

USER GUIDELINES - EVACUATION MODEL

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1 SIMULATION ENVIRONMENT

The model runs on Netlogo environment. The code is divided in the model (file with extension .nlogo) and configuration file (config.nls). The configuration is divided in 2 parts. The most common features are setup directly on the interface, while more specific configurations can be setup into config.nls. Figure 1 shows the Component Diagram of the software. Model.nlogo runs the model and uses the configurations set up in config.nls combined with other parameters of User Interface. The config.nls always will override User Interface. One can add more configurations in config.nls to override or make new rules along the simulation. The Floor Plan Scenario (PNG File) is imported and represents the environment where the passengers interact. The floor plan environment is one of parameters that can be setup. Below are described in items the steps to install the software and run the model.

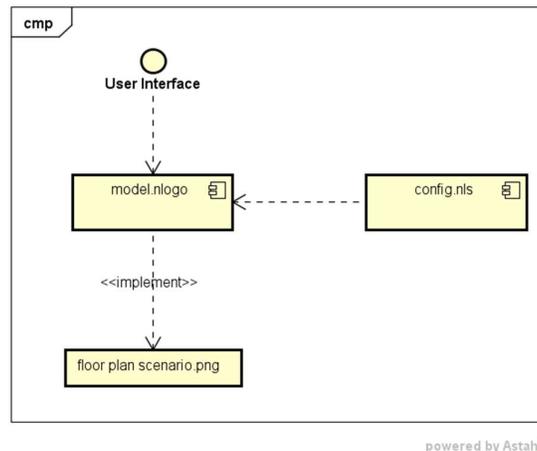


Figure 1: Component Diagram of Evacuation Model Software.

1.1 Requirements

- Netlogo Software. Assessable at <https://ccl.northwestern.edu/netlogo/download.shtml>. The model works for the newest versions but it highly recommended the **Version 5.3.2**.
- Computer: any computer, with O.S. Windows, OSX or Linux.

1.2 First Steps

After install Netlogo, open the .nlogo file file inside the model project like showed in Figure 2. After loaded, the interface changes and should looks like Figure 3. There is possible identify the controls that used to configure scenarios and situations and the animator that shows the outputs of the model, as well as graphs detailing the performance of most important parameters.

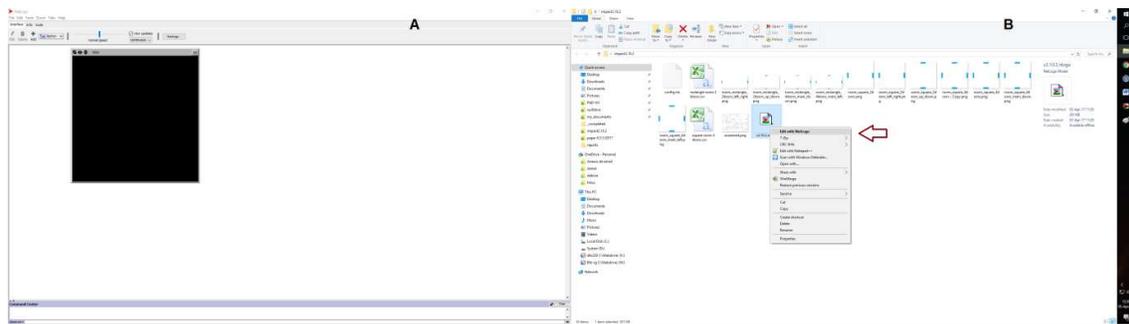


Figure 2: Opening the project.

