Educational Technology Lab

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Cruislet manual

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1. Introduction

Cruislet environment is a digital medium based on GIS (Geographic Information Systems) technology that incorporates a Logo programming language. It is designed for mathematically driven navigations in virtual 3d geographical spaces and is comprised of two interdependent representational systems for defining a displacement in 3d space, a polar coordinate and a geographical coordinate system.

The user is able to explore spatial visualization, geographical and mathematical concepts by controlling and measuring the behaviours of objects. The objects are airplanes and their displacement is represented by a vector. The user is able to navigate the airplanes either by using the predefined functionalities of the environment or through the use of Logo programming language.

The environment provides dynamic visual means that support immediate visualization of multiple linked representations, meaning that any action carried on a specific representation provides immediate change and feedback in all representations. In this way, mathematics are integrated with geo-spatial representations and information, providing opportunities for processes of mathematisation of geographical space.

2. Terrain scene

The terrain scene is splitted into two different windows. These windows are the two map viewers. The above window contains the 3d representation mode of the geographic map of Greece while on the below window the 2d representation mode of the map is displayed respectively (figure 1).

Figure 1. Cruislet map viewers

2.1 Navigating with the mouse

The user can actually explore the 3d map by using the mouse as a navigation tool. In particular, the user moving the mouse across the 3d map can actually see a moving pointer with the symbol X (figure 2, schema i). This pointer is actually connected with the box on the bottom left corner of the map (figure 2, schema ii). This box displays the description of the location, that is the geographical coordinates (Latitude and Longitude) and the height of the point of the 3d map that user points using the mouse.

Figure 2. Pointing a location

By clicking with the left mouse button, the user is able to move the 3D map to all directions (right, left, up, down). While navigating in 3D map, the 2D map represents the area of the map where the mouse is placed (figure 3).

Figure 3. Moving with the mouse

By clicking with the right mouse button, the user affects the actual scale of representation of the area of the terrain and consequently the perspective of the map. In this way, the map is changing according to mouse movement, from the horizontal to vertical view (up and down) respectively to the screen (figure 4, schema i), or it rotates (right – left) from the point that the mouse is placed (figure 4, schema ii).

i. Up – Down

ii. Right – Left

Figure 4. Changing map's perspective

By rolling the wheel mouse button the user affects the scale of representation of the terrain area (figure 5).

Figure 5. Changing the scale of an area

By pressing the wheel mouse button the symbol appears. This enables the user to navigate freely in 3D space, by moving around the mouse. If the user wants to stop navigating this way, he must press the wheel mouse button once again.

3D map's representation takes up more space on the screen than the 2D map. The user is able to change it by moving the bar that splits the map area (figure 6).

Figure 6. Changing 2D and 3D map size

The two map viewers take up almost the 2/3 of the screen. The remaining 1/3 of the screen area is called the Cruislet area and contains the tabs selection. There are three tabs:

1. Avatar tab
2. Contents Tab
3. Logo Tab

Figure 7. Cruislet tabs

3. Avatar tab

Avatar's tab functionalities can be divided in three categories according to the object manipulated or the way it is manipulated by the user (figure 8).

Figure 8. Avatar's tab functionalities

3.1 Avatar

Avatar properties and manipulation consists of:

3.1.1 Creation

By clicking on the 'Add' button

a new avatar is created on the terrain area. The avatar is placed by default at the point the user last clicked with the mouse and in 5000 height. If the user hasn't clicked on the map, the avatar is placed upon the island of Crete.

3.1.2 Deletion

By clicking on the 'Remove' button

the avatar is deleted. If more than one avatar is placed on the map, then the active avatar is deleted. If the user wants to delete a specific avatar, he must choose among the avatars and then press the 'Remove' button (figure 9).

Figure 9. Choosing among the avatars

3.1.3 Avatar properties

The user, through the use of the administrator tab can vary the properties of the active avatar. Each of the agents has a unique name. The default name of the first avatar is Avatar 0, second's avatar name is Avatar 1, etc. The user is able to change avatar's name by editing it. In the following figure (10) avatar's name has changed to "My_plane".

