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SIC Saarland Informatics Campus

Synthetic Dataset for Panic Detection in Human Crowded Scenes

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PROBLEM

Analyzing footage from multiple CCTV cameras in public spaces in real-time presents a significant challenge. Artificial intelligence (AI) methods are employed to rapidly detect dangerous or abnormal situations. However, collecting real data for training the AI models can be difficult and expensive due to privacy concerns or the usage of paid actors.

We have created a synthetic dataset using CARLA simulator to generate panic events with different points of view and weather conditions. Having different points of views of the same scene can help identify the source of panic faster. The images below show two views of a real panic event that occurred in Times Square in 2019.

RELATED WORK

The **public datasets** for **panic detection** are:

- **UMN** [1]: A dataset from a **controlled scenario** where the panic begins at a precise moment among a group of approximately **10 people** walking normally.
- **MED** [2]: a dataset from a controlled experiment simulating scenarios such as panic, fight, congestion, neutral behaviour or abnormal objects.

There are **synthetic datasets** for analyse **pedestrian actions** such as:

- **SHADE** [3]: a synthetic dataset is used to analyse panic events using Grand Theft Auto (GTA) video game. It is not public neither usable commercialy.
- **CP2A** [4]: a CARLA simulator [5] synthetic dataset to analyze people trajectories from a car point of view.

The **public datasets** show panic in **small groups of people**. Both of them have groups of approximately ten to twenty people. Also, the scenario is similar in the different scenes and only has one viewpoint. For that reason, we have created a dataset using CARLA simulator.

OVERVIEW

CARLA simulator is a versatile platform designed for training autonomous driving systems that offers **control** over all **actors** within the simulation. It allows AI models to be trained without relying solely on real-world data and can be **used commercially**.

We have selected **six** different **scenarios** based on the official CARLA maps. To maximize diversity, we ran simulations for all the scenarios under **various weather conditions**, including clear skies, cloudiness and different intensities of rain, such as heavy, moderate and light. **Cars driving** on roads were included to increase realism.

The following figures compare a frame from our simulation (left) with a frame of the UMN dataset (right).

METHODOLOGY

The first step is to understand what constitutes a panic event. In this work, a panic event is defined as people fleeing in different directions after a period of normality.

Programming panic behaviour in crowds is challenging because it is not feasible to manually control each pedestrian's direction. Instead, it is necessary to use **Carla's Pedestrian Navigation** system to **adjust** each route **dynamically**. This algorithm selects the best path to arrive at a destination, avoiding obstacles (such as static or dynamic objects) and walking through the navigable meshes.

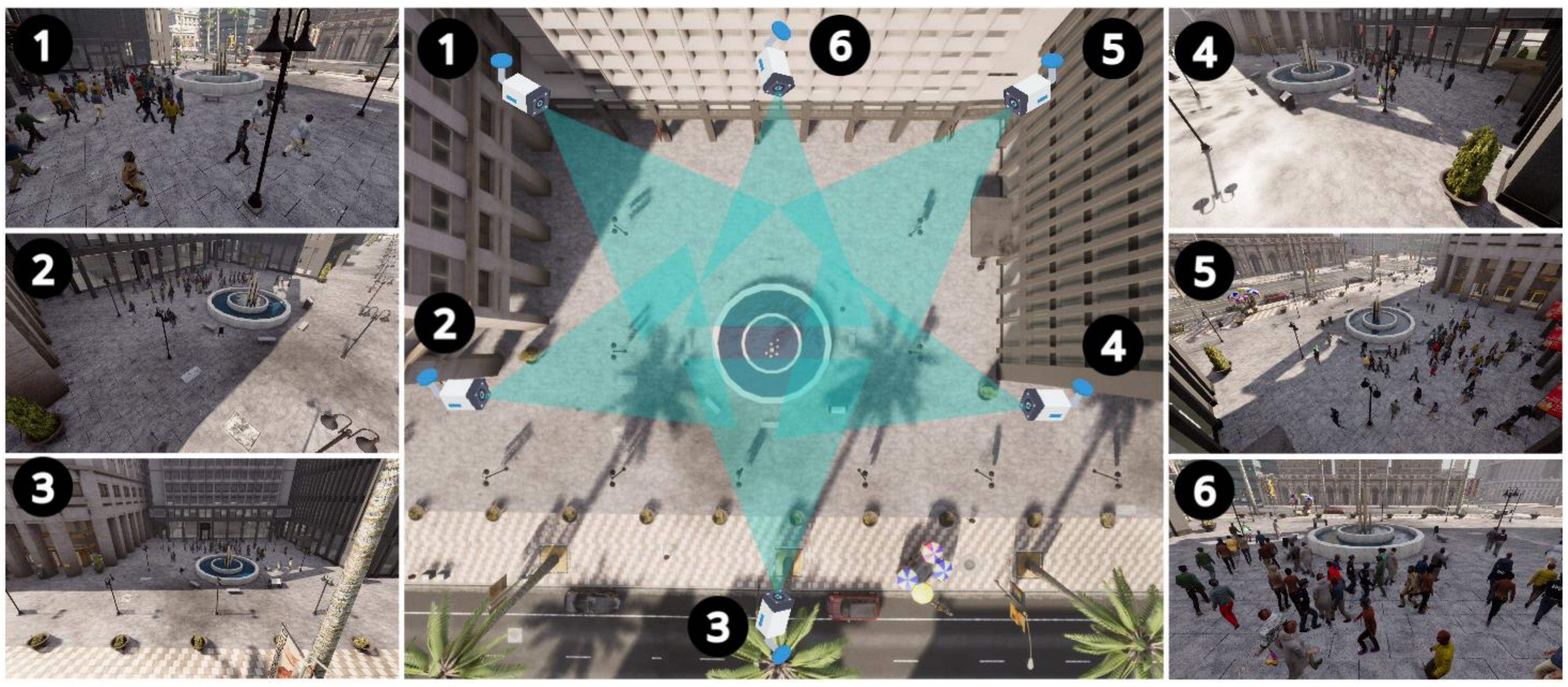
This dataset is a set of sequences where a crowd is spawned in a certain area to analyze their behaviour. The **crowd** will have pedestrians with **different characteristics** such as age, gender, physical aspect or clothing. Each pedestrian will have its **own** movement **velocity**, and **direction** pattern, creating a more realistic simulation. Also, the position and number of pedestrians will be different for each simulation.

