author: Maciej Guba aka macgub web: http://macgub.co.pl - if this site not works, search the web for keyword 'macgub'. macgub@macgub.co.pl email: This application don't uses any particular 3d graphic library. Written from scratch in pure assembler. Thanks to all, who was helping me to do it. Especially: Jan Pawel II, Tomasz Grysztar, Madis Kalme, Mikolaj Feliks, Lostcauz, Brian Paul, Reverend, Pablo Reda, MHajduk, Ica, James Foley, Andries van Dam, Steven Feiner, John Hughes, Richard Phillips, tthsqe, J. Burkardt, Morgan McGuire, Pierre Bezier, Przemyslaw Kiciak and many others... Program is 32 bit, needs SSE4 extension, in full mode. When only SEE3 is present some functions are disabled. After run program shows dialog to open file. Choose file in 3ds or asc format. Program user interface buttons/keys description. Vocabulary: This words ad abbreviations I use as synonims: 1. triangles, faces, tris 2. vertices, points, verts 3. coordinate/es, coord/s 4. button/s, butt 5 displacement, displac 6. tesellation, triangulize, triangulate 7. program, app 8. cooeficients, cooefs Main content: Many GUI buttons is based on cyclic switching between options ex. 'rotary', 'dr.model', 'bumps', 'texture'.. When last option is achieved, after next pressing button - first option is switched. This buttons have /flag/ - see yellow marked flag example on picture I inserted after next few text lines - short description of option currently switched for example. 'rotary' button have /flags/ - 'y', 'x', 'z', 'cust'. Which means rotate around axis y, x, z and custom rotary using mouse. Some buttons have no /flag/, after pressing such button only one operation (block of operations) is (are) performed. Such buttons are for ex. 'zoom in', 'zoom out', 'ran. light'. Moreover some options are available parallel, after pressing button or hitting keyboard key. For example choosing render model may be performed through 'dr. model' menu button or space key. Some operations have no GUI button, only key, for now such operations are: X key load texture, N key - load new 3d object, M key - join object 3d to current existing. All key only operations are OS dependent file loading operations. App window is divided to: /main part area/ – with displayed current model and eventually some help temporary ex edit decorations, see flat shaded tyres fragment on screen shot below; /buttons area/ - on right side of window, marked using red rectangle on picture /info area/ - marked by blue rectangle, this area contains some information about mesh – vertices, faces, edges, manifold chunks and others (current) numbers; /Next edit area/ - violet rectangle, allows modify and (local) manipulation on mesh. do displ. speed idle rotary y do triang. mot. blur off Rm unu ver cur object file Long pipe zoom in off rand. shd. Lp segs cn zoom out p.xy edit mesh. Lp Bez/Bsp Bezr tex. mapp. off Lp quality 1 ran. light set t.area off set t. col whit NextM edit off dr. model rand dsp factor 1 Rm red ver bumps str. bezier sr. Draw norm. off texture off set ap tol 2 Z rdu care on save obj. run / stop stop b.der.edit off Rm ins fac culling off t&d whipos whol Ma Coll Ed off Srch Chunk off Rm dead tr Zero Next Sm ins edg Rm cracks Mirror ch. off Clip faces Tes Wh/Tar Whol Shadow off Invert chn off Show chunk off FFD off Crop front tex + Del. chunk off tex -Ray shdows off fix norm V Tes TIV IE make serie Mark in vr off sort chunk Rm TIV NIE Submit obj Separate chunks number: Unique edges: 117 36237 Faces: 14462 Vertices: 8972 Below I try write some information about GUI buttons. Keys / GUI Buttons description (under left mouse button click): SPACE key / 'dr. model' button - switching between displaying models: flat, smooth shading, spherical environment, texture, bump, smooth + texture, two texture and bump + texture mapping parallel edges only (smooth shaded, textured lines), flat with float single precision Z coordinate, point light with shadow light position dependent, real Phongs shading with float normal vector

Ave Cruce Salus Mea

routines.

compiler: flat assembler

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program: Win3ds35 - *.3ds / *.asc files viewer + demonstration of

several graphics effects + tiny based on Bezier curves and

patches 3d objects editor + some manipulation on 3d mesh

T / 'do triang' - to triangulate the faces of objects; i.e. to divide each face into four smaller faces. Possibility enable tessellation from a separate area - see 'set t. area' button description. Some info related: 'Tes Wh/Tar' button - Sets the flag of this button to 'tesA' -> tessellation from selected area. Flag 'Whol' means tessellation of the entire object after pressing the button described in this

paragraph ('do triang.'). 't&d wh|pos' button - Sets the flag of this button to

'whol' - tessellation of both positive and negative coordinates from vertices based on faces... To apply the correct iteration of the tessellation of only a portion of the object, removal of all cracks (see "Rm cracks") is mandatory, all

