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## THREE LAYER WIND VECTORS FOR WEATHER FORECAST PRESENTATION USING OPENGL

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**ABSTRACT:** This paper describes about the implementation of wind vectors over the globe in different layers using OpenGL. OpenGL is graphics software API used to draw geometrical objects, by making use of many routines/libraries. One of the interesting features of OpenGL is texture mapping and has been implemented in this work.

### 1.INTRODUCTION

This paper concern about the plotting the wind vectors in 3D graphics and the necessary software for the same has been developed. The advantage of plotting the wind vectors in 3D is that we can form many layers of wind vectors. This software plots maximum three layers of wind vectors above the globe.

We are using OpenGL package<sup>[1]</sup> to visualize wind vectors over the globe. OpenGL<sup>[2]</sup> has provided good interface to visualize any object on the computer screen.

This software was developed step-by-step starting with the drawing of sphere, rotating the sphere, texture mapping and then the wind vectors over the globe.

Figure 1 shows the 2D world map, which is texture, mapped over the sphere and the texture-mapped globe is as shown in figure 2.

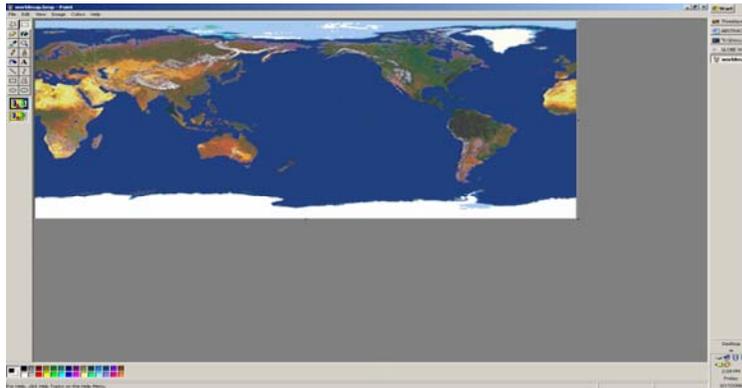


Figure 1

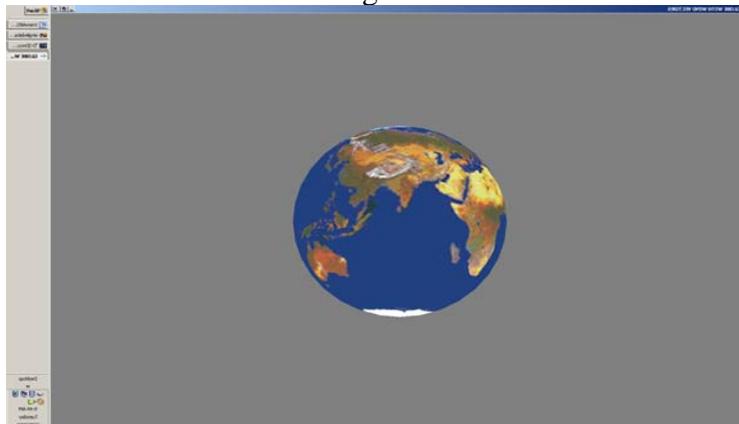


Figure 2

The advantage of showing the wind vector in three layers is,

1. Each layer can be visualized with distance.
2. Easy to analyze each and every layer separately.

## **2.DEVELOPMENT ENVIRONMENT**

Hardware : Pentium IV, 256MB RAM, 40GB HARD DISK, 1.6 GHz

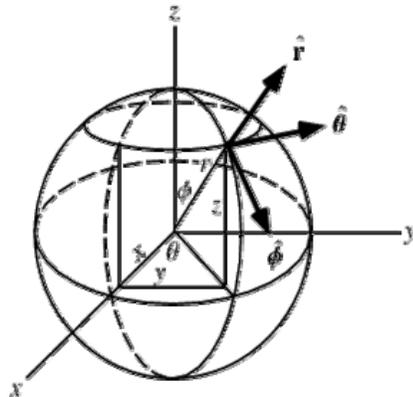
Software : Visual C++ version 6.0 , Windows 2000, OpenGL version 1.1

**Product Perspective:** The three-layer architecture of wind vectors accepts weather data (wind vector components) as an input and frames the arrow over the globe. The arrows are represented with different colors (maximum 25 colors are supported currently).

Spherical coordinates, also called spherical polar coordinates, are a system of curvilinear coordinates that are natural for describing positions on a sphere or spheroid. Define  $\theta$  to be the azimuthal angle in the x y-plane from the x-axis with  $0 \leq \theta < 2\pi$ ,  $\phi$  to be the polar angle from the z-axis with  $0 \leq \phi < \pi$ , and  $r$  to be distance (radius) from a point to the origin. This is the convention commonly used in mathematics.

