FIREMODEL
User's Guide

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1 Introduction

This document is the user's guide for FIREMODEL: a Smalltalk[1] parcel of classes for simulating grass- and forest-fires across a small area.

FIREMODEL is a cell-based simulation. The fire-ground terrain is divided into $5m \times 5m$ *cells*. Each cell has a terrain type (grass, forest, etc.) and a state (unignited, burning, burnt-out, etc.) as well as a height. Each step of the simulation takes 2 minutes and advances the fire across the cells by using the weather conditions, terrain, fuel level, slope, etc. to calculate a spread speed. Each burning cell then spreads the fire across a small oval area. The simulation uses the McArthur models — models developed for the South-Eastern Australian environment — to calculate the speed of spread.

1.1 Obtaining and installing FIREMODEL

Getting FIREMODEL first involves getting a copy of Smalltalk suitable for use with FIREMODEL. For those familiar with Java, Smalltalk is very similar in approach: a virtual machine and class library need to be downloaded before you can run any program.

1.1.1 System Requirements

FIREMODEL was developed on a 128Mb 450MHz Pentium III system running RedHat 6.2 Linux. Smalltalk is a cross-platform environment. It is, therefore, possible to run FIREMODEL on Windows PCs, Macs or other versions of Unix. You simply need to aquire the appropriate virtual machine — see section 1.1.2.

FIREMODEL is both computation- and memory-intensive. It has been run on a 64Mb 233MHz Pentium system running Windows 95 with no particular ill-effects. However, the more the better.

1.1.2 Obtaining Smalltalk

Before using FIREMODEL, you will need to acquire and install a copy of VisualWorks Smalltalk 5i.1. A non-commercial version of this package is available for free download from the following web site:

- http://www.cincom.com/visualworks/

1.1.3 Obtaining FIREMODEL

FIREMODEL can be obtained from the following web site:

- http://www.charvolant.org/~doug/firemodel

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[1] http://www.stic.org

Once you have downloaded and unpacked the FIREMODEL download, you will need to create a suitable Smalltalk image. Copy `visualnc.im` from the `images` subdirectory of your VisualWorks installation into the FIREMODEL directory.[2]

Once you have this image, start VisualWorks and use the **Tools** > **Load Parcel Named ...** menu option to load the BOSS parcel.[3] Typing in BOSS to the dialog box will cause the parcel to be loaded. Choose **yes to all** when any warnings appear. Then load the Fire Model parcel in the same way.

Once you have loaded the parcel, choose **File** > **Save As ...** to save the image. Once you have saved the image, you will be able to start the image again with FIREMODEL already loaded.

2 Using FIREMODEL

2.1 Starting FIREMODEL

Starting FIREMODEL is a little primitive, at present. Open a workspace by using the **Tools** > **Workspace** menu option. Type in `FMFireModelUI open` into the workspace, select what you have typed and choose **Do It** from the middle-button menu. A FIREMODEL screen will then open.

2.2 The Large-Scale Screen

The large-scale screen for FIREMODEL is shown in figure 1. This screen can be used to show a detailed view of the simulation. The screen can also be used to edit the terrain and fire-state of the simulation.

The large-scale screen has a number of areas. The *display area* shows a section of the ground the simulation is run over and the state of the ground. The *time* shows the current time of the simulation. The *current cell* shows the state of the cell that has the pointer over it: it gives a basic report on the terrain and state of the cell, along with the fire danger of the cell.

The large-scale screen shows the terrain of a cell by using a small icon for each terrain type. The currently available terrain types are: grassland, forest (eucalypt forest), water, road and building. Superimposed on the terrain type is an icon showing the state of the cell. The possible states are: unignited, ignited, burning, smoldering and burnt-out. It is possible to use options on the **View** menu to select what is displayed.

Additionally, the large-scale screen may show elevations and contours. This screen may also show labels for special features.

The following menu options are available:

File This menu allows models to be saved and then re-opened.

> **New...** Start a new model. You will be asked for the size of the fire-ground in meters. The model is initialized to be 80% cured grassland.
>
> **Open...** Open a saved fire model. You will be prompted for a file name for the saved model. This model will then be loaded.
>
> **Save** Save the current state of the model to a file. If you have already supplied a file name for loading or saving the model, then this file name will be used. Otherwise, you will be prompted for a file name.
>
> **Save As...** Save the current state of the model to a new file. You will be prompted for a file name.
>
> **Exit** Close the screens and discard the model. You will still need to exit from the VisualWorks system.

View This menu allows control over the types of information shown on the various screens. It also provides options for opening various support screens.

> **Weather Model...** Open a weather screen. See section 2.4.