'posi' means tessellation of only the positive (+) coordinates of the vertices. Flag

U / 'rand. shd.' button - random point (spot) light position and obliquity of

V / 'edit mesh.' button - edit option, possibility to edit according to vertex,

W / 'set t. area' button - set tessellation area - default is whole screen

plane on which shadow falls. Use 'Shadow' button to display.

available options - black 0x00000000, white 0x00ffffff.

single face or edge. Use left mouse button and yellow handlers.

D / 'do displ.' - do displacement mapping texture dependent.

interpolation... Description of actual displaying model on bar located at top of

F1 / 'mot. blur' button - motion blur on/off.

heart (Sanctissimi Cordis Christi) and tetrahedron.

spherical (planar according to axis X, Y, Z).

and optimize chunks - use 'sort chunks' button.

F9 / 'Culling' - backface culling on/off.

- use mouse and hold it left button.

cracks must be removed.

(some margin is not used).

button description).

pipe' button.

only one.

shorter.

currently displayed.

segment).

F11 / 'run/stop' button - main rotary on/off.

from external file (X key).

F3/F4 and +/- keys / 'zoom in/out' buttons - no comment.

TAB / 'ran. light' button - generate three nonlinear directional lights (Phongs

F2 / 'cur object' - cyclic switching between objects - from file and predefined:

F5 / 'tex. mapp.' button - choose bumps also texture mapping planar or

F6 / 'bumps' - switching between random bumps and texture dependent.

F7 / 'texture' - select texture: red white stripes, xored face also blank (which can be used in smoothing objects edges). App also allows load texture

F8 / 'save obj.' - save 3d currently shown object to file "object.asc" and "object.3ds" in current folder. Possibility to save file above 65535 particles (tris, verts) in 3ds format. To for attempt to correctly use this functionality - first sort

F12 / 'rotary' - main rotary cyclic switching - around axis X, Y, Z and custom

app window.

illumination).

F / 'dsp. factor' - set displacement factor, determine displaced bumps that make displacement higher or lower.

B / 'Bezier sr.' button - select Bezier patches, which will be calculated and displayed. Now are predefined four Bezier-patch objects - tea pot, tea cup, tea spoon and a cube. Possibility to edit such patch based object, (see 'b.der.edit'

A / 'set ap tol' button - set approximation tolerance when removing redundant vertices is launched. When vertices are enough *near* they may be collapsed using 'Rm red ver' button. 'set ap tol' button sets haw much near vertices to collapse should be. This button also determine spaces between

cloned/copied object (see 'make serie' button description). Also using this button user can change pipe diameter. This operation is performed after hitting 'Long

E / 'b.der.edit' button - draw Bezier derives, selected by B key, 'Bezier sr.'button. Possibility to edit Bezier patches by stopping animation (button 'run/stop') and move yellow bars with pressed left mouse button, when left

C / 'set t. col' - set color that will by bypassed when displacement occurred,

button is released new position of bar and is accepted. Bezier patches are recalculated permanently. To achieve previous geometry restart app. 't&d wh|pos' button - when displacement is performed (use butt 'do displ.' for diplac) determines which part of object is affected. Flag -> 'posi' - only positive 'z' coefficients vertices are affected, if set on flag -> 'whol' all vertices are affected during displacement process.

S / 'speed' button - toggle animation speed. Flags 'idle', 'full'. Some rendering models use only two threads, some four, a few displaying models

'Rm unu ver' button - remove unused vertices, other words remove this vertices that indexes are unused in triangles list. This option make vertices list

P / 'Long pipe ' button - make long multi segment pipe based on Bspline or Bezier curve. If flag appropriate to this button is equal 'edit' -> editing pipe mode is switched - hold left mouse button on yellow bar - moving node, hold right mouse button and move mouse - rotate pipe project. By pressing once again 'Long pipe ' button -> set flag 'calc' - calculate and render pipe, diameter

according to flag of 'set ap tol'. After next pressing 'Long pipe' butt base object is

'Lp Bez/Bsp' button - determine type of curve that is base to making long

'Lp quality' - determine long pipe object quality (triangles count per

'culling' button switch backface culling default set 'off'.

pipe object. Flag options 'Bezr' - Bezier, flag 'Bspl' - Bspline type.

