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Spiral Design and Simulation-Driven Deployment of a Drive-Through COVID-19 Testing and Housing Check-In System at a Large Public University

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Abstract

COVID-19 pandemic demanded swift and adaptive operational responses to ensure public health and safety. This case study presents the rapid design, modeling, and implementation of a drive-through COVID-19 testing and housing check-in system at the University of Central Florida during the Fall 2020 move-in period. Leveraging a spiral system development methodology, combined with queuing theory (QT) and discrete-event simulation (DES), the project iteratively refined the system design through six simulation-based iterations. These models addressed key decision-making questions regarding resource allocation, process configuration, and throughput estimation under tight constraints. Simulation results projected average time-in-system values of 6.81 minutes for vehicles and 10.10 minutes for pedestrians. Post-deployment, real-world data were collected to validate the simulation outputs using the Kolmogorov-Smirnov test. This study demonstrates how simulation-driven design, in tandem with agile development methods, can effectively guide the deployment of complex, time-sensitive systems. The findings offer a transferable framework for rapidly implementing scalable, data-informed solutions in crisis contexts.

Keyword

COVID-19, spiral development, queuing theory, discrete-event simulation, system design.