CALCULUS(MT119) SEMESTER PROJECT- SECTION C

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Contents

1- Objectives of The Problem

As in our daily life, we will be dealing with such cases and this type of problem will help in solving them. So, it has the following objectives.

- To make us understand how the concepts we learn in class are implements in our daily life.
- To make us understand the requirements of our clients and act accordingly.
- We are to find dimensions (radius, height) of a cylindrical open top can using volume.
- We are provided with costs of materials used in making of the can in cents/cm^2.
- The dimensions must be such that the cost of creating the can is minimum.
- As it is a group project so, one of its objectives is to make us learn how to work as a team and how to understand each other and act accordingly.

2- By Hand Solution of The Problem

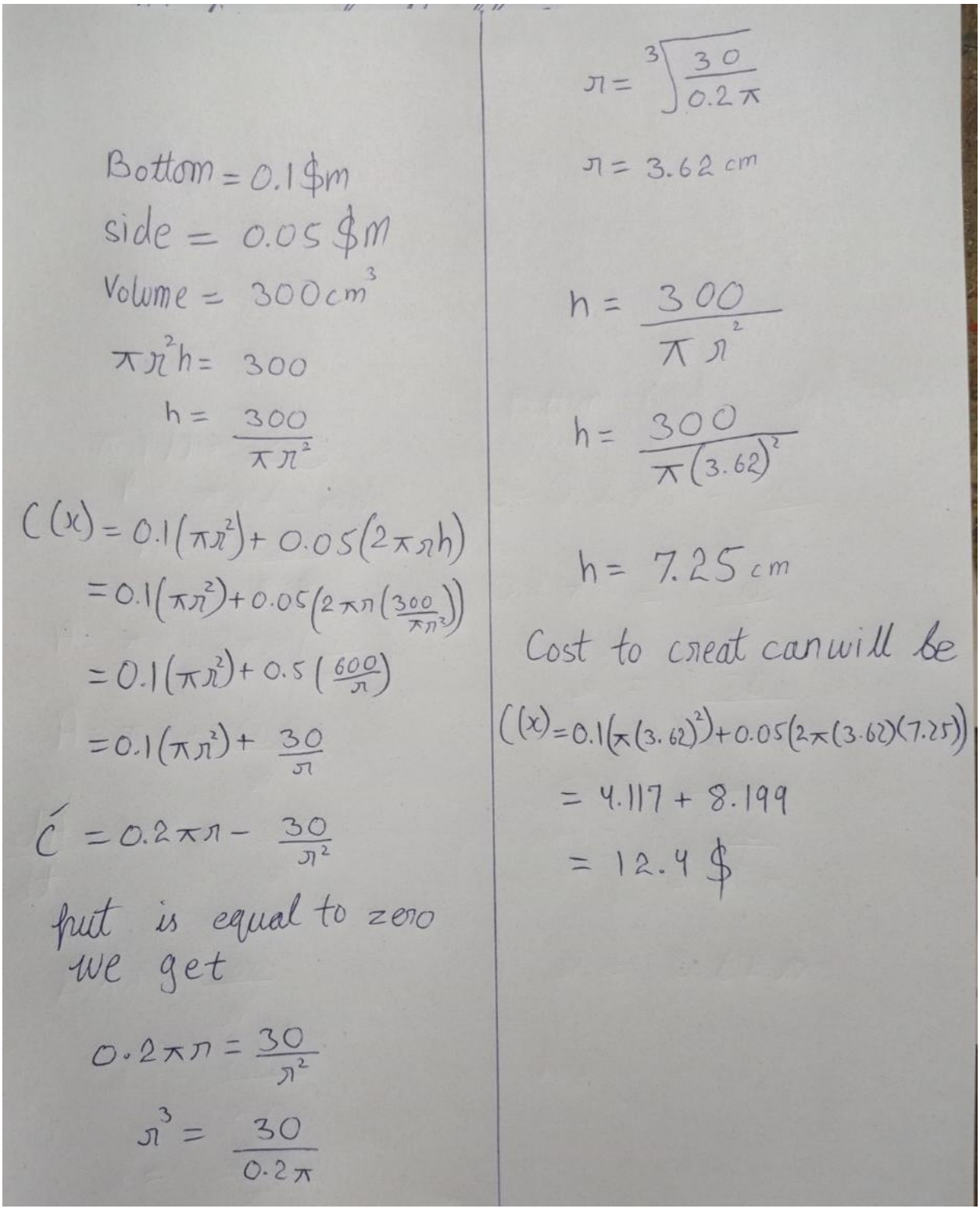

Figure 1 - By Hand Solution of The Problem.

