

FPGA-based MLP Hardware Accelerator for Real-Time Destination Prediction in Autonomous Vehicles

HyeonMuk Park, WonSeok Choi, SeongGon Choi*

The Department of Information and Computer Engineering, Chungbuk National University
Chungdae-ro, Seowon-gu, Cheongju-city, Chungcheongbuk-do, 28644 Republic of Korea
qga0809@chungbuk.ac.kr , choiws@cbnu.ac.kr , choisg@cbnu.ac.kr

(Pt9)Abstract— We propose FPGA-based MLP (Multi-Layer Perceptron) hardware accelerator designed for real-time destination prediction in autonomous vehicles. As personalized destination prediction services in autonomous vehicle systems become increasingly sophisticated, there is a growing need to perform efficient and low-latency AI inference directly within vehicles rather than relying on cloud servers. However, software-based neural network inference on embedded processors creates performance bottlenecks that fail to meet the real-time requirements of autonomous vehicles. The proposed system implements MLP model that takes seven features as input—including Device ID, Device Type, latitude, longitude, time information—and predicts six destination classes. Developed using Vitis HLS on the Zynq-7000 SoC platform, the FPGA hardware accelerator achieves an inference time of 0.0055ms through AXI Stream interface, demonstrating a 68.5× performance improvement compared to ARM-based software implementation (0.374ms).

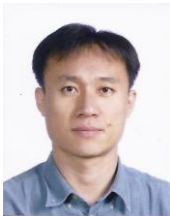
(Pt9)Keyword— Destination prediction, FPGA hardware accelerator, MLP neural network, Autonomous vehicles, Zynq SoC



Hyeon Muk Park received B.S. degree in college of Information & Communication Engineering from Chungbuk National University in 2024. He is currently pursuing the M.S. degree in Radio Communication Engineering, Chungbuk National University. His research interests include FPGA, V2X, IoT and AI.



Won Seok Choi received B.S. and Ph.D. degree in the College of Electrical and Computer Engineering, Chungbuk National University, Korea in 2008 and 2014 respectively. He is currently researcher in Research institute of Computer and Information Communication, Chungbuk National University. His research interests include vehicle network, energy saving network, SDN, NFV, NGN and AI.



Seong Gon Choi received B.S. degree in Electronics Engineering from Kyungpook National University in 1990, and M.S. and Ph.D. degree from KAIST in Korea in 1999 and 2004, respectively. He is currently a professor in College of Electrical & Computer Engineering, Chungbuk National University. His research interests include V2X, AI, smart grid, IoT, mobile communication, high-speed network architecture and protocol.