The principles of CCTV design in VideoCAD

By Stanislav Utochkin, cctvcad.com

CCTV focus readers have already had an opportunity to read about VideoCAD in the past issues. This is the only specialised program for CCTV design, installation of cameras and determining their angles of view. It can be compared with AutoCAD for architects and designers. VideoCAD remains the only such program in the industry and with the latest version 4.0 and it deserves to be looked at in details again.

We recommend it highly and you can read here why.

Effectiveness of CCTV systems, constructed even with the application of the best equipment, is substantially determined by qualification of these systems' designers. The project is the first stage of video surveillance system creation. The current arrangement of cameras in the project isn't satisfactory any more, because it demands frequent re arrangements and replacements of lenses after installation is done. Professionally developed project should contain the information about what and how detailed each video camera will cover and which areas it will control.

VideoCAD software facilitates the process of professional CCTV system design. Actually, the software allows creation of projects at qualitatively new level inaccessible without its application, and within a shorter period of time. However, like any multipurpose tool, VideoCAD requires certain efforts and time at initial studying. This article helps beginners and skilled experts, unfamiliar with the VideoCAD to manage it faster.

Camera view area modelling

Before starting to work with this program, it is necessary to specify camera view area modelling in VideoCAD.

Camera view area

View area is a three-dimensional geometrical pyramid-shaped figure (a convex tetrahedral angle) with the vertex, starting from a camera lens. All objects (or parts of objects) inside the pyramid will be visible on the screen. The objects outside the pyramid will not be visible.

View area can be infinite or limited by ground and other objects. Angles between view area faces are calculated in VideoCAD automatically on the base of lens focal length and image sensor format.

Thus, having set a lens focal length and image sensor format, we completely determine the form and the size of view area.

Let's name the top side of this pyramid, which corresponds to the top image border on the screen "view area upper bound". The bottom side of the pyramid, which corresponds to the bottom border of the screen we will name "view area lower bound" (Fig. 1, Fig. 2).

Projections of view area

It's much more convenient and quick to design CCTV systems in two-dimensional space, than in three-dimensional one. This, probably, explains why the 3D design software in video surveillance is not used much and why the view area was modelled in the form of a triangle or a rectangle.

Thus, it is necessary to model a view area in the form of a two-dimensional figure and it is quite easy to do.

In VideoCAD we can get horizontal and vertical projections of a view area. However in design process the horizontal projection, i.e. projection on location plan, is more often used.

Let's consider the most common case of camera installation:

As a rule, we are not interested in the whole view area, but only in its part in the certain range of heights. If project obtained section of the pyramid in the specified range of heights on a horizontal plane, we'll get a horizontal projection of the view area.

Horizontal projection of a view area in VideoCAD is determined by the following key parameters:

· Height of view area upper bound;
· Height of view area lower bound;
· View area upper bound distance.

On the Fig. 3 we can see the meaning of the following parameters: Height of view area upper bound and Height of view area lower bound. Changing values

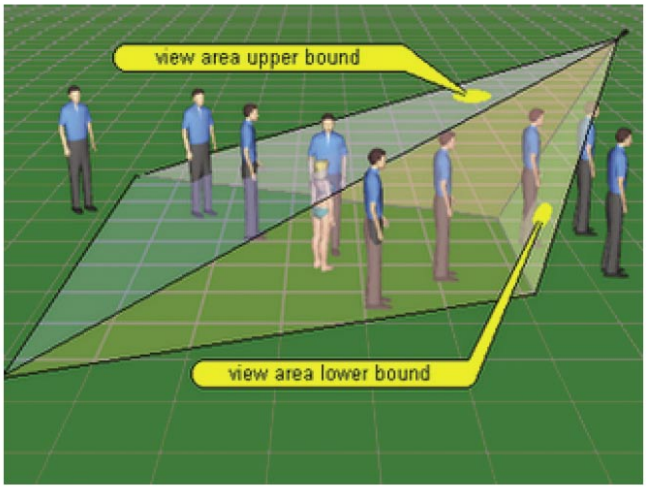


Fig. 1. Camera view area. Side view.

