Behavioral Landmarks: Inferring Interactions from Data

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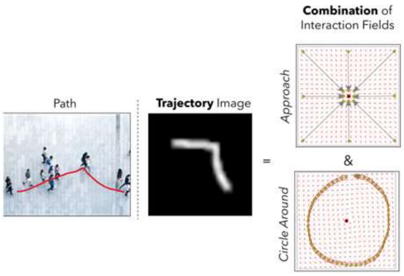
OBJECTIVE & RELATED WORK

We aim to understand how agents move according to environmental cues e.g., timed events and area constraints. So far, there were several attempts to infer simulation parameters from trajectories ([KSH∗12, KSHG18, WJGO∗14]). However, our attention is on ***complex behaviors***, not limited to navigation parameters e.g.., ***people in a train station also interact with vending machines and shops, apart from just going from the entrance to the train.*** This knowledge implies the distribution of simulation parameters in a spatially and temporally discretized environment.

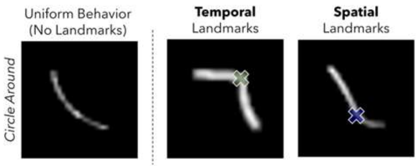
PROPOSITION

We attempt to understand agent-environment interactions by disentangling trajectory images into combinations of basic behaviors i.e., pre-defined Interaction Fields ([CvTH∗20]), thus knowing how agents move in ***space*** and ***time.***

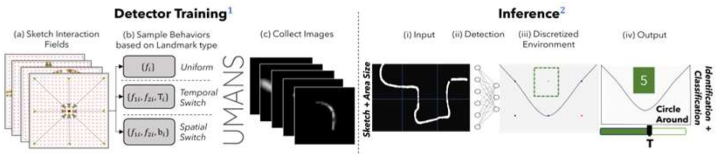


TERMINOLOGY

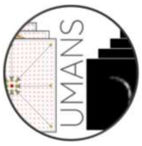
We define points of environment-driven behavior changes as ***"Landmarks"***, distinguishing as temporal/spatial, based on the reason of change i.e., temporal switch or entering another area.



PIPELINE



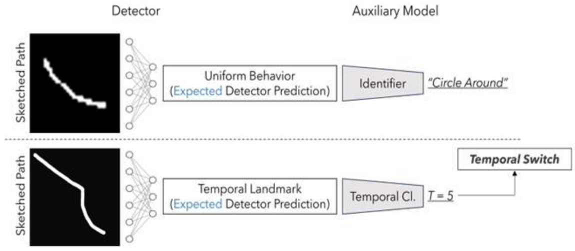
We design a model to detect the existence and type of landmarks, and train on synthetic trajectory images simulated using Interaction Fields and UMANS ([CvTH∗20, vTGG∗20]).

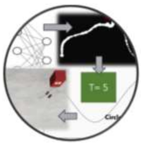


[1]Detector & Auxiliary Models (CNNs)

The detector finds the location of spatial and temporal landmarks.

- Given the detection of uniform behavior, we train an ***identifier*** to find the behavior from the set of predefined bases.
- Given the detection of temporal landmark, we train a ***temporal classifier*** to find the time of the switch.

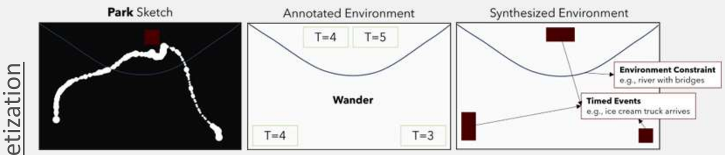




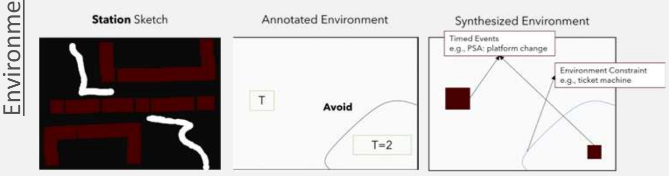
[2]User Control

- Users can arbitrarily sketch crowd flow(s); our interface is built to comply with the training data.
- The detector finds the landmarks; heuristically discretizing the environment spatially, and the classifier finds the time switches discretizing temporally.

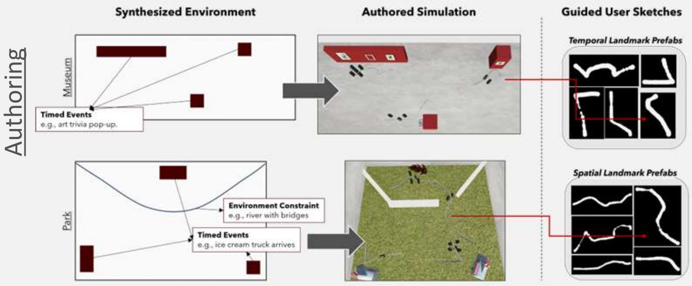
CASE STUDIES



We conduct scenario-specific case studies for plausibility. We collect 5 sketches from an experienced and an inexperienced user. We apply our model, yielding discretization that suggests a new synthesized environment.



We obtain temporal and spatial landmark sketch prefabs, which we distribute guided by the synthesized environment, hence authoring a new simulation with different flows based on the behavior areas implicitly defined by the user.



FUTURE WORK

We aim to improve the generalizability of our framework by training on data from multiple-sized patches and strengthen the evaluation of our framework starting by evaluating on real data, even though it is difficult to obtain the respective ground truths.

It is also interesting to extend this framework to investigate social interactions between agents, and specified environment-agent interactions e.g., ticket machines. Understanding social and environment interactions, and obtaining a way to replicate them, will enable behavior analysis and authoring of novel crowds.

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