

## THE REPRESENTATION OF THE NORTHERN HEMISPHERE SKY IN A RIGHT AZIMUTHAL PROJECTION, EQUIDISTANT ON THE MERIDIAN

Denisa Ana-Maria POPA

Technical University of Civil Engineering Bucharest, 122 -124 Lacul Tei Blvd, District 2, 020396,  
Bucharest, Romania, Phone: +40 21 242.12.08, Fax: +40 21 242.07.81, Email:  
popa\_denisa\_ana\_maria@yahoo.com

Corresponding author email: popa\_denisa\_ana\_maria@yahoo.com

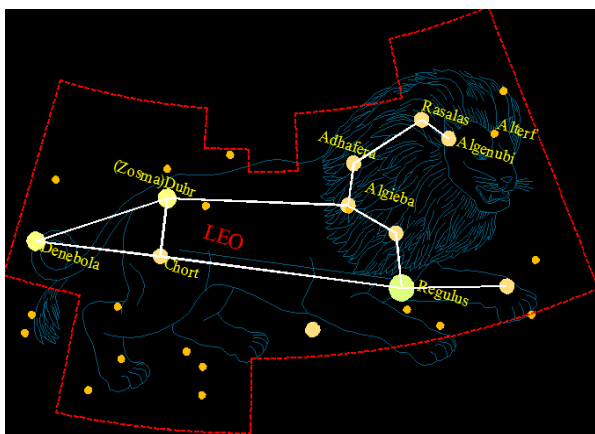
### Abstract

*This presentation brings into your attention one of the possibilities to create a digital sky map (combining the graphical part with the textual one). This map is realised in order to represent the northern hemisphere of the sky vault using a right azimuthal projection, equidistant on the meridians, which contains over 700 stars having the magnitude less than 5, joined in 42 constellations. To achieve this purpose it was used a scanned map in order to draw the constellations limits and the zodiacal signs while the representation of the stars was possible using their equatorial coordinates from the FK 5 catalog. Regarding the textual part of the map this project shows how to create a Microsoft Access database and the method / the steps by which it is attached to the graphical map in a dwg. format. So, it is a fact that using digital maps is more advantageous than using the analog ones, because it is possible to store a much larger amount of information.*

**Key words:** azimuthal projection, constellations, stars, database, digital map.

### INTRODUCTION

Stars are objects composed of gas at a very high temperature. The first atlas that swept the entire celestial sphere was Johan Bayers's Uronometria, which was published in 1603. In this paper Bayer introduced the rule that different stars are noted with Greek letters according to the magnitude. But the first who divided the stars in several classes by the magnitude was Hipercus. After that Pogson has revised this scale taking as reference the star Vega.



While apparent magnitude of a star depends on the brightness of her, and by the distance from observer, absolute magnitude means absolute magnitude if it was 32,6 light years away.

Other information besides absolute and apparent magnitude of certain stars are found in the FK5 catalog. This catalog is a list of star positions calculated from a reference coordinate system at a certain time.

Apparent groups of stars in the sky are called constellations. But in modern astronomy the constellation means a well defined portion of the celestial sphere. However initially in Ptolemy's catalog named Almagest were presented 48 constellations, but at this moment the International Astronomical Union approved 88 constellations.

### ASTRONOMICAL EQUATORIAL COORDINATE SYSTEM

The astronomical equatorial coordinates are astronomical coordinates which are bases on

Figure 1. Leo constellation

the terrestrial equator plane. Equatorial coordinates are right ascension and

The declination of a point on the celestial sphere is the angle between the direction of the observer at that point and the plane parallel to the plane of the equator the point where the observer. The declination is considered positive if the point is north of the equator and negative if the plane is at south.

