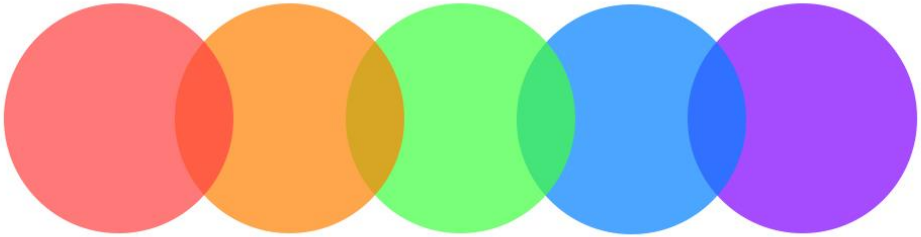


CHROMA KEY SET

Developer's Guide

§1 Quick Start.

Minimum project configuration with Chromakey represented in the scene «QuickStart». The scene contains UI-objects «Canvas» and «RawImage». In component «RawImage (Script)» manually set the field:

1. Texture - arbitrary image with a color key;
2. Material - material «QuickCKS» with shader «Chromakey / OnePassChromakey».

To adjust the background parameters are used directly in the material properties are listed in Table 1.

Table 1.

number	Parameter	Description
1	H min	Parameter defines the lower threshold value H (a color model HSV) color channel for the entry of the pixel in the sample.
2	H max	Parameter defines the upper threshold value H (a color model HSV) color channel for the entry of the pixel in the sample.
3	S min	Parameter defines the lower threshold value S (a color model HSV) color channel for the entry of the pixel in the sample.
4	S max	Parameter defines the upper threshold value S (a color model HSV) color channel for the entry of the pixel in the sample.
5	V min	Parameter defines the lower limit value of a color channel V (color model HSV) for entering pixel in the sample.
6	V max	This parameter determines the upper threshold for the color channel values V (color model HSV) for entering pixel in the sample.
7	Active	The flag permits the use of color-key to constructing the mask image transparency.
8	Invert	Flagging perform inversion mask image transparency.

When working in the minimum draft is not available use the blur functions transparency mask edges - options:

- Smooth Power
- Min Alpha Threshold
- Max Alpha Threshold
- Kernel Cells Count (the value must be equal to 1 for better performance).

Also, the minimum draft is not available to use additional color ranges for complex color keys or scenes with poor lighting - setting «Sample Count».

Parameters «Stencil» not use shaders, they are introduced to Chromakey-compatibility of materials to work with UI-objects.

The result of the project in the minimum configuration shown in Figure 1.