The simulations begin with a **period of normality**, where the pedestrians walk calmly in the area. After the normality, panic begins. In this step, the pedestrians will change their path and velocity to flee the scene.

Three kinds of simulations have been conducted to represent different pedestrian **densities**: low (25 pedestrians), medium (75 pedestrians), and high (150 pedestrians).

The same simulation is recorded from **different viewpoints** of a potential CCTV camera. Each camera position has been selected manually to simulate real CCTV camera positions. The position is **randomized** to get different points of view for **each simulation**. This results in a large number of different viewpoints for each simulation, reducing the number of executions and producing variety in the dataset.

All the frames in the simulation are **saved from all the CCTV cameras' points of view** and are labelled using frame intervals.



RESULTS AND CONCLUSIONS

The dataset consists of sequences obtained from each CCTV camera on each map for each simulation. A simulation was performed for each weather condition, and each of the three crowd densities described earlier (high, medium, and low density), resulting in 375 frames per sequence (250 normal and 125 panic). Due to the gap between some simulations and the real world, some sequences were filtered out. Therefore, the dataset can be summarized in the next table.

The dataset was recorded at 25 frames per second (fps), with 10 seconds of normality and 5 seconds of panic. Within 5 seconds of panic, the crowd will have largely dissipated, concluding the panic event.

We can affirm that CARLA is a powerful 3D software simulator with applications beyond driving contexts. One of its strengths is the ability to generate synthetic data, which can be a valuable alternative when there is a lack of real-world data or when it is difficult to recreate certain scenarios. However, there may be some issues with realism and discrepancies between synthetic data and reality that need to be taken into account, for example, mixing it with a small real dataset.

Scene name	Nº cameras	High density	Mid density	Low density	Total simulations	Total sequences
Terrace	4	12	20	20	52	208
Gas station	4	20	20	18	58	232
Small parking	4	19	20	20	59	236
Big parking	10	20	20	20	60	600
Square	6	16	20	20	56	336
Stairs	3	12	11	12	35	105
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REFERENCES

[1] Unusual crowd activity dataset of university of minnesota [online]. URL: http://mha.cs.umn.edu

[2] RABIEE H., HADDADNIA J., MOUSAVI H., KALAN-TARZADEH M., NABI M., MURINO V.: Novel dataset for fine-grained abnormal behavior understanding in crowd. In 2016 13th IEEE Inter-national Conference on Advanced Video and Signal Based Surveillance (AVSS) (2016), pp. 95–101 doi:10.1109/AVSS.2016.7738074

[3] LIN W., GAO J., WANG Q., LI X.: Learning to detect anomaly events in crowd scenes from synthetic data. Neurocomputing 436 (01 2021). doi:10.1016/j.neucom.2021.01.031.

[4] ACHAJI L., MOREAU J., FOUQUERAY T., AIOUN F., CHARPILLET F.: Is attention to bounding boxes all you need for pedestrian action prediction? In 2022 IEEE Intelligent Vehicles Symposium (IV) (2022), pp. 895–902. doi:10.1109/IV51971.2022. 9827084

[5] DOSOVITSKIY A., ROS G., CODEVILLA F., LOPEZ A., KOLTUN V.: CARLA: An open urban driving simulator. In Proceedings of the 1st Annual Conference on Robot Learning (2017), pp. 1–16.

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