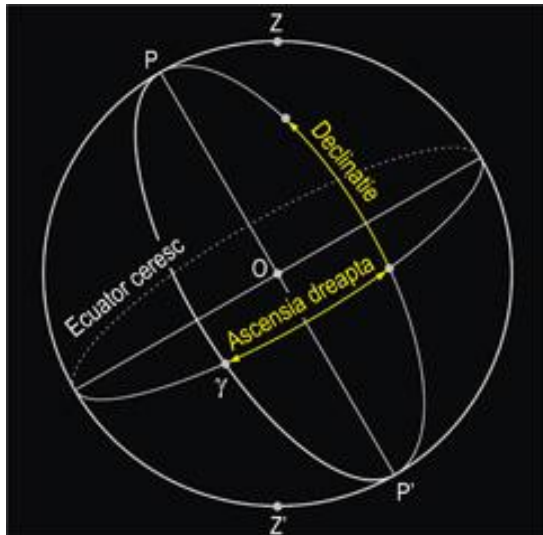


Figure 2 Astronomical equatorial coordinate system

The right ascension of a point is the angle formed by: the half-plane defined by the parallel to the Earth's axis in the observer and the containing vernal point with the half-plane defined by the parallel to the Earth's axis in the observer and the containing that point.

Right ascension is measured eastward from the vernal point from  $0^\circ$  to  $360^\circ$ .

### RIGHT AZIMUTHAL PROJECTION EQUIDISTANT ON THE MERIDIANS

The azimuthal projection si approximates the Earth surface with yhe surface on a sphere with the radius R.

In the case right projections (polar), the normal network coincide with the meridians and parallels network which correspond to the coordinates: longitude  $\lambda$  and latitude  $\varphi$ .

In the azimuthal equidistant projection on the meridians is put the condition that the scale on the direction of the meridians must be constant.

declination.

The calculation of the rectangular and polar coordinates using this projection is done using the formulas:

1.  $\delta = \lambda$
2.  $\rho = R * (90^\circ - \varphi)$
3.  $x = \rho * \cos \delta$
4.  $y = \rho * \sin \delta$

From the azimuthal equidistant projection formulas we note that the meridians are represented by lines that intersect at a point and the parallels with concentric circles centered on the point of intersection of the the meridians.

For representation of the normal grid of the map it was chosen  $R=350$  as the sphere radius. It was considered that  $\varphi$  was taking values from 0 tu 90, and  $\lambda$  from -180 to 180 and the grid densities  $\Delta\varphi = \Delta\lambda = 15$  and then were calculated the coordinates of the network nodes.

Then these were reported in Autocad and by their union it was obtain the normal network.

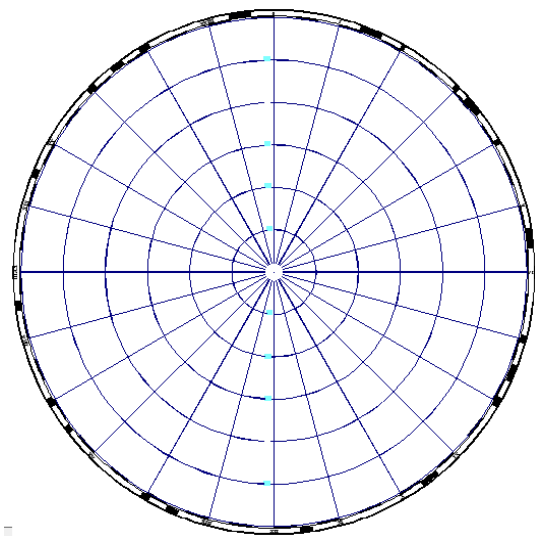


Figure 3 The normal grid of the map

### DRAFTING MAP

Over the network obtained by reporting the coordinates of the points in AutoCAD it was georeferenced the celestial sphere map of the northern hemisphere.

Using that map were vectorized the limits of the constellation and then the outlines of the phantasmagoric figures which represent the zodiacal constellations.

For the stars with the magnitude less than 5 were calculated the rectangular coordinates using the formulas of the azimuthal equidistant projection equidistant on the meridians and the right ascension and the declination of stars in the northern hemisphere.

For this it was considered  $\varphi = \text{declination}$  and  $\delta = \lambda = \text{right ascension}$ . The right ascension was found in degrees, minutes and seconds in the FK5 catalog and the declination in hours, minutes and second and they need to be converted into degrees and fractions of degrees so they could be used in the determination of the rectangular coordinates, knowing that an hour of right ascension is  $15^\circ$ .

