CLAIMS

1. A system for controlling movement of one or more transporting devices said transporting devices transporting containers said containers being stored in a facility, in which the facility stores the containers in a plurality of stacks, the facility further having a plurality of pathways arranged in a grid-like structure above the stacks, the one or more transporting devices operating on the grid-like structure, the system comprising:

one or more computers configured to execute computer instructions which when executed provide:

one or more utilities determining and reserving routes for moving the one or more transporting devices through the plurality of pathways and determining and reserving routes for moving the one or more transporting devices when transporting one or more of the plurality of containers; and

one or more utilities determining and reserving routes to control one or more of the plurality of transporting devices to retrieve one or more of the plurality of containers from within one or more of the plurality of stacks; wherein

the one or more retrieving utilities being arranged to instruct one or more of the transporting devices to move one or more containers from within one or more stacks to an alternative position, either within the stacks or external to the stacks, the utility being further provided with means for ensuring that in moving one or more containers prior to accessing the one or more containers for retrieval the one or more containers replaced in the stacks are placed in positions within any one of the stacks other than the stack the or each container was removed from.

2. A system according to claim 1 in which the or each of the containers contain objects, the objects being stored in the containers in the stacks for subsequent retrieval.

3. A system according to claim 1 or 2 further comprising one or more utilities providing a clearance system for permitting or stopping movement of the one or more transporting devices to avoid collisions.

4. A system according to claim 1, 2 or 3 further comprising one or more utilities configured to optimise the movement and actions of the one or more transporting devices through the plurality of pathways.

5. A system according to any preceding claim further comprising one or more utilities configured to optimise the placement of the plurality of containers by the one or more transporting devices in the facility.

6. A system according to any preceding claim further comprising one or more utilities that control movement or operations conducted within one or more workstations.

7. A system according to any preceding claim wherein the one or more utilities that optimise the movement and actions utilize one or more path finding algorithms.

8. A system according to any preceding claim, wherein the one or more utilities optimise the movement and actions using one or more congestion mitigation techniques.

9. A system according to any preceding claim wherein the one or more utilities optimise the movement and actions using one or more machine learning techniques.

10. A system according to any preceding claim wherein the one or more utilities optimise the placement of the plurality of containers within the facility, and update stock levels of the facility based on the depletion of one or more of the plurality of objects within the facility.

11. A system according to claim 5 wherein the one or more utilities control the movement of the one or more of transporting devices based at least on throughput of the one or more workstations.

12. A system according to any preceding claim wherein the one or more utilities provide a clearance system configured to be tolerant to missed communications with at least one of the one or more transporting devices.

13. A system according to any preceding claim wherein the one or more utilities determine and reserve routes, and instruct a plurality or transporting devices to cooperate in transporting one or more of the plurality of containers.

14. A system according to any preceding claim wherein the one or more utilities determine and reserve routes to move idle transporting devices from otherwise optimal routes for other transporting devices.

15. A system according to any preceding claim, wherein the facility is divided into a plurality of sub-grids to reduce computer processing complexity.

16. A system according to any preceding claim, wherein one or more control commands to control the movement of the plurality of transporting devices is provided to the plurality of transporting devices in advance of the movement of the plurality of transporting devices.

17. A system according to any preceding claim wherein the one or more utilities optimize the return of containers into the most optimal of the vacant positions in the hive.

18. A system according to any preceding claim wherein the one or more utilities operate to dynamically substitute damaged or missing objects from alternative containers within the stack.

19. A method for controlling the movement of one or more transporting devices transporting a plurality of containers, said devices operating in a facility, the facility comprising the plurality of containers arranged in a plurality of stacks, the facility further having a plurality of pathways arranged in a grid-like structure above the stacks, the one or more transporting devices operating on the grid-like structure, the method comprising:

determining and reserving routes for moving the one or more transporting devices through the plurality of pathways;

determining and reserving routes for moving the transporting devices when transporting one or more of the plurality of containers;

determining and reserving routes to control one or more of the plurality of transporting devices to retrieve one or more of the plurality of containers from within one or more of the plurality of stacks;

wherein retrieving the one or more containers from within the one or more stacks further requires moving one or more other containers in the stack prior to accessing the one or more containers for retrieval; and

wherein moving the one or more other containers comprises placing each of the one or more other containers in an optimised position within the facility; excluding the original stack from which the or each container was removed.

20. A method according to claim 19 in which the containers contain objects for storage and retrieval from within the facility.

21. A method according to claim 19 or 20 further comprising the step of providing a clearance system for permitting or stopping movement of the one or more transporting devices to avoid collisions.