'Lp segs cn' menu button - determine long pipe segments count.

H / 'NextM edit' menu button - Draw /Next edit area/ that allow basic edition on Next 3d object - joined to earliest loaded mesh (use key 'M'). Draws bar I called /Next edit area/ below menu buttons and info area. If flag appropriate to this button is set on 'Nx. o': blue bar on this /Next edit area/ determines 'X', 'Y' position, violet bar determines 'Z' position, yellow bar determines scale of loaded freshly new part of mesh, red bar position - allow rotate around center point this part of 3d object, green bar allow nonregular scale, only along 'X' and 'Y' axis. White bars - set bend process of object, Bezier (white dots) curve dependent. Moving bars (with mouse and its left button) perform change parameters described above. Only vertical position of violet and yellow bars can be changed.

If flag appropriate to this button is set on 'chun' it enables separate chunk edition possibility. Press 'Show chunk' button and set its flag to 'on' - app will display bar

button on bar and choose current chunk you will edit. Colored bars on /Next edit area/ now describes chunk editing possibilities. If flag of 'NextM edit' button is

'Rm red ver' button - removing redundant vertices, according to approximate

tolerance value (use 'set ap tol' button to set this value). Removing redundant, enough near vertices option is processed only on verts placed in tessellate area -

O / 'Draw norm.' button - when flag of this button is set on 'tri.' drawing faces (triangles), when on 'vert' drawing vertices dependent normal vectors.

R / 'Z rdu care' button - when set 'on' - take care about 'Z' coefficient of vertex during remove redundant vertices operation, when flag appropriate to this button shows 'off' during collapse enough *near* vertices process, care on only on 'X' and 'Y' position of vertex. 'Rm red ver' button - perform removing redundant

'Rm ins fac' button - try to remove inside faces - that are covered by other faces outside mesh. This operation reduces faces and vertices number. Removing operation is solved by multi time rotating and projecting on about 1000x1000 pixels area (not displayed), works correct when projected front triangles area is not smaller than 1 pixel. Currently operation uses 4 threads. Be patient - it take some time no matter how complex is 3d object. (But calculations on bigger

objects, that contains many vertices and faces for sure will take bigger period of

'Ma Coll Ed' button - mark and count - number displayed on /info area/ collided edges. It means edges that intersect other triangles. Flags allowed for button 'off' and 'on'. This operation will be slow on very complex objects. Brute

'Srch Chunk' button - search for separate manifold chunks. Try find edge of triangles that are adjacent one to another. It mean form one of such triangle is possible "go" to other triangle along its edges (I promote to vertices) to other triangle from separate chunk. Chunks are counted, number displayed on /info

'Sm ins edg' button - smooth inside edges. This option try simplicity mesh. After removing inside faces (which is also simplification option), inside edges of adjacent to faces/triangles that are removed, are usually jagged. This option try to fix such situation. Some small margin is leaved. Option require correct senses

'Clip faces' - clip faces that are in triangulation (tessellation) area. Such area

'Invert chn' button - invert sense of normal vectors in one separate chunk. Pause animation using 'run/stop' button and switch 'Show chunk' button flag 'on'.

center of each triangle, separate to each chunk) and click with left mouse button. Senses of all normal vectors in whole chunk you have chosen will be reversed.

'Crop front' button - crop front (of view area) faces, some small margin (a

'Del. chunk' button. - By pressing this button set its flag to 'Del.' - ability to

delete separate chunk. Pause animation using 'run/stop' button, move mouse cursor on unique triangle mark (bar with unique color, in center of triangle,

separate to each chunk) and click with left mouse button. Selected chunk will be deleted. Object parameters verts/faces/edges/chunks will be recalculated after

'Ray shadows' button - calculate and display ray casted shadows of mesh.

'Tes TIV IE' button - tessellate (triangulate) triangles with at last one inside vertex and at last one edge that intersect. First 'Ma Coll Ed' - mark collided edges

This option is done on 4 threads. To see shadows, object must have proper geometry. Part of mesh cover other objects parts – this parts are hidden to impact of light ray. Operation use three points light sources. Non realtime on

Than move mouse cursor on unique triangle mark (bar with unique color, in

force n to n solving method. Process use 4 threads for now.

on every triangle, unique to chunk possessed this tri. Click with left mouse

set on 'whol' - now user can do modifications on whole object.

set this area using 'set t.area' button.

vertices operation (merging vertices).

time).

area/.

of normal vectors. May be slow.

can be set using 'set t. area' button.

few degrees in each direction) is leaved.

each delete operation.

complex objects.

save memory space.

button.

flag/value.

light' displaying model.

button to drag yellow bars.

buggy.

details.