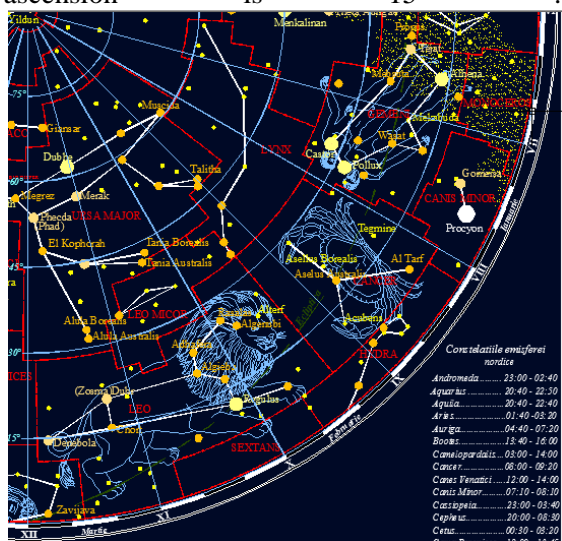


Figure 4 A part of map from AutoCAD

After the stars were reported in Auto CAD by magnitude, over them were inserted filled circles of different colors and sizes to highlight the apparent magnitude of the stars.

Using the previously georeferenced map, the name of a few stars are highlighted on the digital map and then, with a line, the brightest stars in each constellation are connected to each other.

## CREATING THE DATABASE

A database is a collection of related data that refers to a subject or object, together with tools for handling them.

To create a database in Microsoft Access the next steps must be followed:

- launch the application by pressing the „START” button and, from the menu PROGRAMS choose Microsoft Access.

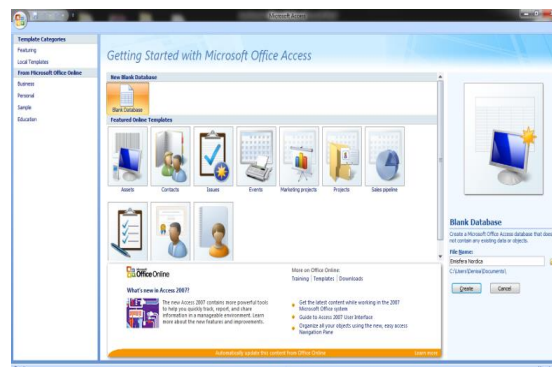


Figure 5 How to create a new database

- to create a new database select Blank Data Base and then name the database.
- to create a tabel press right click on Table option and then select the Save option. It will appear a window where the the table can be named.

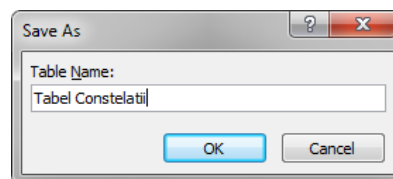


Figure 6 How to save a table

- after this step, choose Design View from

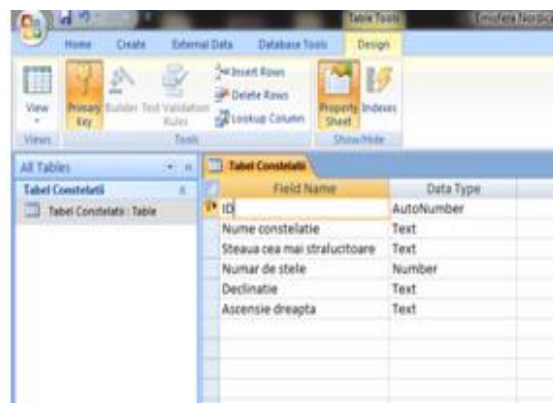


Figure 7 How to create a table

the View menu and start introducing the type (text, number and so on) and the names of the fieds.

- save the tables where the fields have been chosen and then switch to DATASHEET VIEW and start populating them with data.

The FORM is an object within a database that allows typing/introducing data in the tables, display data, control the updates of the data presented in the tables or processing data within an application.

The control panel is a form with which you can browse through other control panels for data entry, reports etc.