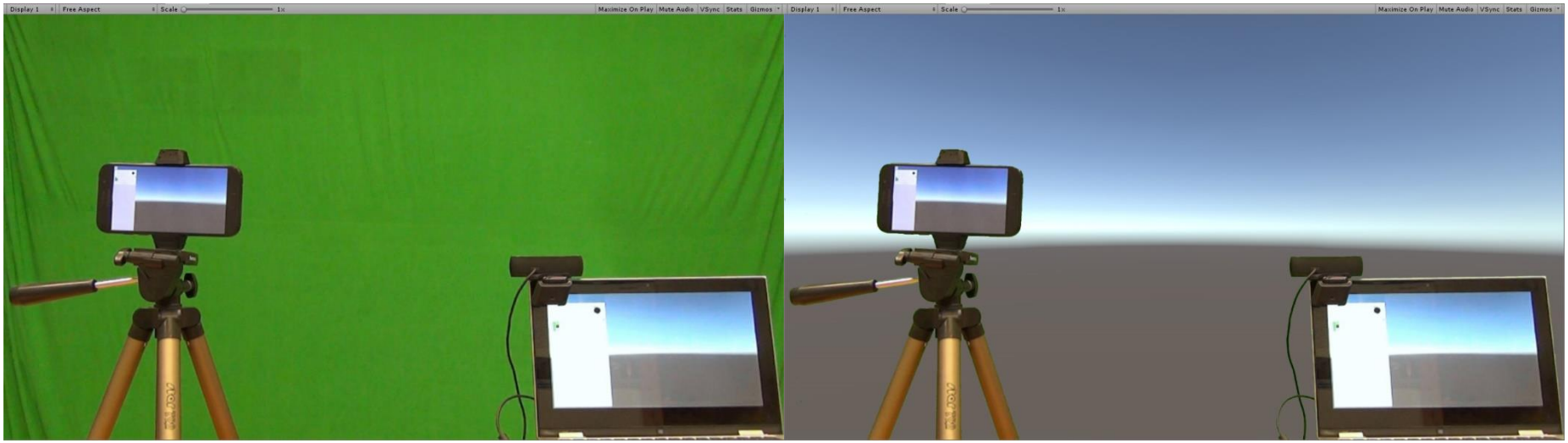


Figure 1. Clipping the background of the test screen. Scene QuickStart.

§2 Video.

Scene «VideoClip» contains UI-objects «Canvas» and «RawImage». An object «RawImage» additionally attached components:

- «Aspect Ratio Fitter (Script)» - Unity embedded component (Component-> Layou), the size control means and the proportions of UI-elements.
- «Video Player (Script)» - built Unity component (Component-> Video), video clips playback means.
- «Chromakey (Script)» - file «Chromakey.cs» folder «Chromakey_System_Folder / Scripts».

Components «Aspect Ratio Fitter (Script)» and «Video Player (Script)» are configured as recommended by UNITY | DOCUMENTATION.

Component «Chromakey (Script)» makes available borders blur function mask Chromakey-setting material - Table 2.

Table 2.

number	Parameter	Description
1	Smooth Power	The variable specifies the blur effect edge mask transparency.
2	Min Alpha Threshold	The variable sets the value of the lower threshold pixel transparency transparency mask. Transparency with a value of pixels below transparency min will be set to 0.
3	Max Alpha Threshold	The variable sets the value of the upper threshold pixel transparency transparency mask. Transparency of pixels with a value higher transparency max is set to 1.
4	Kernel Cells Count	The variable specifies the number of cells used in the convolution kernel. It can take values from 1 to 25.

Convolution - itoperation of calculating new values of predetermined pixels, taking into account the values of its surrounding pixels. To calculate the new value matrix is used, which is called a convolution kernel. Shader «Chromakey / OnePassChromakey» allows matrix size to 5 x 5.

function API component «Chromakey (Script)» allow to set the arbitrary embodiments of the convolution kernel (5 x 5). Without programming convolution kernel can be set one of the predefined sets. To do this, Chromakey-material properties, you must manually set the value of «Kernel Cells Count» parameter. Available preset convolution kernel and its imaging are shown in Figure 2. The complexity of the algorithm increases clipping cells involved fold convolution kernel. When creating applications for mobile devices, should be limited to 3 - 5 cells.

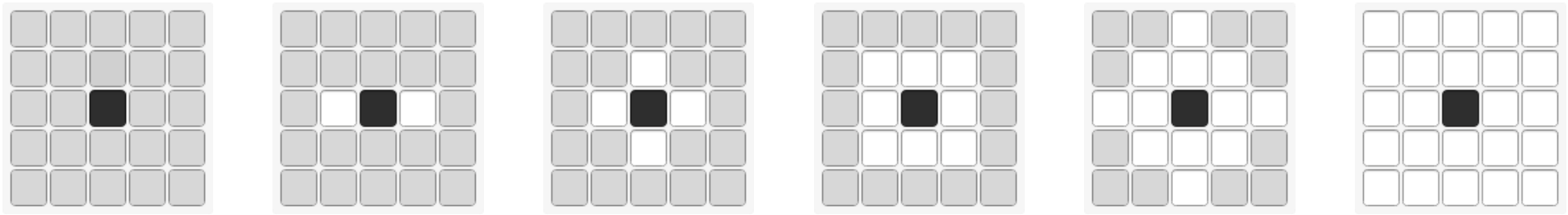


Figure 2. The values of «Kernel Cells Count» parameter and received pre-convolution kernel.

