New Dynamical Methods for the Study of the Euclidean Geometry

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Abstract: - Since the primary education age man knew through philosophy a working tool for the resolution of the problems. The projection of technologies gave well thanks to the design, calculation, planning, the strategy of decision, and the realization itself of the finished product. The informational techniques needs a reconsideration of the learning process, of the programs, manuals structures, a reconsideration of the methods and organization forms of the didactic activities, taking into account the computer assisted instruction and self instruction. This paper presents a software package, which can be used as educational software.

Key-Words: - Educational software, euclidean geometry, Java, distance education.

1 Introduction

In the condition of informatics society whose principal source in the social– economic development is to produce and consumption the information, the complex and fast knowledge of the reality for rational, opportune, effective decisions is a desideratum which generate the necessity to form some superior level habituation in information manage for the whole population. The computers and their programs offer to the users powerful capabilities for the information manipulation: image and text visualize on the screen which can be manipulate later; memory storage of an important quantity of information, his accessing and selection of a part of them; possibility to realize a great volume of computation; possibility of equipment control and fast decisions; Computer Based Training [1].

This facilities offer to the microcomputers higher educational capabilities versus other technologies used in education and provide learning controlled based on many parameters: intellectual aptitude, level of knowledge, abilities, rhythm of work.

2 Computer Based Training as a Didactic Method

The informatics society makes sensitive modification in education programs. In this scope, the school must prepare programmers, maintenance technicians, etc.

In the same time it is necessary that the teacher make ready to use the computer in education process. These informational techniques impose to reorganize the contents of the education process, of the programs, course books and manuals, to reconsider the methods and organization forms of didactic activities, which follow to be center on individualization of the teaching process [2].

As a method of the informational didactic, the computer-based training is based on the programmed teaching. N. Crowder work out a new programming type: the branch programming which is characterized by: division of the content in small steps, his successive presentation according to the student needs and corrective feedback, use of author language.

The programmed teaching consist in information presentation in small units, logic structured, units that compose a program, the teaching program [1]. The user will have possibility that after each sequence to have a knowledge about the measure of understanding the give information. The programmed teaching method organize the didactic action applying the cybernetic principles to the teaching-learning-evaluating activities level, considering like a complex and dynamic system, composed as an elements ensemble and inter-relations and develop his personal principles valid on the strategic level in any cybernetic organization form of teaching.

On the other hand, programmed teaching assume some principles which the teaching program must respect [4]:

▪ The small steps principle consists in progressive penetration, from simple to complex, in a subject content which logic divided in simple units series lead to minimal knowledge, which later will form an ensemble. This principle regards the subject division in contents/information units that give to user the chance to succeed in his teaching activities;

▪ The principle of personal rhythm of study regard mannerism observance and capitalization of each user of the program which will be able to make the sequences of knowledge learning or control, in a personal rhythm appropriate to his psycho-intellectual development, without time limits. The user can progress in the

program only if he accomplished the respective sequence requirement;

▪ The active participation principle, or active behavior, regard user effort trend into selection, understanding and applying the necessary information in elaboration of a correct answer. On each step the user is liable to an active participation to resolve the step job;

▪ The principle of inverse connection, regard positive or negative inputs of user competence, refer to the success or breakdown in task performed;

▪ The immediate and directly control of the task work precision with the possibility to progression to the next sequence, in case of success;

▪ The repetition principle, based to the fact that the programs are based on return to the users initial knowledge.

The combined programming interposes the linear and branch sequence according to teaching necessities.

After linear and branch programming the computer aided generative teaching has appear, where the exercises are gradually present, with different difficulty steps and answers on the students questions.

The computer based programmed teaching realize learning process with a inputs flow – the command, an executive controlled system, an output flux – control and a control system functions which correct measure establish.

In such a system have tree stages of teacher perceive: teaching, evaluating and the feedback loop closing, the computer being present in all of tree stages.

3 Application Present

This paper presents a software package, wich can be used as educational software. The application is implemented in Java, under Microsoft Windows operating system. The graphical user interface was structured in three parts:

▪ the theoretical presentation part;
▪ the simulation part;
▪ the evaluation of the knowledges.

All applets are visual and animation-oriented. Moving figures on the screen help students to grasp the meaning of mathematical ideas intuitively.

From the main application window it can selected by a main menu the following options of the euclidean geometry:

▪ the geometry of the triangle;
▪ the geometry of the quadrilateral;
▪ the geometry of the circle.

