

Computer Aided Design and Drafting (CADD) Modeling for Gas Welding ProcessA.A. Adekunle¹ and S. B. Adejuyigbe²¹Mechanical Engineering Department, LadokeAkintola University of Technology, Ogbomoso, Oyo State, Nigeria.²Mechanical Engineering Department, University of Agriculture, Abeokuta, Ogun State, Nigeria.

Abstract: The application of computer technology offers the potential to reduce a product cycle time through Computer –Aided Design and Drafting (CADD) applications. CADD is the use of computer systems to assist in creation, modification, analysis, drawing or optimization of design. Welding operation is joining two metals together. The need arise for how to minimize or eliminate the error encountered when fatigue sets in, due to low efficiency of the local welder. CADD software for welding was developed using Microsoft Visual Basic 6.0 which was used to weld two mild steel plates together automatically. The result of the research clearly shows that robotic welding is faster, error free and uniformly welded all through like that of the CADD welding model developed. It is highly suggested and recommended that further work on robotics can be embark upon to bring Nigeria to the level of Industrialized Nation.

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Introduction

As computers became more affordable, the application areas have gradually expanded. The development of CADD software for personal desk-top computers was the impetus for almost universal application in all areas of construction. As a general rule, one CADD operator could readily replace at least four or five drafters using traditional methods. Additionally, many engineers began to do their own drafting work, further eliminating the need for traditional drafting departments. This trend mirrored that of the elimination of many office jobs traditionally performed by a secretary as word processors, spreadsheets, databases, etc became standard software packages that "everyone" was expected to learn. Today CADD is not limited to drafting and rendering, and it ventures into many more "intellectual" areas of a designer's expertise. Computer aided design is used in many businesses and organizations around the world. Consequently, a need arises for development of software to aid in model development and at the same time draw the welding operation to ease fabrication. (Adejuyigbe, 2002 and Andersen, 1997).

CAD/CAM Database

The important reason for the development and the use of Computer Aided Design (CAD) system is that it offers the opportunity to develop the database needed to manufacture the product. In the past, engineering drawings were prepared by design craft men and then used by manufacturing engineering to develop the process plan. This is a separate function, which involve a two-step procedure, that is, design

and manufacturing. But in an integrated CAD/CAM system, a direct link is established between product design, drafting and manufacturing. The CAD/CAM had the goal of automating certain phases of design and certain phases of manufacturing, and also to automate the transition form design to manufacturing. The role of computer-based systems is to create much of the data and documentation required to plan and manages the manufacturing operations for the product. The manufacturing database is also an integrated CAD/CAM database. (Angeles, Soucy and Ferrie, 2000, Freund, and Rossmann, 2000)

Welding

Welding, in engineering, is any process in which two or more pieces of metals are joined together by the application of heat, pressure, or a combination of both. Most of the processes may be grouped into two main categories namely *pressure welding*, in which the weld is achieved by pressure; and *heat welding*, in which the weld is achieved by heat. Heat welding is the most common welding process used today. Brazing and soldering are other means of joining metals (Brzakovic, and Khani, 1991 and Craig, 1989).

Gas Welding Process

Gas welding is a non-pressure process using heat from a gas flame directly to the metal edges to be joined and simultaneously to a filler metal in wire or rod form, called the welding rod, which is melted to the joint. Gas welding has the advantage of involving equipment that is portable and does not require an electric power source. The surface to be welded and

the welding rod are coated with flux, a fusible material that shields the material from air, which would result in a defective weld. (Dye, Hunziker, Roberts and Reed 2001 Durrant-Whyte, 1988, Cam and Kocak, 1998))

The objectives of the research therefore are to:

- develop a Computer Aided Design and Drafting software for welding;
- use the developed software to weld a plate of mild steel automatically; and
- compare the CAD gas welding developed with robotic welding in the case study industry.