«Chromakey (Script)» component comprises five control parameters shown in Table 4. Full description of the methods of the component «Chromakey (Script)» is given in Appendix 1.

Table 4.

number	Parameter	Description
1	Material	Link to Chromakey-controlled material. The material may be set manually or automatically.
2	Auto Find Material	Setting the flag to launch the search script Chromakey-material at this Gameobject. The material can be found in the «RawImage» components, «Image», «MeshRenderer».
3	Auto Load Material Settings	Flagging launch configuration script Chromakey-load material from a file on the path of the variable «Settings Path» at the level of the start («Start» event).
4	Auto Save Material Settings	Setting the flag to launch the script save Chromakey-material adjustments in the path of the file from the variable «Settings Path» at the end of the level («OnDestroy» event).
5	Settings Path	The variable specifies the absolute path and file name extension with Chromakey-material settings.

§3 Webcam.

Scene «WebCam» contains UI-objects «Canvas» and «RawImage». An object «RawImage» additionally attached components:

- «ChromakeyWebCam (Script)» - file «ChromakeyWebCam.cs» folder «Chromakey_System_Folder / Scripts».
- «Chromakey (Script)» - file «Chromakey.cs» folder «Chromakey_System_Folder / Scripts».

Y component «RawImage (Script)» manually set field «Material» - material «WebCamCKS» with shader «Chromakey / OnePassChromakey».
Y component «ChromakeyWebCam (Script)» for adjusting web of the camera parameters used are listed in Table 3.

Table 3.

number	Parameter	Description
1	Device Num	Devaysa number from 0 to N-1, where N - number of identified Unity webcams.
2	Width	The width of the image captured from a webcam.
3	Height	The height of the image captured from a webcam.
4	Capture	Flag allows image capture from a webcam.
5	Use Hot Keys	The flag allows the use of hotkeys. Pressing «P» - enables / disables the capture image («Capture» Flag).
6	Auto Find Material	Setting the flag to launch the search script Chromakey-material at this Gameobject. The material can be found in the «RawImage» components, «Image», «MeshRenderer». Use static-class method «Chromakey»
7	Material	Link to Chromakey-material. The material will be installed texture «St» - is created automatically.

§4 Additional color keys

Scene«AdditionalSamles» contains UI-objects «Canvas», «Image», «Menu Button», «Menu Panel»; complex Gameobject «TVStudio». An object «Image» additionally attached component «Chromakey (Script)». Feature Configuration «Image (Script)» and «Chromakey (Script)» made in the previous examples.

Objects «Menu Button» and «Menu Panel» implement the use of methods «Chromakey (Script)» for solving complex clipping Chromakey. Here is an example of a turn-based setting clipping green background in a room with poor lighting.

1. We have a scene in the green room. Figure 3.

Figure 3.

2. Launch by default settings the application will lead to the fact that all the pixels in the image will be visible. Figure 4.