Figure 10. Changing avatar's name

The 3D model of the agent actually determines its appearance. There is a built-in library of 3D models selectable by the user.

Figure 11. Choosing a 3D model

The default model of the active agent is "Plane 1" but can be changed by the user at any time.

i. Plane 1 **ii.Plane 2** **iii.Helicopter**

Figure 12. 3D avatar's model

3.1.4 Avatar visibility

The avatar can be either visible or invisible on the terrain scene. Even if the avatar is invisible, the user is able to change its properties or navigate it. The default is the avatar to be visible. In order to get the avatar invisible, the user must tick on the appropriate box (figure 13).

i. visible **ii. invisible**

Figure 13. Avatar's visibility box

3.1.5 Vectors

The Avatar leaves a trace as it moves (figure 14). The trace is a single, selectable, three- dimensional object (a thin cylinder ending on an arrow). It is actually a 3d vector representation. In order to visualize the arrow in the cylinder (i.e. the vector representation), the avatar must make a displacement more than 3600 meters (figure 14, schema i).

i. vector **ii. cylinder**

Figure 14. Displacement representation

There is check box giving the opportunity to enable or disable the trail (trace) of the avatar. When the trace is disabled, the avatar leaves nothing while navigating.

i. enabled **ii. disabled**

Εικόνα 15. Trace visibility

By pressing the

button the trace of the active avatar is deletes. This button deletes all the traces or vectors created by the avatar. If the user wants to delete a specific trace or vector, but not all of them, he must select one of them. The selection can be done by left clicking once on the vector (figure 16). The selected vector changes its color to green. A second click on the selected vector, turn the vector back to its initial state. The selection of more than one vector can be done by pressing the Ctrl key on the keyboard.

Figure 16. Selection of a vector

By clicking with the right mouse button on a selected vector, a menu pops up (figure 17).

Figure 17. Vector menu

⇨ Multiply

By selecting 'Multiply' a window pops up where the user can define a number with which the selected vector will be multiplied (figure 18).

Figure 18. Choosing a number to multiply

The result is a new vector which is displayed on the map. The new vector begins either from the beginning of the selected vector or from the point of the map where the right-click was occurred (figure 19).

Figure 19. Choosing the starting point of the new vector

The new vector has the same direction with the selected one, but its measure is equal to the length of the selected vector multiplied by the number defined by the user. In the following figure the selected vector have been multiplied by number 2 and the starting point of the new vector is the beginning of the selected one (figure 20).

Figure 20. Multiplication of a vector

⇨ Divide

By selecting 'Divide' a window pops up where the user can define a number with which the selected vector will be divided (figure 21).

Figure 21. Choosing a number to divide

The result is a new vector which is displayed on the map (figure 22). The new vector begins either from the beginning of the selected vector or from the point of the map where the right-click was occurred, as in the case of multiplication (figure 19).

The new vector has the same direction with the selected one, but its measure is equal to the length of the selected vector divided by the number defined by the user. In the following figure the selected vector have been divided by number 2 and the starting point of the new vector is the beginning of the selected one (figure 22).

Figure 22. Division of a vector

⇨ Delete all selected

If the user wants to delete more than one vector (figure 23), he is able to select them by pressing the Ctrl key.

Figure 23. Choosing vectors for deletion

⇨ Select none

Restore the vector to its initial state (unselected – red color).

⇨ Add all selected

This option appears when the user has selected more than one vector. The addition is applied in all of the selected vectors (figure 24 schema i). The addition produces a new vector which begins either from the beginning of the first selected vector or from the point where the user made the right-click (see check box in figure 19).

i. vector selection

ii. addition result

Figure 24. Addition of vectors

3.2 Navigation in space

Navigation in 3D geographical space can be done by using one of the following choices:

3.2.1 Systems of reference

There are two different systems of reference that define avatar's displacement: geographical coordinates and spherical coordinates.