In this work, following the mathematics convention, the symbols for the radial, azimuth, and zenith coordinates are taken as  $r$ ,  $\theta$ , and  $\phi$ , respectively. This definition provides a logical extension of the usual polar coordinates notation, with  $\theta$  remaining the angle in the x y-plane and  $\phi$  becoming the angle out of that plane.

### Spherical coordinate



## **3. SOFTWARE TESTING**

The following are the important functions, which were considered for testing the software.

1. FIND MIN / MAX (...)

I/p parameter	Testing i/p	o/p parameter	Calculated o/p	Tested o/p
Longitude div	3	Max Data	8.485	8.48528
Latitude div	2	Min Data	1.414	1.41421

The above table gives details of input and output to find the wind vector magnitudes

2. FIND CO-ORD (...)

TESTING INPUT

	Latitude range	Longitude Range	Long. Div	Lat div.
Test i/p	0	50	3	2
	45	110		

TESTING OUTPUT

	Phi min	Phi max	Theta min	Theta max
Calculated	-0.78539	-1.5533	0.87266	1.91986
Tested	-0.785398	-1.55334	0.872665	1.91986

The above table's gives the details of available inputs, obtained outputs, testing inputs, calculated outputs, tested outputs to find the screen coordinates. Flowchart with all functions used will be presented in the main paper.

#### **4. APPLICATIONS**

The application of this software is in Meteorological Science. This software is used in weather predictions presentation. This software displays wind vectors of three layers at three different heights (pressure levels). Wind vectors with different speeds are plotted with different colors. So it is easy to analyze.

The wind vectors and the globe can be rotated simultaneously to take a look at the wind vectors on the other side of the globe. It can be rotated on the four side to view the top and bottom of the globe. Figure 3, Figure 4, Figure 5, Figure 6 shows first layer, Second layer, Third layer and all the three layers of wind vectors over the globe respectively

The texture mapping which is one of the important feature of the OPENGL is made use of here. Texture mapping is a method of adding realism to a computer generated graphic. An image (the texture) is added (mapped) to a simpler shape that is generated in the scene, like a decal pasted to a flat surface. This reduces the amount of computing needed to create the shapes and textures in the scene.

The limits of the software are :

1. It accepts only BMP images
2. It accepts 8 bit and 24 bit colored BMP images only
3. The image should not be compressed
4. The format of the data file is limited

