How can robots help greenhouse growers today?
What is robotics in Ag? Takes many forms…

A recent success in Ag robotics:

Blue River Technologies sold to Deere for $305M
Weeding and thinning lettuce
Today’s Robots

Narrow robotic capabilities or structured environments

Industrial Robotics (82%)
• $17.5B total worldwide market value
• strong adoption: 70% automotive & 26% electronics

Service Robotics: Professional (15%)
• $3.2B total worldwide market value
• 45% defense & 30% field (Ag: milking robots), 14% medical

Service Robotics: Personal (3%)
• $538M total worldwide market value
• 66% domestic & 34% entertainment

Market numbers several years old
Our focus at Harvest Automation is on robots that:

- Do physical work
- Make complex decisions for sophisticated tasks
- Work in ‘mostly’ unstructured environments
Robotics is the right solution for Ag labor, but there are challenges
Robots in unstructured environments w no price limit

DARPA Robotics Challenge

video

The biggest and most well-funded international robotics competition in years was a failure.

2015 Popular Science Magazine
The big challenges new robots face; part 1

The balance of cost and capability

• Expectations and Needs: fantastic machines with human-like skills

• Economics: component costs are trending down, but still VERY high

• Result:

what customers want and need

what we can build for a price customers will pay
The big challenges new robots face; part 2

Development costs outpace market potential

- Robots must be very task specific to meet cost targets
  - Grape robot ≠ Strawberry robot
- $1M development cost must = $10M projected annual sales
  - Investor $ all in data, AI, IoT, etc.
- Outcome: funding beyond early research is hard to secure

US Specialty Crop Values 2012 - $50B
What’s here today and in development in Ag robotics?

By no means an exhaustive review, especially regarding projects in development
Advanced automation in structured hort settings
Harvest Automation ~ HV-100 Plant Handling Robot

video
HV-100 in Action ~ Nursery Customers

1 mile across
HV-100 in Action ~ Nurseries

video
Naio Technologies ~ Oz Weeding Robot

Vineyard and vegetable weeding robots in development
Priva Kompano Deleafing Robot

Commercial status unknown
Vineland Research and Innovation Center

Multiple project ongoing
Augean Robotics ‘Burro’ ~ in Development

- Bulk carrier – 300 to 450 lbs
- Can follow a person and retrace a learned path
- Development plans uncertain

This application could represent a great balance between capability and cost
Bonirob
planting, weeding, etc.

Rowbot
in-season nitrogen management

Agrobot
pick strawberries
Smart Graspers ~ in Development
• **Poultry:** tasks relating to animal health and house maintenance
• **Dairy:** controls system for automated hay bail collection
• **Grapes:** harvest collection
• **Cannabis:** handling potted plants
• **Select Vegetables:** growing crops in containers instead of ground
  - Reduces inputs
  - Instant organic
  - Grow anywhere / local
• **Ornamental Horticulture:**
  - Automated fertilizing
  - Moving trays of potted plants
Conclusions

• Current suppliers of ‘classic’ automation provide a wide variety of solutions for greenhouse growers

• Robots with advanced skills to tackle the vast majority of Ag labor ‘in the wild’ remain very challenging

Thank you

Charles Grinnell
Founder and CEO
Harvest Automation, Inc.
charlieg@harvestai.com