Subject: New US dollar coin designed in IDL (details) [LONG].
Posted by D. CARR on Wed, 04 Mar 1998 08:00:00 GMT
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There has been a fair amount of interest about my IDL coin design project, so I'm going to respond to the questions in this post. The first part is IDL related (how I created the images). The second part is comments about the design itself (not directly IDL related). Please ignore the second part if you are not interested.

PART 1. How it was done.
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davidf@dfanning.com (David Fanning) writes:

> Wow, this is spectacular! But done in IDL!?
>
> P.S. I've known Dan for a long time and always admired both
> his artistic *and* IDL programming skills, but this seems to
> take both to a new level. Please, Dan, show us how you did
> this! It's enough to get me studying that damn Object
> Reference manual again to see what *else* I've missed. :-)

Hi David, thanks for the compliment !

I'm sure many other IDL users are curious about how this was done as well. So, I'll discuss the details here. Before I do that, I'd like to mention two things first. First, I am an RSI employee, but I am participating on this list in an unofficial capacity to discuss my coin project, which was performed on my own time, at home, and on my own PC. Second, I must say that it wasn't exactly easy.

The main piece of software behind this, is a widget-based "CAD" application I built using IDL and object graphics. Originally, this CAD application was written because it was required as the basis for an application being developed for an RSI customer. This code (some 15,000 lines) is owned by RSI. Future plans for this code have not yet been determined by RSI. For now, I "play" with it at home (performing QA as I go). In addition, several specialized algorithms were required to do the coin. Those were written at home, as needed.

Basically, the coin is a collection of polygon objects.
However, each different element in the coin's design required a different approach. A few examples:

Obverse/Reverse Background:
To get the highly "lustrous" but smooth look to the coin's field, a special algorithm was used to generate those polygons. First a set of 3D points was generated, starting at the center of the coin, and moving out towards the edge in a radial direction. These points form half of a "dish" shape (in the Z dimension). A duplicate set of points was generated and then rotated a small amount about the Z axis (center of the coin). These two "vectors" were then passed to the IDL "MESH_OBJ" routine to create a "ruled" surface. BTW, I wrote "MESH_OBJ", and it is part of the IDL distribution, in the "lib" directory. 180 of those ruled surfaces were created and then packaged up into IDLgrPolygon objects. In turn, each polygon object was added to an IDLgrModel object.
Each model object was first rotated about the X axis (to tilt the surface off the X-Y plane).
Then the surface would be rotated into position about the Z axis. The end result of this is that the coin's field is made up of many small "slats". The slats at about 5:00 and 11:00 are laying on the X-Y plane. The slats at 1:00 and 7:00 are angled towards one of the light sources at the upper left. This caused some restrictions, however. If the coin were rotated too far off the X-Y plane, it would be possible to see through the slats causing some rendering artifacts (like looking through a set of mini-blinds).
You may be wondering why I didn't just create a flat surface or a fully closed "sawtooth" surface. I tried the flat surface, but it made the coin look "flat". It lacked the radial "mint luster" effect on most newly minted coins.
I also tried a sawtooth surface, but it caused considerable aliasing problems.

Finally, all the model objects were added to a single parent model and the parent model was saved to a file using the "SAVE" command.

All of the above processing was performed by the special algorithm. Once the save file was created, it was interactively loaded into the CAD application just like any other CAD model. The benefits of the CAD application were many, including the ability to manipulate (edit, scale, rotate, translate, etc.) and render the objects with different colors, views, lights, etc.

Astronaut:
I used my home scanner to scan in a photo of an Apollo

astronaut. The CAD application allowed me to create a flat rectangular surface with this image as the surface colors (effectively warping the image onto a plane). I then used the mouse to freehand draw polygons on top of the astronaut image. I assigned different Z depths to each polygon, representing the desired relative height I desired for the final sculptured surface. There were about 150 polygons total, at about six different Z depths. I then saved the polygons to a model file. I then wrote a specialized routine which opened up the CAD model file and extracted the polygons. Then, using a combination of smoothing, "bulging", and interpolation, a 2D array was generated. This 2D IDL array contained the Z height for the astronaut surface. This surface array was then passed to MESH_OBJ to create a "rectangular" surface. The output from MESH_OBJ was a vertex list and a polygon list. The algorithm then searched through the polygon list finding the "background" polygons whose Z values were below a certain threshold. The corresponding entries in the polygon list were set to zero, effectively "hiding" the polygons within the rectangular surface that were not actually on the astronaut. The algorithm then packaged up the polygons and saved them to a model file suitable for loading into the CAD application.

Back in the CAD application, the astronaut model was loaded (effectively merging it with the current coin background model).