22. A method according to claim 19, 20 or 21 further comprising the step of optimising the movement and actions of the one or more transporting devices through the plurality of pathways.

23. A method according to any one of claims 19 to 20 further comprising the step of optimising the placement of the plurality of containers by the one or more transporting devices in the facility.

24. A method according to any one of claims 19 to 23 further comprising the step of controlling movement or operations conducted within one or more workstations.

25. A method according to any one of claims 19 to 24 wherein optimising the movement and actions comprises using one or more path finding algorithms.

26. A method according to any one of claims 19 to 25 wherein optimising the movement and actions comprises using one or more congestion mitigation techniques.

27. A method according to any one of claims 19 to 26 wherein optimising the movement and actions comprises using one or more machine learning techniques.

28. A method according to any one of claims 19 to 27 wherein optimising the placement of the plurality of containers within the facility, and updating stock levels of the facility based on the depletion of one or more of the plurality of objects within the facility.

29. A method according to claim 24 wherein controlling the movement of the one or more of transporting devices is based at least on throughput of the one or more workstations.

30. A method according to any one of claims 19 to 29 comprising providing clearances tolerant to missed communications with at least one of the one or more transporting devices.

31. A method according to any one of claims 19 to 30 comprising

determining and reserving routes; and

instructing a plurality or transporting devices to cooperate in transporting one or more of the plurality of containers.

32. A method according to any one of claims 19 to 31 comprising determining and reserving routes to move idle transporting devices from otherwise optimal routes for other transporting devices.

33. A method according to any one of claims 19 to 32 wherein the facility is divided into a plurality of sub-grids to reduce computer processing complexity.

34. A method according to any one of claims 19 to 33, wherein one or more control commands for controlling the movement of the plurality of transporting devices is provided to the plurality of transporting devices in advance of the movement of the plurality of transporting devices.

35. A system or method according to any preceding claim wherein one or more utilities is provided to determine a further optimization of the remainder of the stack on a cost function analysis.

CLAIMS

1. A system for controlling movement of one or more transporting devices said transporting devices transporting containers, said containers being stored in a facility, in which the facility stores the containers in a plurality of stacks, the facility further having a plurality of pathways arranged in a grid-like structure above the stacks, the one or more transporting devices operating on the grid-like structure, the system comprising:

one or more computers configured to execute computer instructions which when executed provide:

one or more utilities determining and reserving routes for moving the one or more transporting devices through the plurality of pathways and determining and reserving routes for moving the one or more transporting devices when transporting one or more of the plurality of containers; and

one or more utilities determining and controlling retrieval of the one or more containers by the one or more transporting devices from within one or more of the plurality of stacks; wherein

the utilities together control retrieval and movement of the one or more containers once retrieved by the or each transporting device, said utilities being further arranged to instruct one or more of the transporting devices to move one or more containers from within one or more stacks to an alternative position, the or each utility being further provided with means for ensuring that in moving one or more containers the one or more containers be placed in an alternative position within any one of the stacks other than the stack from which the or each container was removed.

2. A system according to claim 1 in which the alternative position may comprise a location external to any stack but within the facility.

3. A system according to claim 1 or 2 in which the or each of the containers contain objects, the objects being stored in the containers in the stacks for subsequent retrieval.

4. A system according to any preceding claim comprising one or more further utilities providing a clearance system for permitting or stopping movement of the one or more transporting devices to avoid collisions.

5. A system according to any preceding claim comprising one or more further utilities comprising optimizing means configured to optimise the movement and actions of the one or more transporting devices through the plurality of pathways.

6. A system according to claim 4 said optimising means comprising placing means configured to optimise the placement of the plurality of containers by the one or more transporting devices in the facility.

7. A system according to any preceding claim comprising one or more further utilities that control movement or operations onone or more of the containers conducted within one or more workstations.

8. A system according to any one of claims 4 to 7, wherein any one of the utilities that optimise the movement and actions of any one of the transporting devices use one or more path finding algorithms.

9. A system according to any one of claims 4 to 7, wherein any one of the utilities that optimise the movement and actions of any one of the transporting devices use one or more congestion mitigation techniques.

10. A system according to any one of claims 4 to 7, wherein any one of the utilities that optimise the movement and actions of any one of the transporting devices use one or more machine learning techniques.

11. A system according to any claims 4 to 7, wherein any one of the utilities that optimise the placement of the plurality of containers within the facility, further comprises updating means for updating stock levels of the facility based on the depletion of one or more of the plurality of objects within the facility.