Geographical Coordinates: Every spot of the 3D map corresponds to specific geographical coordinates (latitude and longitude) and height. Therefore, the position of each avatar is specified by three coordinates (lat, long, height). Lat and Long inputs are actually the conversion of the geographical coordinates to its decimal form and the Height of the avatar is measured in meters.

Avatar's displacement in 3D space can be done by editing the values of the three coordinates and pressing

button (figure 25). After pressing the button, avatar's displacement appears on the terrain scene and on the left column of 'Position' the current position of avatar appears. Every time the user changes avatar's position in the right column of 'Position', on the left column there are available the previous avatar's position. If the user wants to keep the same values in coordinates, he is able to transfer one or more of them by clicking on the middle column (figure 25, Coordinates transfer).

Figure 25. Defining geographical coordinates

Spherical coordinates: The displacement of the avatar according to its direction is defined by a vector in terms of its length (R), an angle between the vectors projection onto the xy plane and the y-axis (Theta) (figure 26, schema i) and the angle between the vector and the x-axis (Fi) (figure 26, schema ii).

i. Turning according to theta angle

ii. Turning according to fi angle

Figure 26. Turns and angles in spherical coordinates

The user is able to displace the avatar by pressing the

button (figure 27). After pressing the button, avatar's displacement appears on the

terrain scene and on the left column of 'Direction' the current direction of avatar appears. Every time the user changes avatar's relative position in the right column of 'Direction', on the left column there are available the previous avatar's relative position. If the user wants to keep the same values in coordinates, he is able to transfer one or more of them by clicking on the middle column (figure 26, Coordinates transfer).

Figure 27. Defining avatar's spherical coordinates

While changing avatar's relative position by using one frame of reference, the other one changes its values correspondingly to avatar's displacement. If for example the user chooses spherical coordinates to displace the avatar, geographical coordinates will change according to the position that the avatar will be placed.

The direction of the avatar can also be controlled by a build–in 3D controller. The controller is a semi transparent sphere (figure 28). Using the controller the user actually defines the direction of the displacement of the agent. The centre of the sphere is the starting point of the vector and the user can actually drag the arrow of the vector and by moving around the mouse can vary each of the 2 variables (theta, fi) that define the vector.

Figure 28. 3D controller

The length of the vector, can be defined by the user either by editing it or changing its value using the buttons with the '+' and '-' symbols. Pushing these buttons causes the increment or decrement of the vector's length by 1000 meters (figure 29).

Figure 29. 3D controller's vector length

While the user uses the 3D controller the values of geographical and spherical coordinates change correspondingly (figure 30).

Figure 30. Changing coordinates with 3D controller

The user watches at the controller at the same view angle that watches the active agent. Consequently, by changing the position of the camera, the view of the 3D controller changes correspondingly (figure 31).

i. default viewpoint of 3D controller

ii. changing camera's pitch

iii. changing camera's yaw

Figure 31. Changing 3D controller's viewpoint

The user is able to define if the controller will be visible or not, below the tab area, by pressing the button (figure 32).

i. visible

ii. invisible

Figure 32. 3D controller visibility

3.2.2 Select a destination

The user can move the avatar to an absolute position by selecting the destination of the avatar. This can be done by using

selector.

By pressing the button, predefined cities appear, and the user can choose one of them (figure 33).

Figure 33. Select a destination

By clicking on a destination (city), the corresponding coordinate values appear on 'Position' and 'Direction' (figure 34). On 'Position' the user can see the geographical coordinates of the selected city, while on 'Direction' the user can see the angles the avatar must turn and the distance the avatar must cover to get to the destination.

Figure 34. Changing of coordinates according to a destination

3.2.3 Transfer commands in Logo Tab

The user can set the position or the direction of the avatar and transfer the corresponding commands in Logo Tab. This can be done by checking the Export to Logo box and pressing the Export button that has replaced the Go button (figure 35). The user is able to run the commands by using the Logo Tab and move the avatar in terrain scene.