Research Methodology

In carrying out this research, Renoyld Construction Company, Ogbomosho site office, was visited where robotic welding operation was observed, and Mechanical Engineering Department of Ladoke Akintola University, Ogbomosho, where manual welding was performed, both in Oyo State. The artisan welders at Ogbomosho were also visited to learn some of their primitive ways of welding.

CADD Software was developed using Microsoft visual basic 6.0 which was used to automatic weld two mild steel plates together.

Usage of CADD Files to Generate Welding Program

Currently, since the vast majority of companies used CAD programs to design their products, information from CAD files could be used

to generate robotic welding program. (Gonzalez, and Woods, 1993, Freund and Rossmann, 2000)

The 3D models should be very precise in dimensions and part positioning. Then the user should draw all the trajectories required to fully weld the piece as desired, using the available layers, i.e. using one layer for each trajectory, which is composed of a start-point and an end-point, both with orientation, and the type of motion (welding trajectory, straight line welding or approach/escape trajectory). The welding parameters (velocity, voltage, torch distance to the surface) are introduced in the selected layer, just by adding labels with the corresponding values. The weld layers should be renamed for easy identification. Following this simple small set of rules, the designer can add to his 3D models information about how the welding process should be done.

The generated data file is used as input for the application used in this project, application shows the available definition with the help of several push-down buttons, and enables the user to change the welding parameters, correct point and orientations, simulate the whole process using the real robot and the real piece to weld. The simulation is very realistic, making the final program ready for production.

Results and Discussion

Results of the CADD Software for Gas Welding Developed

The following shows the sequence of welding operation obtained in this research.(Plates 1-12).



PLATE 1

Plate 1 has the Process at the left corner at the top which has the menu table that contains the process to be followed stepwise in order to achieve the expected result.



PLATE 2

Clicking the process at the top left corner in the plate 1, the table in the plate 2 above would be displayed as shown in the plate 2 above. What we have there in the table is as shown above, i.e. Settings, Reset, Clear, Weld, and Exit, in descending order. Clicking Settings brought about what we have in plate 2, that is, the X-Y position of the plates would be displayed and changed if need be, and if Clear is clicked, the plates will disappear automatically. Also if Weld is clicked, welding parameters would be displayed, and whatever we input as Start and Stop positions would be displayed and effected.

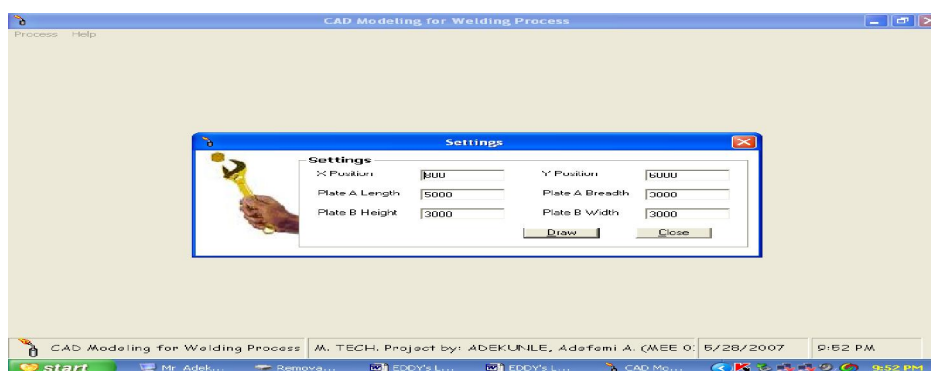


PLATE 3

Clicking the process, displayed the settings table. This settings table contained the X position and Y position of plate A and Plate B, at the same time the height and width of plate B, all in millimeters. This is being displayed automatically on plate 3. Draw and Close is situated at the base of the table to effect the input figure.