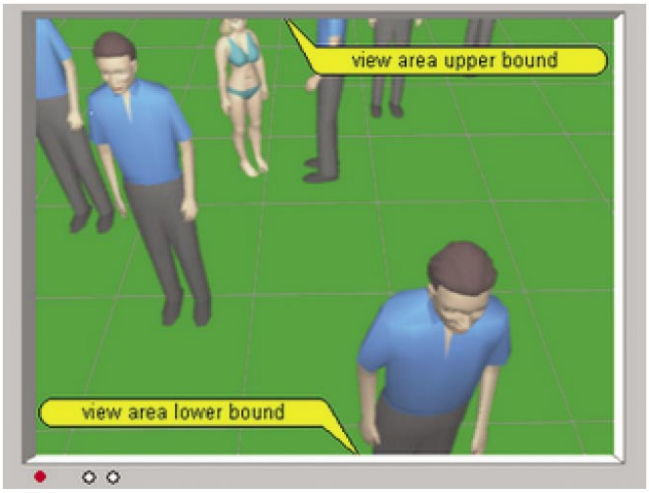


Fig. 2. Image on the screen from the same camera.

of these heights, we'll get different sizes of projection, and any object, which is at the height between these bounds, and on a horizontal plane within the limits of horizontal projection of view area will be visible on the screen.

For example, if we are interested in people surveillance, who are not trying to hide from surveillance, it is enough to set 1 m. View area lower bound and 2 m. Height of view area upper bound. If crawling crossing of the controlled area is possible, then the lower bound should be lowered to zero. If surveillance over trucks is necessary, the height of the upper bound should be lifted up to height of a truck.

The last parameter which we should determine is the View area upper bound distance. From Fig. 3 we can see, that this is the projection on the horizontal plane of the distance from the camera to the intersection of View area upper bound with Height of view area upper bound which we have set earlier.

Though the view area can be infinite, as a rule, we are interested in surveillance not only in a range of heights from the lower bound up to the upper bound of a view area, but also up to the specified distance.

This distance is the View area upper bound distance in this particular position of camera.

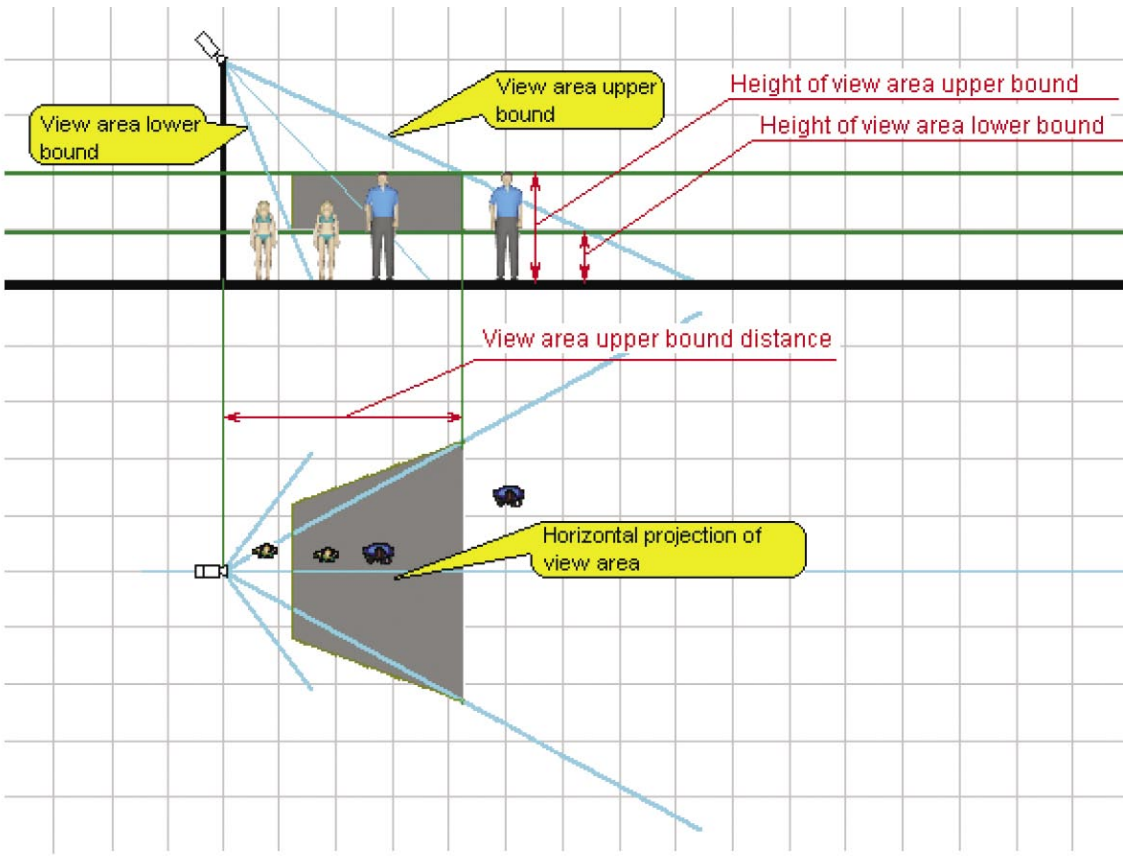


Fig. 3. Camera view area projections.