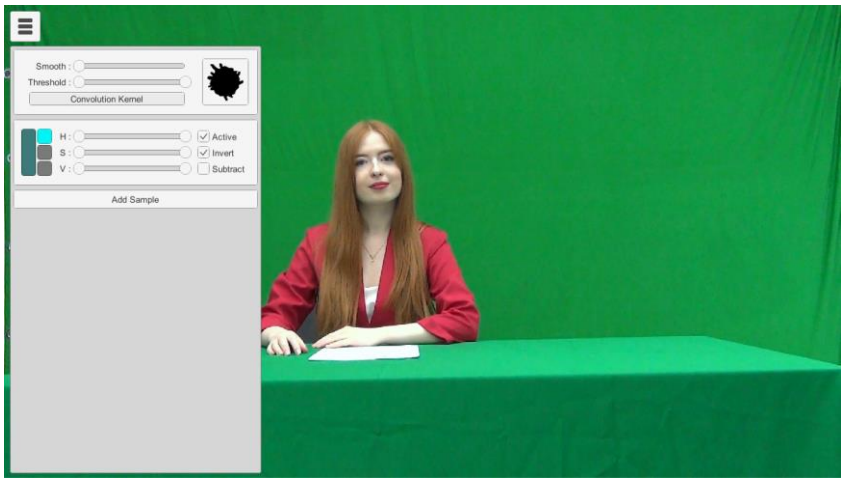


Figure 4.

3. Removal Invert flag will cause that all pixels in the image will get concealed sample (transparency mask). Figure 5.

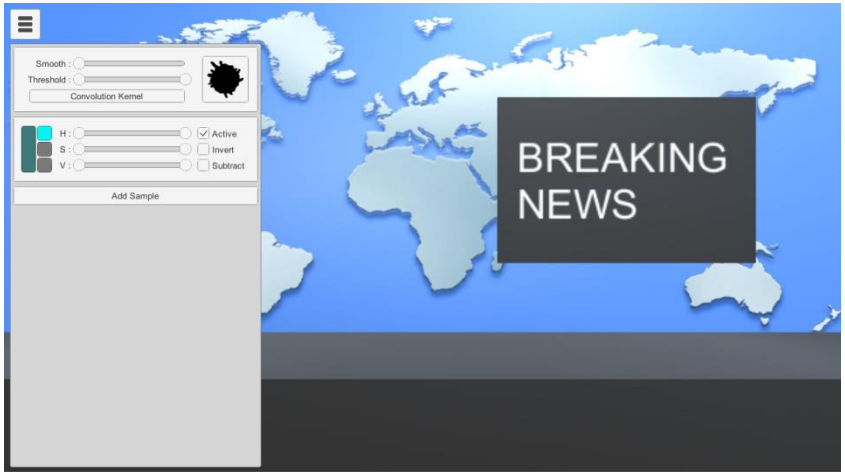


Figure 5.

4. Make settings HSV channel to hide the green pixels. Figure 6.

Figure 6.

5. Not bad. However ... Dark streaks on the background of green folds spoil the picture. Figure 7.
6.

Figure 7.

7. Fix this. Add additional sample using the Add Sample button. Figure 8.

Figure 8.

8. Disable the first sample to make a clear example. A second sample configure allocation darkened portion green background. Figure 9.

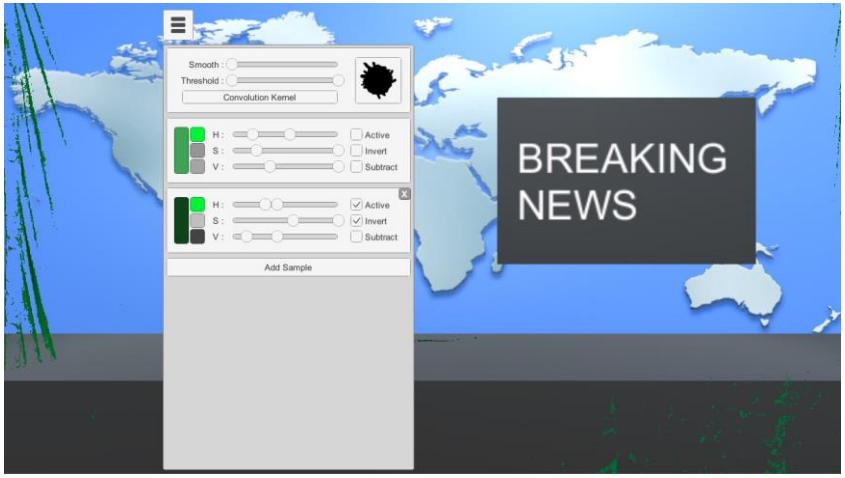


Figure 9.

