Automation of Inventory Processes for Nurseries

Dr. James Robbins – Extension Specialist
The Future of Nursery Automation

By Roy E. Young

For years, the American Association of Nurserymen has asked Congress to fund research on plant-handling systems and other forms of industry-specific automation and mechanization (sidebar, page 45). Last year, the AAN requested an annual expenditure of $2.05 million. And while Congress has consistently refused these requests, the association's emphasis on futuristic R&D may prompt most growers to ask: Will this actually impact my operation in the near future?

Clearly, the answer is yes. Many factors are pushing toward the development of nursery machinery and equipment (sidebar, opposite). But perhaps the most important is the competitive pressures from international producers, particularly the Dutch industry (see "Plants Across the Water," March 16, 1992, page 44—ED). Federal statistics reveal that, for the past eight years, the US has imported at least 2.5 times more nursery and greenhouse products (such as cut flowers, bulbs and live plants) than it has exported. Although American growers have been traditionally viewed as the largest group of producers of plants and flowers (the US government has estimated growers' cash receipts at $7.8 billion), they currently account for less than 1 percent of the expanding world trade.

The best way to visualize this is to picture the US industry as a lethargic, giant bear just becoming conscious of the fresh scents of an impending spring. To catch up and compete with the earlier risers, such as Holland, the "bear" must awaken and focus its eyesight rather quickly.

And the object of our blurry vision must be a continued push for automation and mechanization. Many factors contribute to the dichotomy between the US industry and those of other countries. Unlike Holland's dominating greenhouse trade, the US industry is geographically broad, highly diverse in product line and not centrally organized.

In addition, the nursery industry has not traditionally sought research funding in any organized fashion, unlike other US commodity groups (such as soybean and corn farmers). Nor has there been a close partnership among grower, government and manufacturer in pursuing R&D projects, as is characteristic of Holland.

If our industry is to gain significantly higher shares of both the domestic and export markets, we must strive for greater competitiveness. One way is through new mechanization and automation. During the 30s, we saw rapid adoption of this concept, leading, for example, to automated shade curtains for greenhouses and trickle irri-
<table>
<thead>
<tr>
<th>Container</th>
<th>Field</th>
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</table>

- **Container**: A person is working with plants in a container setting.
- **Field**: A person is working with plants in a field setting, using a tool to measure something.

Image of a tool for measuring, possibly related to plant growth or health.
Tallymaster – 2003

Introduced MidAm 1996
First use: 1974
Tree Nursery Inventory Barcode System

Abstract
A hardwared and software solution is designed and build for a Tree Nursery to allow them to keep track of their inventory and sell trees. This solution will allow the nursery to capture the tree data for inventory and sales.

General Background
A nursery grows various types of plants, trees, shrubs, and plants. There are millions of individual plants tracked in the nursery database. Each year, trees are removed from the nursery, which can lead to economic loss. The trees are replaced and sold to clients. The trees are tracked and sold through the nursery, and the client information is recorded. The trees are sold at various stages, from seedlings to fully grown trees. The nursery will continue to sell trees to clients. The nursery will capture the tree information and record the tree sales. The trees are sold to the nursery client through the nursery database.

End-Product Description
This Tree Nursery System allows the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information. The system will allow the nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Technical Approach
The system will allow the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information. The system will allow the nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Design Objectives
Design a system that will allow the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Functional Requirements
The system will allow the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information. The system will allow the nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Design Constraints
The system will allow the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information. The system will allow the nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Testing Approach
The system will allow the Tree Nursery to capture and store data on the trees, including the tree type, size, location, and sales information. The system will allow the nursery to capture and store data on the trees, including the tree type, size, location, and sales information.