Please, be aware that if the values of Height of view area upper bound, View area upper bound distance and installation height of camera are specified, then the position of the camera which is optimal for surveillance up to the specified height and specified distance is completely determined (Fig. 4). That means that it's not necessary to introduce any other parameters, for example angle of slope. In case of change of the

*Camera position in VideoCAD is not determined by the **Height of installation** and **Angle of slope**, as in others 3D software, but by the **Height of installation, Height of a view area upper bound and View area upper bound distance**. It is much more convenient in practice, as we will see further in this article.*

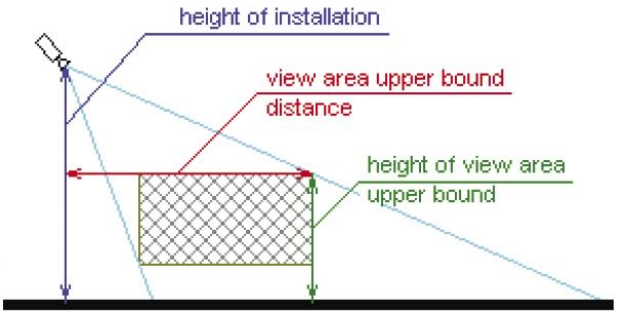


Fig. 4. Definition of the camera position in VideoCAD.

camera inclination, its position will not be optimum for surveillance up to the specified height and up to the specified distance.

Thus, in order to get the sizes and position of a view area projection in relation to a camera, it is necessary to set the following parameters (Fig.3):

· Image sensor format and a lens focal length.

· Height of the camera installation.

· Heights of the upper and the lower bounds of view area.

· View area upper bound distance

VideoCAD will calculate all other parameters of the view area projection and will display the projection graphically.

It is very convenient to work with such projections. It is enough to set the initial parameters defined above, to place a camera with a projection of view area to the location plan, and directly on the plan we'll see the area, within which the objects will be visible on the monitor screen.

Designing in VideoCAD basically consists of creation, placing and editing of view areas' projections of cameras. For this purpose there are a lot of convenient tools.

Camera positions

We have considered only one, the most common camera position. Depending on a ratio of set parameters, there can be 8 such positions on each pointing direction of the camera (from left to the right or from right to the left), (Fig.6).

VideoCAD can calculate all positions. In any case an exact position of the camera and a projection are determined by the same parameters, mentioned

