Robot weed killers: no pain more gain!

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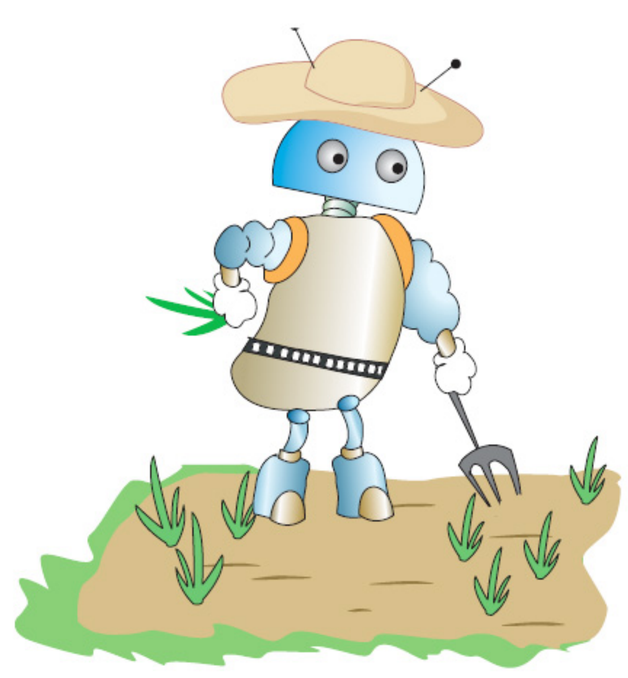
Why robot weed killers?

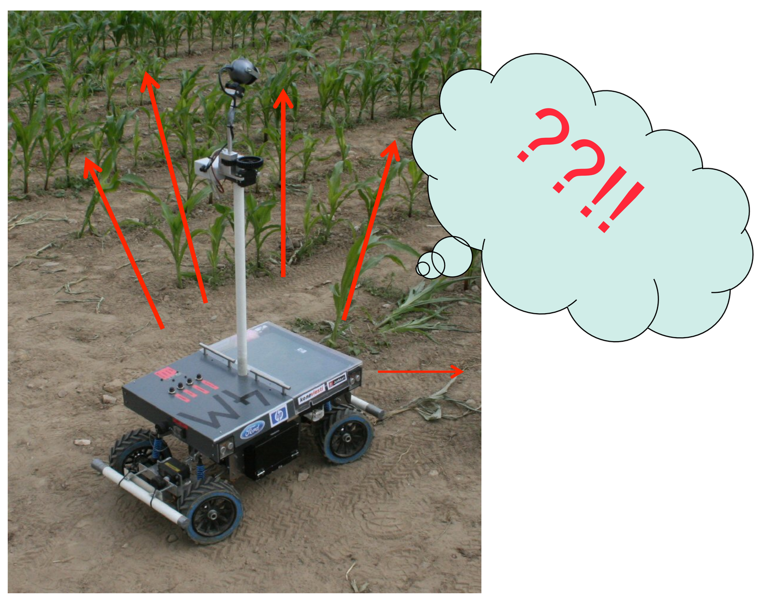
Autonomous robotic weed destruction has both **economic and environmental benefits** as it enables,

- Significant rise in crop production
- Mechanization of the manual and drudging weed killing task
- Reduction in the usage of chemicals leading to long-term sustainability