9. Adjust the mixing of samples. On the map the first sample. Note Subtract flag of the second sample. Excellent! Figure 10.

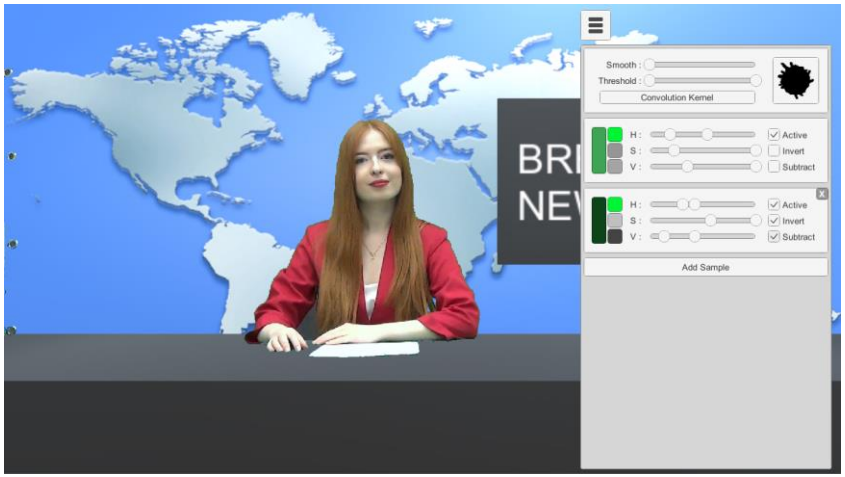


Figure 10.

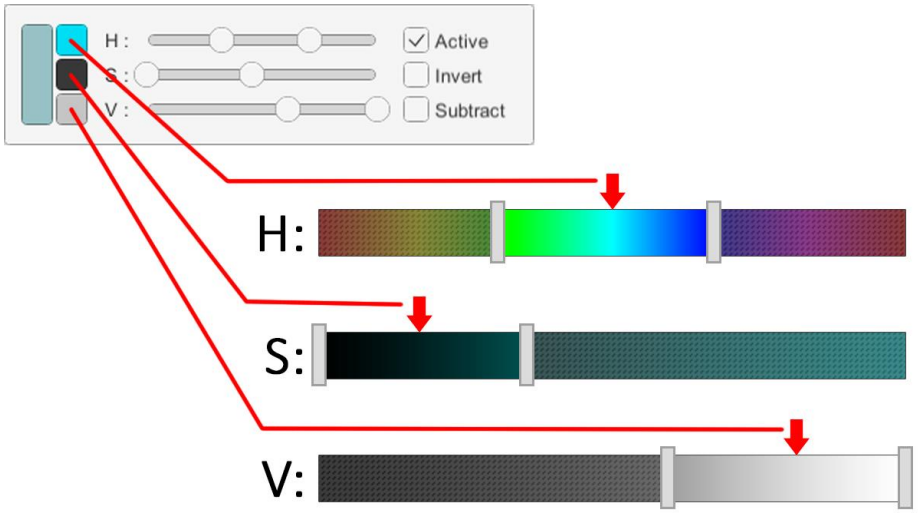
10. Perform shading transparency mask boundaries. Convolution Kernel button will open the editing form of the convolution kernel. The central cell of the matrix core is always marked and highlighted in black. By clicking the mouse, add 8 cells surrounding the central cell. Smooth slider put to maximum. Figure 11. The result of the algorithm is shown in Figure 12.