3.1 The geometry of triangle

In this part are presented notions and theorems such as:

Congruent triangles, Pythagorean Theorem, Ceva's Theorem, Menelaus's Theorem, Stewart's Theorem, Ortic triangle, Medial triangle, Euler Line, Incenter of a triangle, Circumcenter of a triangle, Orthocenter of a triangle, Triangle centroid, Circumcircle of a triangle, Incircle of a triangle, Symmedians of a triangle, Desargues' Theorem, Carnot's Theorem, Pompeiu's Theorem, Brocard Line, Gergonne Line, Lemoine Line, Simson Line.
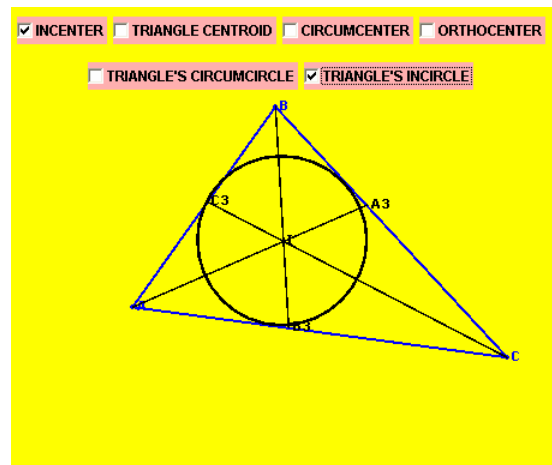

Fig. 1 The incenter of a triangle

The corresponsive applet of the option: „Incenter of a triangle" is presented in the figure 1 and for the option „Circumcenter of a triangle" is presented in the figure 2. The incenter I is the center of the incircle for a given triangle [6]. It can be found as the intersection of angle bisectors, and it is the interior point for which distances to the sides of the triangle are equal.
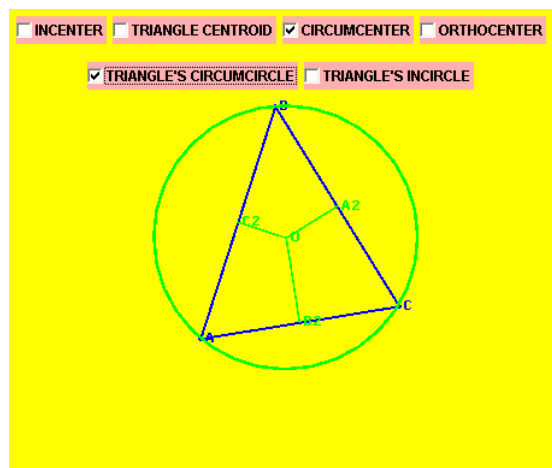

Fig. 2 The circumcenter of a triangle

The circumcenter is the center O of a triangle's circumcircle. It can be found as the intersection of the perpendicular bisectors [5]. If the triangle is acute, the circumcenter is in the interior of the triangle. In a right triangle, the circumcenter is the midpoint of the hypotenuse. If you click on a point of the triangle, you

can usually move it in some way. The rest of the figure will adjust automatically.

The corresponsive applet of the option: „Orthocenter of a triangle" is presented in the figure 3 and the applet of the option „Triangle centroid" is presented in the figure 4. The intersection **H** of the three altitudes of a triangle is called the orthocenter [6]. The name was invented by Besant and Ferrers in 18655 while walking on a road leading out of Cambridge, England in the direction of London.
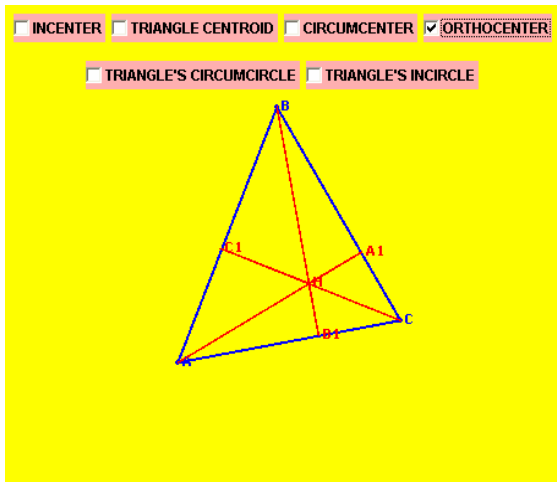