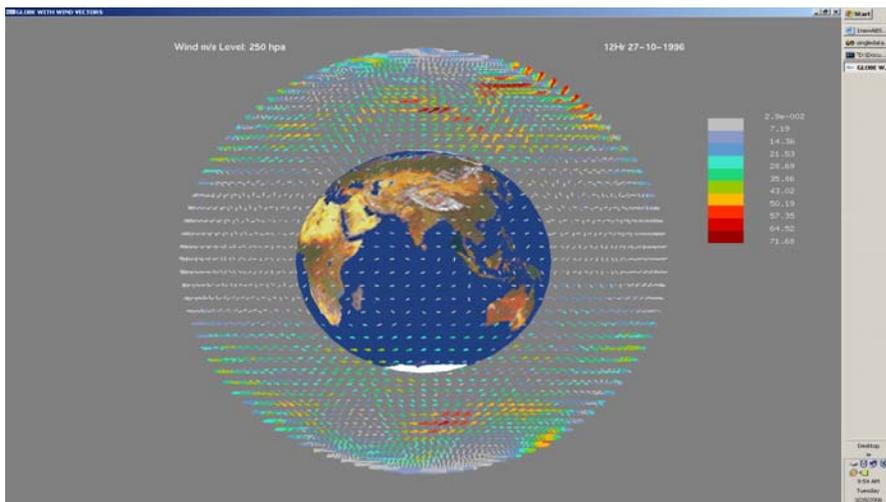


Figure 3

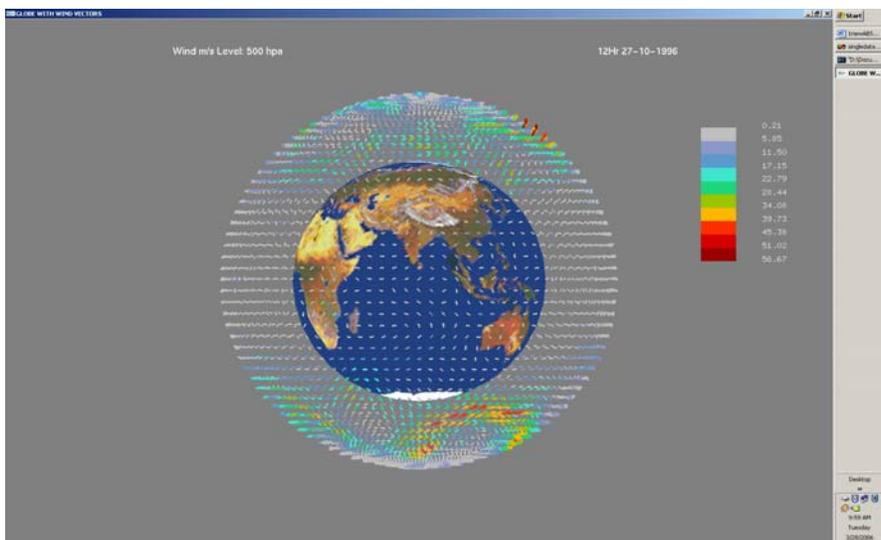


Figure 4

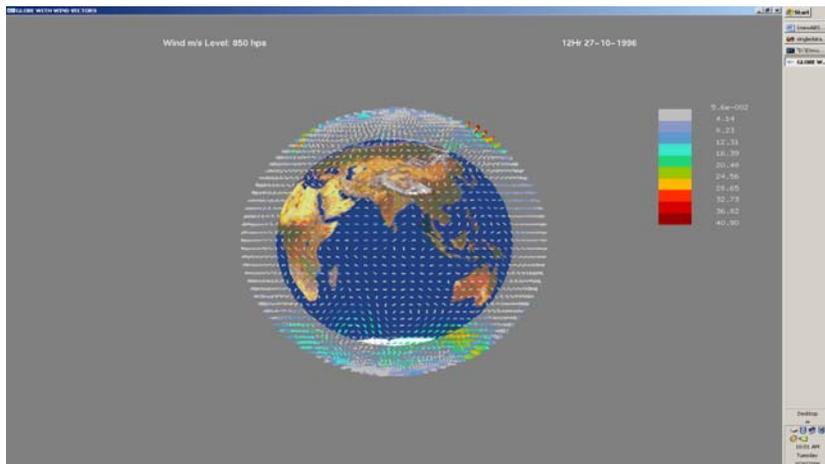


Figure 5

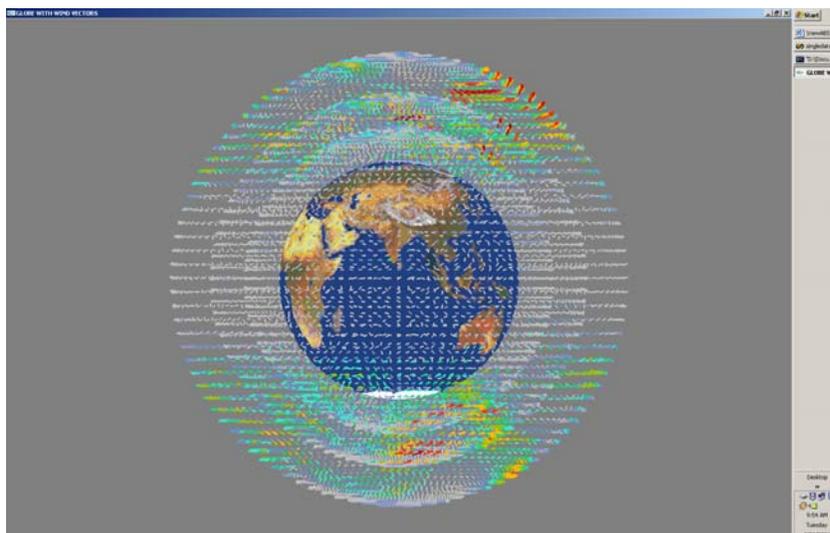


Figure 6

## **5. CONCLUSION**

Plotting of wind vectors over the globe makes us visualize the wind vectors in three dimensions. This software developed helps in weather prediction presentation. Wind vectors are analyzed and they are grouped into different levels and they are given separate colors.

## **6. ACKNOWLEDGEMENT**

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## **7. REFERENCES**

1. Edward Angel : *“Interactive Computer Graphics”*
2. Manson Woo, Jackie Neider etc. : *“OpenGL Programming Guide”*

## **8. WEBSITES**

1. <http://mathworld.wolfram.com>
2. <http://www.flipcode.com>
3. <http://en.wikipedia.org>