Figure 35. Transfer commands in Logo tab

3.3 Camera

Each avatar has a camera adjusted at initial distance1000 meters off it. The camera can be moved around the avatar forming an imaginary sphere. The avatar is actually on the centre of the sphere and its camera can be moved across the circumference of the sphere. The distance between the camera and the avatar is the radius of this sphere. The user is able to change the distance either by editing it or changing its value using the buttons with the '+' and '-' symbols. Pushing these buttons causes the increment or decrement of the distance by 1000 meters (figure 36).

i. distance value

ii. viewing of the avatar at different camera distance

Figure 36. Changing camera's distance

The relative position of the camera is defined through the use of the two position controllers: azimuth and pitch. The variation of the azimuth controller is actually shows the right or left motion of the camera on the circumference of the sphere.

Figure 37. Changing camera's azimuth

The pitch controller shows the motion to the forward or backward respectively.

Figure 38. Changing camera's position pitch

The orientation of the camera view is defined using two controllers: pitch and yaw. Pitch is varying the up – down camera's orientation.

Figure 39. Changing camera's orientation pitch

Yaw is varying the right – left camera's orientation.

Figure 40. Changing camera's yaw

The user is able to define if camera's properties will be visible or not, below the tab area, by pressing the button (figure 41).

i. visible **ii. invisible**

Figure 41. Camera's properties visibility

The initial state of camera's properties is to be 'locked to changes' for the user. In order to allow changes, the user must check the appropriate box (figure 42).

i. enable changes **ii. lock changes**

Figure 42. Enable camera's properties

The user is able to restore the initial camera's properties in their default values, by pressing the Defaults button under camera's controllers.

In order the user to see or enable camera's properties, there must be an active avatar in the terrain scene. If the user deselect the avatar or delete it, camera's properties will be disabled. If the user wants to change map's viewpoint while there is no avatar enabled, he must use the mouse instead (see §2.1 Navigating with the mouse).

4. Contents tab

The Contents tab contain a thematic browser with the configure tree of the layers' visibility of the geo – coded information (figure 43). The real geo-coded information contained in the terrain scene is descriptive information of the various land features and geographic entities.

Figure 43. Contents tab, geographical features and entities

The user is able to display or not the entities of each category by pressing the box that appears at the beginning of each category, with the symbol '–'.

4.1 Bed texture

The user is able to choose among two different representation of the map in terrain scene (figure 44). In hypsometric coloration the 3D map doesn't appear and the geographic information can be seen only in the 2D map.

i. satellite image

ii. hypsometric coloration

Figure 44. Choosing bed texture

4.2 Geophysical characteristics

The user is able to display the geophysical characteristics by clicking the corresponding box (figure 45). The corresponding characteristics appear on the map just like it is shown in figure 44.

Figure 45. Choosing geophysical characteristics

4.3 Regions

The user is able to display the border lines of geographical regions by clicking in the corresponding box (figure 46, schema i). The corresponding lines are shown on the 2D map (figure 46, schema ii).

ii. enable border lines of administrative regions

ii. representation of border lines on 2D map

Figure 46. Choosing administrative regions

4.4 Cities

Cities are represented with several symbols according to their population. By default the names of the major cities are displayed when the altitude of the avatar or the camera distance from the sea, is below 400 km. According to

the distance or the scale that the map is represented, other capital or towns are displayed on the map. The user is able to choose which cities' category will be displayed, by clicking the corresponding box (figure 47).

Figure 47. Choosing cities' category

4.5 Road network

The user is able to display the national and provincial network by clicking in the corresponding box (figure 48, schema i). The road network is displayed only in the 2d map (figure 48, schema ii).

ii. choosing road network

ii. representation of road network

Figure 48. Road network

4.6 Point of interest

The user is able to display specific points of interest (like beaches, archeological sites, etc.) by clicking the corresponding box (figure 49, schema i). Points of interest are displayed in both maps (figure 49, schema ii).

i. choosing category of 'points of interest'

ii. representation of points of interest in maps

Figure 49. Points of interest

4.6 Additional functionalities

The user is able to search for a specific geographical feature, entity or location through Contents tab, by using the search box at the top of the tab. If for example the user is searching for Naxos island on the map, by editing 'Naxos' on the search box, and by pressing the search button, there will be displayed all the geographical entities that contains this word, at the bottom of the tab (figure 50).