3- Flowchart

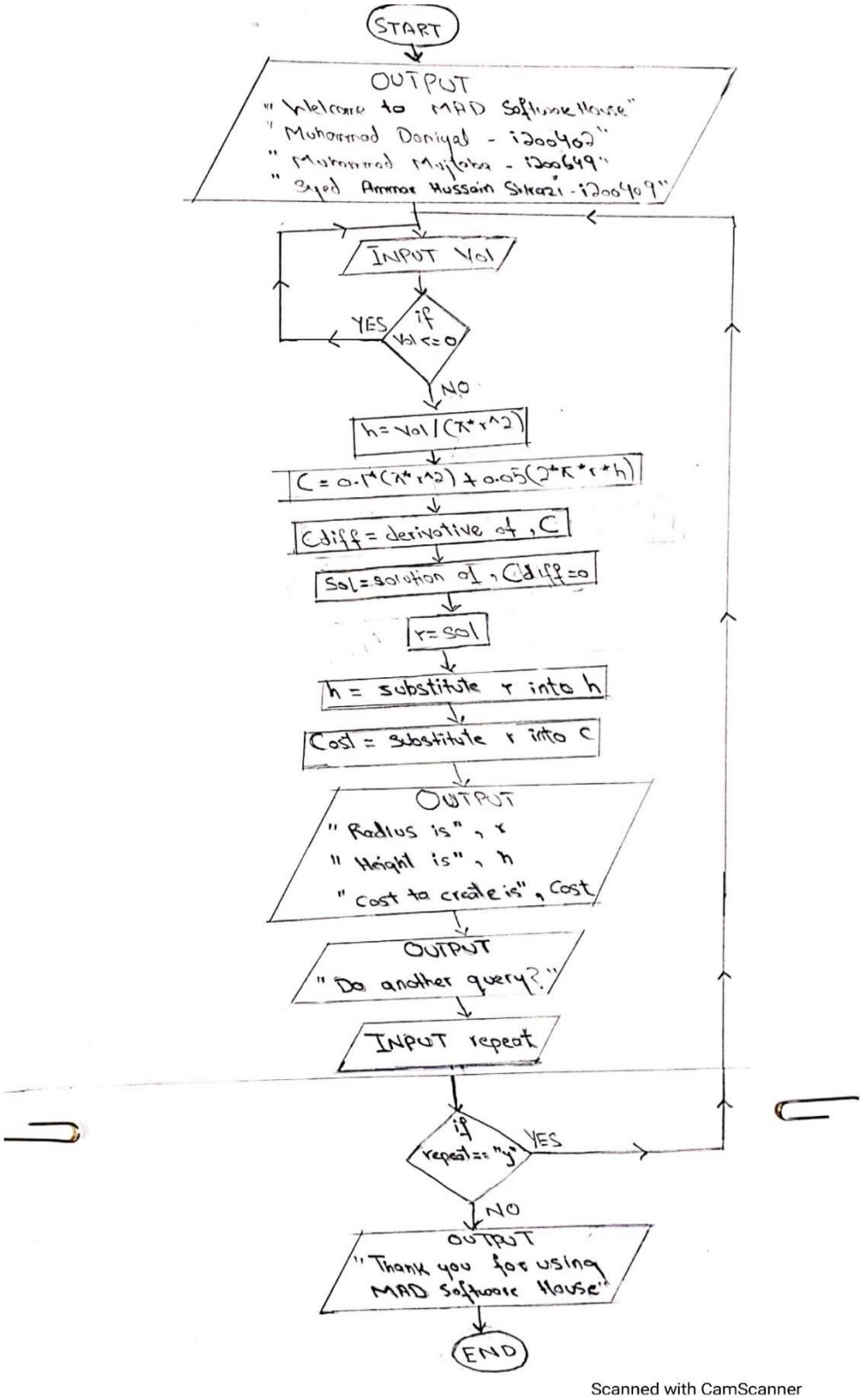

Figure 2 - Flowchart of The Program.

