

SOLVE FOR X.

Breaking Barriers: A New Generation of AGVs

Presented by:

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Agenda

- Transportation Options
- What is an AGV/AGC
- Humble Beginnings
- A Changing Consumer and Industry
- Types of AGVs → The Small, Agile Bot
- Latest Technology
- New Navigation Principles
- The Next Generation

An AGV is One of Many Transportation Options

HUMAN?



PUSH UNIT?



POWER CASTER?



TOW TRACTOR



AGV/AGC/SDV



MOTHER/DAUGHTER



FORKLIFT



CONVEYOR



What is an AGV/AGC?

- An AGV/AGC is a driverless, electric vehicle with a programming capability of path selection, destination, collision avoidance, and navigation. An AGV/AGC offers advantages in logistics by handling material flows automatically.



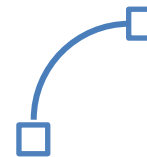
SELF DRIVING



COLLISION WARNING



NAVIGATION



PATH SELECTION



DESTINATION SELECTION

Humble Beginnings

- Developed by Arthur Barrett
- Followed a wire in the ceiling
- Traveled at 2.75 mph
- Pulled up to five (5) trailers



Humble Beginnings

- First used in Assembly by Volvo in Kalmar, Sweden
- Nearly 200 AGVs followed a wire in the floor
- The AGVs ran until 1994 when the old plant was shut down



The Early Days – Dumb Beasts

- Wire in the floor provided magnetic field for AGVs to follow
- Floors were considered smart
- AGVs were considered dumb



Change is the Only Constant

- AGVs have been known to be expensive, limited in flexibility, space-takers, and hard to justify
- With a trend towards more agile manufacturing setups, new technology enables small “bots” that are able to navigate safely and quickly through unstructured, dynamic environments more cost effectively



Autonomous cars

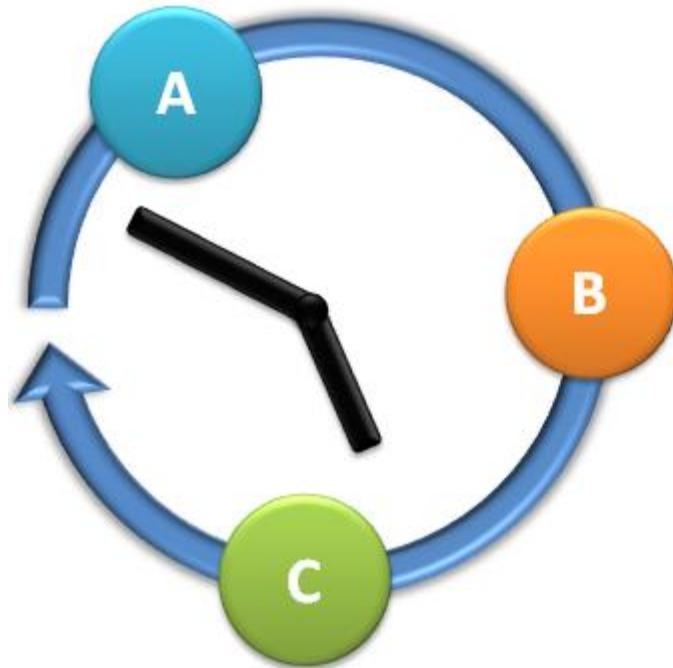


Autonomous mowing

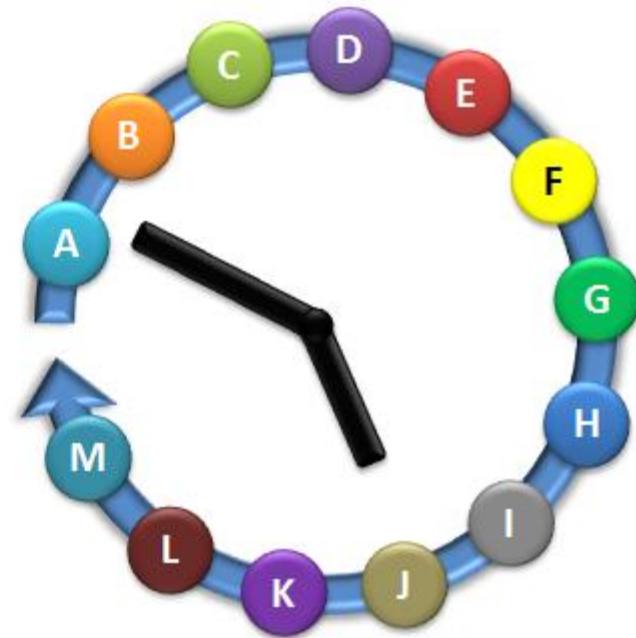


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Increased Frequency



THE PAST

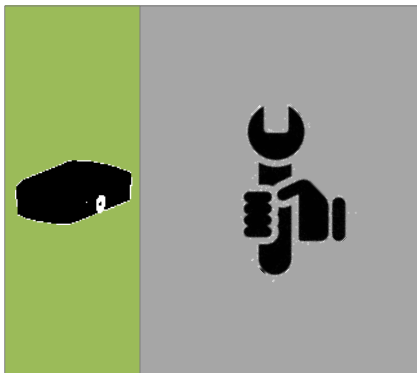


FUTURE

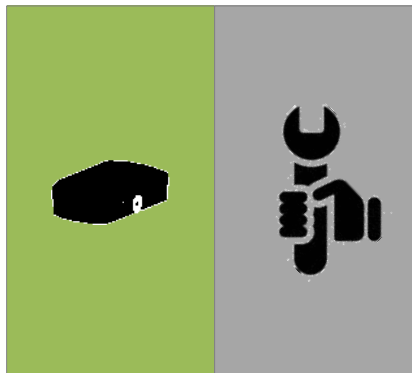
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More Footprint Used for Intralogistics Operations

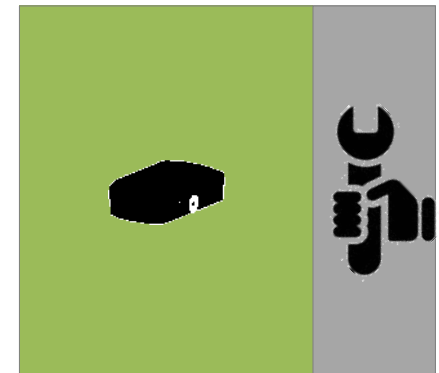
THE PAST



PRESENT



FUTURE?