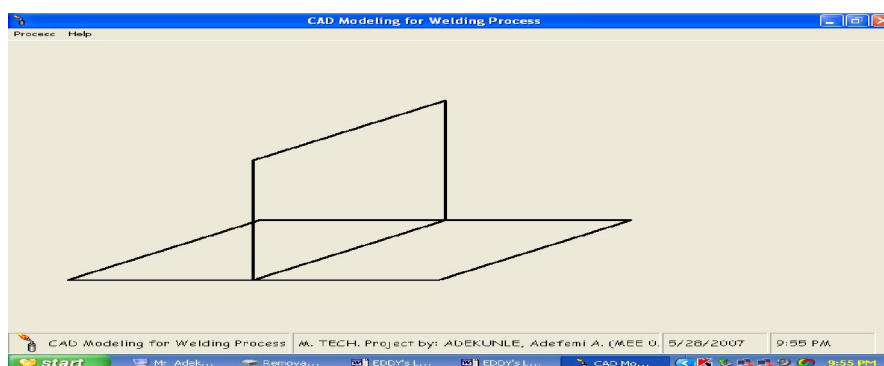


PLATE 4

The plate 4 shows the plates to be welded. Inputting 800mm and 6000mm d for X and Y co-ordinate of plate A, while the size of the plate B is 3000mm in height and 3000mm in width, then, clicking Draw will automatically display the figure shown above.

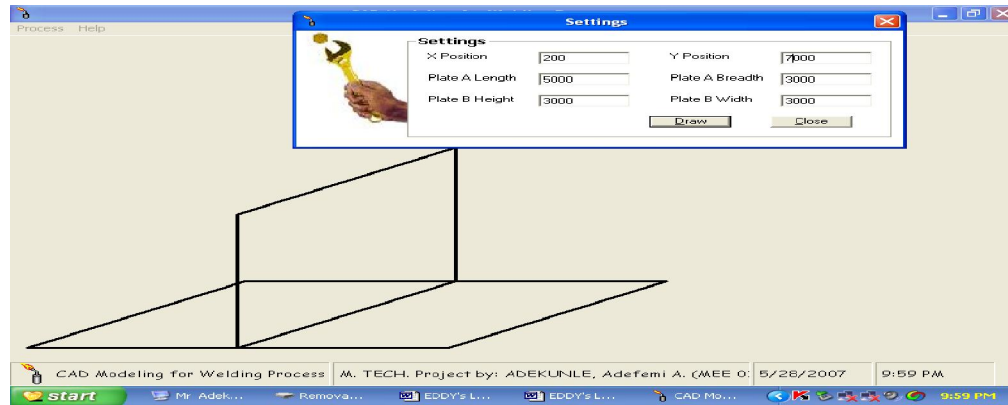


PLATE 5

Clicking close button automatically made the table to disappear. The initial table that we had in plate 4 would be left on the screen. After that, clicking process, and then weld on the menu table where we have process. What we are going to have is the next plate 5 shown above.

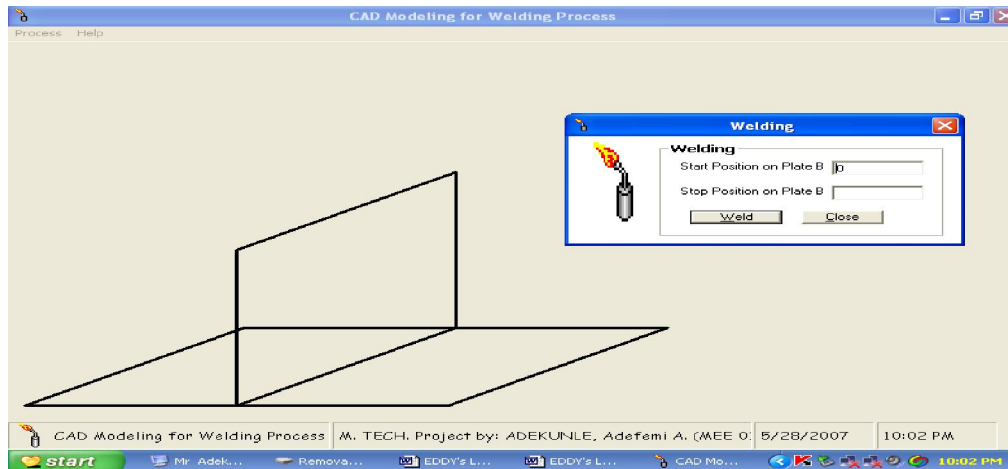


PLATE 6

In plate 6 a table with welding torch at the top will be shown. The starting position on plate B and Stop position on plate B will be shown, then Weld and Close box to execute any computed figure will also be shown.

