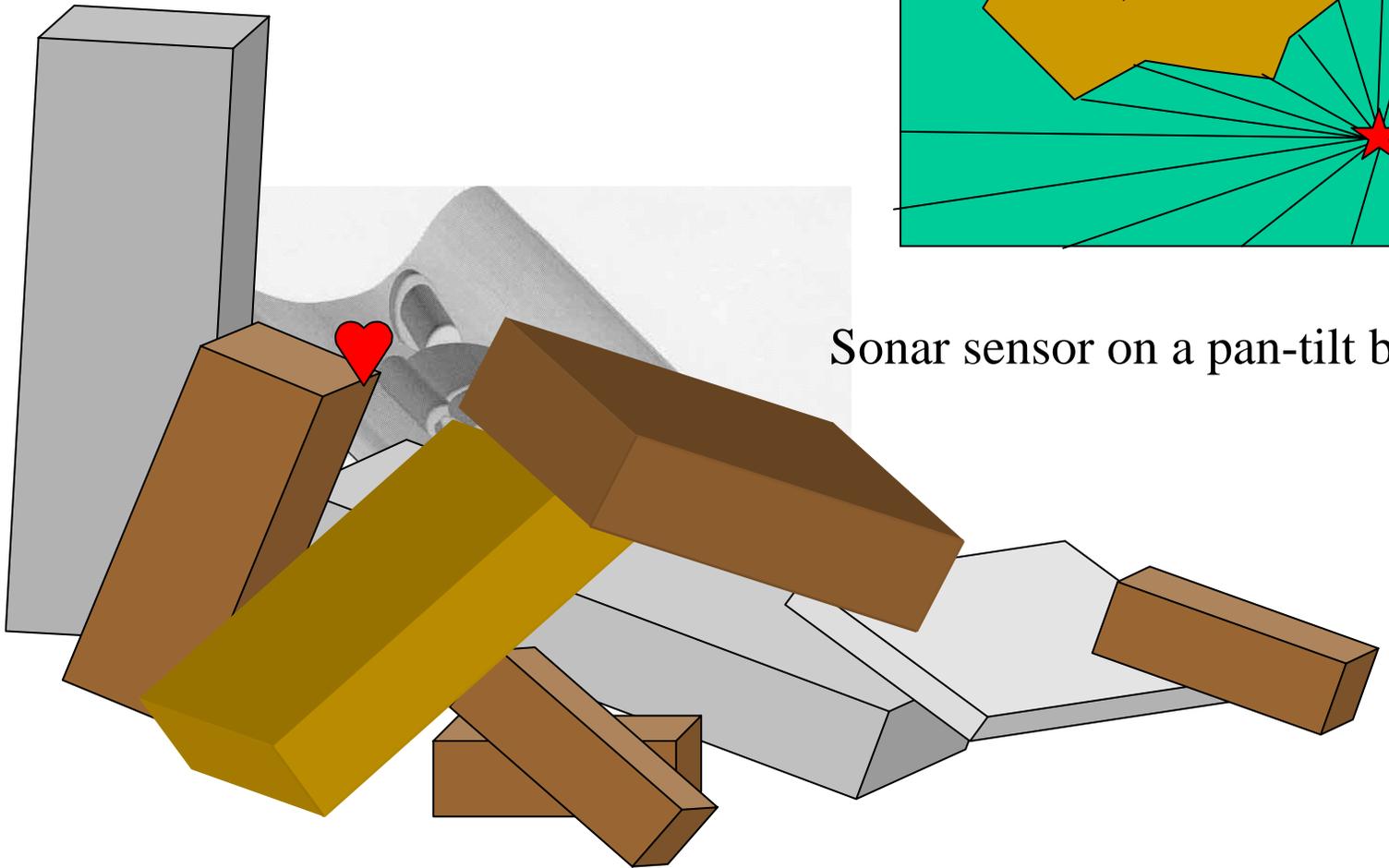


Rescue Robots for Disaster Casualties

A candidate final