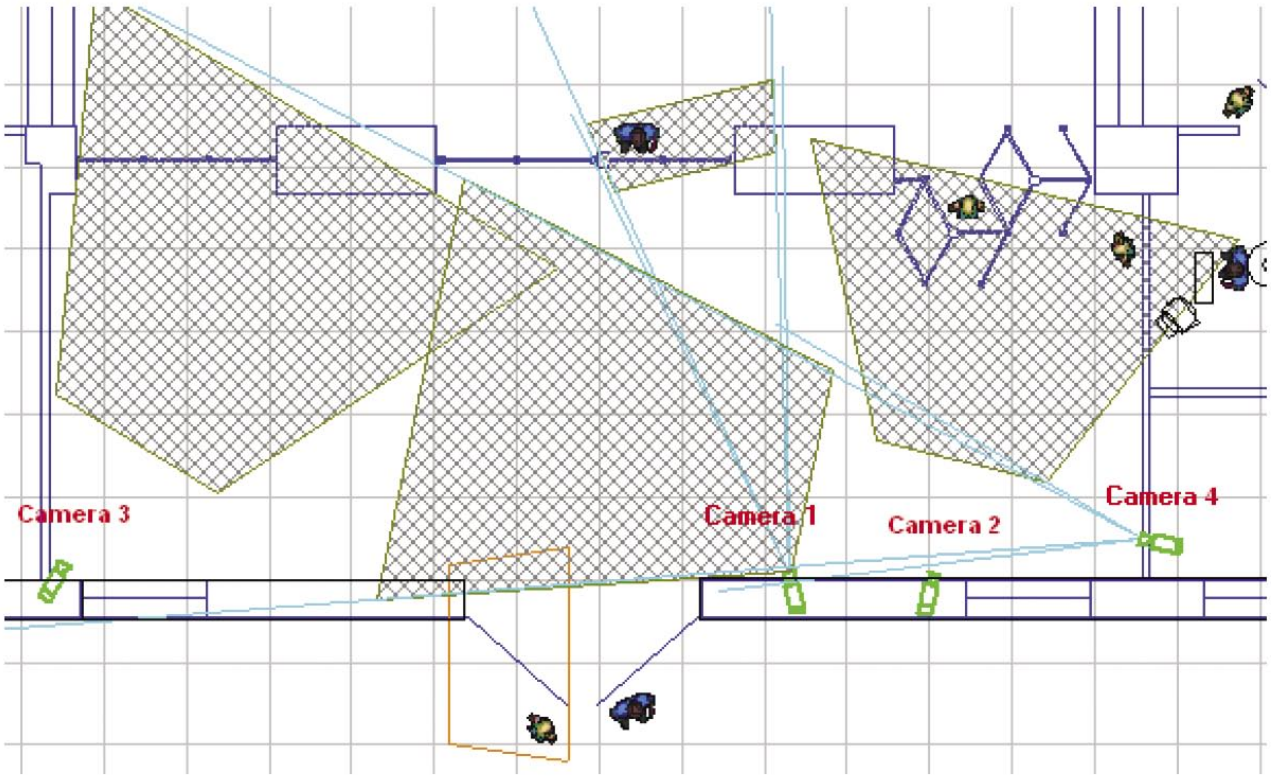


Fig. 5. Layout of view area projections on the location plan.

above. But the meaning of parameters, depending on a camera position, can vary.

Cameras 2, 5, 8 have infinite projection of view area. Cameras 6 and 7 don't have it at all (obviously, positions of cameras 6 and 7 have no practical sense). View area upper bound distance of cameras 2 and 8 determines not the end, but the beginning of the view area projection.

* In VideoCAD the camera position is displayed by the figure in the Camera parameters box.

Navigation in the Graphics window

A Wheel mouse is particularly convenient when working in the Graphics window. Using the Wheel mouse you can change a drawing scale with the simultaneous zooming in the drawing sections pointed by the cursor.

You can move the drawing by pressing and holding down the mouse wheel (the middle button). If **Ctrl** is not pressed, the entire drawing can be dragged; if **Ctrl** is pressed, only the horizontal projection can be dragged.

To increase any screen area press in the corner of the area and hold the right mouse button then move the mouse with the right button pressed in the diagonal direction. At the same time you will see the zoom window.

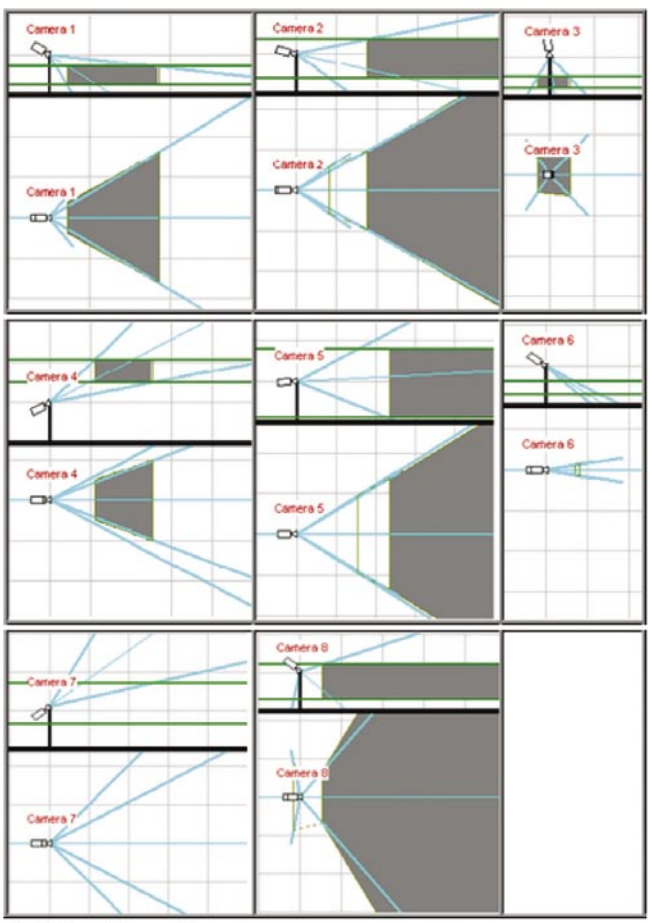


Fig. 6. Possible positions of a camera.