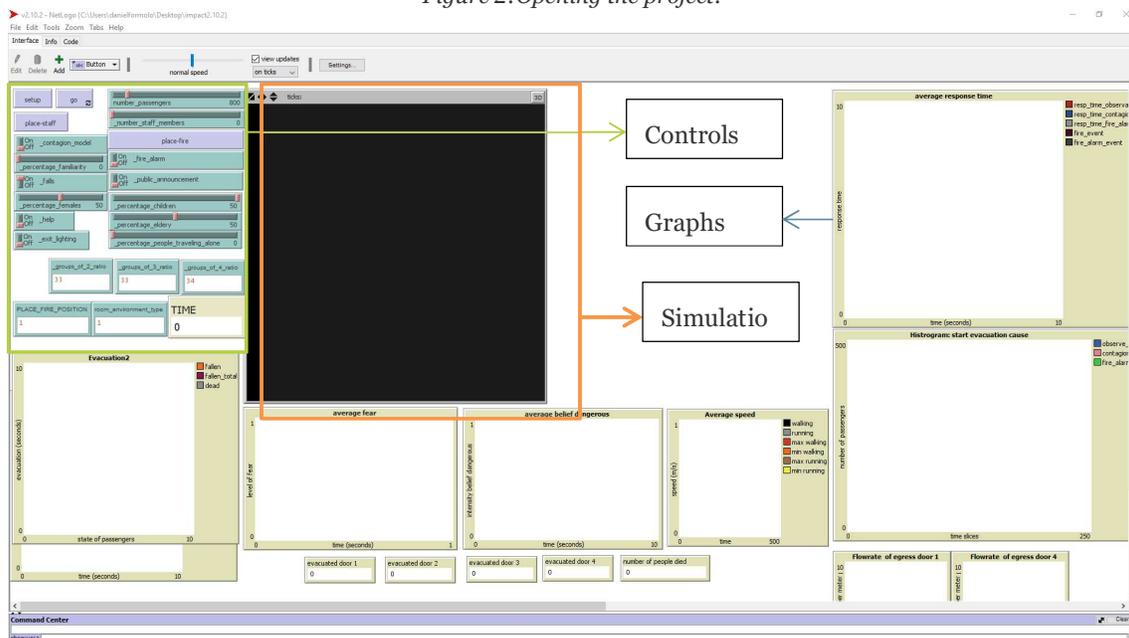


Figure 3: Project Interface.

For run the model some steps might be follow in this order:

1. Adjust the Controls according to desired scenario;
2. Press button SETUP (at this point the configurations will be loaded). See Figure XXX;
3. Press button GO to run the simulation. See Figure YYY;
4. The simulation stops automatically when finished. At any time is possible press button GO to stop it and GO again to continue from the same time point.

Figure 4 shows a scenario type 6 (Rectangle room, 4 doors). The green people are staff that helps passengers to evacuate, Pink passengers are those started to evacuate, Black aren't aware of the incident (Fire in Red) and Grey passengers are dead. The Orange lines are the lightings to guide the evacuation and Blue blocks are the exits. The Grey lines connecting some passengers are indications of

group formation, according to the user configuration. At first second people belonging to same group are moved close to each other and remains close until the end of simulation. Sometimes, Grey lines appears along the simulation, that means Helping behaviour, i.e. someone fallen and another passenger decided to help him.

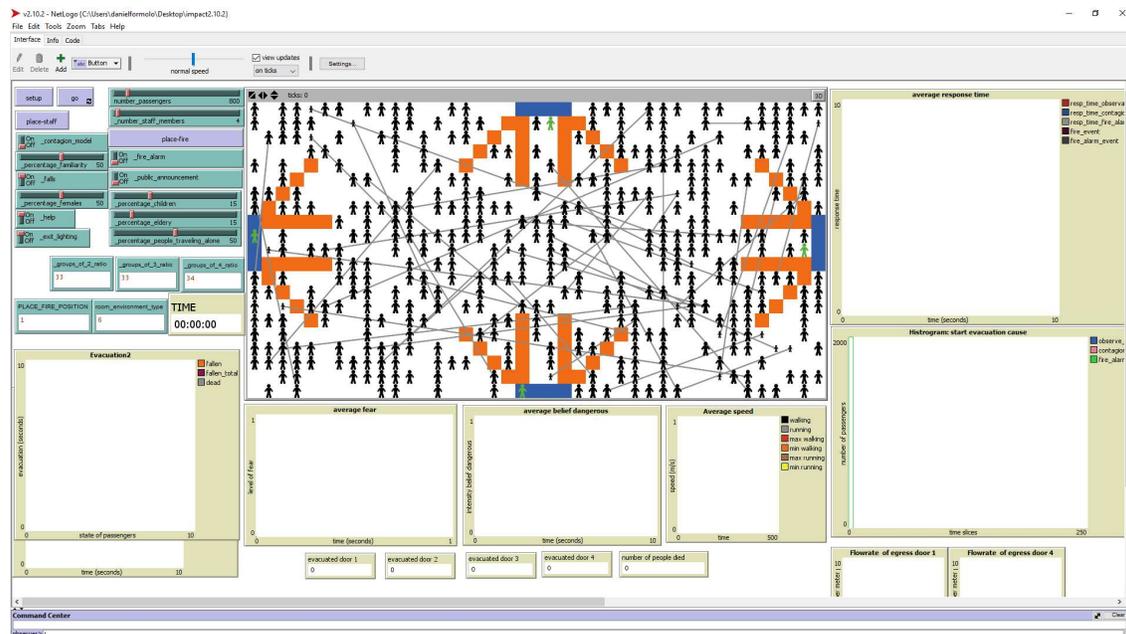


Figure 4: Scenario Example after SETUP button pressed.

Figure 5 shows simulation scenario type 1 (Square room, 4 doors) running after GO button pressed. It is possible observe the graphs plotting online values collected from the simulation and the movement of the passengers in direction to the exists.