Milestones
- Design Phase: Completed
- Implementation Phase: Completed
- Testing Phase: Completed
- Deployment Phase: Completed

Budget & Personnel Info
- Budget: $50,000
- Personnel: 100

May 02-08 Project Team Information

Client
- Name: Tree Nursery
- Contact: info@treenursery.com

Advisor
- Name: Dr. John Doe
- Contact: john.doe@university.edu

Design Team Members
- Name: Jane Smith
- Contact: jane.smith@treenursery.com

Project Website
- Link: http://www.treenursery.com
Radio chips help keep tabs on plants

"An implantable radio frequency identification device can be used by commercial nurseries to track plants in their inventory or as plants move in and out of a retail outlet."

— Richard Harkness

Cost?  Effective range?  Interferences?  Standardization?

2005
Goal, or target: we are aiming for the ‘development of automated, non-contact, inventory tools’
NURSERY INDUSTRY RESEARCH NEEDS
Prepared by the
American Association of Nurserymen

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1. Engineering/Mechanization Systems research is just one of the prime needs of the nursery industry. Because of its specialized production practices (e.g. its use of seed beds, propagation benches, field nursery crops, container production, etc.), new mechanization systems need to be developed to improve the efficiency of these practices. In addition, many new engineering advancements in other agricultural enterprises need to be adapted for nursery farm uses. Some examples include tractors, sprayers, materials handling systems, container growing media, irrigation, harvesting systems, as well as refrigeration and humidification for woody plant storage.

3. The AAN recommends continuation of the IR-4 research program to obtain data to support extension of existing pesticide registrations for additional crops and/or pests.

4. Little or no substantive, qualitative research has been done in marketing for the nursery segment of agriculture. Topics for marketing research include:
   a. Determination of the effects of production facility layout, location, equipment, methods of handling, and transportation on marketing costs;
   b. Evaluation of the effects of characteristics of products (e.g. bare-root, B&B, container grown nursery crops, etc.) on marketing and processing costs;
   c. Examination of the changing structures of production-marketing systems, including size and number of firms, patterns of ownership, development of contracted relationships, and competitive practices of firms;
# Workshop Report: Engineering Solutions for Specialty Crop Challenges

Table 2. Needs identified by the ornamentals breakout group.

<table>
<thead>
<tr>
<th>Issue/need/concern</th>
<th>Priority</th>
<th>Barrier</th>
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<tbody>
<tr>
<td>ACESys (automation, culturing, environment), including monitoring, decision support, and chemical application technologies</td>
<td>3</td>
<td>Lack of sensors, lack of uniform approach, infrastructure flexibility.</td>
</tr>
<tr>
<td>Business operations mgmt (including supply chain, inventory control, and transportation)</td>
<td>3</td>
<td>Lack of models, data gathering.</td>
</tr>
<tr>
<td>Enterprise automation (production-to-consumer systems)</td>
<td>2</td>
<td>No standardization, high capitalization, inertia to change, loss of flexibility.</td>
</tr>
<tr>
<td>Renewable resources for containers</td>
<td>2</td>
<td>Lack of technology, no standards, lack of raw materials, economic incentives.</td>
</tr>
<tr>
<td>Energy use, price, and availability</td>
<td>2</td>
<td>Controlled-environment facilities are expensive to operate.</td>
</tr>
<tr>
<td>Lack of standardization (e.g., containers)</td>
<td>1</td>
<td>Industry resistance.</td>
</tr>
</tbody>
</table>

*High (3) to low (1)*
Moving towards automation

The beginnings of superior inventory management and precision agriculture for nursery field crops

Increasing production costs and declining market prices are serious challenges for nursery growers, just as they are for specialty crop growers in general. Economic returns within nurseries are limited not only due to input cost pressure, such as fuel for heating greenhouses, but also from labor costs and the availability of skilled workers. Additionally, consumers are increasingly demanding safe, affordable, traceable, and high quality products. The market is also demanding that suppliers demonstrate how they are minimizing their environmental impact, which can be a key challenge for some growers.