After releasing the button, the area inside the zoom window will be shown on the full screen.

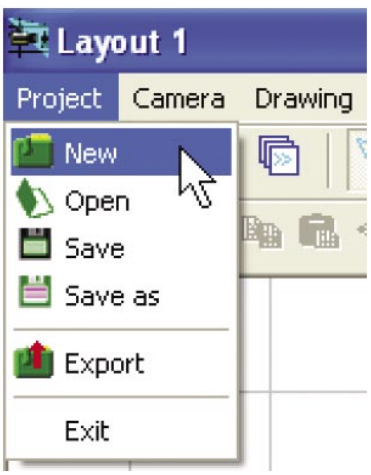
* A regular click of the right mouse button without moving between pressing and release displays the pop-up menu, as well as in other programs.

Creation of a project

Create a new project (at the first start of the program a project is created automatically).

Main menu>Project>New

In the dialogue box of new project type the new project name and click OK. It is possible to choose the measurement system for the new project: Metric (meters, millimetres) or Imperial (feet, inches).



* To get the context help for any menu item select it by mouse and press **F1**

Saving the project

Main menu>Project>Save as

In the appearing dialogue box choose a file name and a directory to save it.

Opening the project

To open the earlier saved project, click on the menu item: *Main menu>Project>Open*.

In the appearing dialogue box choose a project file and click Open.

Setting of projection visibility

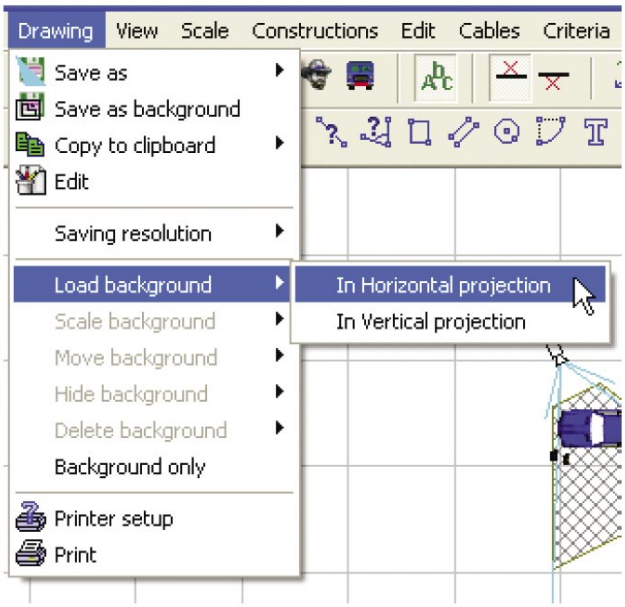
During creation of this simple project we'll work only with the horizontal projection, therefore hide the vertical projection, by clicking on the Hide vertical projection button on the tool bar.

* To get the context help for any button on the tool bar click it by the right mouse button and then on the appeared item What's this?

Loading a background

Though VideoCAD has its own drawing tools, it is more convenient to use the layout, already created in AutoCAD, Visio or in other graphic programs. The *.bmp, *.jpg, *.jpeg, *.wmf, *.emf, *.dxf, *.dwg graphic files can be used as a background. To load a plan of surveillance object as a background, click on the item M*ain menu>Drawing>Load background>In Horizontal projection.* Choose the necessary file in the dialogue box and click Open.

The background will appear in the horizontal projection along with the Scale Background dialogue box . Using its tools is necessary to bring an image



scale on the background in correspondence with the general VideoCAD scale.

* To get the context help for any window click it and press **F1**. If there is a Help button in the window, you can click it.

Presetting camera parameters

Click the Show Camera parameters box button .

Camera parameters box appears, in which you can see those parameters about which we read in the first part of the article. If you move cursor to a box with a parameter, a name of the parameter will be shown.

* To get the context help for any box select it by mouse and press **F1**

We can change values of parameters only in white boxes. Parameters in grey boxes are calculation results and for now we can do without studying them.

Now we'll set parameters preliminary, subsequently we'll be able to change any parameter for any camera. The Image sensor format can be chosen only out from the list: 1/4", 1/3", 1/2", 2/3", and 1". Choose a value given in the camera manual in this box.

