Course Project Documentation

CS101 Project (Year 2015)

ImaGe/The Image Generator

Team:428

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1.Introduction:

- ❖ In the past few years, the use of internet has increased excessively for study purpose by students of all age groups. This project is also for the study purpose of the students.

- ❖ ImaGe is a software which can be used as a teaching tool for students who are newly introduced to the topic of 'OPTICS'.

- ❖ This software first requires the user to select which type of optical instrument he/she requires. Then the usere has to input the instrument parameters like radius of curvature and refractive index.

- ❖ A Canvas window opens and the user is required to click the position of the object, after which the image is generated along with the required construction lines.

2. Problem Statement:

- ❖ The main objective of this software is to make teaching of optics more interactive by giving on the spot demonstration of what is taught in the class.
- ❖ To give the user as much information about the image formed.

3.Requirements :

The hardware requirements of this project are the basic hardware components like CPU, monitor, mouse and keyboard,

The software requirements are listed below:

1.	GTK	: For adding features like buttons in the menu
2.	IDE Code::blocks	: For running the simplecpp code and displaying graphics in Canvas.

3. Implementation:

Taking input from user: The software asks the user to select the type of optical instrument, enter the radius of the instrument (in all but plane mirror), the refractive index (in case of lens), the type of object (point or extended) and the no. of vertices (in case of extended object) and then constructs the optical instrument in Canvas. After that, the user is asked to click in the box provided in canvas as many times as the no. of vertices he/she has entered (in case of a simple extended object, the user is asked to click all the points only on one side of the focus of the optical instrument) which is actually the object (real or virtual) for which he wishes to get the output.

Displaying the Image: Finally, an image of the object is generated in canvas showing the position (in pixels) of the object and image with respect to the optical centre, the type of image, and magnification (in case of point objects).

4.Functionality:

Function Prototypes:

- ❖ class mirror
  Contains all the member functions and data members required to draw the mirror, accept an input object and display the image along with the image properties.
- ❖ class lens
  It is an inherited class of class mirror and contains all the extra member functions required to draw the lens, accept an input object and display the image along with its properties.
- ❖ Functions:
  1. Void drawpx(): Draws the principal axis.
  2. Void rangebox(): Draws a box which restricts the position of the object.
  3. Void getradius(int p): Inputs the radius of the mirror and lens.
  4. Void intersection(float x1,float y1,float m1,float x2,float y2,float m2): Computes the intersection point of two lines.
  5. Void mark(int p): Displays all the important points like optical centre, center of curvature and focus.
  6. Void drawmir(int p): Draws the corresponding mirror for the radius inputted.
  7. Void Dash(float x1, float y1,float x2, float y2): Draws a dashed line between two points.
  8. Void intersection(float &ax, float &ay, int n1, int p):Takes the object coordinates and converts them to image coordinates using intersection function used in point 4.