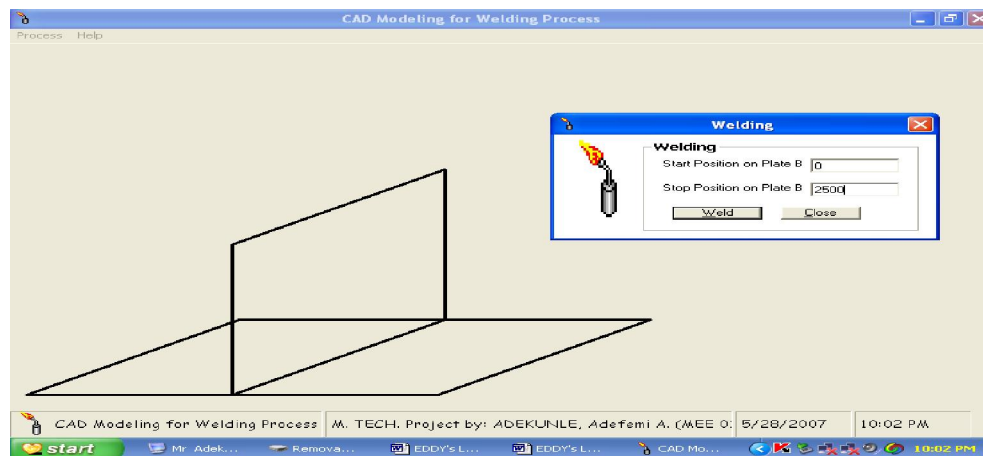


PLATE 7

The plate 7 shows the start position which was inputted as zero, and stop position input was 2500mm, then weld button was clicked. What we are going to have is the next plate.

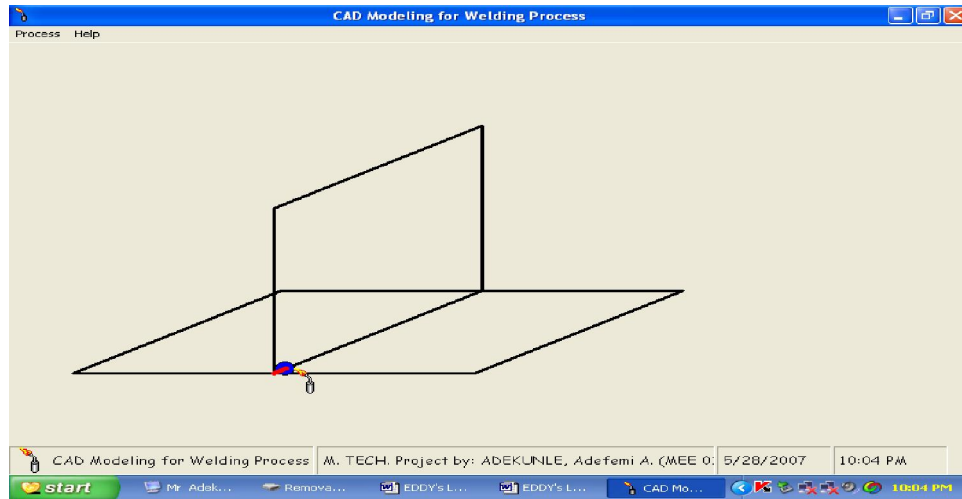


PLATE 8

In plate 8, the welding operation commenced automatically starting from zero position as shown.