UNITED STATES of AMERICA:

The CAD application was used to create a flat polygon model for each required letter on the coin. The USA letters were then laid out on a horizontal baseline and then the whole thing was saved as a CAD model. Another algorithm processed that model outside the CAD application and generated a polar surface. This polar surface was created using "MESH_OBJ", specifying the minimum radius, maximum radius, and the starting and ending sweep angles. The Z coordinates of the polygons along the outer radius were increased, to follow the dish-shaped contour of the coin's surface. Again, these polygons were saved to a model file, and then loaded into the CAD application.

Eagle:

This was similar to the astronaut, except that I scanned in an old freehand sketch that I had done. Then, I used a "paint" program on my PC to touch it up. I used various shades of gray representing the desired Z height. The paint

image was then saved to a "tif" file and then processed by
another algorithm to turn it into a model file.

Edge:
This was easy since it was done interactively, completely
within the CAD application.

The coin was rendered in a variety of ways. Actually, all of
the polygons are white. It is the lights that supply the color.
There is one low intensity "yellowish" ambient light, a medium
intensity "silver" directional light (from the upper right),
and a stronger gold colored light from the upper left.
The "proof" versions are identical, except that before rendering,
in the CAD application, the background surface color was changed
from white to black. (See below for a discussion of proof vs
circulation).

steinhh@ulrik.uio.no (Stein Vidar Hagfors Haugan) writes:

> Now, I'm not a US citizen, so I can't really "push" this
> design to any elected official - but I strongly urge people
> to take a look at the web page - the design is very good,
> and the images are stunning!
>
> One great thing would be to publish the code, and maybe
> allow people to add a twist to it - like rotating the
> thing with the trackball-thing etc. And imagine creating
> a screensaver with one of these rotating coins floating
> around!! Makes me proud to be an IDL user.... :-)

Thanks !

I thought about making it into a VRML file (or whatever) so
people could "spin" the coin themselves, but there are too
many restrictions. The big problem is that the model file
is *HUGE* (lots and lots of polygons). I built the coin
one half at a time. The obverse is saved in one model file
and the reverse is saved in another. The obverse file is
18 megabytes and the reverse is about 27 megabytes.
The CAD application has a "track ball" type rotation built in,
but on my home PC it takes about 20-30 seconds to render the
obverse (too slow for dynamic rotation). BTW, my PC is a
266mHz Gateway. On some platforms which support hardware GL,
it could be possible to rotate the coin in "real time".
I am in the process of making an MPEG movie of the coin
rotating around (see below).

I recently got an email from someone on rec.collecting.coins .
They wondered if my software could allow me to simulate what
the coin would look like as it got worn down in circulation.
I hadn't really thought of that before, but decided that it
was a neat idea. The new IDL 5.1 beta version has a feature
allowing the contents of the Z-buffer to be read (similar to
how you can read the depth information from the direct graphics
Z-buffer). I installed the 5.1 beta at home and proceeded to
modify the CAD application code so that I could render the coin
and then save the Z-buffer contents to a file. I wrote yet
another special procedure to read in this data. It then used
a combination of smoothing and minimizing to simulate the wear.
The procedure then generated about 50 model files for each
step in the wearing down process. I then, in turn, loaded
each of those models into the CAD, rendered them, and saved
them as "JPEG" files. Because these models were the output
of an "integer" device (Z-buffer) and because they are at a
relatively low resolution, they lack the "mint luster" effect
of the original model. However, the resulting images look
interesting. The lower grades (higher amounts of wear) look
very much like real coins that have been in circulation a long
time.

I have just put some of those images on the web page:
www.rmi.net/~dcarr/dollar.htm

I have also created some "MPEG" movies using the new "IDLgrMPEG"
output device in IDL 5.1 (beta). These MPEG movies show the coin
wearing down, as well as spinning around. Look for them on the
web page soon (MPEG viewer required).

PART 2. Comments about the design.
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haferman@table.jps.net (Jeff Haferman) writes:

> What is the difference between the "proof" and "circulation"
> versions?

The circulation version (sometimes called a "business strike")
is the coin as intended for circulation. The "proof" versions
are made from specially prepared, highly polished dies. This
gives the coins a highly mirrored background. The proof coins
are generally sold only to collectors. Each year, for example,

the US mint sells a million or two "proof sets". These sets contain proofs of each coin from the 1 cent coin up to the half dollar. The mint sells them for about $20. Some go down a bit in value, and some go up in value. In a few years the proof sets will also contain a one dollar proof. The Mint will probably raise the price for proof sets when that occurs.

sb@early.com (Jonathan Boswell) writes:

> The design is unusually good, and I hope yours flies. But
> can you tell us if this new coin is going to be the size of
> a quarter, like the loathsome SBA coin? Clearly your design
> needs massive real estate for greatest effect.

