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An FPGA-Based Track Finder for the L1 Trigger of the CMS Experiment at the High Luminosity LHC

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A new tracking system is under development for operation in the CMS experiment at the High Luminosity LHC. It includes an outer tracker which will construct stubs, built by correlating clusters in two closely spaced sensor layers for the rejection of hits from low transverse momentum tracks, and transmit them off-detector at 40 MHz. If tracker data is to contribute to keeping the Level-1 trigger rate at around 750 kHz under increased luminosity, a crucial component of the upgrade will be the ability to identify tracks with transverse momentum above 3 GeV/c by building tracks out of stubs. A concept for an FPGA-based track finder using a fully time-multiplexed architecture is presented, where track candidates are identified using a projective binning algorithm based on the Hough Transform. A hardware system based on the MP7 MicroTCA processing card has been assembled, demonstrating a realistic slice of the track finder in order to help gauge the performance and requirements for a full system. This paper outlines the system architecture and algorithms employed, highlighting some of the first results from the hardware demonstrator and discusses the prospects and performance of the completed track finder

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