12. A system according to claim 6 wherein any one of the utilities further comprises control means that controls the movement of the one or more of transporting devices based at least on throughput of the one or more workstations.

13. A system according to any preceding claim wherein any one of the utilities provides a clearance system, said system comprising configuring means enabling

the system to be tolerant of missed communications with at least one of the one or more transporting devices.

14. A system according to any preceding claim wherein any one of the utilities comprises determining and reserving means that determines and reserves routes, and instructs a plurality or transporting devices to cooperate in transporting one or more of the plurality of containers.

15. A system according to any preceding claim wherein any one of the utilities further comprises determining means that determines and reserves routes to move idle transporting devices from otherwise optimal routes for other transporting devices.

16. A system according to any preceding claim, wherein the facility is divided into a plurality of sub-grids.

17. A system according to any preceding claim, wherein one or more control commands to control the movement of the plurality of transporting devices is provided to the plurality of transporting devices in advance of the movement of the plurality of transporting devices.

18. A system according to any preceding claim wherein any one of the utilities comprises optimising means for optimising the return of the or each container into the most optimal of the vacant positions in the stacks within the facility.

19. A system according to any preceding claim wherein any one of the utilities comprises operating means for to dynamically substitute damaged or missing objects from alternative containers within the stack.

20. A system according to any preceding claim wherein any one of the utilities comprises further optimizing means for the remainder of the stack on a cost function analysis.

21. A method for controlling the movement of one or more transporting devices transporting a plurality of containers, said devices operating in a facility, the facility comprising the plurality of containers arranged in a plurality of stacks, the facility further having a plurality of pathways arranged in a grid-like structure above the stacks, the one or more transporting devices operating on the grid-like structure, the method comprising:

determining and reserving routes for moving the one or more transporting devices through the plurality of pathways;

determining and reserving routes for moving the transporting devices when transporting one or more of the plurality of containers;

determining and reserving routes to control one or more of the plurality of transporting devices to retrieve one or more of the plurality of containers from within one or more of the plurality of stacks;

wherein retrieving the one or more containers from within the one or more stacks further requires moving one or more other containers in the stack prior to accessing the one or more containers for retrieval; and

wherein moving the one or more other containers comprises placing each of the one or more other containers in an alternative position within the facility; excluding the original stack from which the or each container was removed.

22. A method according to claim 21 in which the containers contain objects for storage and retrieval from within the facility.

23. A method according to claim 21 or 22 further comprising the step of providing a clearance system for permitting or stopping movement of the one or more transporting devices to avoid collisions.

24. A method according to any one of claims 21 to 23 further comprising the step of optimising the movement and actions of the one or more transporting devices through the plurality of pathways.

25. A method according to any one of claims 21 to 23 further comprising the step of optimising the placement of the plurality of containers by the one or more transporting devices in the facility.

26. A method according to claim 25 further comprising the step of controlling movement of or operations on the or each of the containers conducted within one or more workstations.

27. A method according to any one of claims 25 or 26 wherein optimising the movement and actions of the or each transporting device comprises using one or more path finding algorithms.

28. A method according to any one of claims 25 or 26 wherein optimising the movement and actions of the or each transporting device comprises using one or more congestion mitigation techniques.

29. A method according to any one of claims 25 or 26 wherein optimising the movement and actions of the or each transporting device comprises using one or more machine learning techniques.

30. A method according to any one of claims 25 to 29 wherein optimising the placement of the plurality of containers within the facility, and updating stock levels of the facility is based on the depletion of one or more of the plurality of objects within the facility.

31. A method according to claim 24 wherein controlling the movement of the one or more of transporting devices is based at least on throughput of the one or more workstations.

32. A method according to any one of claims 21 to 31 comprising the further step of providing clearances tolerant to missed communications with at least one of the one or more transporting devices.

33. A method according to any one of claims 21 to 32 comprising the further step of instructing a plurality or transporting devices to cooperate in transporting one or more of the plurality of containers.

34. A method according to any one of claims 21 to 33 further comprising the step of determining and reserving routes to move idle transporting devices from otherwise optimal routes for other transporting devices.

35. A method according to any one of claims 21 to 34 wherein the facility is divided into a plurality of sub-grids.

36. A method according to any one of claims 21 to 35, wherein one or more control commands for controlling the movement of the plurality of transporting devices is provided to the plurality of transporting devices in advance of the movement of the plurality of transporting devices.

37. A system method according to any one of claims 21 to 36wherein one or more utilities is provided to determine a further optimization of the remainder of the stack on a cost function analysis.