The steps to create the control panel:

- from the main menu we select CREATE-MORE FORMS- FORM WIZARD

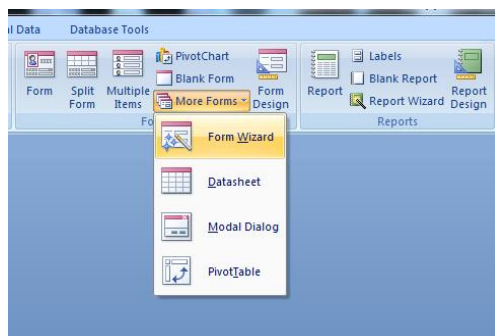


Figure 8 How to create a control panel

- select the desired fields
- choose the form type and style

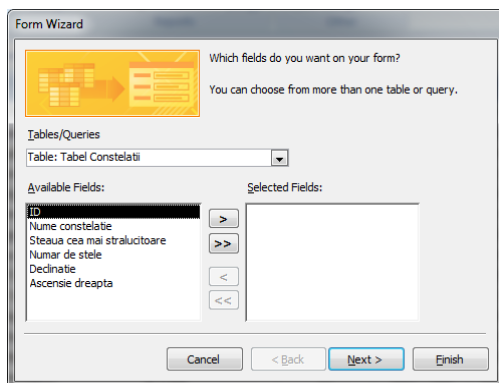


Figure 9 How to create a control panel

- The forms can be edited by selecting Design View from the main menu.



Figure 10 How to edit a form

- to create the control panel, select the TOOLS DATABASE SWITCHBOARD MANAGER menu and then by choosing the command NEW it will appear a table which will be completed depending of the project.

"Entering Data" - allows user to add new

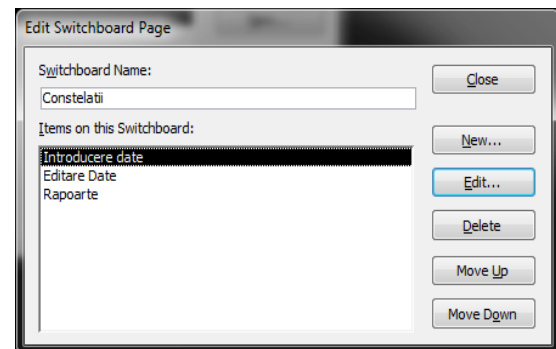


Figure 11 How to edit switchboard

- data to the existing database;
- "Edit Data" - allows the user to modify the data in the current database;
- "Reports" - allows the user to open and view reports;

The connection between the panels created is done with the help of buttons. They are created as follows:

- from the Design View menu press the Button icon.

- from the Command Button Wizard window it can be chosen the operation that the newly created button will perform.

Populating the database refers to loading the data in its tables. The data loading can be done whether directly in tables, or through forms created either by importing data from other formats such as Excel.

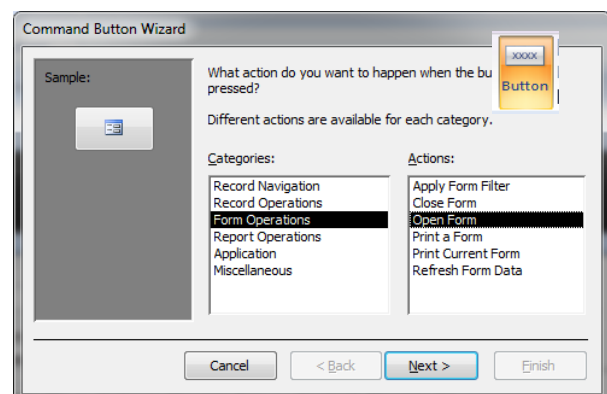


Figure 12 The Command Button Wizard window



Query is an object that allows viewing information from one or more tables based on selection criteria or specified by the user processing.

From the menu CREATE choose the option QUERY DESIGN and add the tables necessary to accomplish query.

QBE grid structure consists of several lines:

Figure 13 QBE grid structure

- Field - the name of the selected attribute;
- Tabel – the name of the table attend to the query – data source;
- Sort – is indicated the sorting sense of the attributes;
- Show - allow or disallow display the values of that field;
- Criteria – allows to specify the criteria for building the interrogation- you can use specific functions, operators, specific constants MS Access.
- OR - indicate the selection criteria using

Figure 14 Report Wizard

logical operator "OR".

The reports are database objects that allow to view on screen or print the contents of a query to the database by various criteria.

Figure 15 The form for the constellation

They are useful in the decisions process.