Fig. 3 The orthocenter of a triangle

The geometric centroid (center of mass) of the polygon vertices of a triangle is the point **G** which is also the intersection of the trianggle's three triangle medians [5]. The point is therefore sometimes called median point. The centroid is always in the interior of the triangle. If you click on a point of the triangle, you can usually move it in some way. The rest of the figure will adjust automatically.
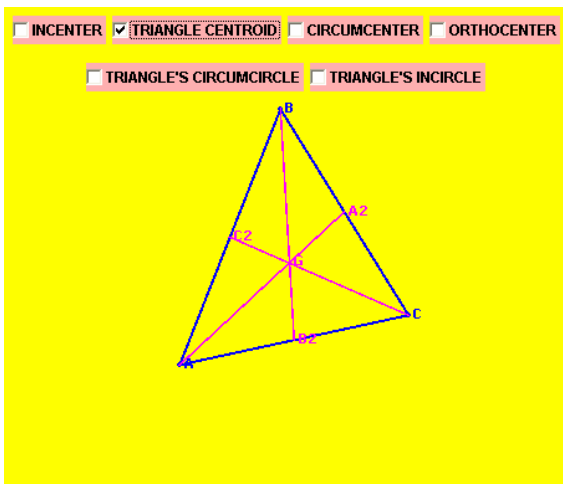

Fig. 4 The triangle centroid

The corresponsive applet of the option: „Symmedians of a triangle" is presented in the figure 5. The point of concurrence **K** of the symmedians, sometimes also called the Lemoine point [5]. Equivalently, the symmedian point is the isogonal conjugate of the triangle centroid **G**.
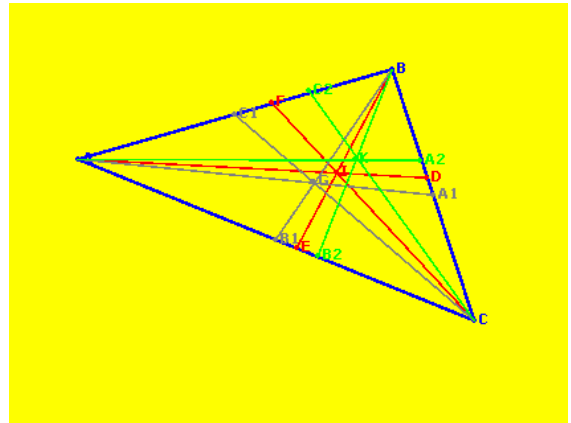

Fig. 5 The symmedians of the triangle

The corresponsive applet of the option: „Desargues' Theorem" is presented in the figure 6. If the three straight lines joining the corresponding vertices of two triangles ABC and A'B'C' all meet in a point (the perspector), then the three intersections of pairs of corresponding sides lie on a straight line (the perspectrix) [7]. Equivalently, if two triangles are perspective from a point, they are perspective from a line. If you click on a point of the triangles, you can usually move it in some way. The rest of the figure will adjust automatically.
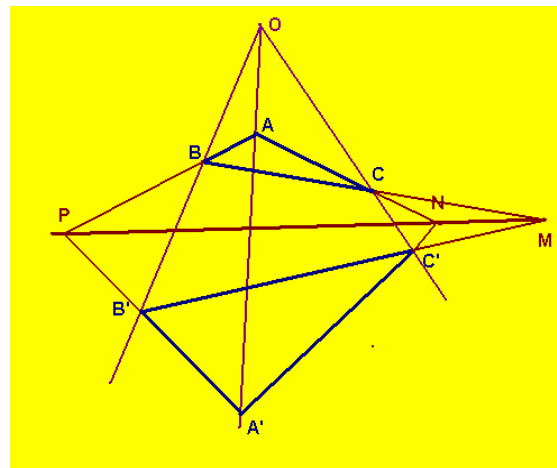

