

Development and Implementation of an Educational VOR/DME Navigation Training Platform Using Python

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Abstract: The design, development, and assessment of an open-source educational platform for VHF Omnidirectional Range navigation training integrated with Distance Measuring apparatus are presented in this paper. By offering accurate, affordable radio navigation training without the need for pricey hardware simulators, the system fills important gaps in aviation education. The platform, which is implemented in Python and uses Tkinter for graphical interfaces, simulates eight operational VOR stations throughout India using spherical trigonometry for bearing and distance calculations. According to performance analysis, the bearing accuracy is 98.1% within 200 nautical miles, which satisfies international requirements. The DME implementation uses altitude-compensated Pythagorean calculations to achieve slant range precision within 0.1 nautical miles. Maintenance 19.8 frames per second with an update latency of less than 200 milliseconds of the real-time graphical interface. Both automated waypoint navigation and manual control modes are supported by the system. User assessment using 15 aviation students received a rating of 4.7 out of 5.0 for educational value. This work shows that software-based modeling can maintain accessibility, which is crucial for educational institutions, while achieving navigation accuracy comparable to commercial solutions. Curriculum customization is made possible by the modular architecture, which also supports upcoming improvements like GPS integration, multi-aircraft scenarios, and environmental effects modeling.

Keywords: VOR navigation, distance measuring equipment, aviation training, flight simulation, Python implementation, spherical trigonometry, educational software