Wire Wizard: Automation of Dash Tester Connections

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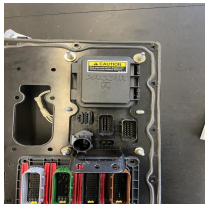
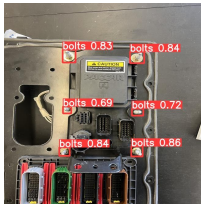
Background Information and Objective

- At the Kenworth production plant, there is a tedious process involving a worker plugging cables into the assembled dashes. This is a slow process, as the worker must plug in each cable one at a time and flip a clip on the plugs. A worker may repeat this process hundreds of times a day.
- The objective is to develop an automated solution capable of accurately and repeatedly connecting and disconnecting a plate containing multiple cable connectors to the connectors on the rear of an assembled at PACCAR production plants.
- The basic idea of our "Wire Wizard" is to build a CNC system to finish the job. Our plan was to use a 3D printer microcontroller to control the motors so the cables can be placed into the dash testers. The automation system will be designed without using a robotic arm, but instead will use a camera and motor, along with 3D-printed components, to accurately and repeatedly connect and disconnect the cable plate to the dash connectors. The 3D-printed components will be used to securely hold the cable plate and assist in its connection and disconnection to the dash testers.

Deep Learning Aided Computer Vision Solution

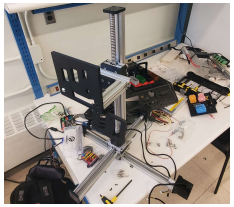
- Wire Wizard needs to identify the exact locations of dash testers.
- The surface of dash tester board is complex, traditional image processing methods may be hard to adopt the variant backgrounds.
- We are doing research into applying the deep learning algorithm Yolo V5 objection detection techniques to locate the bolts on the dash boards.
- Yolo v5 algorithm is used to track the six bolts on the dash boards.
- The controller board could control the motions of motors based on the results of Yolo v5.



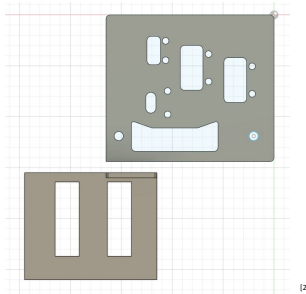


System Overview

- Wire Wizard consists of three linear rails for three-axis motion (XYZ).
- The linear rails are held together with 3D-printed adaptors.
- To ensure stability, the X-axis rail (bottom-most rail) is securely attached to an optical board.
- The 3D-printed plug-plate is connected to an arm consisting of aluminum extrusions on the Z-axis rail.



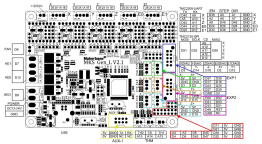
Wire Wizard Assembly



Plug-Plate Model

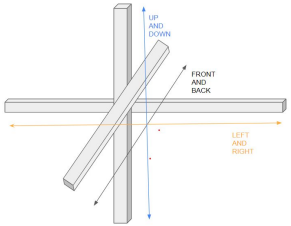
MKS Gen L V2.1 Features

- Our system is based on the ATmega2560 microcontroller. The ATmega2560 is the same microcontroller used in the Arduino Mega board, allowing for compatibility with Arduino software and libraries.
- The board has integrated stepper motor drivers and we are using A4988 chips. These drivers enable precise control of stepper motors for accurate positioning and smooth motion in the X, Y, and Z axes.
- The MKS Gen L V2.1 provides connectors for endstops, which are used to detect the limits of the axes.



Movement Tracking

- Movement tracking involves monitoring and controlling the position of stepper motors to achieve precise and accurate movement.
- By using sensors and feedback mechanisms, movement tracking allows real-time monitoring and adjustment of stepper motor positions during operation.
- The feedback obtained from movement tracking sensors enables closed-loop control, where adjustments are made based on the actual position of the stepper motors to ensure precise and consistent movement.



Future Work, References, and Acknowledgments

- Further improvements to AI
- Testing in a factory setting
- Bolster structural stability
- Integration of the computer vision and microcontroller motors

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YOLOv5: A Universal Object Detection Framework, Glenn J. Wong, Jonathan Kamalu, David Solomon, Ajay Chandra, GitHub repository, 2020, Ultralytics

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