Fig. 6 Desargues' Theorem

The corresponsive applet of the option: „Simson Line" is presented in the figure 7. The Simson line is the line containing the feet A', B', and C' of the perpendiculars from an arbitrary point M on the circumcircle of a triangle to the sides or their extensions of the triangle. This line was attributed to Simson by Poncelet, but is now frequently known as the Wallace-Simson line since it does not actually appear in any work of Simson [8]. If you click on the point M of the circle, you can usually
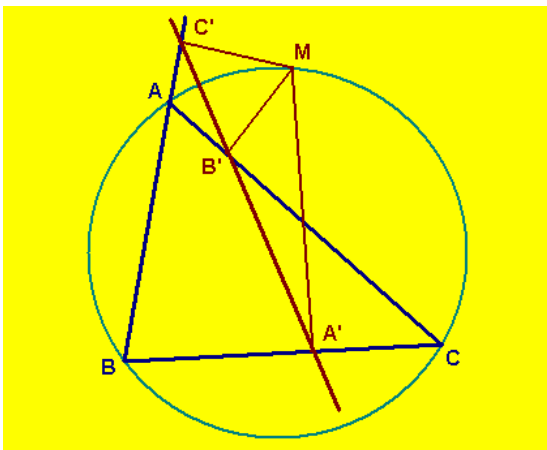
move it in some way.
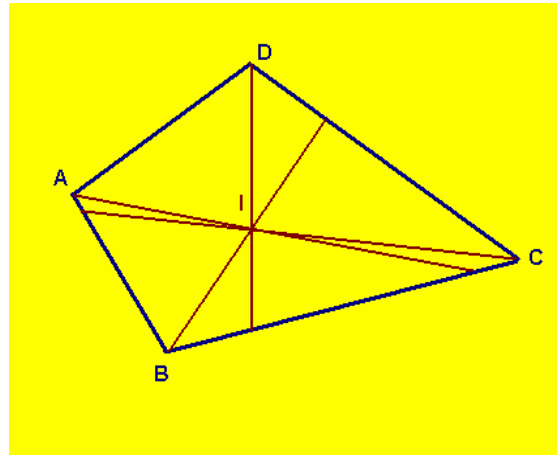

Fig. 7 Simson Line

3.2 The geometry of the quadrilateral

In this part are presented notions and theorems such as: complet quadrilateral, bicentric quadrilateral, cyclic quadrilateral, Newton's Point, Ptolemy Inequality, Ptolomy's Thorem, Miguel's Point, Mathot's Point, Gauss Line.

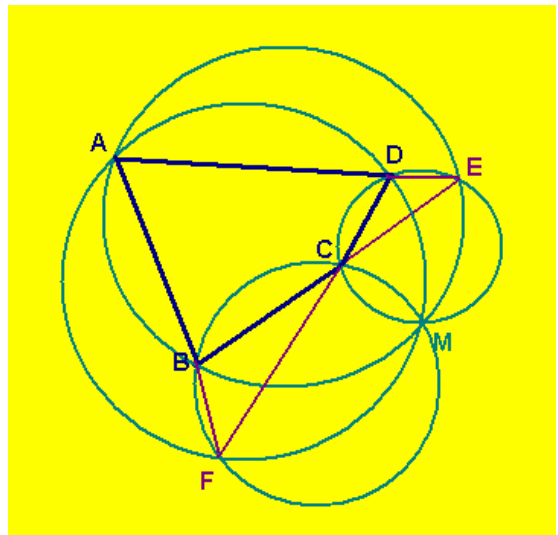The corresponsive applet of the option: „Newton's Point" is presented in the figure 8.
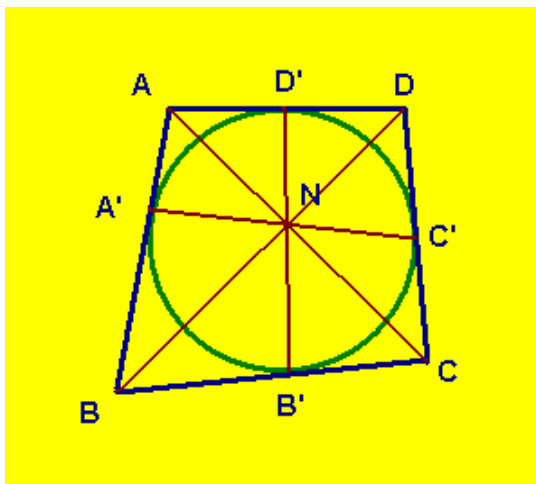

Fig. 8 Newton's Point

The corresponsive applet of the option: „Concurrent bisectrix" is presented in the figure 9. The bisectrices of the convex quadrilateral are concurrent and the point of concurrence represents the center of the incircle of the quadrilateral [6]. If you click on a point of the quadrilateral, you can usually move it in some way. The rest of the figure will adjust automatically.