ESC key - exit.

and 'Mark in vr' - mark inner vertices buttons flags must be set 'on'. Don't forget about removing cracks from triangle net ('Rm cracks' button). 'Mark in vr' button - searching for inside vertices option. Vertices are counted. This value is displayed on /info area/ - below buttons menu area. Calculations may take some time - are done using many parallel projections.

'Rm TIV NIE' button - remove triangles with at last one inside vertex and

'Rm dead tr' button - some triangles have duplicated, or even tripled index of vertex - so it geometric representation is line, or point - remove such triangles to

'Rm cracks' button - remove cracks. After tessellation of chosen area of object (not whole) may take place such unneeded artifact: Along edge may occur vertex that only touch edge but is not possessed by this edge. Routine appropriate to this button cure this situation. Only vertices that are in the middle of edge are computed, so operations may require repeating to patch all cracks. Removing all cracks is obligatory to iterate correctly tessellation/triangulation operation when not whole object is affected. See 'do triang.' button description.

'Tes Wh/Tar' button - set flag tessellation mode (under 'do triang' button) if flag of this button is set to 'tesA' -> area tessellation. Setting flag of 'Tes Wh/Tar' button to 'Whol' means whole object tessellation after pressing button 'do triang.'

'Show chunk' - show manifold chunks bars, color is individual for each chunk.

'tex +', 'tex -' buttons - changes 'zoom' of texture mapping. Visual effect

'fix norm V' button - fixing normal vectors option - Do random rotary and

'make serie' button - make copy of current object, and display this copy with

'sort chunks' - sort triangles list according to detected manifold chunks. Also

increased current 'X' coord value - this value determines 'set ap tol' button

parallel projection two times with disabled and enabled backface culling. Triangles that was rendered first time and not second time have non correct sense of normal vector. (Render operation is performed only in inside memory area, not displayed on screen.) Pressing a few times this button make possible cure mismatched sense of normal vectors. Use this option when mismatched normal vectors are inside separate chunk. If whole chunk has uncorrected

may be different in various rendering models - (clipped/tiled/..).

normal vectors - better use 'Invert chn' option and button.

Chunks may be found by 'Srch Chunk' button.

without any intersected edge. First 'Ma Coll Ed' -> mark collided edges and

'Mark in vr' -> mark inside vertices buttons flags must be set 'on'.

do chunks structure - describes min, max, middle vertices coordinates in chunk. I tried rearrange vertices list - tried perform situation when every chunk has one continuous part of this list. But now it's to buggy. 'Submit obj' - this button allow submit changes after /Next edit area/ (ex. separate chunks edition) and after free form deformation. See 'FFD' button description. 'Zero Next' button - allow set Next variables - showed as color bars on /Next edit area/ to its start position. Also FFD (free form deformation) patch net will be restarted.

'Mirror ch.' - allow perform mirror X axis depend reflection of chosen chunk. First display chunks using 'Show chunk' button. Set flag of button I describe in this paragraph to 'on' and click mouse left button on bar visualize chunk you want to mirror. Mesh geometry will be changed, chunks count will be increased.

'Shadow' - display flat shadows on current texture - like in 'Shadow + spot

'FFD' button - allows free form deformation based on single Bezier patch. Green derives are displayed - possibility to deformation model using left mouse

X key - load texture (raw format 512X512 pixels 24bit 0xRRGGBB). I tried

M key - load new mesh and join it to the old. Possibility to edit position of

fresh load mesh using 'NextM edit' button. See description of this button for

bmp format, (uncompressed 24, 8, 4bit win and os2 versions) but it is very

N key - load new mesh (old will be abandoned).

all drawing models, but is visible only in texture displaying models). General note about implemented operations. - Some of it may run terrible slow especially on 'large' objects. Maybe some tests for low detail objects may prevent your speed disappointing. Note that even operations on small objects

may be slow, because way of solving problem. Its 32 bit app, so object above ~10 000 000 vertices/faces may be too big for 4GB RAM limit - some operations

Right mouse pressed button and move - setting position of texture, (works in

allocate temporally many memory (because using memory greedy pivot lists). Many operation cannot be launched parallel in the same time (ex. editing chunks / Bezier patches / long pipes). "No work is ever complete, and this one is no exception." Pierre Bezier