Student number : 1025560
Name : Sejin Kim

ODD description of the model

1. Overview

1.1 Purpose

The purpose of this model is to compare and simulate virus propagation patterns in confined spaces under various conditions. This model does not mention the mutation of the virus and the duration of immunity maintenance, and attempts to investigate the factors that accelerate the spread of the virus in an enclosed space by adjusting other variables under the situation where the virus does not mutate and the immunity that has been generated once is maintained for a lifetime.

1.2 Entities, state variables and scales

This model was created assuming an enclosed space and is filled with agents from two breeds (virus and human). The model is operated according to the structure of the SIR model until There are no infected people remaining. Global variables that can affect agents are also modeled. A list of parameters for agents and global variables is provided below.

Entities and State variables in this model:

Agents

<breed> human person
- outside?
- masked?
- infected?
- cured?
- susceptible?
- infection-length
- recovery-time
- staying-time
- nb-infected
- nb-recovered

<breed> virus particle
- infected?
- life-time

Environment variables
- Air-conditioning?',
- ventilation?
- number-of-people
- mask-wearing-tendency
- infection-chance
- recovery-chance
- caughing-chance

Temporal scale
- nb-infected
- nb-recovered
- life-time (virus)
- indoor-time (human)

Spatial scales
- patch size of 26 * 26
- agent size 2 (human)
- agent size 0.5 (virus)

1.3 Process overview and scheduling

In each scenario, the variable R0 and the cumulative number of infected people are updated by the setting of initial environment variables as time processed (tick count). Note that a tick in the model means one hour.

The number of agents(human) in each scenario is defined by 'number-of-people' input space in user interface, randomly placed throughout the environment, facing random directions.

People initially assigned as susceptible, except the ones assigned already infected or wearing mask. Infecting stage starts as people are moving, that is infecting each other by contacting infected agents or virus particles in the air.

Each agent might be infected or not depending on their other conditions such as whether the the agent is wearing a mask, or already has recovered from the infection.

2. Design Concepts

The model is **based on SIR**(susceptible, infected, reduced) disease spread modeling approach, extending and modifying given model in NetLogo([7]) library 'epiDEM basic' ([6]) where each agent **follows basic rule of SIR epidemic model**. Each agent moves independently with its assigned state variable and interacts through contact to change the other's state.

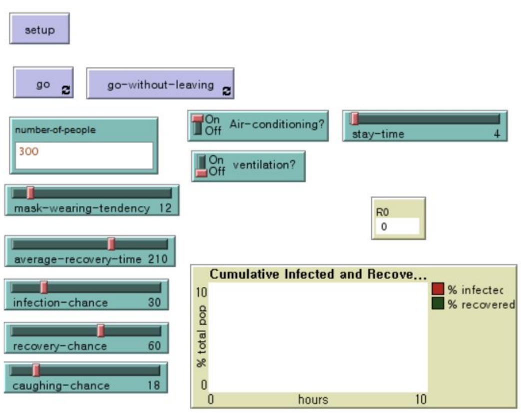
This model assumes the agent <breed> 'human' are able to see other agents that are also human, but are not able to see or sense the virus particle in the air. Agents(human) are **not able to sense** the health status of

their neighbours and they are not avoiding encounters with each other. They **interact** with each other by contacting other agents (human contacts with other human or virus particles in the air). **Stochasticity** is used to determine each agent's tendency to act (i.e., whether an agent wears a mask or not) or to determine the next status of each agent after encountering other agents (i.e., chance of getting sick after encountering infected agent or virus particle).
We **observe** system behaviour by comparing R0 value of each scenario and comparing the speed of reaching the maximum number of infected agents in each scenario.

3. Details

3.1 Initialisation

In the initialization step, various variables to be used in the simulation process can be set. A user can set the initial number of people, the ratio of the number of infected people, the ratio of the number of people wearing masks and set the probability of recovery and the duration of symptoms.



[figure 1 UI of model to initialize the model]

3.2 Input data

There is no specific input data used for this model. However, in initialization phase, we can choose the input value of some environ mental variables such as 'Air-conditioning?', 'ventilation?' , 'number-of-people', 'mask-wearing-tendency', 'infection-chance' 'recovery-chance' and 'caughing-chance'

3.3 Submodels

Details of the relationships defining the model are given below, followed by specific parameter values chosen to represent several hypothetical scenarios.

Air-conditioning in confined area model

Movement speed of virus particles in the air can be increased, hence they can travel further than without air-conditioning due to increased artificial air circulation.
To represent this, when 'Air-conditioned' option is on, the distance they travel at once are in much wider ranges to represent virus particles spreading further through the air with the wind blowing.

Ventilation model

In this submodel the modification can be tricky as we assume whole patch area represents one confined room. Hence there's no door or window in the user's sight to let the particles out. The modification was made by reducing the life-time of virus particles so that it disappears earlier than its initial life-time in the scene, which is mimicking the procedure that virus are going out through an open window or door.

Staying-time model

This submodel is to check the significance of the duration of staying indoor time in terms of virus transmission. To compare this, a variable 'staying-time' can be introduced and modified. In this submodel, each human agent who exceeded assigned indoor time, set as to be outside of the room by changing their shape to square shape. As we are only interested in the spread situation happens indoor, we set the agent set outside is not contagious, and not susceptible.

6. Reference

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