Manufacturing with AIVs

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Today’s Outline

• AGV – current guidance technology

• AIV technology – “autonomous” versus “automatic”

• Safety & State-of-the-art indoor navigation (all environments)

• Operating AIV fleets

• Examples of AIV worldwide deployments in manufacturing environments
AGV Guidance Technology Options

• Laser Scanner vehicles

• Line / Wire following vehicles

• Magnet / Barcode following vehicles
AGV – Laser & Target Beacons

- 360° laser scanner
- Reflective beacons
AGV – Line-Following Technology

- Buried wired
- Magnetic tape
Magnet / Barcode Following AGV

Buried Magnets

Barcodes
Safety Laser – Object Detection

- Protective Field
- Warning Field
AGV Limitations

• Costly & time-consuming to install
• Follow pre-programmed paths
• Inflexible, and hard to reconfigure
• Can’t drive around obstacles and obstructions
Autonomous Intelligent Vehicles (AIV)

Definition of Truly autonomous vehicles

• Can safely operate alongside people
• No workspace retrofit required – rapid installation
• Capable of planning alternate routes
• Operate in very dynamic environments
• Work collaboratively in a fleet
Installing an AIV – Creating a Map
Sample Map

- Goals
- Forbidden Sectors
- One-ways
- Resisted
- Trigger events
- Control speeds
- Traffic mitigation
Autonomous Intelligent Vehicles

- Safe operation alongside employees
- Non-threatening operation
- Intelligent path planning
- Autonomous navigation
Water Spider – Customer Example

• Assembly process – jewelry manufacturing–
  – Transport of Inventory, WIP and FGI

• Two shift operation –
  – Two people per AIV moved to assembly tasks
Transporting Carts in a Manufacturing Environment

- Off-line assembly kitting
  - Carts custom configured
  - Line-side replenishment
- Traceable transport
  - Barcode/RFID
AIV Deployment - Kitting

Example: Kitting food trays – delivery to final assembly area

• Two shift operation –
  – Two people per AIV moved to higher value-add tasks to accommodate growth
Managing Fleets of AIV’s

Customer enterprise management systems (WMS / MES / ERP)

Tasks are issued

EM selects vehicle and issues command

Enterprise Manager
Managing Fleets of AIV’s

Customer enterprise management systems
(WMS / MES / ERP)

Robot notifies EM of progress and when task is completed

EM communicates status - traceability

Enterprise Manager
Importance of Enterprise Manager

• Central point of contact & integration
• High-level job management (i.e. taxicab dispatch)
• Automatic selection of optimal vehicle
• Centralized configuration management, makes it very easy to scale
Transport of Work-In-Progress

Customer example

• Manufacturing
  – Movement of WIP from inventory to the process station

• Three shift operation
Transport of Finished Goods

Customer example

- Logistics warehouse
  - Transport of finished goods from inventory to shipping
  - Seasonal variations – move from 10 packing stations to 28 stations
Multiple Payloads – Common Mobile Robot Base
Next Generation - Mobile + Fixed Robots
Next Generation – Mobile + Fixed Robots
Conclusion

• There is a new generation of truly autonomous vehicles already field proven
  – Highly advanced, easy to install, deploy, and operate
  – Safe, and capable of navigating highly dynamic environments
  – Improving traceability, productivity, and supporting lean manufacturing
Contact Information

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