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Laser Guidance to Project Planned Human or AGV Paths

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ABSTRACT

This disclosure describes a system of ceiling mounted laser projectors that can display bright visual indications, e.g., arrows, of a path to direct users to a next work location. The techniques of this disclosure can be implemented in various ways. For example, the projected arrow can move as the user moves; a visual path is projected for the next few seconds of transit time or the whole of the path going to the next task; different shapes or colors are projected to indicate different workers or tasks; etc. For different spaces, with different aspect ratios, different numbers of laser projectors may be installed. The techniques of this disclosure can also be used to illuminate the paths of Automated Guided Vehicles (AGV) or robots.

KEYWORDS

- Path guidance
- Projected paths
- Lighted paths
- AGV
- Robots
- Warehouse
- Data center

BACKGROUND

Localizing a worker in a large environment, e.g., a warehouse or a data center is challenging. The worker must have a keen sense of where they are and where their next task is. This is made more challenging by virtue of being present in an environment with large numbers of rows that look nearly identical.

DESCRIPTION

In a large space such as a warehouse or data center, a worker can benefit from having a clear visual indication as to where the worker ought to walk next. This disclosure describes a system of ceiling mounted laser projectors that can display bright visual indications in a user's path to direct them to their next work location.

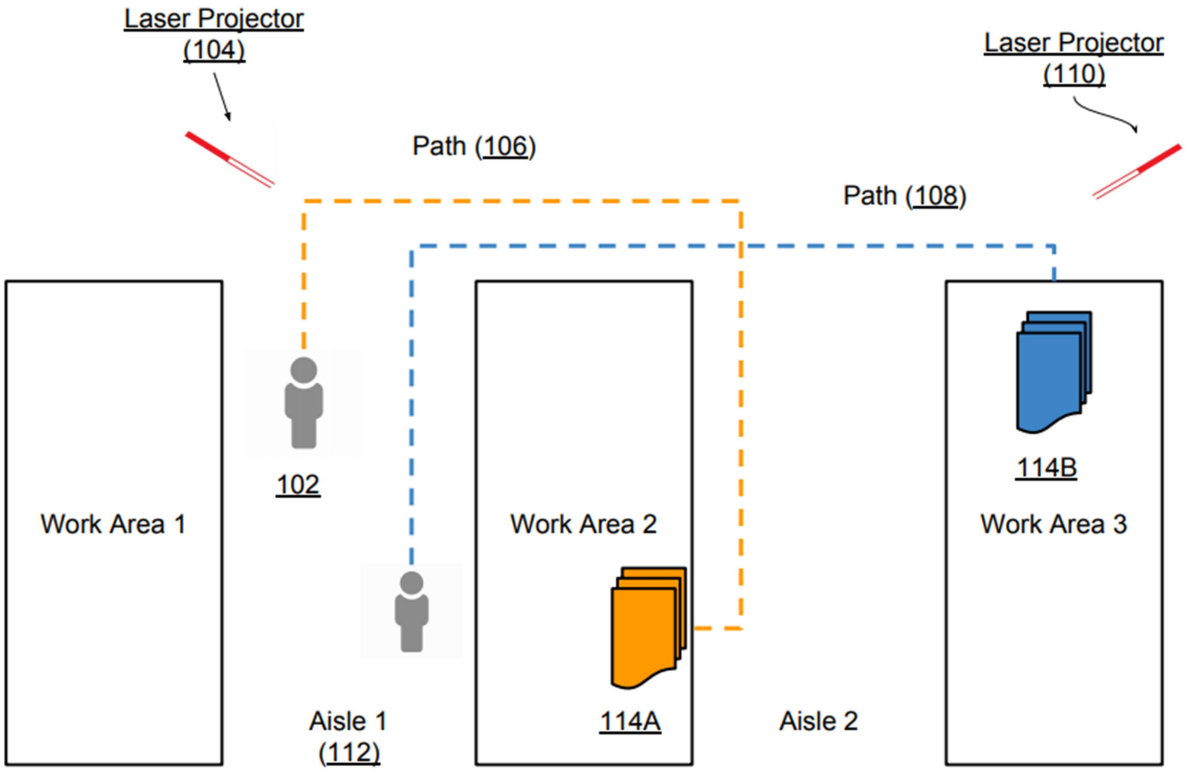

Fig. 1: Projected visual indications of a user's work path

Fig. 1 illustrates a simplified example path lighting, per the techniques of this disclosure. Ceiling-mounted laser projectors (104, 110) project bright visuals that illustrate paths for workers. A user (102), currently in aisle 1 (112), follows the projected path in orange (106) to their work point (114A) in aisle 2. Similarly, another user has a blue path (108) projected that guides them to their next work point (114B).

The users can observe the large lighted paths on the floor and follow them to arrive at the subsequent work point. The lighted indications can be dotted lines, arrows, etc. In another example of the techniques of this disclosure, the projected arrow moves as the user moves. In yet another example, the system projects visual indications of the next few seconds of transit time or the whole of the path to the next task, depending on the requirements within the work environment. Different shapes or colors can be projected to indicate different workers or tasks. The projected indications can be user selectable. For example, all the tasks of a user may be represented by a line with an orange cat.

For a space with tall ceilings, it is possible that one laser projector could service an entire facility. Alternatively, laser projectors can be positioned above each aisle (or groups of aisles) and used to illuminate aisles with specific tasks for specific workers. Alternate mounting points such as at the top or bottom of racks, including on telescoping mounts, can also be used for the laser projectors. In many spaces, multiple laser projectors may be utilized for more uniform coverage down all aisles and to offer full coverage of the working floor. In these spaces, the system is implemented using a three-dimensional (3D) map of the space that is utilized to determine relative mounting locations to assign specific laser projectors configured for coverage of specific areas. In addition, or alternative to ceiling mounted projectors, projectors can be mounted to a cart or a vehicle used by a worker, e.g., a data center technician. Further, projectors can also be worn by a person, e.g., on a helmet or hard hat.

The techniques of this disclosure can also be used to enable simple line-following autonomous robots to be visually directed by the warehouse system without requiring RF transmission or a complex control system. Different patterns projected on the line can direct the

robot to perform different actions at a given floor location, including discharging or picking up an asset.

The techniques as disclosed herein have an advantage over augmented reality solutions in that the system does not obscure the wearer's eyes while visually indicating to other parties the intended direction of the worker. This is in turn helpful in getting other workers or equipment to clear out of the way.

Further, the system can also illuminate the paths of AGVs on a work floor to provide proactive warning to humans as to the likely imminent transit of a robot. This is especially helpful for AGVs that have limited ability to detect a human in their path or when the AGVs come to a sudden stop upon such detection. The laser projector can also be mounted on an AGV to visually indicate the present intended path.

CONCLUSION

This disclosure describes a system of ceiling mounted laser projectors that can display bright visual indications, e.g., arrows, of a path to direct users to a next work location. The techniques of this disclosure can be implemented in various ways. For example, the projected arrow can move as the user moves; a visual path is projected for the next few seconds of transit time or the whole of the path going to the next task; different shapes or colors are projected to indicate different workers or tasks; etc. For different spaces, with different aspect ratios, different numbers of laser projectors may be installed. The techniques of this disclosure can also be used to illuminate the paths of Automated Guided Vehicles (AGV) or robots.