The corresponsive applet of the option: „Miguel's Point" is presented in the figure 10. The point obtained through the intersection of circumcircles of triangles ABE, ADF, BCF and CDE in the complete quadrilateral ABCD is
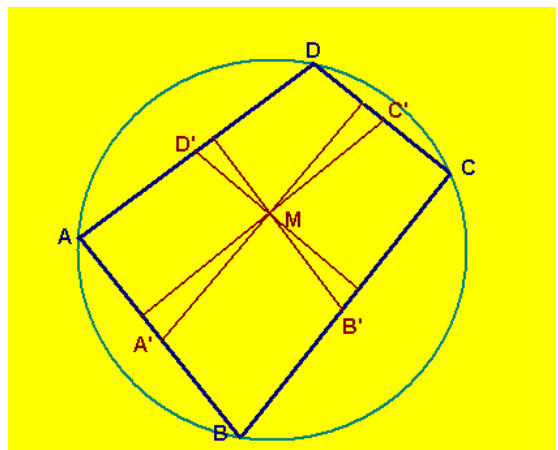
name Miguel's Point [7]. If you click on a point of the quadrilateral, you can usually move it in some way. The rest of the figure will adjust automatically.

Fig. 9 Concurrent bisectrix

Fig. 10 Miguel's Point

The corresponsive applet of the option: „Mathot's Point" is presented in the figure 11.

Fig. 11 Mathot's Point

The point obtained through the intersection of the perpendiculars from the midpoints of sides of ciclic quadrilatelars to the opposite sides is name Mathot's Point [8]. If you click on a point of the quadrilateral, you can usually move it in some way. The rest of the figure will adjust automatically.

3.3 The geometry of circle

In this part are presented notions and theorems such as: Nine-point circle, First Lemoine Circle, Third Lemoine Circle, Tucker Circles, Brocard Circle, Apollonius Circle, Coaxal Circle, Concentric Circles, Tangent Circles, Brianchon's Theorem, Pascal's Theorem.

The corresponsive applet of the option „Nine-point circle" is presented in the figure 12. The nine-point circle [6], also called Euler's circle or the Feuerbach circle, is the circle that passes through the perpendicular feet HA, HB and HC dropped from the vertices of any reference triangle ∆ABC on the sides opposite them. Euler showed in 1765 that it also passes through the midpoints MA, MB, MC of the sides of ∆ABC. By Feuerbach's theorem, the nine-point circle also passes through the midpoints EA, EB and EC of the segments that join the vertices and thee orthocenter H. These points are commonly referred to as the Euler points. These three triples of points make nine in all, giving the circle its name. The nine-point circle is the complement of the circumcircle. If you click on a point of the triangle, you can usually move it in some way. The rest of the figure will adjust automatically.
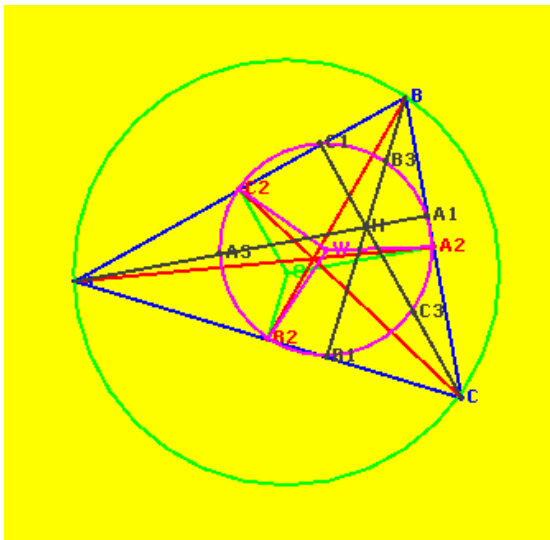

Fig. 12 The nine-point circle (Euler's circle)