Figure 50. Searching for geographical features or entities

By double clicking on a specific search result (e.g. Naxos, Bay of Naxos, etc.) the map displays the area where the result is placed. The user is able to select the way navigation will take place in order to display the place. By pressing the right mouse button, a menu with several options appears (figure 51).

Figure 51. Representation of the selected result

The menu consists of:

Locate: A circle is displayed at the selected point.

Fly to: The user watches a navigation through the map until the map displays the area of the selected location.

Go to: The map displays directly the location on the map (without navigating to that point).

Copy: The selected location is copied. The user is able to paste the location in his collections (bellow personal content). In this way he can restore it easily the at any time (figure 52).

Figure 52. Collections

When the user is searching for a specific entity within the area displayed in the terrain scene (e.g. beaches near Chania city), he must choose the corresponding category (in this case: Points of interest – Beaches) and click on it (figure 53). The results are shown at the bottom of the tab, where the user can click on a specific result and display it on the map.

Figure 53. Searching for an entity within an area

5. Logo tab

Logo tab is a Logo – like programming environment where the user is able to write Logo commands (or procedures) and to run them by pressing the 'Insert' key. If the user wants to run all the commands edited on the Logo Editor, he must press 'F6' key. The Logo Response component provides an "answer" to the user's scripting indicating whether a procedure is defined (or redefined) or not (figure 54). In cases of mistaken commands or procedures the Logo Response component automatically notifies the problem providing comments.

Figure 54. Logo tab

The Logo manual of Cruislet includes all the available Logo commands.

The menu consists of:

- File (figure 55): it is used to open and save a Logo file (ending in '.lgo' or '.logo'), or print the Logo code.

Figure 55. Logo menu – File

- Edit (figure 56): it is used for editing or processing commands in Logo code.

Figure 56. Logo menu – Edit

- Search (figure 57): it is used for searching or replacing parts of Logo code.

Figure 57. Logo menu – Search

- Logo (figure 58): it is used for syntax checking or running the Logo code. The 'Format code' option modifies the Logo code so that all comments and extra empty lines will be removed.

Figure 58. Logo menu – Logo

- Help (figure 59): it consists of information about the construction of the tab and a selection for deleting all recent files history that have been opened in Logo editor.

Figure 59. Logo menu – Help

6. Menu

The menu of Cruislet consists of:

Open file: The user is able to open files that have been created by Cruislet environment. When the file is opened all the avatars included in the file are displayed on the terrain scene. In order to see the avatars, the user must change map's viewpoint, as it doesn't change when opening a file. Additionally the user is able to see the Logo code saved in the file.

Save file: The user is able to save the avatars or / and the Logo code he has created in Cruislet environment.

Moving map: The user is able to move the 3D map by using the mouse (see §2.1 Navigating with the mouse).

Information: By pressing this button a box is displayed on the bottom left corner of the 3D map (figure 60, see also figure 2, schema ii). This box displays the description of the location, that is the geographical coordinates (Latitude and Longitude) and the height of the point of the 3d map that user points using the mouse. By pressing once again the 'Information' button, the box is disabled and disappears from the map.

Figure 60. Location description

Photo: By pressing the button, a photo of the 3D map is taken. The button function similar to PrtSc (Print Screen) key, but it doesn't capture the whole screen, but a specific area on Cruislet environment.

Print: By pressing the button a window pops up with several print options. The user is able to print the 3D map with additional information about the location description the user is pointing, either in portrait or landscape printing format (figure 61).

Figure 61. Printing options

Font size: By pressing the button the user is able to change the font size at the tabs (figure 62). The default font size is 11.

Figure 62. Changing font size