The most popular formats are 1/4" (for the mini- and DOME cameras), 1/3" (for the better part of cameras) and 1/2" (for the certain cameras of extended quality).

A Lens focal length can be chosen out of the list or typed. Meanwhile it is possible not to change this parameter. We'll choose a focal length later.

Choose from the list or enter from keyboard Height of installation. Possible height of installation is determined by room parameters, requirements of vandal-protectability, etc.

For surveillance over people you should set Height of view area lower bound - 1 m., Height of view area upper bound - 2 m.

Close Camera parameters box.

In Graphics window on a background of the object's plan you see one camera with a projection of view area, calculated according to the set parameters.

Pay attention to the buttons on the Tool bar. These buttons switch on and off display of View area edges, View area projection border lines and Hatching of view area projection accordingly. Try these buttons in order to see, how they operate.

* If the View area edges button is down, these area edges will be displayed as three dimensional and semi-transparent in the 3D window. This will allow us to see the camera view area from the outside.

Placement of the camera on a plan

Switch to the Selection mode, by clicking on the Select/Edit button.

Click on the plan near the camera's icon and drag the selection window diagonally to enclose the camera's lens. Then click once again. The camera's

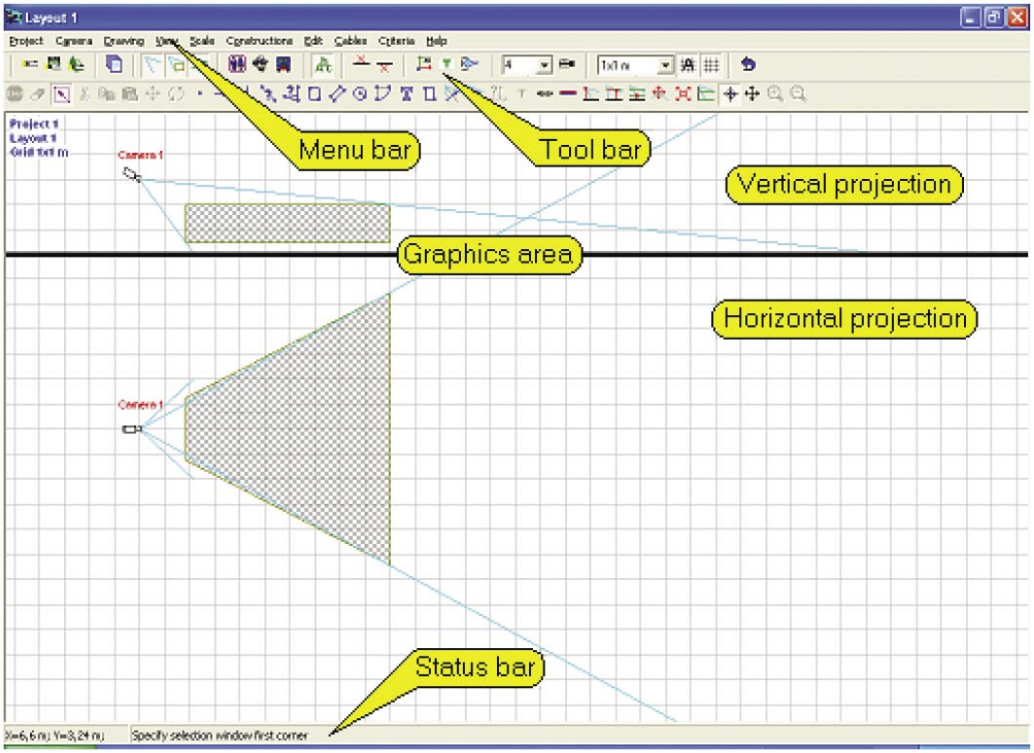


Fig. 7. Graphics window.