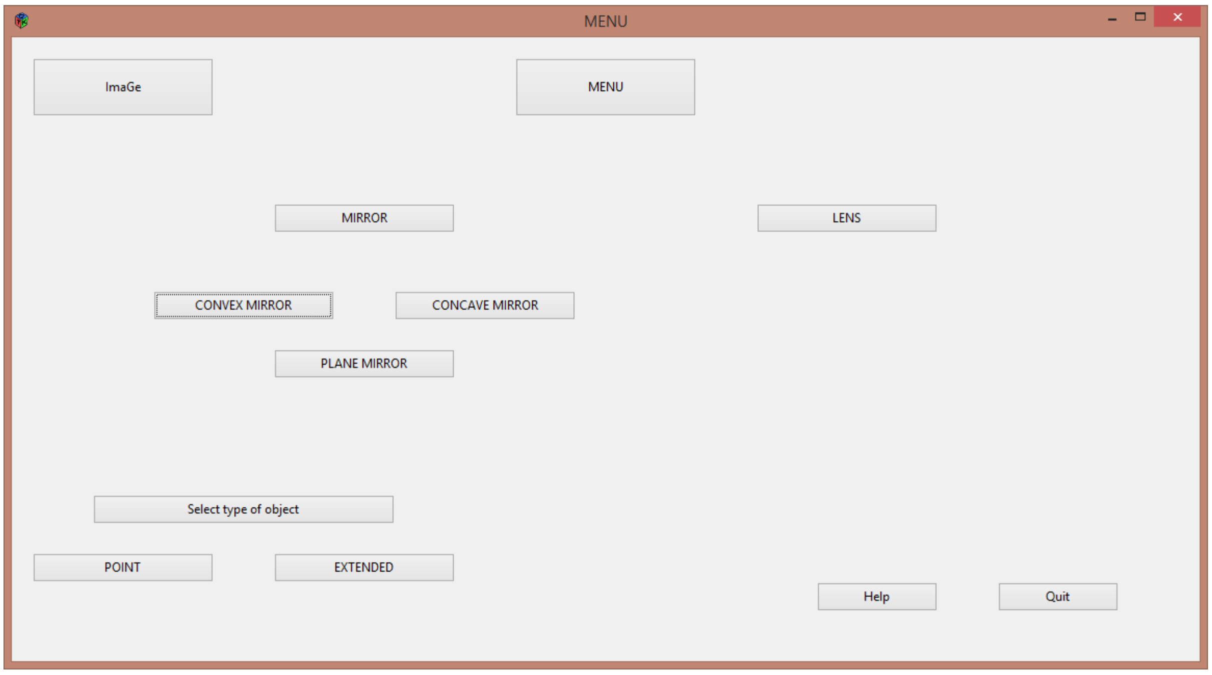
9. Void extended(int q): Initializes an nx2 array to store the object coordinates.It also calls the intersection function(call by reference).
10. Void extendeddisplay(float a[][2], int n): Takes an array and forms a closed polygon for each of the points in the array (Simple Extended Object).
11. Void getobject(int w): Store the corresponding object coordinates after the user clicks on the Canvas.
12. Void drawpl(int p):Draws a horizontal line from the object to the mirror.
13. Void drawrl(int p): Draws a line from the mirror to the image.
14. Void drawcl(int p): Draws a line passing through the centre of curvature.
15. Void getimage(int p): Computes the image coordinates for a point object.
16. Void display(int p): Displays the radius of curvature of the lens and mirror.
17. Void mark2(int p): Displays all the important points like optical centre, center of curvature and focus.
18. Void getradius2(intp): Inputs the radius of curvature and the refractive index of the lens.
19. Void drawlens(int p): Draws the lens for the corresponding radius of curvature.
20. Void drawpl2(int p): Draws a horizontal line joining the object to the lens.
21. Void drawrl2(int p): Draws a line from lens to the image.
22. Void drawol(int p): Draws a line passing through the optical centre of the lens.

23. Void getimage2(int p): Calculates the image coordinates for a point object.
24. Void extendedobjmir(int p): Initializes the object for class mirror.
25. Void extendedobjlens(int p): Initializes the object for class lens.
26. Void convexmirror(int p): Initializes the object for class mirror when convex mirror is selected.
27. Void concavemirror(int p): Initializes the object for class mirror when concave mirror is selected.
28. Void planemirror(int p): Initializes the object for class mirror when plane mirror is selected.
29. Void convexlens(int p): Initializes the object for class lens when convex lens is selected.
30. Void cocavelens(int p): Initializes the object for class lens when concave lens is selected.

5.Testing Strategy and Data :

We have considered a few test cases to check the validity of our software. They are as follows:

I. Menu Window:



II. Convex Mirror:

a) The real object placed anywhere on the left side of the mirror has a virtual, erect and diminished image.