4- Explanation of Major MATLAB Commands Used

- fprintf: It used to print information on the screen.
- syms: It create one or more symbolic variables.
- vpa: It sets number of digits used to evaluate expressions.
- subs: It substitutes variables or expressions.
- disp: It displays content of array or string.
- surf: It creates shaded 3D mesh surface plot.
- x/z label: It adds a label to horizontal / vertical axis of the plot.

5- Detailed Example: How to Run the Program.

```
Command Window
>> CalProject
WELCOME TO MAD SOFTWARES
Muhammad Daniyal - i200402
Muhammad Mujtaba - i200649
Syed Ammar Hussain Shirazi - i200409
-----------
Press Enter To Continue:
Enter your required volume (cm.^3):300

Dimesion required for minimum cost:
 Radius = 3.628 cm
 Height = 7.256 cm

Cost to create = 12.404 $

Would you like to perform another query(y/n):y
Loading....
-----------
Enter your required volume (cm.^3):500

Dimesion required for minimum cost:
 Radius = 4.301 cm
 Height = 8.603 cm

Cost to create = 17.437 $

Would you like to perform another query(y/n):n

Thank You For Using MAD Softwares :)
fx >>
```

Figure 3 - Output of The Code.

- Name of group and its members is outputted.
- A prompt is given to press enter before continuing further.
- A prompt is asked to take input of volume in cm^3. If volume <= 0 the user is requested to input volume again.
- Then dimensions (radius, height), and minimum cost that are calculated backhand are outputted.
- User is prompted that if they want to make another query, and an input is taken. If input is ‘y’ the program will loop back, and ask for volume again to make another query. If input =/= ‘y’ the program will end.

6- 3D-Plot

```
r=3.628;
[X,Y,Z]=cylinder(r);
h=7.256;
Z=Z*h;
surf(X,Y,Z)
xlabel('Radius (cm)')
zlabel('Height (cm)')
title('3D Can Plot [MAD Softwares]')
```

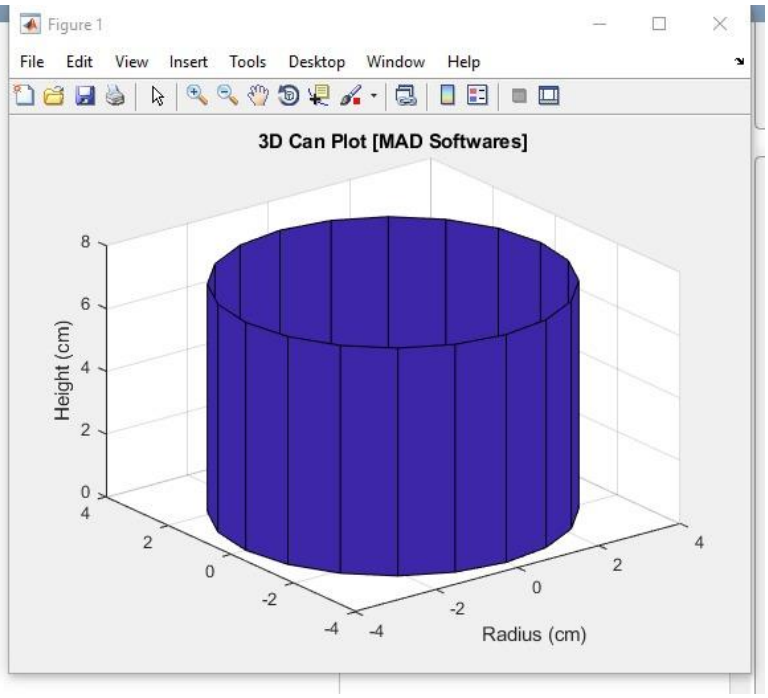

Figure 4 - 3D Plot of an open top cylinder (300 cm^3).