A multi-institutional team recently began a four-year effort to develop a comprehensive automation strategy for ornamental and fruit tree production. The project, called “Comprehensive Automation for Specialty Crops” (CASC),
‘Development of automated, non-contact, inventory tools’
Non-contact Measurement Approaches

- Distance Measurement sensor
  - Laser Sensor
  - Ultrasonic sensor
- Camera
  - Webcam
  - Stereo Camera
Automated Caliper and Counter

A fast, low-cost method to measure caliper and count trees ‘on-the-go’.

Manually measuring and counting trees is time-consuming and expensive. Our goal is to increase production efficiency and assist in projecting inventory with a mobile device to do both automatically. We are developing a laser tool to measure tree trunks—within the 3 mm nursery standard—and count them as fast as an employee walks through rows.
Farwest Show Tours
August 23-24

Find new ways of thinking and meet your industry network face to face on behind-the-scenes VIP tours!

Grow your success and competitive advantage. Discover new varieties. Meet new growers and suppliers. Explore new ideas. And meet other wonderful people and leaders in our industry.

Who Should Register
- Garden centers
- Growers
- Wholesalers and brokers
- Landscape architects, contractors and designers

Choose the experience that is right for you:

Tour 1
COOL STUFF
Tuesday, August 23
8 a.m. - 6 p.m.
Recommended for:

- Take advantage of a rare opportunity to see one of the largest collections of plant material and display gardens in one day.
- All stops will appeal to garden centers and brokers.

Tour 2
INNOVATIVE IDEAS
Tuesday, August 23
8 a.m. - 6 p.m.
Recommended for:

- Implementing changes can dramatically impact the success of a business. This tour will explore profitability, marketing strategies and customer satisfaction.
- All stops will feature cutting-edge businesses that are finding innovative ways to stay competitive.

- Amazing Flowers Collection
- Rare Plant Research
- Willbur Nursery Inc.
- Doe Valley Nursery Co.
- Surface Nursery Inc.

- Cool Stuff
- Innovative Ideas
Methodology

1. **Classifying the trunk from other objects**
2. **Distance measurement from the sensor to the area of interest, e.g. the trunk.**
3. **Approximate the diameter of the trunk based on the previous information.**
Challenges
Experimental Setup and sensors used

Previous setup

Current setup

Webcam
Laser
Ultrasonic
Stereo camera
Sensors

- Direction of motion
  - Tree counting algorithm
    - Distance, Thickness, Jump (in-between distances trees) Threshold

ASABE 2010 Annual International Meeting
THURSDAY • AUGUST 25
Room B-115-116

Automation and Technology

MODERATOR: Joe Kopfles, co-founder for Water, Allied Solutions by Kopfles, LLC

Terrestrial Approach to Inventory Management for Field Nursery Production
9 - 9:45 a.m. • SPEAKER: Dr. Jim Clower, assistant professor, Virginia Tech (formerly Oregon State University)
This presentation summarizes the efforts by a team of scientists, engineers, and nurserymen from Oregon State University and Conifer Farms to develop an online, real-time, and cost-effective approach for inventory management.

Aerial Approach to Inventory Management for Container and Field Nursery Production
9:45 - 10:30 a.m. • SPEAKER: Rosa Uihlein, assistant professor, University of Florida
Collection of real-time inventory data is expensive, time-consuming, and often inaccurate. This presentation summarizes the efforts by a team of scientists and engineers from the University of Florida, Oregon State University, and the University of Arizona that are working on utilizing a new unmanned aerial vehicle for inventory management. This natural system has the potential to be used in the future for other levels of inventory management, such as identification of seed pests, pressure, or to determine statistics (e.g., poor soil conditions) or pests (e.g., spider mites) stress, or as-needed basis.

Development of Intelligent Spray Systems to Increase Pesticide Application Efficiency
10:30 - 11:15 a.m. • SPEAKER:袆ing Zhu, agricultural engineer, USDA-ARS Application Technology Research Unit
This presentation will introduce newly developed intelligent spray systems for floral and ornamental nursery crop growers to increase pesticide application efficiency and minimize drift impact.
These are TEAM efforts!!!