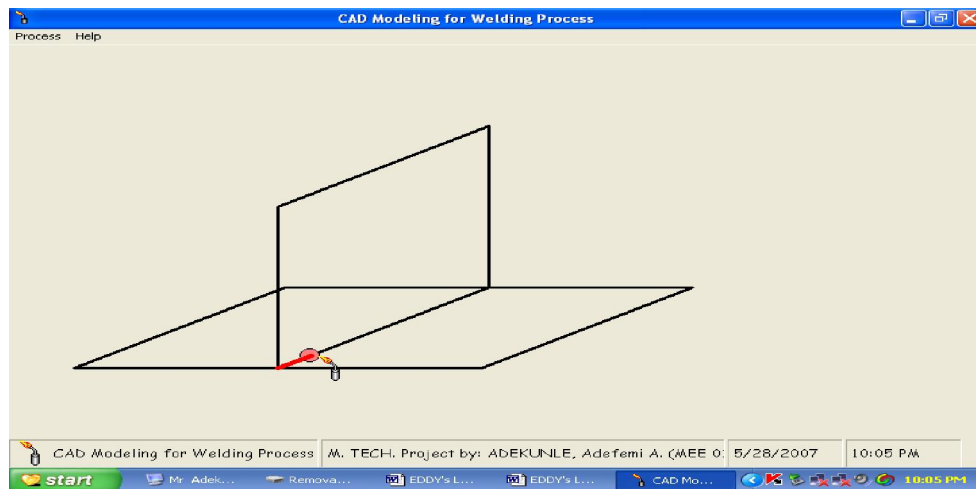


PLATE 9

Plate 9 shows the automatic welding operations continuation.

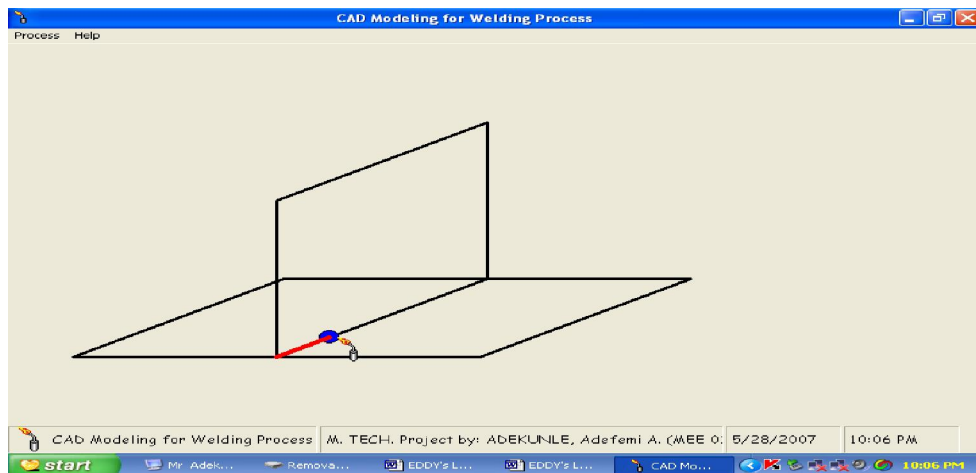


PLATE 10

Plate 10 shows the welding operation still in progress.