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[2] Make sure you *copy* this file. Otherwise, you will be modifying the Smalltalk image that all other programs use.
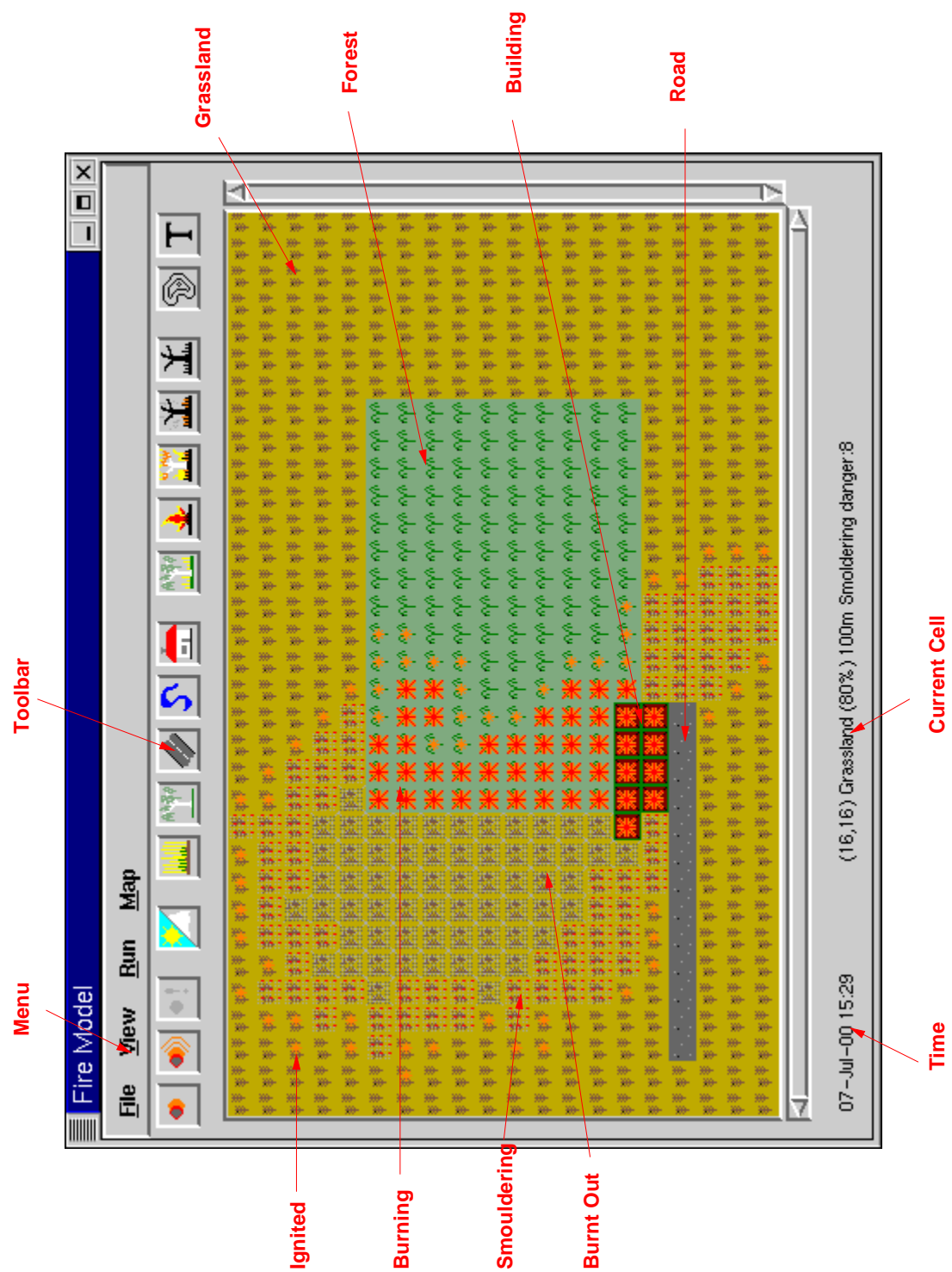[3] You shouldn't have to do this, but something goes wrong if you don't here.
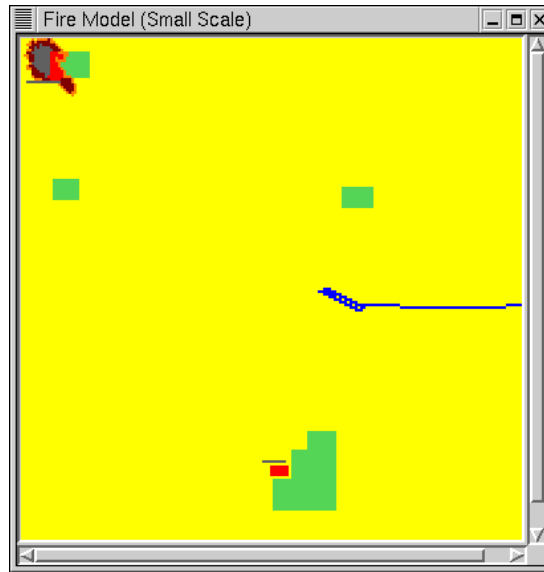
Figure 1: Large-Scale Screen

Figure 2: Small-Scale Screen

Small Scale... Open a small scale map. See section 2.3

Terrain Show the terrain of each cell on all screens.