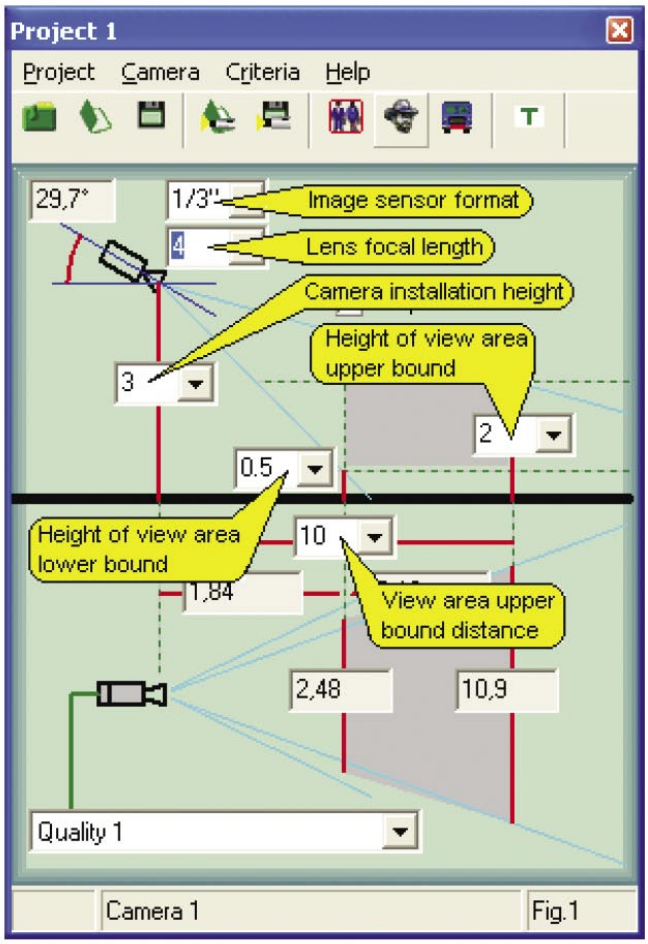


Fig. 8. Camera parameters box.

icon will become lilac - the camera will be selected.

* It is similarly possible to select some objects simultaneously, and not only cameras, using the selection window.

* It is possible to select one camera, just having click precisely on its lens. .

* For more information about various opportunities of selection and removal of selection from objects see the description of the Select/Edit button in the Help system.

* Pay attention to tips, which are displayed on Status bar below the window.

Switch to the Move mode, by clicking on the Move button

Specify by clicking initial (1) and final (2) point of moving. The initial point is lens of a camera; a final point is that point on the plan where you wish to place it.

* You can interrupt any operation by clicking the Stop operation button

Switch to the Rotate mode by clicking the Rotate button. Sequentially specify by clicking the centre of the rotation (1), initial (2) and final (3) point of the rotation. The centre of rotation is camera lens. Thus, turn the camera in the necessary direction.

Set necessary View area upper bound distance. For this purpose click on the Change view area upper bound button Specify by clicking a point on the plan, up to which this camera should do people surveillance.

If the projection is too wide or narrow, choose lens focal length. It can be done directly in Graphics window, using the box .

In order to change Camera installation height, Heights of view area upper and lower bounds it is more convenient to use Camera parameters box, which can be displayed or hidden at any moment by clicking the button .

Use moving, rotating, changing of the view area upper bound and lens focal length to locate and adjust the first camera in the optimum way.

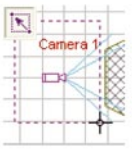
Three-dimensional model of image from the camera

It is possible to see 3D model of image from this camera.

To get the image click on the CD window button In order to see, how a person or a car will appear in view area of the camera, click on the corresponding item in the list *Main menu> Constructions> 3D model>*.., and then on any point within the limits of a projection of view area.

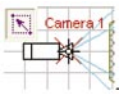
* Located 3D model is possible to select, move, rotate and copy, as well as the camera.

It is possible to draw walls, windows, doors, various objects in 3D space, using tools from the main menu *Main menu> Constructions>* … or corresponding buttons on the Tool bar.



Such modelling in VideoCAD is performed as well easy, as in 2D space. You do not need to study complexities of 3D modelling for this purpose!

Main menu of 3D window contains tools, which allow to obtain an image, that is very similar to the image from the real camera taking into account possible distortions of real cameras and DVRs.



For more information about this see Help system, chapter 3D window.

Copying cameras

Switch to the Selection mode again and select the only camera by selection window or by clicking on its lens.

Click Copy button .

Specify by clicking the base point of copying - camera lens. The camera will be copied.

Click Paste button .

Specify by clicking the place for new camera. New camera box will appear. In this box you can change camera name and enter the description for it.