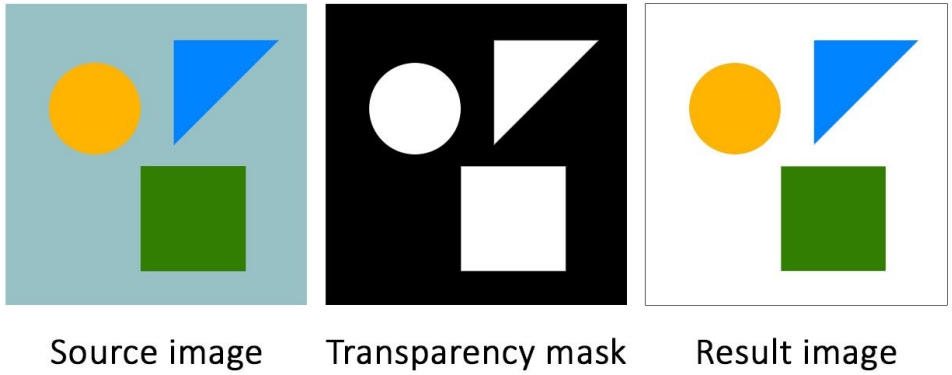
Figure 11.

Figure 12.

§5 Principles of Operation

1. Sliders Sample setting panel ranges define channels HS V. If three pixel color coordinates are within the boundaries of the channels ranges, then the pixel is flagged in the sample. The mask of transparency of such a pixel is black. Setting the flag Invert inverts the transparency mask.





2. Samples Sample may be several main sample 1 and up to 16 additional. Transparency mask samples are added in the order according to the rules of Boolean algebra. Installing Subtact flag will make a subtraction. Black mask transparency corresponds to the number 0. The white color transparency mask corresponds to the number 1.

0 + 0 = 0; 0 - 0 = 0;

0 + 1 = 1; 0 - 1 = 0;

1 + 0 = 1; 1 - 0 = 1;

1 + 1 = 1; 1 - 1 = 0.

Appendix 1. Class Chromakey.

class Chromakey: MonoBehaviour

Fields		
1	_material	***A type:*** Material ***modifiers:*** public ***Default:*** null ***Description:*** Variable is a reference material for CKS. A variable can be initialized manually using the Editor or automatically when you install _autoFindMaterial to true.
2	_settingsPath	***A type:*** String ***modifiers:*** public ***Default:*** "ChromakeySettings.ini" ***Description:*** The variable specifies the path to the configuration file. Configuration File stores XML-serialization instance SETTINGS class.
3	_autoFindMaterial	***A type:***

		bool ***modifiers:*** public ***Default:*** false ***Description:*** Variable allows the call AutoFindMaterial method in the event Start.
4	_autoLoadMaterialSettings	***A type:*** bool ***modifiers:*** public ***Default:*** false ***Description:*** Variable allows the script load settings from a file: 1. Call LoadSettingsFromFile method on the way _settingsPath; 2. Call Set2Material_AllPropertiesData method to install the downloaded settings in the shader; 3. Call OnLoadComplete events.
5	_autoSaveMaterialSettings	***A type:*** bool ***modifiers:*** public

		Default: false ***Description:*** Variable allows the call SaveMaterialSettings method OnDestroy event.
Events		
1	OnLoadComplete	***A type:*** void ***modifiers:*** public ***Parameters:*** SETTINGS s ***Description:*** The event will happen after running the script automatically download settings (_autoLoadMaterialSettings variable). Subscribe to the event will provide a structure loaded SETTINGS or null in case of failure.
2	Start	***A type:*** void ***modifiers:*** - ***Parameters:*** - ***Description:***

		ResetShaderSettings event will cause the method, and the method marked with the flag AutoFindMaterial _autoFindMaterial and the script automatically download settings marked with the flag _autoLoadMaterialSettings.
3	OnDestroy	***A type:*** void ***modifiers:*** - ***Parameters:*** - ***Description:*** ResetShaderSettings event will cause the method, and the method marked with the flag SaveMaterialSettings _autoSaveMaterialSettings.
Methods		
1	AutoFindMaterial	***Return Type:*** void ***modifiers:*** public ***Parameters:*** - ***Description:*** The method searches for the material in the classroom or in the UI class MeshRenderer on site GameObject containing class Chromakey. The method will be implemented in the event Start at the flag marked _autoFindMaterial.

