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A REVIEW ON PATH OPTIMIZATION OF AUTOMATED GUIDED VEHICLE SYSTEM IN FLEXIBLLE MANUFACTURING SYSTEM USING HYBRID ALGORITHMS

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Abstract

In this paper investigates the relation between AGVs performance on the basis of hybrid Algorithm in flexible manufacturing system. AGVS is a transportation tool for improving flexibility from one station to another. Clubbing the benefits of two algorithms improves the shortest path finding mechanism.

Keywords—Automatic guided vehicle (AGV), Flexible Manufacturing System, Hybrid Algorithm ,

1. INTRODUCTION

Automatic guided vehicle (AGV) is self-driven. It follows markers or wires in the floor, or uses vision, magnets, or lasers for navigation. They are most often used in industrial applications to move materials around a manufacturing facility or warehouse. AGV can tow objects behind them in trailers to which they can autonomously attach. The trailers can be used to move raw materials or finished product. The AGV can also store objects on a bed. The objects can be placed on a set of motorized rollers (conveyor) and then pushed off by reversing them. AGVs are employed in nearly every industry, including pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done. Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse, and deliver loads. Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line,

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transport goods throughout a plant or warehouse, and deliver loads.

An AGV system provides a material handling system i.e. both flexible and readily adaptable to either production or production changes

AGVs are popular in:-

- Automatic Material Handling System
- Flexible Manufacturing System
- Container Handling Application

AGVs are composed of:-

- Hardware: AGVs, paths, controllers, sensors etc.
- Software : Algorithms for managing the hardware

AGVs increase efficiency and reduce cost by helping to automate a manufacturing facility or warehouse.

Types of AGV's

- **Towing Vehicles** : AGVs used for towing were the first one to be developed. Towing vehicles have ability to pull a variety of trailer and load carrying capacity limit from 01 ton to 75 ton.
- **AGVS Unit Load Vehicles:** These are equipped with platform for unit load transportation either automatic or manually. The platform can be lift up and lower down. It have rollers for pushing the load on platform .Pushing of load be done automatically or manually .Chain or belt are used for holding the load. It customize platform with compartments for different sizes of load.
- **AGVS Pallet Trucks**: These are designed to move palletized loads up and down from floor level. It helps in eliminating the need for fixed load stands.
- **AGVS Fork Truck:** These have various functions such as to lift heavy load at high racks. Sometime servicing of loads is done by keeping on its fork.
- **AGVS Hybrid Vehicles**: These are converted from manual forks lifter to a self driven AGVs. These can be used for transferring loads around warehouses. These can be used for boarding/de-boarding loads on transporting truck platform. These are fitted with the adjustable forks for moving loads.

Types of AGV's Path algorithms

I. Wire Guided AGV Path algorithms
   a. Dijkstra Algorithm
   b. Genetic Algorithm
   c. Floyd-Washal Algorithm
   d. Minimum spanning tree

II. Wireless guided AGC path Algorithms
   a. A+ Algorithm
   b. Uni vector field approach

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c. PSO (Particle swarm optimization)
d. Neural Network Approach
e. Artificial Potential fiel algorithm
f. Beizer curve with genetic algorithm (BCGA)
g. Fuzzy Logic approach

2. MERITS AND DEMERITS

A. Merits

Flexibility:

AGV system is flexible due to its adaptability to change in production and product. It optimizes the manufacturing system and also improves the productivity. AGV delivery method is safe and predictable while it avoids interference with human and building factors. It increases the system speed and accuracy. It provides more favorable condition for better optimization of flexibility of manufacturing process.

Unobstructed movement:

AGV are provided with anti-collision mechanism. This means these are equipped with sensors which detect the any obstruction in the path of the system. Obstruction can be due to human movement or stoppage of other AGV in the path.

Re-Programming

Locations, path, Pick up/Drop off points can be reprogrammed suiting the desired manufacturing plant or ware house. Easy to change guide path system immensely adds benefit of the AGVs. Number of vehicles can be altered depending on requirement of production. Adding the AGV in the system increased the per hour production or per hour delivery in a warehouse.

Greater reliability,

AGV possess less environmental problems as the carbon emission of the vehicle are lesser than conventional vehicles. AGV can be replaced by another in case of failure of any vehicle. This also enhances the product reliability.

Reduced labour cost

AGVs have higher operating savings on the long run. Labour cost is also minimal in terms of manual labour. Problems like Healthcare expenditure, Wage of employee, increasing of salary, vacation of employee are reduced.

Easy maintenance

Maintenance of AGVs are also less costing. Advanced AGV go to charging station before the battery discharge completely. Such system reduce the time taken to process the desired production in conventional process.

Increased Safety

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Human safety factor also benefited from AGVs. It reduced number of incidents/accident which may arise due to human error or technical failure. It easily work on dangerous position which may cause fatigue or exhaustion due to nature of long hour of work.

Increased Accuracy and productivity

By replacing the human element with AGVs, it may eliminate some of the prospective for erroneous workflows, eventually reduces waste and aggregating output. It permits procedures to turn out to be extra productive and accurate. Though a person is restricted in how long he can work, AGVs are proficient enough of running 24/7.