You should not change values in Camera number

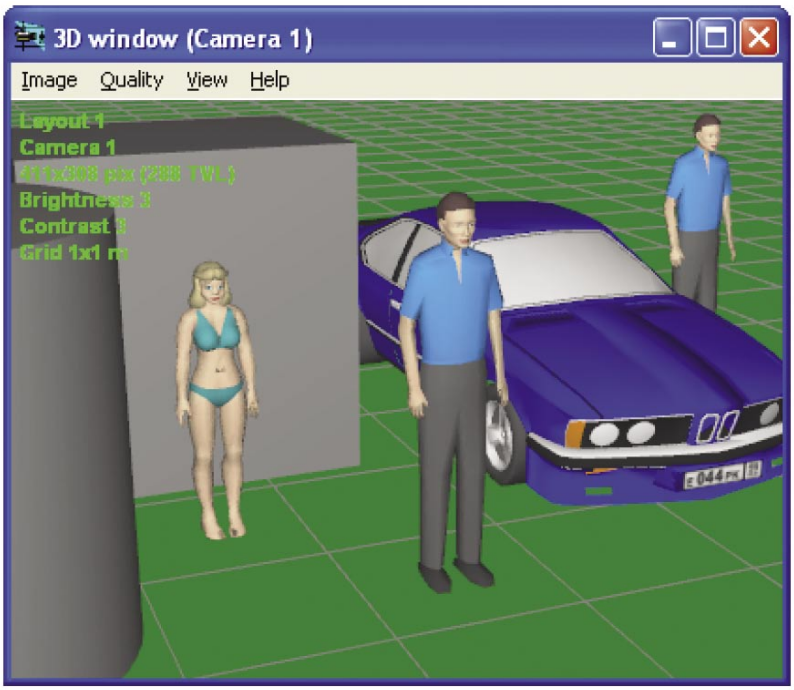


Fig. 9. 3D window.

and Layout boxes now. Click OK. The exact copy of the first camera will be created on the plan.

Specify by clicking the places for all other cameras in the project, creating new cameras every time.

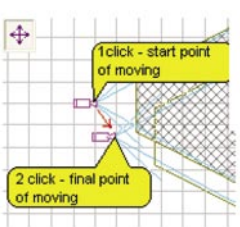
After creation of all cameras, click on the Stop operation or Select/Edit button.

Loaded camera

Pay attention, that the name of the first camera is red highlighted, and names of other cameras are blue. The first camera is loaded. Parameters of loaded camera are displayed in Camera parameters box. The image from loaded camera can be seen in 3D window, the view area upper bound distance of the loaded camera can be changed after clicking the button and display of loaded camera view area can be changed by clicking the buttons .

Other cameras can be moved, rotated, copied, but it is impossible to change parameters of their view areas. In order to load another camera –double click precisely on its lens

* It is possible to load cameras sequentially by Alt+Space hot keys or to load the camera from the list of cameras which can be displayed by clicking on the Load from project button



Arrangement of cameras

Moving cameras, changing their view area parameters, get optimum layout.

If necessary, create new cameras by copying the existing ones. Delete the cameras which became unnecessary.

To delete the camera, select it and click on the Erase button or press Del on the keyboard.

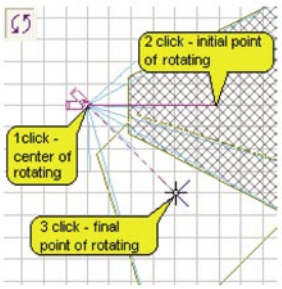
* It is impossible to delete the loaded camera.

* You can rename, delete, load cameras from the list of cameras which can be displayed by click on the Load from project button

Completion of the project

Layout of cameras is ready, all you have to do is to print it out or to export it to any format: *.bmp, *.emf, *.wmf, *.dxf for further processing.

It is possible to get three-dimensional models of images from all cameras in the project, to get directly on the plan person detection area, person identification area, vehicle license plate reading area, taking into account the image quality of each camera. Also, it is possible to calculate Depth of field for every camera, add constructions, texts, frame and Title-Block to the layout, full description of all cameras in the project, which can be later inserted into explanatory note. It is also possible to calculate length and parameters of coaxial and power cables and so on.



Conclusion

In this article we have considered step-by-step creation of a simple project in VideoCAD. Because of limited size of the article we did not cover a lot of useful opportunities. Within the limits of the article one can give only impetus to studying this multipurpose and very useful software, usage of which will allow creating effective video surveillance systems, saving time and considerable funds. All necessary information is available in Help system.

You can always receive answers to your questions directly from the program developer, having sent them by email.

We wish you every success with your projects!

All figures for the article made by means of VideoCAD.

To order the VideoCAD scroll down to the middle of the main page of CCTV focus http://www.cctv-focus.com. [•]

For more information visit www.cctvcad.com.