2	LoadSettingsFromFile	***Return Type:*** SETTINGS ***modifiers:*** public ***Parameters:*** string path ***Description:*** The method is downloading SETTINGS structure of the XML file. The file path is specified string path parameter. The method returns the completed structure SETTINGS or null. The method will be implemented in the Start event marked with the flag _autoLoadMaterialSettings, in this case, the file path is specified in the parameter _settingsPath.
3	FindMaterial	***Return Type:*** SETTINGS ***modifiers:*** public ***Parameters:*** MonoBehaviour monoBehaviour ***Description:*** The method searches for the material in the classroom or in the UI class MeshRenderer MonoBehaviour to set parameters monoBehaviour object. The method returns a reference to the Material or null.
4	ResetShaderSettings	***Return Type:*** void

		modifiers: public ***Parameters:*** - ***Description:*** The method performs a factory reset CKS shader to the default values. Method will be called in the event Start and OnDestroy.
5	GetMaterialSettings	***Return Type:*** SETTINGS ***modifiers:*** public ***Parameters:*** - ***Description:*** The method returns the current settings CKS material.
6	SaveMaterialSettings	***Return Type:*** bool ***modifiers:*** public ***Parameters:*** -

		Description: Method does save the current settings CKS shader file. The file path is specified by _settingsPath. The method will be implemented in the event OnDestroy marked with the flag _autoSaveMaterialSettings.
7	SaveSettings	***Return Type:*** bool ***modifiers:*** public ***Parameters:*** string path, SETTINGS s ***Description:*** The method performs a save SETTINGS s structure file string path.
8	Set2Material_ThresholdMax	***Return Type:*** void ***modifiers:*** public ***Parameters:*** float max ***Description:*** The method performs the setting of the upper threshold pixel transparency transparency mask. Transparency of pixels with the value max higher transparency will be set at 1.0f.

9	Set2Material_ThresholdMin	***Return Type:*** void ***modifiers:*** public ***Parameters:*** float min ***Description:*** The method performs the setting of the lower threshold pixel transparency transparency mask. Transparency with a value of pixels below transparency min will be set at 0.0f.
10	Set2Material_Kernel	***Return Type:*** void ***modifiers:*** public ***Parameters:*** int kernelCellsCount, float [] kernel; ***Description:*** Method installs coordinate array of active cells convolution kernel: kernelCellsCount - number of active cells convolution kernel from 0 to 50; kernel - convolution kernel coordinates of active cells from -2 to 2. The length of the kernel array must always be equal to 50.
eleven	Set2Material_MainSample	***Return Type:*** void

		modifiers: public ***Parameters:*** sAMPLE sample ***Description:*** Method installs settings structure 0-HSV range.
12	Set2Material_SamplesData	***Return Type:*** void ***modifiers:*** public ***Parameters:*** SAMPLE [] samples ***Description:*** Method installs an array of structures setting N-HSV ranges from 0 to 16 units.
thirteen	Set2Material_Settings	***Return Type:*** void ***modifiers:*** public ***Parameters:*** sETTINGS settings

		Description: Method installs all the settings from the SETTINGS CKS shader structure.
14	Set2Material_Smooth	***Return Type:*** void ***modifiers:*** public ***Parameters:*** float smooth ***Description:*** Method installs the blur strength transparency masks from 0.0f to 1.0f.

class SAMPLE

Fields		
1	option	***A type:*** int ***modifiers:*** public ***Default:*** - ***Description:*** Installing a variable bit sets use Active flags, Invert and Subtract: 1. Active - bit 1 (0001 ...); 2. Invert - bit 2 (0010 ...); 3. Subtract - bit 3 (0100 ...).
2	Active	***A type:*** bool ***modifiers:*** [XmlIgnore] public ***Default:*** ***-*** ***Description:*** Flag specifies use of a plurality of pixels in the construction of sample SAMPLE resultant mask transparency. Accessors get, set set setup and reading 1-bit variable option.