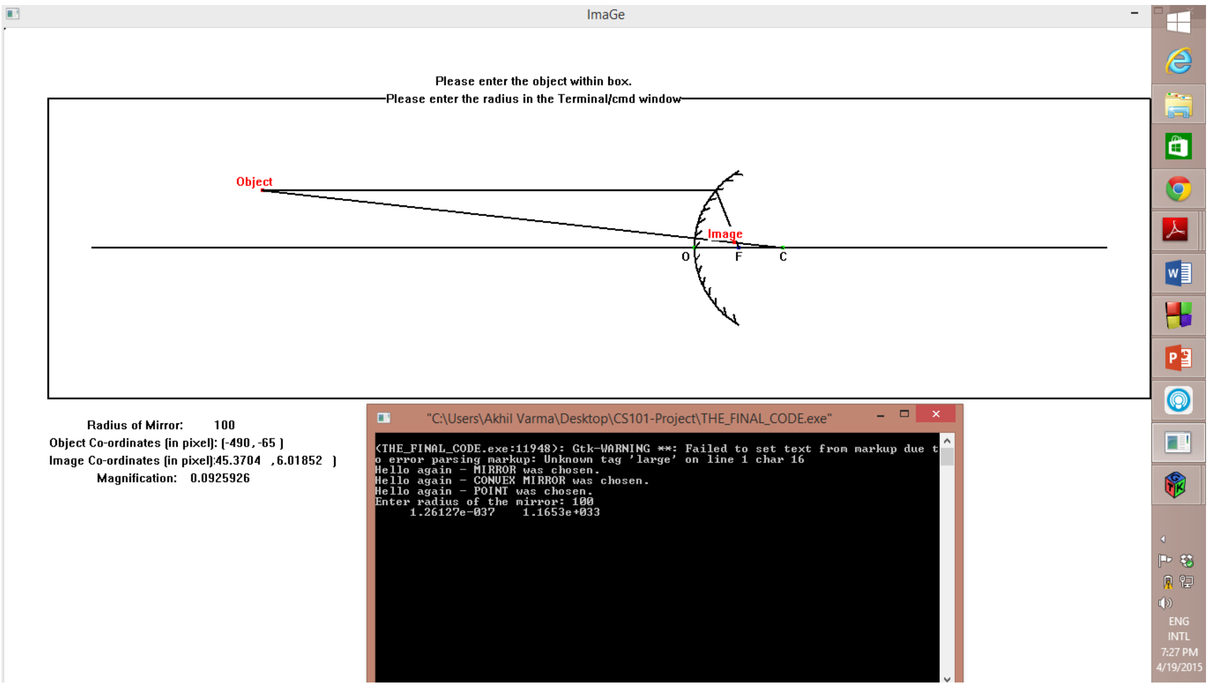
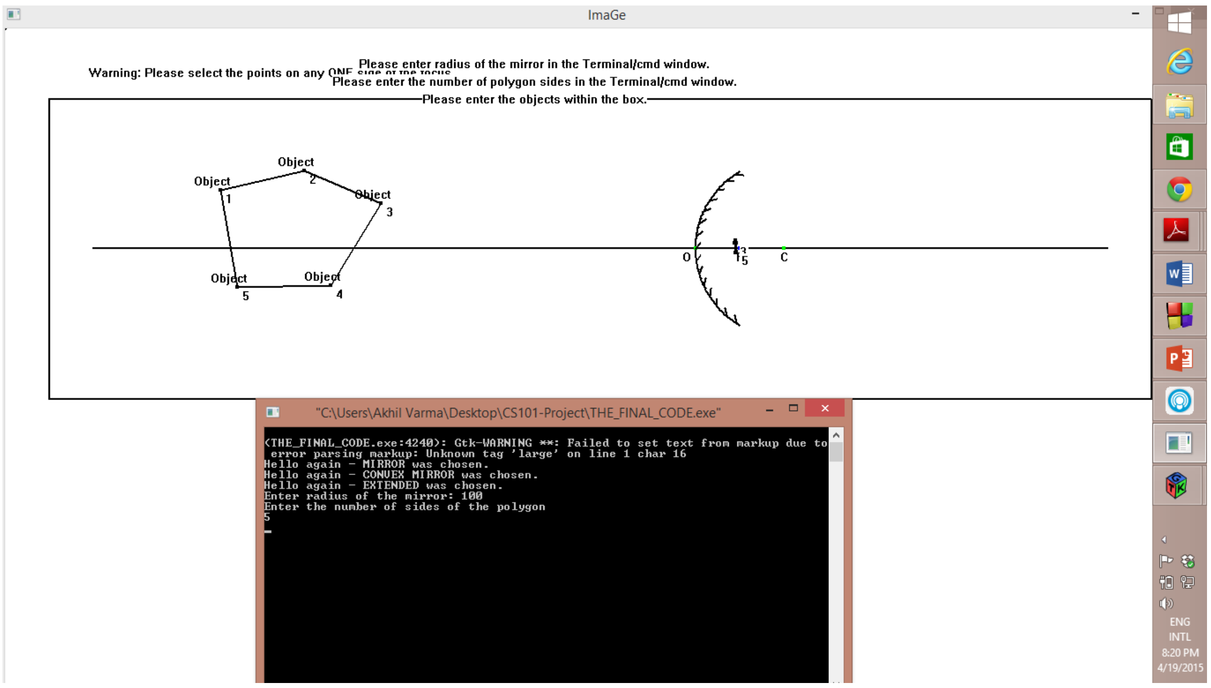