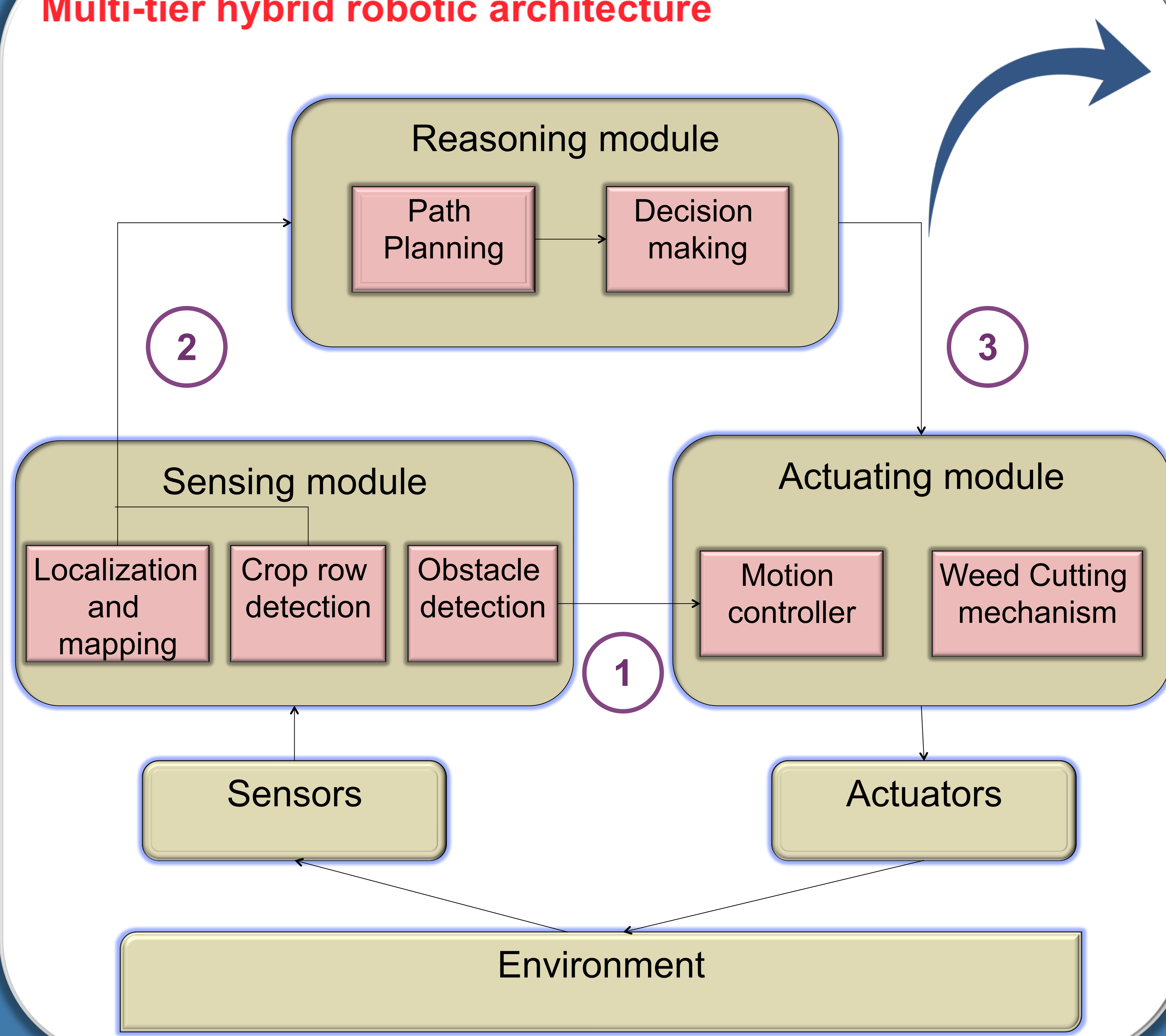
Main objective

To build a small, low-cost, intelligent and autonomous robot, destructing the weeds lying between the crop rows by navigating through the field, using a minimum of a priori information about the field configuration.



- How can the robot make sense of the world it is going to act upon?
- How to enable accurate and robust detection of crop rows in the field?
- How to map the unknown geometry of the field?
- How to ensure the complete coverage of the field?
- How to control the low-level tasks?

Multi-tier hybrid robotic architecture

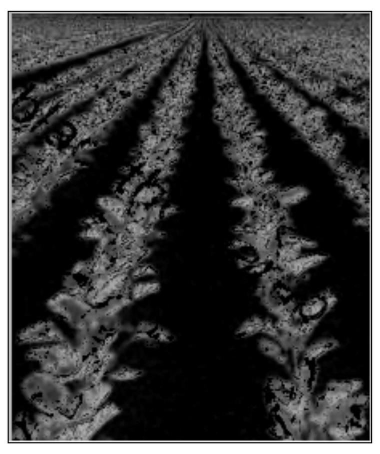


① Reactive approach whenever an obstacle is detected
② Interpreting the information from the sensing module for decision-making on where to go and when to cut the weeds
③ Controlling and coordinating the low-level operations of robot according to the decisions made (proactive)

Vision-based crop row detection

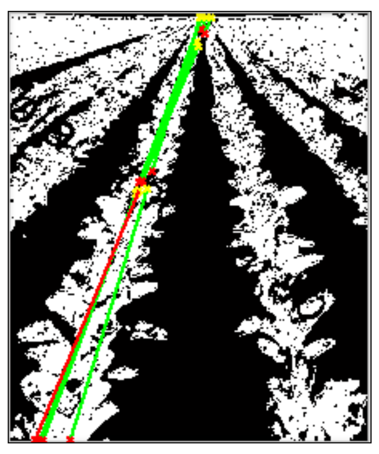
Necessary and sufficient information can be supplied by a vision system to detect the crop rows under varying conditions. Steps followed and the results obtained for the ideal case (no weeds and no missing crops):

Original Image



Pre-processed image with enhanced contrast between the plants (crops and weeds) and soil

Plants separated from soil to ease the detection of crop rows in the image



Crop rows detected in the image by the line detection algorithm (Hough transform)

Parameters of the line detection algorithm can be tuned with the previous estimates by using techniques like Kalman filter

Supplementary sensors

Vision-based localisation might not be always viable due to the varying weather conditions of the field.

① to assist the vision system in localization and mapping for navigation
② to complement the vision system in crop row and obstacle detection

Intelligent stochastic data fusion and machine learning algorithms to combine data from heterogeneous sensors.

Roadmap for PhD?

- Enabling accurate and robust detection of crop rows even amidst missing crops along the rows and presence of many weeds
- Achieving efficient and complete coverage of the field
- Creating flexible hardware and software platform to implement the system enabling weed elimination
- Testing the system and assessing its performance on an actual case study

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