Thanks !
This new dollar is going to be the same size as the SBA dollar so that it will fit in any vending machines that currently accept the SBA dollar. Some vending machines do use them, like at US Post Offices. The US Treasury has been dispersing the remaining stockpile of SBA dollars by giving them out as change at Post Office vending machines. The stockpile will run out in about 30 months.

The legislation authorizing the production of the new dollar specifies that it will be a different color (gold) and have a distinctive edge to help visually differentiate it from other coins. It didn't help the SBA much that not only was it similar in size and color to the quarter, but from a distance, the Anthony portrait looked a little like George Washington.

I think it is ture that just about any coin design works better on a larger surface. I think my design would work fine on an SBA-sized coin. The only problem area might be the two seals on the reverse (the lettering on them is small). But, take a look at a penny. On the back, at the bottom left corner of the monument are the small letters "FG" (you may need a magnifying glass). These are the designer's initials and they stand for "Frank Gasparro" (former chief engraver of the US Mint). Those letters are actually *smaller* than the lettering on the seals of my coin would be.

> From an aesthetics point of view, I prefer the design without the "E PLURIBUS UNUM" and "IN GOD WE TRUST" mottos, but current US laws require them on every US legal tender instrument.

Joe <J.M.nospam.Zawodny@LaRC.NASA.gov> writes:

> Lastly, while the design is pretty to look at, it does not live
> up to the "author's" wish that it 'look to the future'. Consensus
> here upon showing it to a number of folks without any introduction
> is that they respond 'Oh, is that a Moon Landing comemorative?'

It is true that even my design uses an image from the past.
I debated using a space shuttle or some other space related item
from the future (who knows what that would be). US coinage during
the last 100 years has had a strong tendency to "commemorate" things
(mostly former presidents). In the end, I decided that the Apollo
astronaut on the moon is an instantly recognizable symbol around the
world, and that was the most important factor.

********** **********

However, there is a futuristic theme to this design which I did
not point out on the earlier version of my web page. The 13 stars
represent the original 13 US colonies (like the 13 stripes on our flag).
THE ASTRONAUT STANDING IN FRONT OF A FIELD OF 13 STARS IS MEANT TO
SYMBOLIZE THE FUTURE COLONIZATION OF SPACE.

********** **********

bowler@eisner.decus.org writes:

> Sorry to disagree but as a casual numismatist, I've got to say it's
> got some nice features, but it's close to one of ugliest coins
> I've ever seen.

I have received numerous emails about my design from different sources,
many from outside the field of numismatics. Of the responses that I
have received so far, about 75% support the design. About 25% like
the design but may have other preferences. Only one
response (above) flat-out didn't like it.

The majority of those 25% (and the one negative response) are
coin collectors. There are many examples of beautiful circulating
US coins featuring an allegorical figure of "Miss Liberty". The last
of these coins was produced in 1947. Coin collectors (myself included)
appreciate these designs as works of art. I think many collectors
would like to see these types of designs return on circulating coins.
The US Mint realized that coin collectors really like some of the
earlier designs, so they adopted them for use on the current US bullion
coins to improve sales. This probably worked, since a healthy
percentage of the bullion coins are sold to collectors. But taken as
a whole, there is something lacking about the modern renditions.

They just don't compare with the originals.

The era when people recognized a "Liberty Head" figure is gone. That was a completely different time when coinage was an art and coins were produced in much smaller quantities, with great attention to detail. Today, the US Mint must stamp out coins at a phenomenal rate (trillions per year) to keep up with demand. This places numerous restrictions on the type of design used. I shudder to think what a resurrected Liberty Head would look like on a modern mass-produced circulating coin. In today's culture, a "Liberty Head" design means nothing to the general public outside numismatics. There is virtually no chance of it ever being used on a circulating US coin again.

There is, however, a serious proposal right now to use a Statue of Liberty design for the new dollar. This may end up the chosen design unless support for my astronaut design continues to grow strongly. I have nothing against the Statue of Liberty design, except that (to me anyway) it is not particularly inspiring. It is a great symbol (a gift from France to the US). But, it is difficult to do that tall figure justice on a coin. An image of the Statue's head is already in use on the US platinum bullion coins. Actually, if it could be done all over again, it might make sense to use the astronaut on the platinum coin, and the Statue of Liberty on the dollar.

Imagine, however, taking a Statue of Liberty dollar and an Astronaut dollar into a 6th grade classroom. Which design do you think would make the kids go "wow, cool !" ?

I look at it this way:
The United States has accomplished something that no other country has ever been able to do. Why not use it as a national symbol, just like the flag, the eagle, and the Statue of Liberty ?