ImaGe
Please enter the object within box.
Please enter the radius in the Terminal/cmd window
Object
Image
O
F
C
"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"
ENG
INTL
7:27 PM
4/19/2015

Radius of Mirror: 100
Object Co-ordinates (in pixel): (-490 , -65)
Image Co-ordinates (in pixel):45.3704 ,6.01852)
Magnification: 0.0925926

```
(THE_FINAL_CODE.exe:11948): Gtk-WARNING **: Failed to set text from markup due t
o error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again - CONVEX MIRROR was chosen.
Hello again - POINT was chosen.
Enter radius of the mirror: 100
     1.26127e-037    1.1653e+033
```

b) For an extended object:



Warning: Please select the points on any ONE side of the focus

Please enter radius of the mirror in the Terminal/cmd window.

Please enter the number of polygon sides in the Terminal/cmd window.

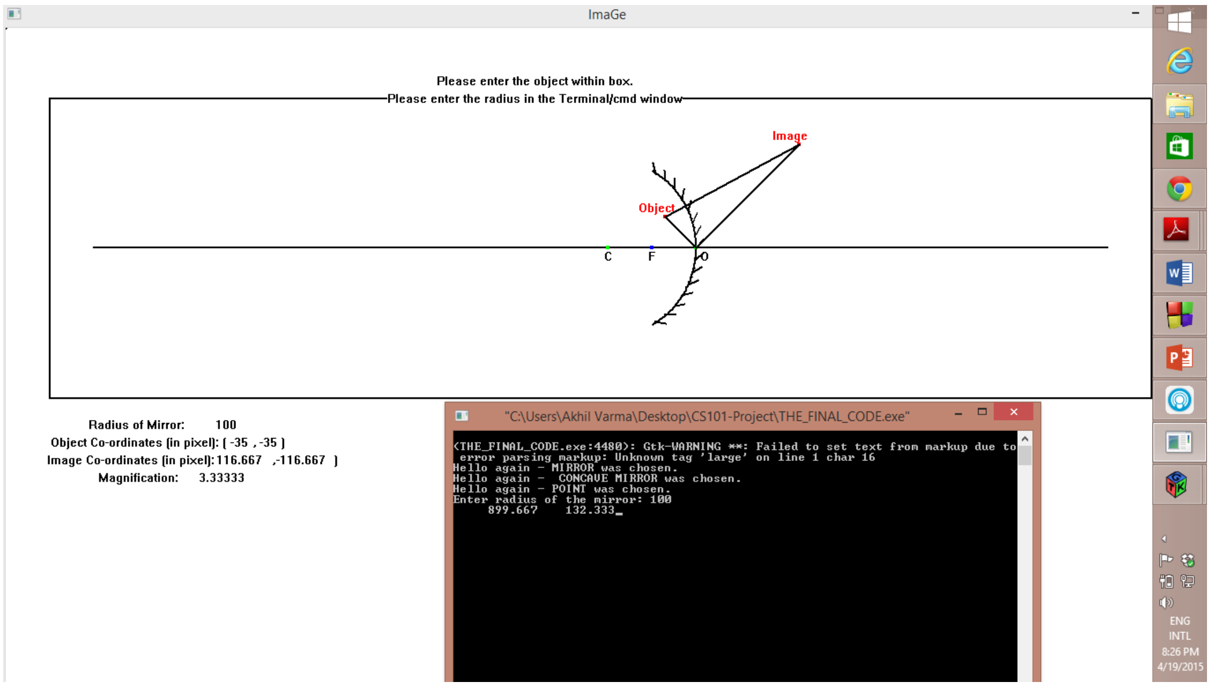
Please enter the objects within the box.