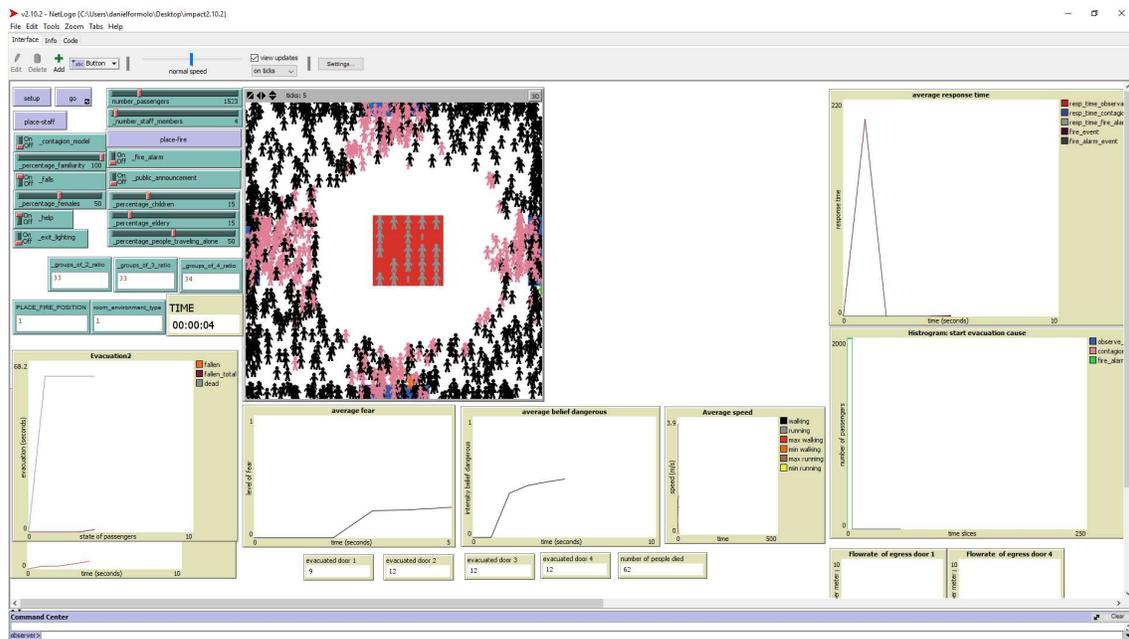


Figure 5: Example of simulation running.

2 Advanced Configurations

Opening the file `config.nls` like indicated in Figure 6 (press Code, and after that select `config.nls` you can access other configurations of the model. All of configurations are commented and can be changed, impacting directly the behaviour of the model. One of them is `room_environment_type` that loads the floor plan environment. There are 8 predefined environments able to be simulated, but more can be included following the examples already coded. To add more environments is necessary some basic knowledge of NetLogo syntax. That information is available at NetLogo website¹ and many examples in the web.



```

v2.10.2 - NetLogo [C:\Users\daniele\Documents\impact2.10.2]
File Edit Tools Zoom Tabs Help
Interface Info Code
Procedures Includes Inherit automatically
config.nls
set q_st_urgent_toaction 0
set q_st_fear 0
set q_st_belief_dangerous 0
set q_st_compliance 0
set q_st_dead 0
set q_st_fall 0
set q_st_desire_walkaround 0
set q_st_desire_evacuate 0
set q_st_intention_walkaround 0
set q_st_intention_evacuate 0
set q_st_familiarity 0
set q_st_express_belief_dangerous 0
set q_st_express_fear 0
set q_st_action_walkaround 0
set q_st_action_evacuate 0

;; ENVIRONMENT INITIAL CONDITION
setup-environment
set statistics_hist_observefire 0
set statistics_hist_companion 0
set statistics_hist_firealarm 0
repeat 8000 [
  set statistics_hist_observefire input 0 statistics_hist_observefire
  set statistics_hist_companion input 0 statistics_hist_companion
  set statistics_hist_firealarm input 0 statistics_hist_firealarm
]

if (member? "square" room_environment_filename [resize-world -10 10 -10 10]
if (member? "rectangle" room_environment_filename [resize-world -20 20 -10 10]
if (member? "2" room_environment_filename) and (member? "left_right" room_environment_filename) [
  set list_exits input (patch min-pcolor 0) list_exits
  set list_exits input (patch max-pcolor 0) list_exits
]
if (member? "2" room_environment_filename) and (member? "up_down" room_environment_filename) [
  set list_exits input (patch 0 min-pcolor) list_exits
  set list_exits input (patch 0 max-pcolor) list_exits
]
if (member? "4" room_environment_filename) and (member? "main_left" room_environment_filename) [
  set list_exits input (patch min-pcolor 0) list_exits
  set list_exits input (patch max-pcolor 0) list_exits
  set list_exits input (patch 0 min-pcolor) list_exits
  set list_exits input (patch 0 max-pcolor) list_exits
]
if (member? "4" room_environment_filename) and (member? "main_down" room_environment_filename) [
  set list_exits input (patch 0 min-pcolor) list_exits
  set list_exits input (patch 0 max-pcolor) list_exits
  set list_exits input (patch min-pcolor 0) list_exits
  set list_exits input (patch max-pcolor 0) list_exits
]
set main_entrance_target item 0 list_exits

input-pcolors room_environment_filename
let fire_exit_lighting = TRUE
[ask patches with [pcolor = EXIT_LIGHTING_COLOR - 1 and pcolor = EXIT_LIGHTING_COLOR + 1] [set pcolor EXIT_LIGHTING_COLOR] in]
[ask patches with [pcolor = EXIT_LIGHTING_COLOR - 1 and pcolor = EXIT_LIGHTING_COLOR + 1] [set pcolor white]] in]
ask patches with [pcolor = white and pcolor = EXIT_LIGHTING_COLOR] [set pcolor EXIT_COLOR] in]
if fire_exit_lighting = TRUE [
  foreach lighting-list [
    let vx (pcolor)
  ]
]