State Show the state of each cell on all screens.

Elevation Show fixed elevations and contours on the large-scale screen.

Labels Show labels for special features on the large-scale screen.

Fire Danger Show a fire danger map on the small-scale screen.

Magnification Set the magnification of the small-scale screen to ×1, ×2 or ×4.

Run This menu allows control over the running of the simulation.

Step Advance the simulation by a single 2 minute step.

Run Run continuously until instructed to stop.

Stop Stop running continuously.

Map Various tools for editing the map. All of these tools allow you to "paint" rectangles or lines of terrain or state on the map. Editing the map is covered in section 2.5.

The tool-bar provides short-cuts for some of the menu options. The menu options contain tool-bar pictures beside them.

2.3 The Small-Scale Screen

The small scale screen is shown in figure 2. It shows the same fire as the screen in figure 1; the area shown in the large-scale screen is in the top-left corner. This screen can be used to give an overview of the entire fire area.

The small-scale screen uses colors to indicate the terrain and state of the cells. Yellow indicates unburnt grassland, green unburnt forest. Burning cells are colored various shades of orange and red. Burnt-out ground is black.

If you choose the **View** > **Fire Danger** menu option, then the colors on the small scale screen show various levels of fire danger: grey, green, blue, yellow and red for increasing levels of danger.
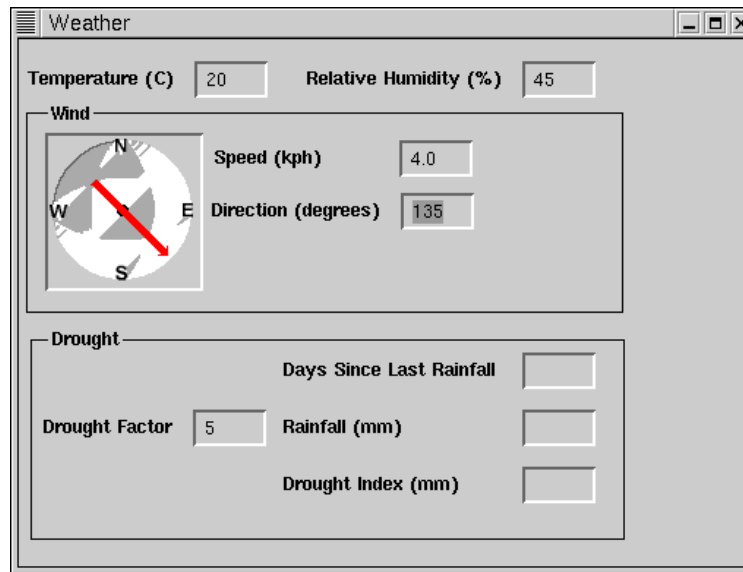
Figure 3: Weather Screen

2.4 The Weather Screen

The weather screen, shown in figure 3, allows control of the weather conditions. The weather conditions can be changed at any step of the simulation. The items that can be controlled are:

Temperature The temperature in degrees Celsius.

Relative Humidity The relative humidity, expressed as a percentage.

Wind Speed The wind speed in kilometers per hour.

Wind Direction The direction of the wind, in degrees. The wind direction can also be set by dragging the needle on the compass to the desired direction.

Drought Factor The drought factor for forest fires. This factor can either by entered directly, or calculated by entering the following information:

Days Since Last Rainfall

Rainfall The rainfall, in millimeters, when rain did fall.

Drought Index A complex index based on the amount of water required to wet the ground. This index is usually supplied in weather reports.

2.5 Editing a Model

The **Map** menu and tool-bar provide a number of tools for editing a FIREMODEL simulation. Essentially, terrain and fire state is painted onto the map by selecting an appropriate tool and then dragging out a rectangle on the map. Roads and water appear as lines, rather than rectangles.

The elevation tool allows you to fix the elevations of various points on the map. To use this tool, select the elevation tool and click on a cell; you will be asked to enter the elevation of the cell. Once a few elevations have been set, the simulation interpolates between the elevations you have set to create a smooth model of the heights in-between.[4] Once the interpolation has been completed, contours (in white) show the shape of the terrain.

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[4] This can take some time.

The label tool allows you to add labels to indicate areas of interest. Once you have selected the label tool, clicking on a cell will cause a prompt for a label. Labels appear in black.