"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"

```
(THE_FINAL_CODE.exe:4240): Gtk-WARNING **: Failed to set text from markup due to
 error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again - CONVEX MIRROR was chosen.
Hello again - EXTENDED was chosen.
Enter radius of the mirror: 100
Enter the number of sides of the polygon
5
_
```

III. Concave Mirror:

a) A real object placed anywhere on the left side of the mirror (beyond center of curvature) has an image which is diminished, inverted and real in nature.



Please enter the object within box.

Please enter the radius in the Terminal/cmd window

Radius of Mirror: 100

Object Co-ordinates (in pixel): (-35 , -35)

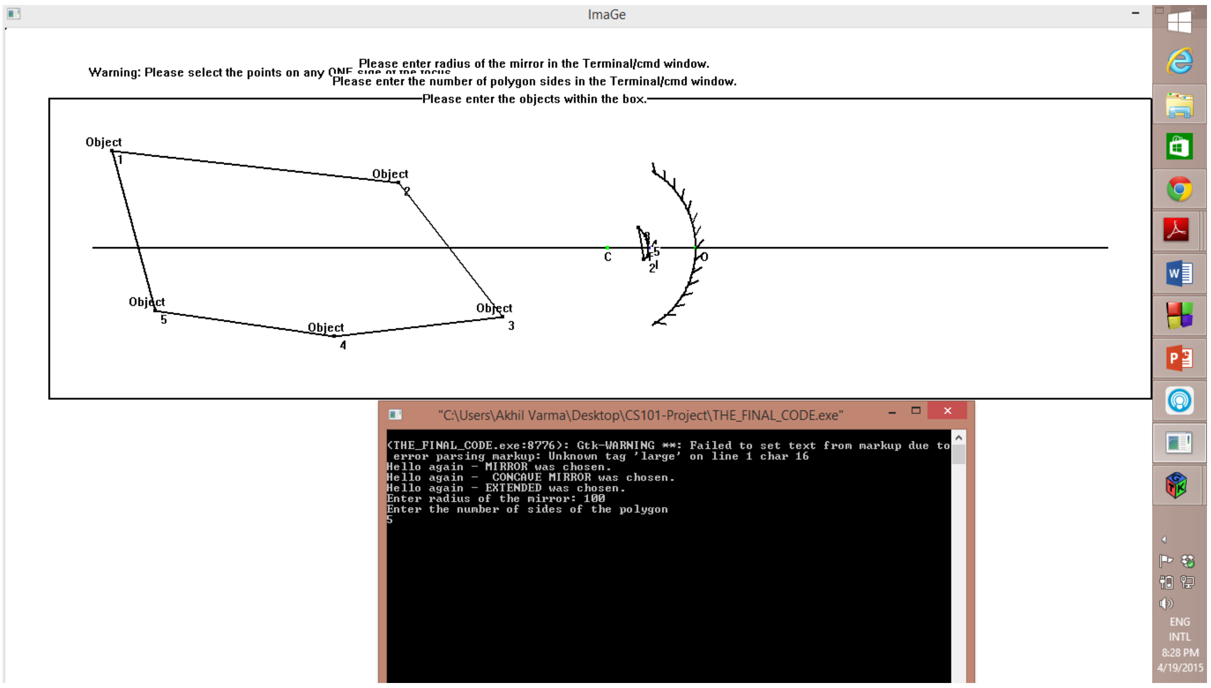
Image Co-ordinates (in pixel): 116.667 ,-116.667)