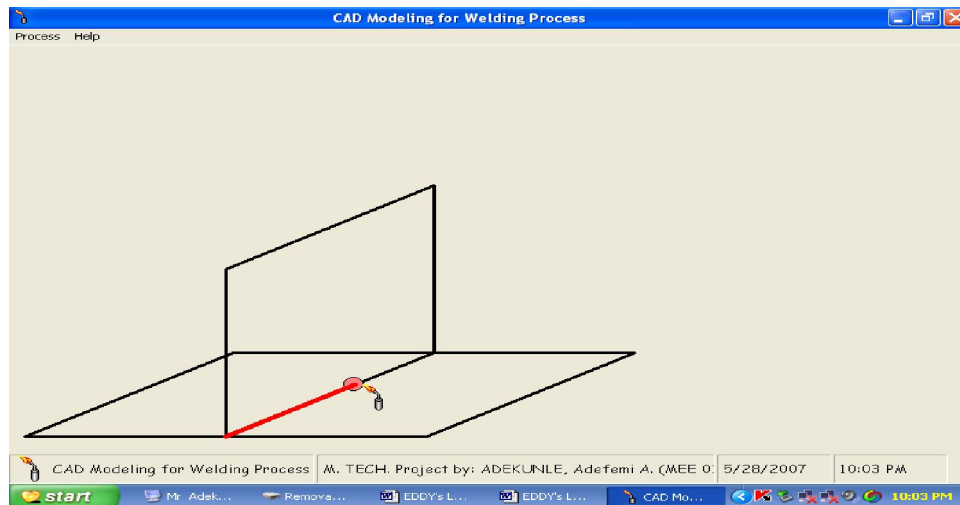


PLATE 11

Plate 11 shows the automatic gas welding operation at an advanced stage.

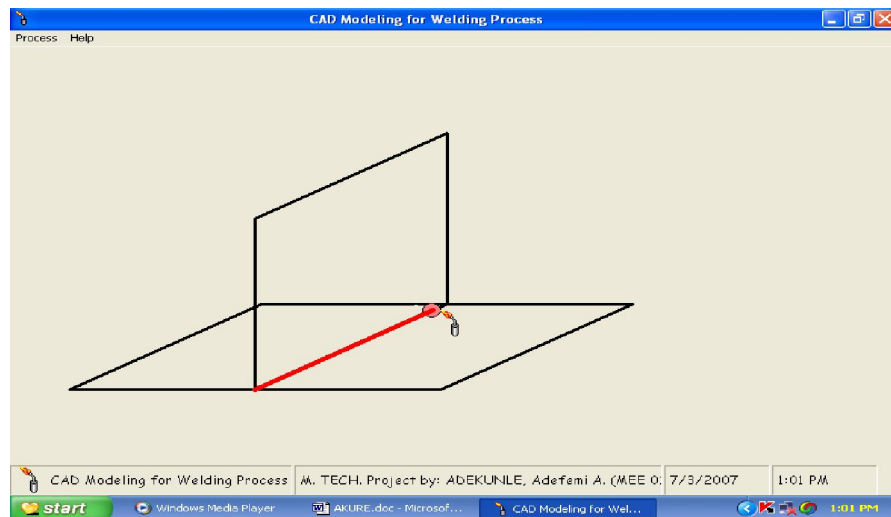


Plate 12

Plate 12 shows the automatic gas welding operation completed. It stopped at the input figure which was 2500mm.

The materials' positions can be varied and at the same time, weld's stop position can be altered. Consequently, various welding position was captured.

Comparing Robotic Welding, CADD Developed Welding and Manual Welding

The error always encountered in robotic welding is always minimal compared to that of the manual welding. A robotic welding system may perform more operation repeatedly than a manual welder because of the monotony of the task.

Another consideration with manual welding of large components is the arduous nature of the work. There is a risk of neck injury if the head is held for too long in one position and additionally, continuous feeding of wire into a joint can cause repetition strain

injury. Such health and safety issues are eliminated if a robot is used.

On the other hand, manual welding is cost effective compare to the robotic welding. Cost of maintenance of robots is so exorbitant to the extent that ordinary person cannot afford it.

Conclusion and Recommendation

CADD software for welding was developed using Microsoft visual basic 6.0 which was used to weld two mild steel plates together automatically. Robotic welding operation performed at Renoyld Construction Company (RCC) was critically

examined, and this is compared with the CADD welding process developed.

The result clearly shows that Computer Aided Welding developed and the Robotic welding carried out are faster, error free and uniformly welded all through when compared with manual welding.

It is highly suggested and recommended that further research work on robotics and automatic welding should be embark upon to bring Nigeria to the level of Industrialized Nation.

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