Easy to Expand

With the expansion of operations, it is easy to add additional AGVs as the requirement demands. It means in phases AGVs strength can be increased , so instead of high initial cost of purchasing 50 or 60 AGVs at a go, 10 or 20 AGVs can be purchased and in transition it can be expanded to fully automated system.

B. Demerits

Potentially elevated Initial Investment

Procuring an AGV, in brief term, is probably working to be pricier than employing workers or consuming additional equipment such as forklifts. It is typically in extended tenure that investments are completely recognized. This early outlay can be troublesome on lesser jobs that may not have arranged access to funds.

Not suitable for Non-repetitive Tasks

AGVs mark the utmost logic in jobs that deal with repetitive tasks as that is what they are preset to do. If the jobs in the setups tend not to be repetitive, then they can almost certainly be complete more swiftly and competently by staff working with other tools (for instance a forklift).

Preset systems and processes

AGVs effort according to preset systems and processes, which can make prompt modification problematic. A commercial model that inclines to respond to developments or that is else agile may not be the finest appropriate for AGVs

To determine whether or not AGVs right for a process, It need to evaluate the merits and shortcomings of AGV usage and choose whether they match or hamper operations.

3. HYBRID ALGORITHM

A **hybrid algorithm** is a set of rules that conglomerates two or more additional set of rules that explain the same problem, either selecting one (reliant on the facts), or swapping amid them over the sequence of the algorithm. This is in general

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completed to cartel anticipated structures of each, so that the inclusive procedure is superior to the discrete mechanisms. Automated Guided Vehicles (AGVs) and FMS are supposed to be cohesive for the reason that FMSs practice AGVs as a fragment of transportation in the plant.

In this paper genetic Algorithm is used .Genetic algorithm is evolutionary method which works according to coding of machines Scheduling of machines station along with automated guided vehicles is done according to steps of genetic algorithm. This scheduling finds out the makespan time. This algorithm uses mutation and crossover changes to get the fittest chromosome in which makespan is optimum. Comparison is done through various heuristics process like Shortest Possible Time(SPT), First Come First served(FCFS) and Least Processing Time(LPT).Genetic Algorithm outperform all the above heuristics method. Explanation is done by taking 10 jobsets .4 layouts of machine and 2 AGVs are used .Matrix chart of AGV travelling time from machine to machine are given.

4. LITERATURE REVIEW

1. **Methodologies to optimize Automated Guided Vehicle Scheduling and Routing Problems, Hamed Fazlollahtabar says:**

In the context of manufacturing areas, static and dynamic algorithms have been developed to solve the routing of vehicles. Network models, queuing networks, simulation and intelligent routing techniques are used to route AGVs through the network.

2. **Optimisation of AGVs path layout in flexible manufacturing system using 0-1 linear integer programming, Suman Gothwal and Tilak Raj says:**

The performance of the overall system is greatly influenced by the guide path layout since it has direct impact on the travel time, on the installation costs, on the complexity of the control system software and efficiency of vehicle dispatching and scheduling. The objective of this study was to develop an approach to design an optimal flow path for AGVS. The problem was analyzed and formulated as 0-1 linear integer programming model with the objective of minimizing the total distance travelled by individual loaded AGV.

3. **Research on Visual Navigation Algorithm of AGV used in the Small Agile Warehouse, Wu Chung-Fu at al. says :**

That in small warehouse, mechanical and control system of AGVs are based on the color

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difference threshold segmentation method to extract and merge navigation path deviation. The idea of advance at closed loop control is adopted and the path tracking controller is realized. The experiments results shown that the navigation is flexible, high precision, stable operation and visual navigation for AGV can satisfy the demand of flexible storage, this study of related fields has certain reference points.

4. Time Window Based Path Planning of Multi-AGVs in Logistics Center , Zheng Fan says:

This promotes the transportation throughput with less path finding failures. It find out that the sorting throughput and maximum number of active AGVs will increase with the scale of warehouse.

5. An Improved Differential Evolution Based Artificial Fish Swarm Algorithm and Its Application to AGV Path Planning Problems, G Li at al says:

Artificial fish swarm algorithm is a novel algorithm and it has both advantages and dis advantages of AFSA. Aiming at
improving the disadvantages of AFSA, It introduces global optimal position information stored in bulletin board into swarming and following behaviors, and hybridize AFSA with differential evolution algorithm.

6.**Simultaneous Scheduling Of Machines And Agvs Using Evolutionary Optimization Algorithms, MV Satish Kumar proposes**

In this work, different evolutionary algorithms like genetic algorithms (GA), particle swarm optimization (PSO) and differential evolution (DE) are simulated to generate the sequence of operations. A heuristic is developed for vehicle assignment, which selects a vehicle for every operation. This is hybridized with the evolutionary algorithms to solve the simultaneous scheduling problems. A machine selection heuristic is developed which takes care about balancing the load of individual machines while minimizing the makespan and it is integrated with the evolutionary algorithms to address the bench mark problems.

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