

Use of AutoCAD in An Electrical Engineering Curriculum

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ABSTRACT

Computer aided drafting or drawing is a fundamental in the engineering design process. Many companies use CAD programs in every aspect of their business. Electrical engineering students, however, normally have no exposure to traditional CAD programs in their curriculum. This can be remedied by the addition of a CAD exercise in and appropriate EE lab course. Advanced Digital Electronics is a likely location, because of the complexity of circuit diagrams that must be electronically generated. Other programs exist for digital logic circuit generation, such as ORCAD, Electronics Workbench, Altera, etc. These programs also perform some time of specialized simulation. However, our students are not routinely exposed to commonly utilized general CAD programs. This paper presents the results of an AutoCAD Laboratory exercise completed and evaluated by a class of Advanced Digital Design students in an electrical engineering undergraduate curriculum. In addition, a detailed list of students' comments and future developments are included.

Introduction

the engineering design process is a problem solving activity, and an end product is the formulation of a prototype for a finished product before its actual production. The actual design process has several similar definitions. 'PDCA - plan, do, check, act' is one short-moniker embodiment of the design process. However the step-by-step process is defined, a part of the final product is a specific drawing, which is usually computer generated. Graphics or engineering drawing computer programs are necessities, and often an industry will utilize one CAD package throughout its entire manufacturing operation. Often, electrical engineers are unfamiliar with industry standard CAD programs, typically utilizing electronics or digital specific tools. This electrical engineering exercise for AutoCAD was a very successful transition to traditional CAD programs for the student.

AutoCAD Explanation

The students had no previous AutoCAD exposure, therefore it was necessary to start from the very beginning. The basic overview steps to access AutoCAD are:

1. Enter AutoCAD from the DOS environment
2. give the Command 'ACAD'
3. the AutoCAD menu system, which consists of pull-down menus, toggle and status line, graphics area, UCS icon, and command line
4. AutoCAD operates under a pop-up menu system with a list of various options, consisting of file, assist, view, draw, construct, modify, data, options, tools, and help. As with many software programs, the location of various commands takes experience to master
5. The menu options must be examined in detail, because often one item can be accomplished several different ways. This exercise was designed to demonstrate this to students. For example, rectangle can be constructed as a Draw-rectangle option, Draw-square option, or as a series of connected lines.

A typical set of commands for a circle:

MENU: Draw- Circle - Center, Radius

-circle 3P/2P/TTR/<Center point>: 6,7.5

diameter/<Radius>: 3.0

The command format for zoom:

Menu: View - Zoom - Window

click on first corner, near 2.0 11.0

click on other corner, near 10.0, 4.0

6. Once the circuit was constructed, the students were to save it to disk in two formats, regular and zoom. Once saved, the students were required to print out the two formats.

A brief subset of commands was demonstrated in the classroom: OPEN existing drawings, TEXT/DTEXT for writing on the drawing, Grid, Color, END, QSAVE, RECTANGLE, QUIT, SAVE, WIRE, etc. However, one can gain expertise in software only when the knowledge is applied. In other words, the questions did not begin until the students tried to create their drawings.

Circuit Application of AutoCAD

The Objective of the laboratory exercise was stated: The students were to gain some familiarity with 2D AutoCAD as a typical computer aided design program. The stated task was to create an AutoCAD drawing of a commonly used digital design circuit. The students were required to design and draw a circuit of a BCD counter using the TTL IC 7493 or 74161 counter chip, the 7447 BCD seven segment decoder driver chip, and the seven segment LED display unit. They were required to utilize three differently sized rectangles representing the chips, and wires representing the pins as well as the circuit connection wires.

Further, the steps were explained as follows:

1. Hand draw the circuit, accounting for each pin that will be utilized in the design, specifying Vcc and ground for each chip.
2. Create the AutoCAD drawing in the CAE laboratory room. The circuit is basic, so a subset of 2D AutoCAD commands will be utilized.
3. Two printouts will be created from this AutoCAD exercise:
 - A. The overall two chip plus one seven segment LED circuit showing all connections
 - B. Enlarge one chip section of the circuit, showing the details of just one chip.

The final report that the students were expected to submit consisted of three sections:

1. Introduction or Objective -- must be briefly stated
2. Procedure, describing the AutoCAD design process applied to electrical engineering
3. Conclusion, specifically describing at least three difficulties using AutoCAD that were encountered in the completion of this assignment.

Technical communication of the material is essential, and the computer generated reports are graded for clarity, presentation, content, and technical correctness.

An example of a student's full drawing for this assignment is given in Figure 1. An example from another student, showing the details of a chip section is shown in Figure 2.

Student Feedback

The students were generally pleased to learn how to utilize AutoCAD, if only for this simple assignment. Being new users of the program, they identified the following concerns specific to electrical engineering student perspective:

1. Controlling dimensions is mouse-driven and requires a light touch
2. Erasing mistakes is tricky, because of the dotted lines
3. Curved lines require patience
4. One often undoes more than intended
5. Pull down menus were cryptic
6. Fitting the drawing on the 8 x 11 page
7. Font changing with text was difficult
8. Endpoint command was not well defined
9. Line alignment was tricky, and needed patience
10. ZOOM requires repetition
11. Saving is essential to practice, otherwise the circuit disappears!
12. Toolbar requires exploration for meaning
13. Flipping circuit segments is easier than intended
14. Printing requires time to perfect
15. Break, Undo, and Move have special AutoCAD meaning.

Conclusions

The laboratory exercise proved to be successful. The students were able to adapt from an electronics specific drawing program to a general drawing package (AutoCAD). However, future development is needed to ensure that the electrical engineering students are utilizing the AutoCAD in the most efficient manner.