The applet of the option „First Lemoine Circle" is presented in the figure 13. Draw lines PAQA, PBQB and PCQC through the symmedian point **K** and parallel to the sides of the triangle ∆ABC [7]. The points where the parallel lines intersect the sides of ∆ABC then lie on a circle known as the first Lemoine circle, or sometimes the triplicateratio circle. The first Lemoine circle and Brocard circle are concentric, and the triangles ∆QAPCK, ∆KQCPB and ∆PAKQB are similar to ∆ACB. The chords cut from the sides by the Lemoine circle are proportional to the squares of the sides. The first Lemoine circle is a special case of a Tucker circle. If you click on a point of the triangle, you can usually move it in some way. The rest of the figure will adjust automatically.
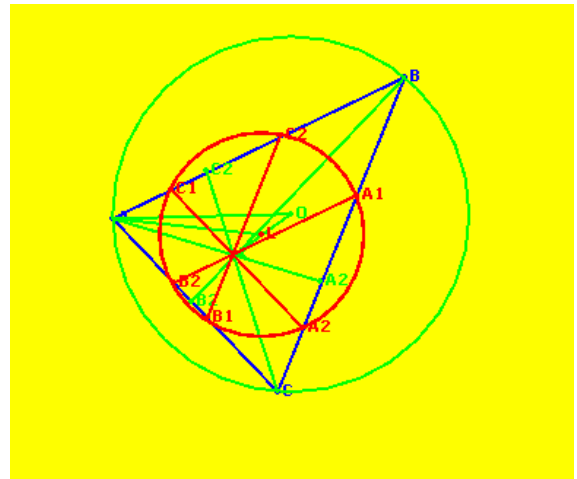

Fig. 13 The first Lemoine circle

The applet of the option „Brianchon's Theorem" is presented in the figure 14. If a hexagon is circumscribed about a circle, then the main diagonals are concurrent. This theorem due to C.J. Brianchon (1760-1854) couples nicely with the next theorem, Pascal's Mystic Hexagram. Brianchon's proof uses projective geometry and can be generalized to an ellipse [7]. If you click on a point of the hexagon, you can usually move it in some way. The rest of the figure will adjust automatically.
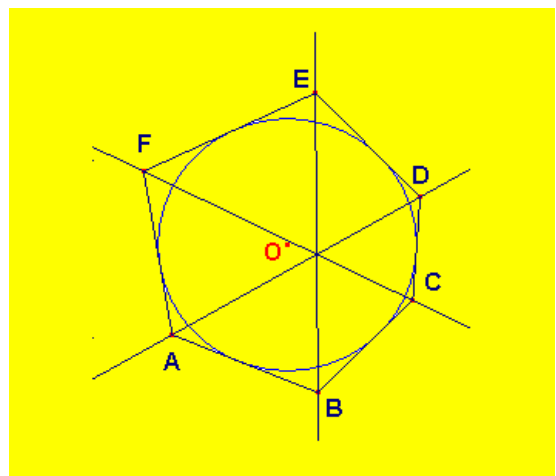

Fig. 14 Brianchon's Theorem

The applet of the option „Brianchon's Theorem" is presented in the figure 15. The intersection points of the

opposite sides of a hexagon inscribed in a circle are collinear [8]. This is the dual of Brianchon's theorem. Blaise Pascal (1623-1662) proved this theorem by the time he was 16. The line is called the Pascal line. The converse of the theorem is not true; however, by extending this theorem to a conic, both it and its converse are true. If you click on a point of the hexagon, you can usually move it in some way. The rest of the figure will adjust automatically.
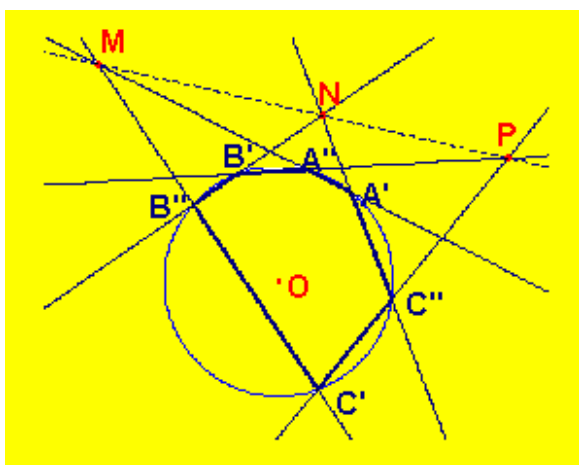

Fig. 15 Pascal's Mystic Hexagram

4 Conclusion

On this application, authors take into consideration the condition, which must accomplish a courseware, being made necessary steps. So, in elaboration and utilization of this application must take into consideration next criteria:

- To follow up the curriculum for a specific domain;
- To accomplish some teaching and learning strategy.

In this kind of self-instruction and evaluation program it must find basic notions and representation and scanning notions. Animation and graphical modeling must represent the graphical construction way and also scanning of them;

- To exist the possibility to use parameterized variable, in conditions in which users have the possibility to input the variables value;
- To present a method in which the user can be informed about how can use graphical module, i.e. an interaction user-computer exist.

The presented application accomplishes these criteria, and for this we consider that is a good example of how educational software must be realized.

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