75% of an item's production cost is related to material handling

55% of factory space is used for material handling

Different Types of AGVs

Forklift



- Move and lift pallets

Assembly



- Carries objects during assembly operations
- Short movements
- Slow speed
- Indexing or continuous movement

Load Transfer



- Carries objects during assembly operations
- Indexing or continuous movement
- Conveys or shuttles loads on and off

Towing



- Pulls/tows one or more carts in a train
- Heavy payloads over a long distance

Small Load



- Flexible and agile
- Used to deliver small items such as boxes, totes, trays, or carts
- Repetitive and continuous actions at high speed

What Can Latest Cart Technology Do?



ATTACH



- Simple
- No Caster



- Simple
- No Caster



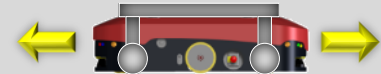
LIFT



- No Noise from Cart
- No Wear on Casters
- Flexible Caster Config.
- Flexible AGV Interface



- Lift Limits Capacity
- More Weight on Bot During Transport Limits Weight Capacity



MOUNT/PULL



- Less Complex Bot Design
- Cart Supports Weight – Allows for More Weight Capacity



- Requires Custom Mounting Interface
- Caster Set Up Must Align with Bot

What Can Latest Cart Technology Do?



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What Can Latest Cart Technology Do?



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What Can Latest Cart Technology Do?



Get Lean

Waste of Floor Space

- Less floor space than larger AGVs
- More guidance options for increased flexibility
- Agile bots twist and turn nimbly around structures

Waste of Motion

- Deliver materials to workers limiting walking
- Add scissor lifts to improve ergonomics and limit movement
- Add roller conveyor and lifts to eliminate picking up



Auto Manufacturer Cuts Cost with 5% per Car

- Projected to help cut costs by 5% per car annually
- Vehicles autonomously find the desired parts container(s) and transport it to packing area
- Saves money with shorter response times and improved flows



Global Manufacturer Improves Efficiency

- 20 low profile AGVs move 1,800-lb. refrigeration units through assembly
- Integrated with friction drive conveyor system
 - Friction conveyor moves loads on cart
 - AGV tunnels under line of carts, auto hitches to last cart in line for delivery
 - Returns empty carts for loading



Appliance Company Receives Fast Payback

- 10 AGVs move stoves through assembly process
 - Magnetic tape guidance
 - Moves alongside workers
- Integrates with conveyors to further automate process and achieve lean goals
- ***ROI expected in under one year***



The New Fulfillment Technology

- Natural Features Navigation
- S.L.A.M. Navigation
- Contour Navigation



The New Fulfillment Technology

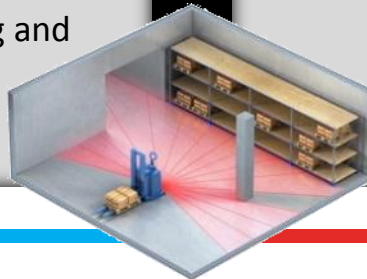
NATURAL FEATURES NAVIGATION

Pros

- No need for reflectors or markers to the existing environment for vehicle navigation
- Guide path is easily changed and/or expanded
- System can be expanded without alteration to the facility
- Dynamic control of blocking and traffic management
- Quick and easy to install

Cons

- Vehicle movement can be unpredictable
- Constantly changing environment can cause problems
- Open space creates issues if no reference markers are available



The New Fulfillment Technology

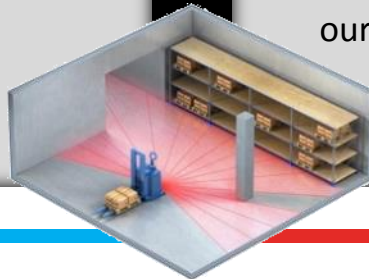
S.L.A.M. NAVIGATION

Pros

- No need for reflectors or markers to the existing environment for vehicle navigation
- System can be expanded without alteration to the facility
- Dynamic control of blocking and traffic management

Cons

- Still a challenge to manage
- Estimation methods are still uncertain
- Large scale systems cause challenges
- In order to build a map, we must know our position; To determine our position, we need a map!



The New Fulfillment Technology

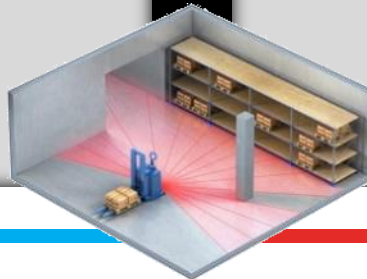
CONTOUR NAVIGATION

Pros

- Guide path is easily changed and/or expanded
- System can be expanded without alteration to the facility
- Dynamic control of blocking and traffic management
- Predictable path – always follows same path
- Quick and easy to install

Cons

- Still requires a few reference markers as backup to the contour
- Open space creates issues if no reference markers are available



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The New Fulfillment Technology



The New Generation of AGVs

- Flexible and small
- Agile and fast
- Autonomous
- Cost effective
- Environment “friendly”



The Next Generation of AGVs

- Mobile Robots
- Order Picking



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