Future Recommendations

On the basis of the students' feedback and our evaluation, the following improvements are planned:

1. A tutorial will be developed, which will take the students through the basic AutoCAD commands. The tutorial will correct many of the students' concerns. After completing the tutorial, the students will be asked to draw their own complex circuit.
2. The students will be introduced to the idea of LAYERS. This could be used to allow students to easily explore several wiring scenarios for the same circuit.
3. The students will be introduced to the idea of BLOCKS. The use of BLOCKS will allow the students to develop their own library of common electrical symbols, which should make it easier to complete their drawings.

In addition to the above improvements, the following refinements are also planned:

1. Students will be required to create several AutoCAD drawings for other circuits
2. Students will be required to create a 3D AutoCAD model. Again, a tutorial would be developed to familiarize the students with the basic concepts of 3D modeling. Three dimensional modeling is particularly useful when packaging electronic components, to be sure that there is no spatial interference between them.
3. Once 3D models are incorporated, the students would be able to do Finite Element Analysis (FEA) on them. These analyses may be of interest in certain prototype boards, chips, or other experimental items.

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Biographical Information

Dr. Anneberg has been affiliated with Lawrence Technological University for seven years, and is an associate professor. Dr. Anneberg graduated with a Ph.D. in 1991 from Wayne State University, Detroit in computer engineering. Her research activity is in the areas of parallel processing, statistical quality control, and error correction and detection.

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Dr. Yaprak is with Wayne State MI; in Engineering Technology. She has been with WSU for five years, and before that was affiliated with Western Michigan University in Kalamazoo, MI. She has a Ph.D. in computer engineering, from WSU in 1988. Her research interests are distributed processing and performance evaluation.

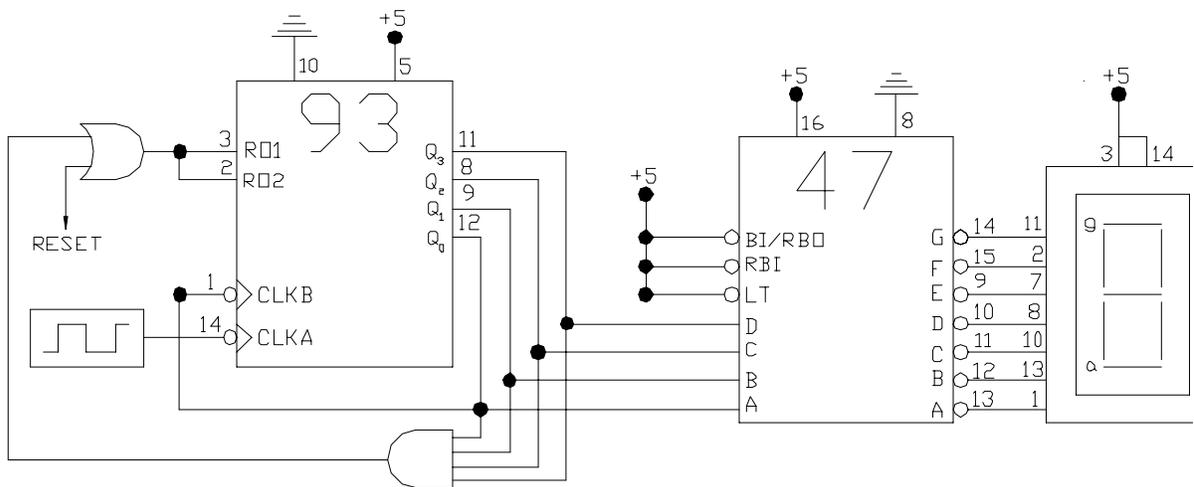


Figure 1. An example from a student drawing of a BCD counter circuit (full extent of drawing).

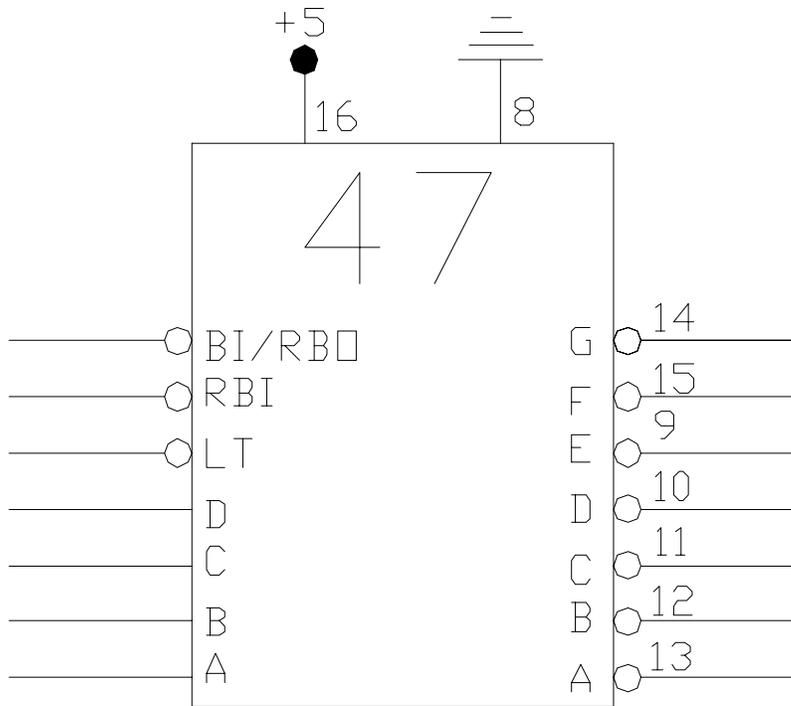


Figure 2 An enlarged view of a 7447 chip taken from a student's drawing.