Keyence 3D Vision Bin Picking with ABB Robot

Cummins

PROBLEM STATEMENT

The Cummins facility in Fletcher, NC, wants to implement a bin-picking process. Using a Keyence 3D vision system and an ABB IRB 1200-800052 robot, the team must develop a proof of concept for the automation process of picking various bolts and pinions from a box and placing them into a nearby flange. Upon completion, the flange will be utilized as a housing unit for a semi-truck's inner axle differential.

REQUIREMENTS

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1. **Gripper Design**
   - Creo Parametric and Autodesk Fusion 360 for modeling gripper jaws for a Schunk gripper
   - **Engineers**: Drew, Brooklynne

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2. **Picking Function Software**
   - Keyence 3D Vision Software
   - ABB RAPID programming controls
   - **Engineers**: John

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3. **Placing Function Software**
   - Keyence 3D Vision Software
   - **Engineers**: John

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4. **Gripper + Pick-and-Place testing**
   - Extensive systems engineering
   - **Engineers**: All

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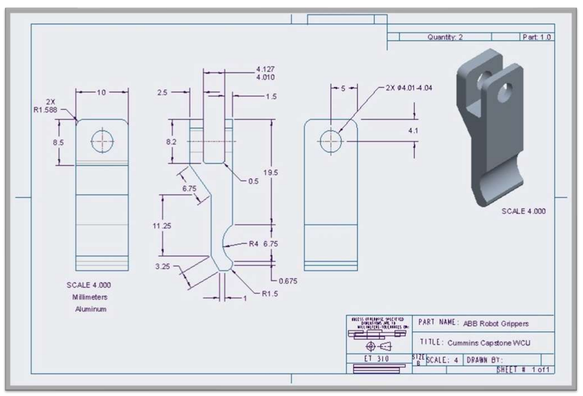
5. **Documentation and Process Management**
   - Reports, testing plans, future work, etc.
   - **Engineers**: Evan (primary), all

Machined Gripper Jaws Design



CELL LAYOUT

Keyence Vision:
Uses 4 cameras and a single projector to detect the location and orientation of cell

Gripper & Jaws:
The Schunk gripper is attached to a custom designed and machined aluminum gripper jaws.

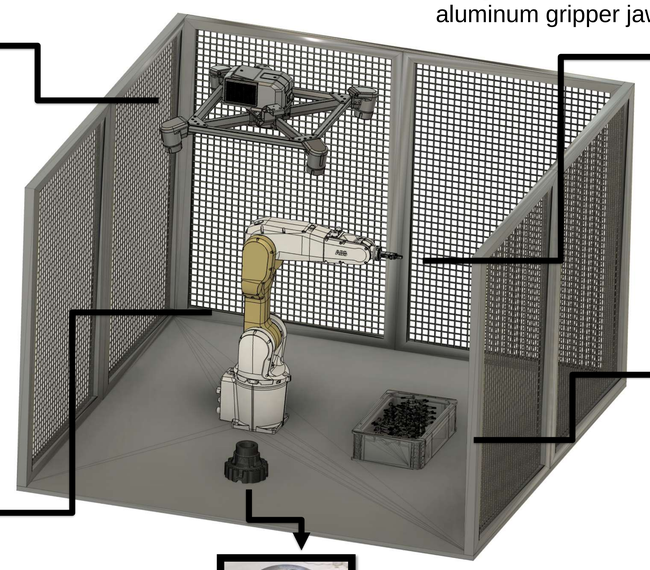


ABB IRB-1200 ARM:
This is an ABB manufactured 6-axis robot utilized by Cummins in Fletcher, NC, to implement a 3D vision pick-and-place proof of concept

Box of Bolts:
Random orientation of bolts to be placed in the flange

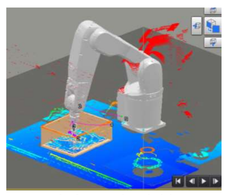
Flange:
The flange holds together the differential core. The robot will be moving the bolts and pinions from the box of bolts and populate this flange

KEYENCE VISION SYSTEM SOFTWARE

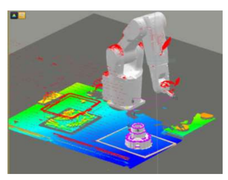
The Keyence Vision Software was utilized as a brain for sending information via inference to analyze subjects to be relocated. The system was heavily programmed to tell be capable of analyzing various bolts and pinions in a box, detect their position, tell the ABB robot how to pick them up, detect the bolt holes in the flange, and tell the robot how to place the bolt.

Program Breakdown

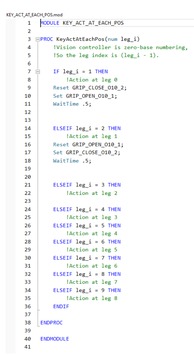
Phases	Final Status
Phase 1 Identify available bolts and executable picking path	Fully tested and validated
Phase 2 Pick up bolts with designed grippers	Fully tested and validated
Phase 3 Identify available holes and executable placing path	Demonstrated and tested
Phase 4 Place bolt in flange	Successfully demonstrated
Phase 5 Empty box of bolts and populate flange(s) with bolts	In progress, partially demonstrated



Path for Bolt Picking



Path for Bolt Placing



Program Flow for "Each Point"

SUMMARY AND CONCLUSIONS

Our team was tasked to program an ABB robot to pick and place objects utilizing the cutting-edge Keyence Vision System as a brain to control the IRB-1200 robotic arm and Schunk gripper. The Keyence software provided a user-friendly process for programming path plans, allowing us to pick objects. The custom gripper jaws enabled precise movements and forces when collecting objects, especially when machined out of aluminum. In conclusion, the system was designed as a proof of concept to automate a manual labor-intensive process for placing randomized bolts from a box into the housing unit of a semitruck's inner axle differential.

FUTURE WORK

For the future of this project, there should be detailed refinement for the robot's pick and place program. The Keyence vision system should be able to create a more accurate image of the bolts and pinions' locations and where to place them in the flange. With refinements to the program, the ABB robot should be consistent and accurate with its picking and placing.

Further development in communicating path plans and indexing would need to be established, using ABB RAPID programming, to successfully use the system as intended in manufacturing.

TEAM & ACKNOWLEDGEMENTS

Team

John Davis	(Electrical Engineer)
Brooklynne Smith	(Mechanical Engineer)
Drew Johnson	(Mechanical Engineer)
Evan Reid	(Mechanical Engineer)
Tom Spendlove	(Faculty Mentor)

Sponsors

Bejamin Thomas	(Sponsor)
Jesse Mull	(Advisor)
John Karakkattu	(Keyence Advisor)