3	Invert	***A type:*** bool ***modifiers:*** [XmlIgnore] public ***Default:*** 0 ***Description:*** Inversion flag specifies a plurality of pixels SAMPLE sample with a plurality of image pixels. Accessors get, set and set the reading unit 2 variable bit option.
4	Subtract	***A type:*** bool ***modifiers:*** [XmlIgnore] public ***Default:*** 0 ***Description:*** Flag defines a plurality of pixels from the subtraction SAMPLE sample of the resultant transparency mask. Accessors get, set set setup and read bit 3 Variable option.
5	H_min	***A type:*** float ***modifiers:*** public

		Default: 0 ***Description:*** Variable determines the lower threshold value of the channel H (inclusive) for entering pixel sample SAMPLE.
6	H_max	***A type:*** float ***modifiers:*** public ***Default:*** 1 ***Description:*** Variable determines the upper threshold value of the channel H (inclusive) for entering pixel sample SAMPLE.
7	S_min	***A type:*** float ***modifiers:*** public ***Default:*** 0 ***Description:*** Variable determines the lower threshold value of the channel S (inclusive) to enter a pixel in the sample SAMPLE.

8	S_max	***A type:*** float ***modifiers:*** public ***Default:*** 1 ***Description:*** Variable determines the upper threshold value of the channel S (inclusive) to enter a pixel in the sample SAMPLE.
9	V_min	***A type:*** float ***modifiers:*** public ***Default:*** 0 ***Description:*** Variable determines the lower threshold value of the channel V (inclusive) to enter a pixel in the sample SAMPLE.
10	V_max	***A type:*** float ***modifiers:*** public

		Default: 1 ***Description:*** Variable determines the upper threshold value of the channel V (inclusive) to enter a pixel in the sample SAMPLE.
Methods		
1	SAMPLE	***The default constructor*** ***Parameters:*** - ***Description:*** The constructor initializes the variables with default values. Variable value option set to 1.
2	SAMPLE	***Constructor with parameters*** ***Parameters:*** int option ***Description:*** The constructor initializes the variables with default values. Option field value is set to the option parameter.

class SETTINGS

Fields		
1	smooth	***A type:*** float

		modifiers: public ***Default:*** 0 ***Description:*** The variable specifies the blur effect edge mask transparency. Value of the variable should be in the range from 0.0f to 1.0f inclusive.
2	threshold_min	***A type:*** float ***modifiers:*** public ***Default:*** 0 ***Description:*** The variable sets the value of the lower threshold pixel transparency transparency mask. Transparency with a value of pixels below transparency min will be set at 0.0f.
3	threshold_max	***A type:*** float ***modifiers:*** public ***Default:***

		1 ***Description:*** The variable sets the value of the upper threshold pixel transparency transparency mask. Transparency of pixels with the value max higher transparency will be set at 1.0f.
4	sampleMain	***A type:*** SAMPLE ***modifiers:*** public ***Default:*** The value is set by calling a constructor parameter value from SAMPLE equal to 3. ***Description:*** Variable sets a reference to an instance of the class settings 0-HSV range (setting range 0-HSV visible in the CKS material settings);
5	samplesArray	***A type:*** SAMPLE [] ***modifiers:*** public ***Default:*** An array of length 0. ***Description:*** Variable sets a reference to the array configuration class instances N-HSV ranges from 0 to 16 units.

6	kernelCellsCount	***A type:*** int ***modifiers:*** public ***Default:*** 1 ***Description:*** The variable specifies the number of active cells convolution kernel from 1 to 25.
7	kernel	***A type:*** float [] ***modifiers:*** public ***Default:*** An array of length 50. The values of all the elements are equal to the value float by default. ***Description:*** The variable specifies the convolution kernel coordinates of active cells from -2 to 2. The length of the kernel array must always be equal to 50.
Methods		
1	SETTINGS	***The default constructor*** ***Parameters:*** -

		Description: The constructor initializes the variables with default values.