Magnification: 3.33333

"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"

```
(THE_FINAL_CODE.exe:4480): Gtk-WARNING **: Failed to set text from markup due to
 error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again -  CONCAVE MIRROR was chosen.
Hello again - POINT was chosen.
Enter radius of the mirror: 100
     899.667    132.333_
```

b) For a simple extended object:



Warning: Please select the points on any ONE side of the focus

Please enter radius of the mirror in the Terminal/cmd window.

Please enter the number of polygon sides in the Terminal/cmd window.

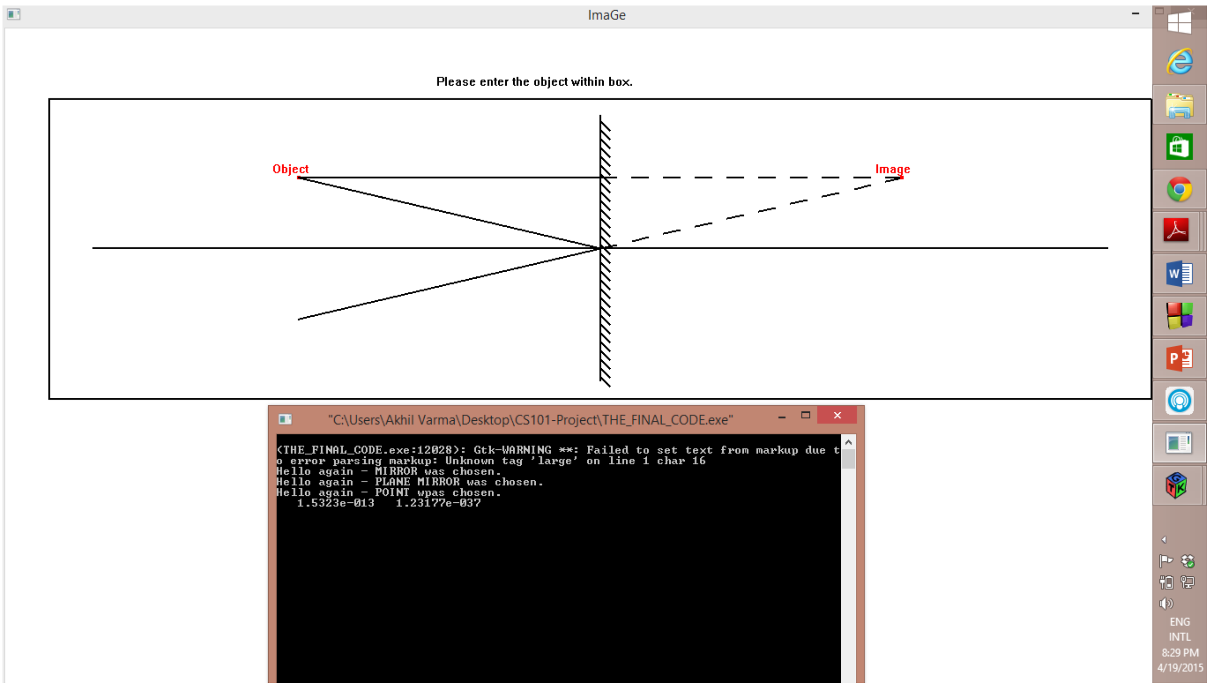
Please enter the objects within the box.

