

Informal Proposal

Concept

Computer numerically controlled (CNC) machining and stationary robotic arms have rapidly become staples of the construction and manufacturing industry. However autonomous tools have yet to become prevalent in this field limiting the ability of robotic agents to assist in on site assembly. The idea I have for my robotic platform is an autonomous construction stage. The specific goal of the design is to support building construction crews by anchoring wall paneling in place. The robot would be able to locate a stud and raise itself to sequentially drill a number of support screws into the wall.

Mobile Platform

The mechanical design needs to allow for easy navigation throughout the environment and provide the capability to follow walls along the perimeter of rooms. For this reason I believe that a two wheel platform would be the best choice. The issue with this design will be the support and pressure needed to get the screw into the wall. Additionally, the design will need a mechanical means of lifting itself to provide a vertical line of support screws in the wall. In the interest of decreasing weight and the complexity of the design I hope to answer both problems with a single design solution. My plan is that upon arriving at the designated location the robot will lift itself off the ground on extending legs. This rig could be extended and retracted to specific distances to provide an accurate height positioning system. Importantly the legs would offer a significant stability advantage over the two wheels used for motion. This should allow the drill sufficient leverage to force the screws into the wall. Lowering the legs to lift the body allows me to firmly secure the drill and screw feeding system in place on the assembly without having to worry about individually raising and lowering these components.

Sensors

One of the first tasks for this robot upon being introduced into an environment will be to find a wall so it can begin tracking and looking for studs. Additionally, while it's traveling around the room it will need to be able to avoid workers and other people in the area. To distinguish between walls and people I plan to use a motion/ heat sensor to detect and avoid people in the immediate area. This is particularly important because autonomously operating power tools in the vicinity of other people, even at low speeds, has a degree of risk involved. I plan to use a combination of Infrared and bump sensors to detect the immediate surroundings for the use of obstacle avoidance and wall tracking. Particularly important and possibly functioning as my special sensor will be the stud finder. There are two types of stud finders to choose from

using either capacitance or radar. The first method uses an internal capacitor plate to detect changes in the dielectric constant of the wall as the finder moves over the surface of the wall. The second method uses a small radar device to show exactly where the edge of the stud is behind the sheetrock. I believe I can use one of the commercially available stud finders from a home improvement store by adapting it to work with the Atmel microcontroller.

Automation

The robot will require three directions of automation to complete its assigned task. As mentioned in the design of the mobile base, legs will extend below the robot to lift the platform to varying heights. The legs will move as a group since there is no need for them to move independently. In addition the drill will need theta rotation to tread the screw into the wall. Finally, in order to provide the force necessary to push the screws in to the sheetrock, the drill will need linear motion.

Conclusion

I like this design idea because it will, at least initially, allow me to focus on an interesting platform design challenge, something that appeals to me as a ME. Additionally the real value of a robot capable of meeting the goals laid out in this brief proposal would be substantial. Onsite construction projects, like the forty-eight currently in progress on campus, could be completed at considerable savings to cost and time.