7- Conclusions, Analysis, Methodology & Comparison

- The main part of the problem is to understand it. In this problem we were asked to design a software for a soft drink manufacturer. They provide us with their requirements and asked us to make them a general software for their company. Hence, from this software they can easily get the minimum price of one can according to their budget. In conclusion, the basic object of this problem was to make us understand the requirement of the clients and act accordingly.
- In the question we are given the price of sides of the can and its bottom, top of the can is not included. Volume of the can is also provided to us. At first, we wrote the equation of volume of the can. Then, we write the equation for the cost of the can. Secondly, we substitute the value of height in equation to express it as one variable. Next, we find the first derivative of the equation and put it equal to zero to get the value of radius. Then, we put that value of radius in the volume equation to get the value of height of can. Finally, we put both the values in the cost equation to get the minimum cost value of can.
- Methodology, at first, we made a function with respect to the given values. Then we find the first derivative and put it equal to 0 for minimum value of the can, from there we got the value of radius of can. we put that value in the volume equation to get height. for the minimum cost of can we put these values in equation.
- In the comparison with the hand solution (Figure-1), we can see that both the answers are same and from this we can conclude that the methods which we applied for solving question on MATLAB and by hand are appropriate and correct. Furthermore, the price of one can is also same.

8- Contribution Section

Ammar Hussain Shirazi

- Contributed in MATLAB code.
- Worked on report.
- Compiled the final report.

Muhammad Daniyal

- Did MATLAB coding.
- Helped in report.
- Helped overcoming a lot of MATLAB issues faced.

Muhammad Mujtaba

- Did problem by hand.
- Contributed in MATLAB code.
- Worked on report.

9- Difficulties Faced

1. MATLAB was giving complex values of radius and height.
   We solved it by adding “real” while declaring “r” as a symbolic value.
2. MATLAB was giving error while trying plot 3D can using value of radius directly obtained after solving the derivative of cost.
   We solved it by assigning the value of the solution to “r” as double type.
3. MATLAB was giving errors when trying to substitute the value of “r” into the height equation and assigning the final value in “h”.
   We solved it by substituting to double type before assigning it to “h” variable.
4. MATLAB was not converting “pi” from its symbolic from to its numerical value in the final results.
   We solved it by using vpa() function with “pi” to remedy that problem.
5. While using input function normally, MATLAB would not consider character inputs, in this case y/n, properly and therefore was unable to apply the required checks on the input.
   We solved it by using input('prompt','s');.

10- Complete MATLAB Program

```
%Displaying the initial welcome message.
fprintf('WELCOME TO MAD SOFTWARES\n');
fprintf('Muhammad Daniyal - i200402\n');
fprintf('Muhammad Mujtaba - i200649\n');
fprintf('Syed Ammar Hussain Shirazi - i200409\n');
%awaiting action from user to continue.
cont = input('-----------\nPress Enter To Continue: ');

while 1 %using a loop incase user wants to take multiple queries.
    syms r real ; %declaring variables dynamically.
    syms Cdiff ;

    %Obtaining the required volume from user.
    Vol = input('Enter your required volume (cm.^3):');

    %Checking if value for volume enter is valid.
    if (Vol <= 0)
       fprintf('\nVolume must be greater than 0!\n')
        continue; %retaking input by going to next iteration directly
    end

    %Forming equation of height in terms of Volume and radius.
    h = Vol/(pi *(r.^2))  ;
    %Forming the Cost function.
    C = (0.1*( vpa(pi)* (r.^2) )) + ( 0.05 * (2*pi*r*h ) )  ;
    %Taking the derivative of Cost function.
    Cdiff = diff(C);
    %Solving for Derivative of Cost function = 0.
    sol = solve(Cdiff);
    %Assigning radius attained for minimum cost to r.
    r = double(sol);
    %Subsituting value of radius into the equation of height.
    h = double(subs(h,r)) ;
    %Subsituting value of radius into the Cost function.
    Cost = subs(C,r);

    %Displaying the final results.
    fprintf('\nDimesion required for minimum cost:\n');
    fprintf(' Radius = %.3f cm\n',r);
    fprintf(' Height = %.3f cm \n',h);
    fprintf(' Cost to create = %.3f $ \n',Cost);

    %Asking the user if they want to perform another query.
    repeat = input('\nWould you like to perform another query(y/n):','s');

    %Performing another query, if user wants.
    if (repeat == 'y')
        fprintf('Loading....\n----------\n');
        continue; %next iteration of loop
    else %Ending the program ,if user wishes to stop.
        fprintf('\nThank You For Using MAD Softwares :)\n');
        break; %breaking loop and ending program.
    end
end
```

Figure 5 - Main MATLAB Program Code.