To create a report is used Report Wizard which is found in Create. Then choose the

Figure 16 Switchboard

layout and style you want.

After creating database the control panel is used to navigate through the database.

## BINDING THE DATABASE

For binding a data base to a .dwg file is using Auto CAD Map.

Autocad Map in an AutoCAD which is based on the producing of maps. It containboth the functions of AutoCAD and specifically designed tools for maps and GIS (geographic information system).

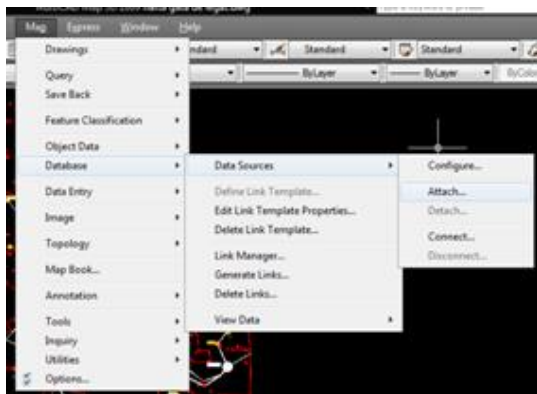


Figure 17 How to bind a database with a AutoCAD

To bind a database with a AutoCAD we must enter the Map menu, choose Database, then Data Sources and then Attach.

In the box that appears select the database you want to bind the AutoCAD.

In the box that appears select the database you want to bind the AutoCAD. To create a link between an entity in AutoCAD and the information found in the database press double click on the table that contains information about that entity and will open the following table:

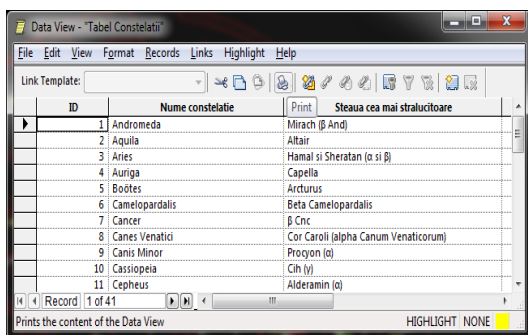


Figure 18 Data View for the Constellatin table

Press the Define Template button, defines the link and then choose the column after which will be done the ties.

After this select a row from the table displayed in Data View and then press the Link Objects button, then select the Autocad entity which we wish to tie with the selected line in the table.



To use the connections made between the database and AutoCAD will use the

buttons: View Linked Object and Highlight Linked Records.

Using Linked View Object can be seen in

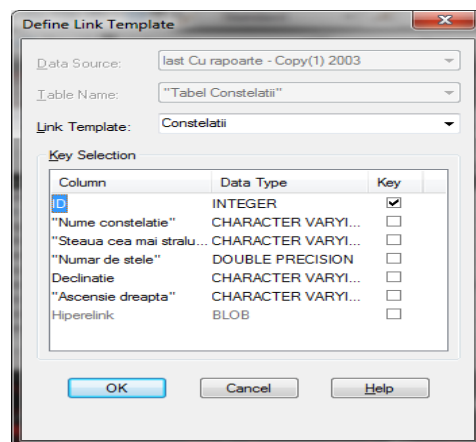


Figure 11 Define Link Template

Auto CAD the entities that match the selected line from the table, in this case it is line 3 and the constellation Aries.

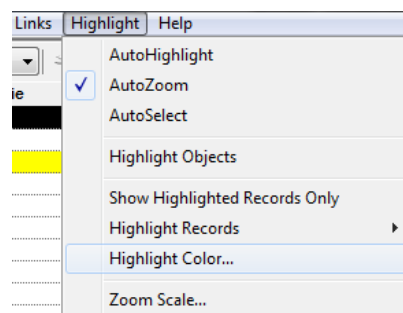


Figure 19 How to choose the autozoom option

Linked Records Highlight button is used to show the information in the database table corresponding to a selected entity in AutoCAD.