"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"

```
(THE_FINAL_CODE.exe:8776): Gtk-WARNING **: Failed to set text from markup due to
 error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again -  CONCAVE MIRROR was chosen.
Hello again - EXTENDED was chosen.
Enter radius of the mirror: 100
Enter the number of sides of the polygon
5
```

IV. Plane Mirror

a) For any real or virtual object, the image formed is erect, same size and has a nature opposite that of the object.

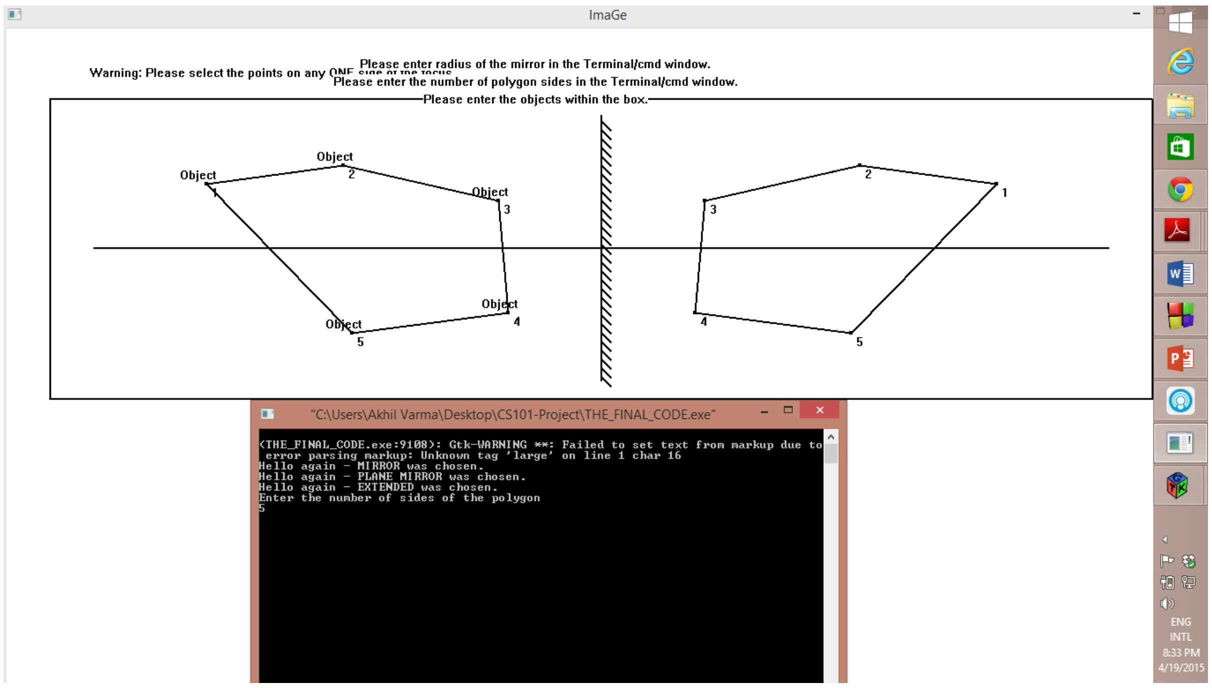


Please enter the object within box.

"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"

```
(THE_FINAL_CODE.exe:12028): Gtk-WARNING **: Failed to set text from markup due t
o error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again - PLANE MIRROR was chosen.
Hello again - POINT wpas chosen.
   1.5323e-013   1.23177e-037
```

b) For a simple extended object:



Warning: Please select the points on any ONE side of the focus

Please enter radius of the mirror in the Terminal/cmd window.

Please enter the number of polygon sides in the Terminal/cmd window.

Please enter the objects within the box.