```

Figure 6: Code of the model and how to access `config.nls` file.

The function “`setup-environment`” runs only once at beginning of simulation. In the function “`control-experiments`” is possible program dynamic situations that occurs along the simulation, i.e. when the fire starts or when alarm goes on. Below are two examples already programmed in the file. The Annexe A provides a list of the main parameters possible to be configured.

¹ <https://ccl.northwestern.edu/netlogo/docs/programming.html> and <https://ccl.northwestern.edu/netlogo/docs/dictionary.html>

```
to control-experiments
  if ticks = 0 [;At beginning of simulation (TICKS=0) switch the buttons to OFF.
    set _fire_alarm FALSE
    set _public_announcement FALSE
    set _fire_alarm FALSE
  ]
  ...
  if ticks = 200 [;At second 200 (TICKS=200) fire alarm goes ON.
    set _fire_alarm TRUE
  ]
  ...
end
```

ANNEXE A

USER INTERFACE	
Place-staff	Add new staff agents along the simulation
_contagion_model	Enable/disable contagion model
_percentage_familiarity	% people familiar with the environment
_falls	Enable/disable falls simulation among the crowd
_help	Enable/disable helping behavior the crowd
_exit_lighting	Enable/disable lightings in the environment
_groups_of_2_ration, 3 and 4	Proportion of people in groups of 2, 3 and 4, the sum of this values must be 100, otherwise default values are setup.
PLACE_FIRE_POSITION	0 = no fire in the room with dangerous situation, 1 = random, 2 = centre, 3 = in front of main door, 4 = in front of another door, not the main, 5 = in a corner.
room_environment_type	0=room_square_2doors_up_down.png 1=room_square_4doors_main_down.png 2=room_square_2doors_left_right.png 3=room_square_4doors_main_left.png 4=room_rectangle_2doors_left_right.png 5=room_rectangle_2doors_up_down.png 6=room_rectangle_4doors_main_down.png 7=room_rectangle_4doors_main_left.png
_percentage_people_traveling_alone	% people alone, based on number_passengers
_percentage_eldery	% elderly, based on number_passengers
_percentage_children	% children, based on number_passengers. (children are always connected to a groups)
_public_announcement	When ON, passengers receive announcements to evacuate, every 60 seconds, see in config.nls: public_announcement_frequency and START_PA_ACTION)
_fire_alarm	Users could switch it ON at any moment. It starts automatically, after 180 seconds after the incident. Repeats each 60 seconds. To change this default values see config.nls: alarm_frequency

	and START_FIRE_ALARM_ACTION
CONFIG.NLS	
helping_chance_matrix	Probabilities to decide to help
START_FIRE_ACTION	When the incident starts (in seconds)
cultural_cluster_distribution	<p>Distribution cultures presented in the environment. The sum of all distributions might be 1.</p> <p>It follows this order: "Arab" "Near East" "Latin Amerca" "East Europe" "Latin Europe" "Nordic" "Germanic" "African" "Anglo" "Confucian" "Far East"</p> <p>English proficiency of each cultural group: 0.140 0.211 0.0751 0.1628 0.3605 0.8601 0.6951 0.4826 0.9539 0.0156 0.1827</p>
compliance_level_matrix	Matrix of compliance depending on the passengers in the environment (vary between 0 and 1)
L_STEEPNESS L_THRESHOLD AL_STEEPNESS AL_THRESHOLD ETA_MENTAL ETA_BODY W_sensing_fire W_sensing W_affectivebiasing W_persisting W_amplifyingfeeling W_inhibitingfeeling W_amplifyingevacuation W_inhibitingwalkrand W_amplifyingintention W_decreasingintention W_decreasingfear	Tuning of the model. These parameters define the internal behavior/reaction of the agents.