README - Socially CompliAnt Navigation Dataset (SCAND)

This dataset provides human-teleoperated socially-compliant navigation demonstrations.

Social navigation is the capability of an autonomous agent to navigate in a socially compliant manner such that it recognizes and reacts to the objectives of other navigating agents, at least somewhat adjusting its own path in response, while also projecting signals that can help the other agents reciprocate. Some examples of socially compliant navigation behavior include sticking to the right of the road, following a crowd, overtaking a crowd, waiting for a human to pass, etc.

SCAND contains 25 miles and 8.7 hours of robot driven trajectories through a variety of social environments around the University of Texas at Austin campus.

DATA CONTENTS

1) 138 robot-driven trajectories,
2) 15 days of social navigation data on 2 robots : A wheeled Clearpath Jackal and a legged Boston Dynamics Spot,
3) Indoor and outdoor environments @ UT Austin campus,
4) 2 highly crowded football game days (including a concert at the same time!),
5) Mild to heavily crowded environments,
6) 4 different human demonstrators.

DATA DESCRIPTION

Data gathering method:

The data was gathered between the days of Oct 28 and Dec 20, 2021.

Four human demonstrators tele-operated two morphologically different robots using DS4 joysticks "in the wild" at the University of Texas at Austin campus. The robots completed indoors and outdoors trajectories in presence of human crowds including during two football game days.

SCAND utilized 2 robots. Wheeled Jackal robot manufactured by Clearpath https://clearpathrobotics.com/jackal-small-unmanned-ground-vehicle/, and a legged Spot Mini manufactured by Boston Dynamics https://www.bostondynamics.com/products/spot. The "Jackal" is a

wheeled robot with skid-steer drive mechanism, and the "Spot Mini" is a legged robot with 4 legs, also capable of climbing stairs.

The demonstrators were volunteers (including the first two authors of this dataset) within the age group of 20-30 years. Two of the demonstrators (A and B) had domain knowledge on socially compliant robot navigation, whereas the other demonstrators (C and D) did not have expertise in socially compliant robot navigation.

For each trajectory the human demonstrator was tasked with tele-operating the robot in a socially compliant manner from a starting location towards a target goal location within the UT Austin campus.

Data types, formats and file naming convention:

Each SCAND trajectory includes: RGB Azure Kinect camera, velodyne pointclouds, stereo camera, Visual Odometry (Spot), Wheel odometry (Jackal), Leg positions (Spot), Joystick commands issued by the demonstrator, Monocular cameras (Spot). All data is stored in the ROSBAG data format http://wiki.ros.org/Bags/Format.

For each trajectory accompanying video contains a sped up version of the robot's camera view, intended to provide a quick overlook of the scene in a particular trajectory for the end user.

SCAND data follows the following file naming convention :
{Demonstrator tag}_{Robot name}_{Start location}_{End location}_{Day}_{Month}_{Date}_{Trajectory number}.bag/.mp4/.avi

Data processing:

We utilized ROS melodic (http://wiki.ros.org/melodic) to play and process the data contained in the rosbags for all the trajectories. In addition to using ROS for data collection, we used the AMRL navigation stack (https://github.com/ut-amrl/ut_automata) for tele-operating the robots using DS4 joystick. For data gathering, we record the recorded rosbags realtime on the robot's internal storage, and then transferred it to a storage server after a data collection run. The recorded rosbags are provided in the SCAND dataset as-is without any post-processing.

Labelling the dataset:

In SCAND, we provide among twelve different labels (shown below) of

socially compliant navigation events, along an entire trajectory for all the trajectories in the dataset. To label the dataset, the second author of this dataset manually annotated the trajectories by monitoring the camera information. Note that the labels provided are coarse labels because they are not associated with a timestamp. One can fine-label events between timestamps, which is an interesting direction to enrich this dataset with more information, in the future. The labels are included in the metadata corresponding to each file published in this dataset.

Here is a list of the 12 different labels, their description and number of occurrences in the SCAND dataset:

Against Traffic= Navigating against oncoming traffic.(22)

With Traffic= Navigating with oncoming traffic.(74)

Street Crossing= Crossing across a street.(34)

Overtaking Overtaking a person or groups of people.(14)

Sidewalk Navigating on a sidewalk.(57)

Passing Conversational Groups= Navigating past a group of 2 or more people that are talking amongst themselves.(38)

Blind Corner= Navigating past a corner where the robot cannot see the other side.(6)

Narrow Doorway= Navigating through a doorway where the robot waits for a human to open the door.(15)

Crossing Stationary Queue= Walking across a line of people.(6)

Stairs= Walking up and/or down stairs.(22)

Vehicle Interaction= Navigating around a vehicle.(21)

Navigating Through Large Crowds= Navigating among large unstructured crowds.(27)

HUMAN SUBJECT DATA

SCAND data contains images of people on campus. The IRB (number STUDY00002561) allows collecting data in a public environment such as a university campus.

SCAND DATA REUSE

SCAND can be used to study imitation learning approaches for robot social navigation. In addition to this, SCAND can also be utilized to explore additional challenges such as representation learning for social navigation, trajectory prediction, and demonstrator classification. We recommend the readers refer to the associated publication for potential use cases with the SCAND dataset.

REUSING AND CITING THIS DATASET

This dataset was created for purposes of being reused by others, entirely or in parts. As per the Public Domain Dedication license, users are free to copy, modify, distribute and perform the work, even for commercial purposes, all without asking permission. However we do ask you to provide attribution to the authors by always citing the dataset in the reference section of your work - as if you are citing a paper publication - using the following citation also available in the landing page of this dataset.

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REFERENCES

The following are papers about this dataset.

Haresh Karnan, Anirudh Nair, Xuesu Xiao, Garrett Warnell, Soeren Pirk, Alexander Toshev, Justin Hart, Joydeep Biswas, Peter Stone (2022) Socially Compliant Navigation Dataset (SCAND): A Large-Scale Dataset

of Demonstrations for Social Navigation. arXiv. doi: 10.48550/ARXIV.2203.15041

Karnan, Haresh, Anirudh Nair, Xuesu Xiao, Garrett Warnell, Soeren Pirk, Alexander Toshev, Justin W. Hart, Joydeep Biswas and Peter Stone. “Socially Compliant Navigation Dataset (SCAND): A Large-Scale Dataset of Demonstrations for Social Navigation.” Robotics and Automation Letters (RA-L)

If you want to cite a publication related to this dataset you can use the following citation.

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@article{https://doi.org/10.48550/arxiv.2203.15041,
  doi = {10.48550/ARXIV.2203.15041},
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  title = {Socially Compliant Navigation Dataset (SCAND): A Large-Scale Dataset of Demonstrations for Social Navigation},
  publisher = {arXiv},
  year = {2022},
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