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Depth sensing for automatic detector construction and quality control

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The LHC at CERN will soon be upgraded to the high-luminosity LHC (HL-LHC) that will deliver larger scattering rates. Along with the increased data rate, the HL-LHC will produce a more challenging environment that current detectors used in CMS cannot cope with. To address this issue, a new calorimeter will be built and used to measure the energy of particles. The TTU HEP group is responsible for building roughly 5 thousand silicon modules for the new CMS calorimeter. This work involves laminating components with high precision alignment and bonding around 700 wires per module. Performing quality control tests of mechanics, sensors, and electronics is key to producing high-performance detectors. Manual inspection is not practical and together with the limited timelines it intensifies the assembly and quality control work generating a need for robust and efficient automation tools. We developed a high precision automatic depth sensing algorithm, which is incredibly useful for integration of the assembly and quality control protocols in a single robot, since it only requires a camera, making the process faster and more efficient. Other methods such as stereo vision are needed while working with a larger field of view. For this method object recognition is necessary so the robot knows the location of its points of reference. Machine Learning tools are being developed in the context of quality control, object detection and depth sensing so that these tasks can be performed by the same instrument in an efficient way.

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