project theme

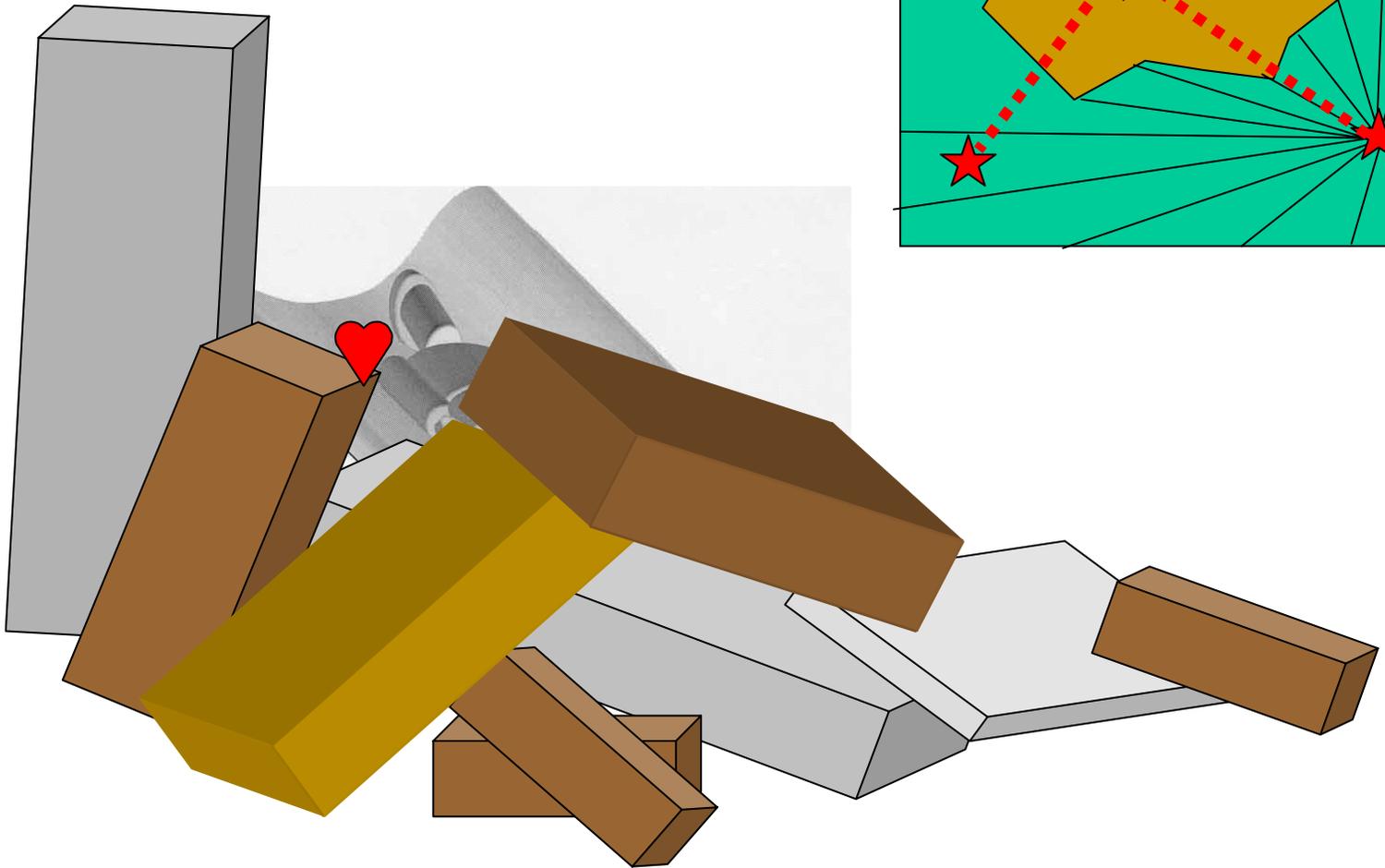
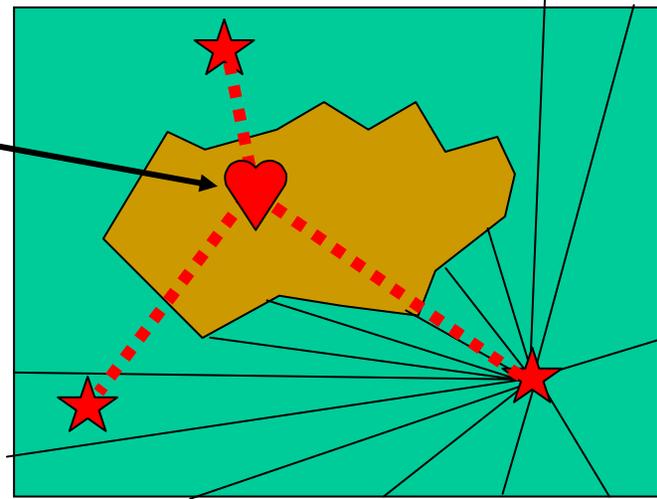