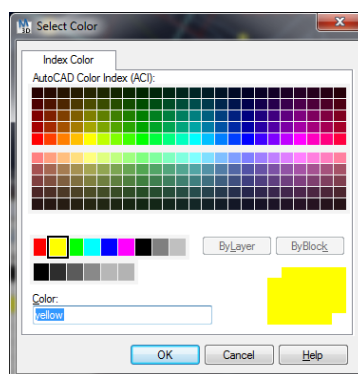


Figure 20 Highlight Color

In this case it is all about the constellation Aries and the constellation corresponding line is colored in yellow. This color can be changed from Table Data View by clicking the Highlight Color Highlight then you can

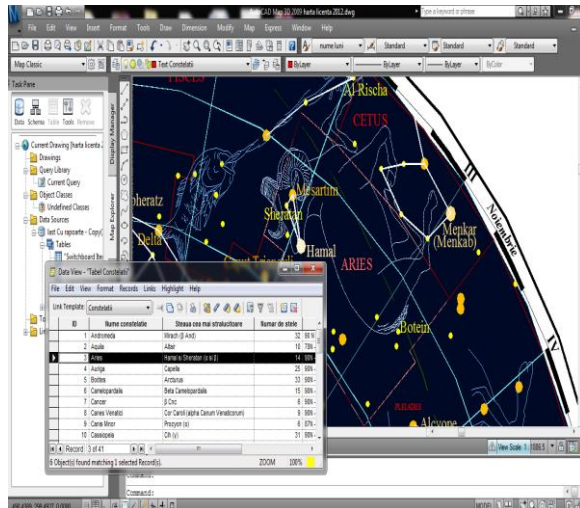


Figure 21 Using Highlight Linked Records

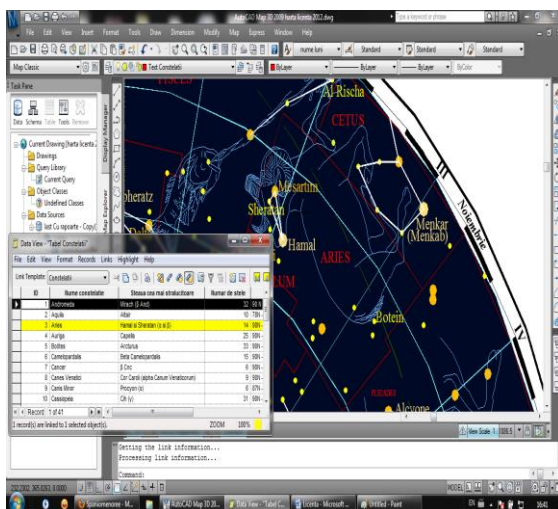


Figure 22 Using View Linked Object

select another color.

## CONCLUSION

The map is a generalised, conventional and reduced representation of the Earth's surface in the plan. The decrease is based on a proportion scale and for drawing the map is used a cartographic projection. A map used certain abbreviations and

symbols explained in a legend.



Figure 23 The map legend

The projection used to create the map is aright azimuthal projection, echidistant on the meridians. This projection is characterized by the fact that  $\phi_0 = 90^\circ$  and the design is done using mathematical functions.

It should be noted that the present work is not limited to being a simple map. Behind it there is a database created using Microsoft Access.

With this database were attached various information to the AutoCAD entities to pup out some information that can not be extracted from a normal map.

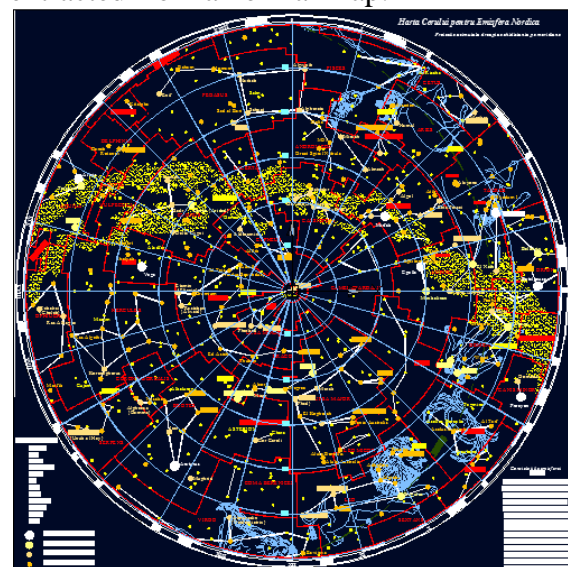


Figure 24 The map in AutoCAD

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