Crowd Avoider: A Study on Development of Crowd Density Assessment Program Using Particle-Based Fluid Simulation and Time Series Data Prediction

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Crowd crushes are a widespread global issue often resulting in significant loss of life. Proactively addressing this challenge involves avoiding locations predicted to attract large crowds. However, currently there are few services that provide this kind of information and it is not yet commercialized.To facilitate this, we have developed a mobile app that assesses population density risk, providing users with information about areas prone to overcrowding. The population density risk is quantified based on the area and population of densely populated locations, utilizing Smoothed Particle Dynamics-based fluid simulations to calculate forces acting on individuals, subsequently quantifying the risk level. To enhance the accuracy of risk assessment, we adapted existing SPH equations to suit population density situations, improving the precision of risk assessment through the incorporation of real-world data. To predict population in crowded areas, the prophet time series data prediction model was employed because prophet's significantly faster training and inference times, made it the most suitable for real-time population updates and learning. Acknowledging limitations in simulating detailed obstacles at each location, but the observed error range when compared with actual values indicated that incorporating obstacles did not introduce significant discrepancies. We developed a program to update data for population-dense locations. Enabling the real-time update of population data will contribute to the development of an effective information-providing platform, allowing relevant authorities to provide information about crowded areas. This approach holds promise for effectively reducing the occurrence of crowd crushes in densely populated areas.