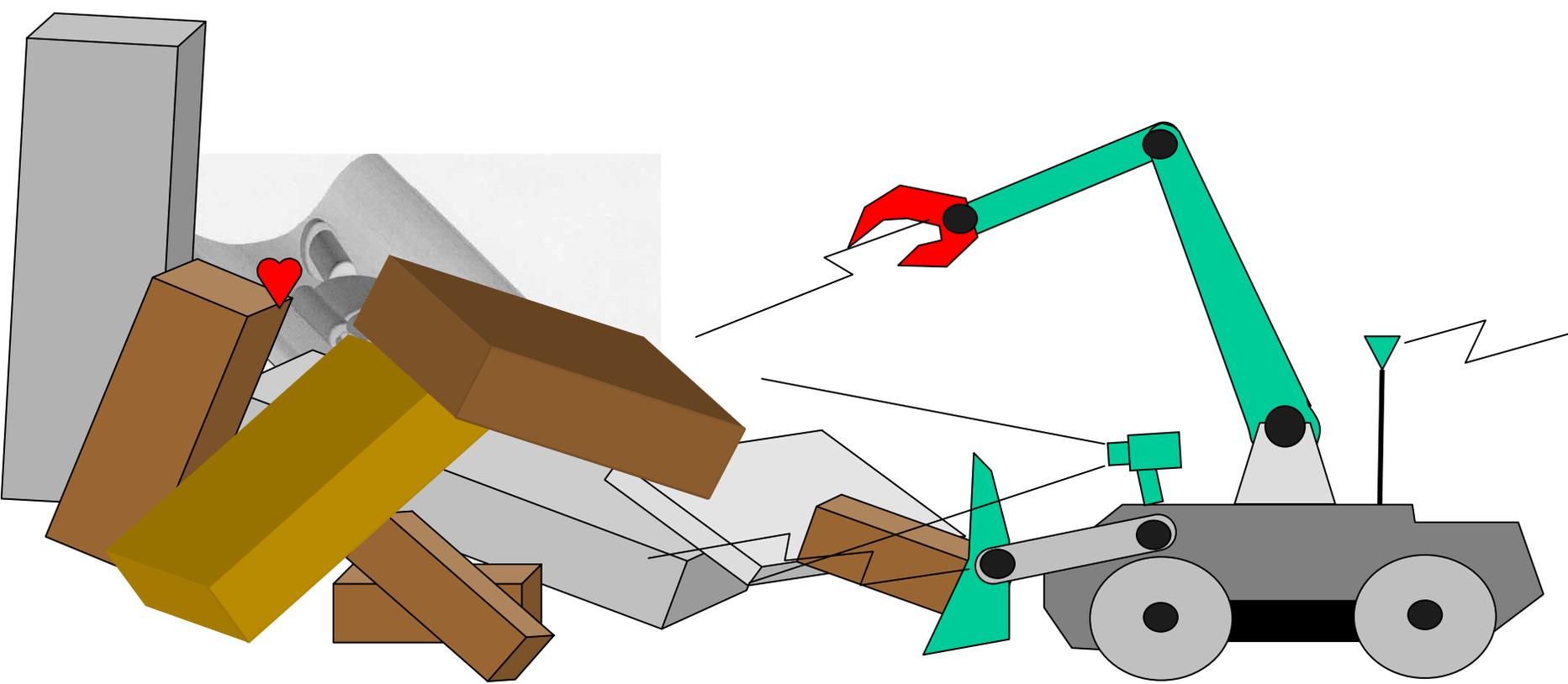
A Grand Challenge



Sonar sensor on a pan-tilt base

Beacon:
Ultrasound?





Proximity / Range sensor