"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"

```
(THE_FINAL_CODE.exe:9108): Gtk-WARNING **: Failed to set text from markup due to
 error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - MIRROR was chosen.
Hello again - PLANE MIRROR was chosen.
Hello again - EXTENDED was chosen.
Enter the number of sides of the polygon
5
```

V. Convex Lens:

a) When a real object is placed beyond twice the focal length the image formed is inverted, real, diminished and lies between the focus and twice the focal length.

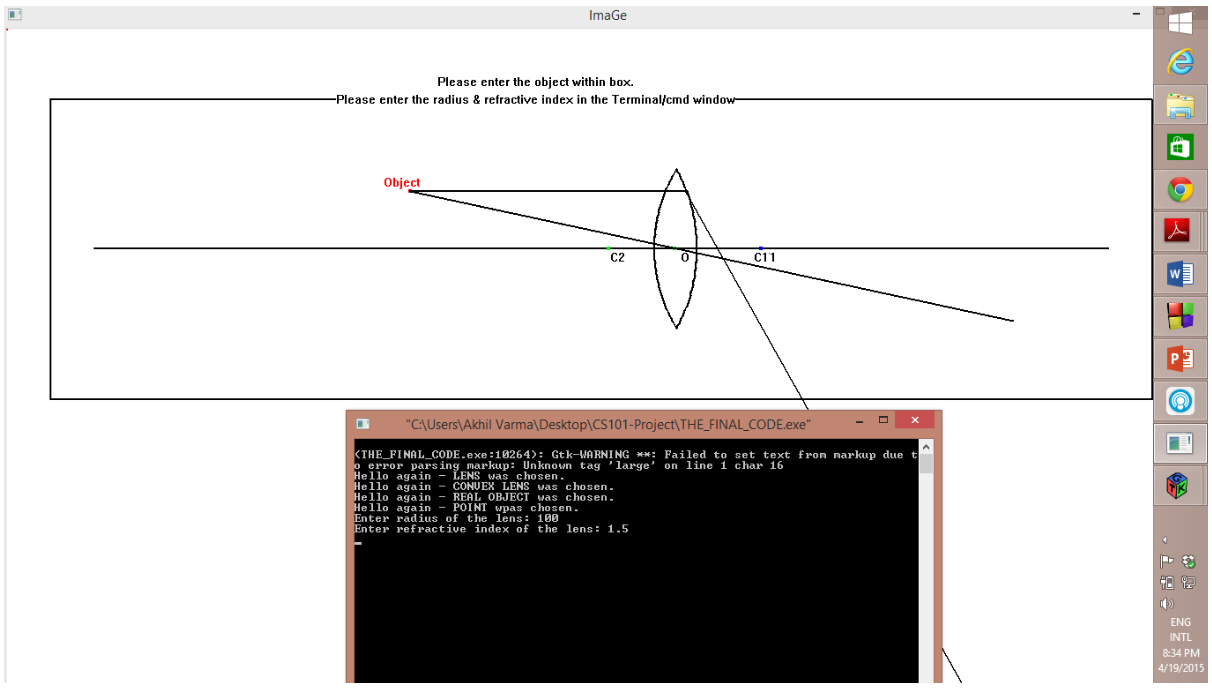


ImaGe
Please enter the object within box.
Please enter the radius & refractive index in the Terminal/cmd window
Object
C2
O
C11
"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"
ENG
INTL
8:34 PM
4/19/2015

```
(THE_FINAL_CODE.exe:10264): Gtk-WARNING **: Failed to set text from markup due t
o error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - LENS was chosen.
Hello again - CONVEX LENS was chosen.
Hello again - REAL OBJECT was chosen.
Hello again - POINT wpas chosen.
Enter radius of the lens: 100
Enter refractive index of the lens: 1.5
_
```

VI. Concave Lens:

a)When a real object is placed anywhere, the image formed is always erect,virtual ,diminished and lies between focus and optical centre.

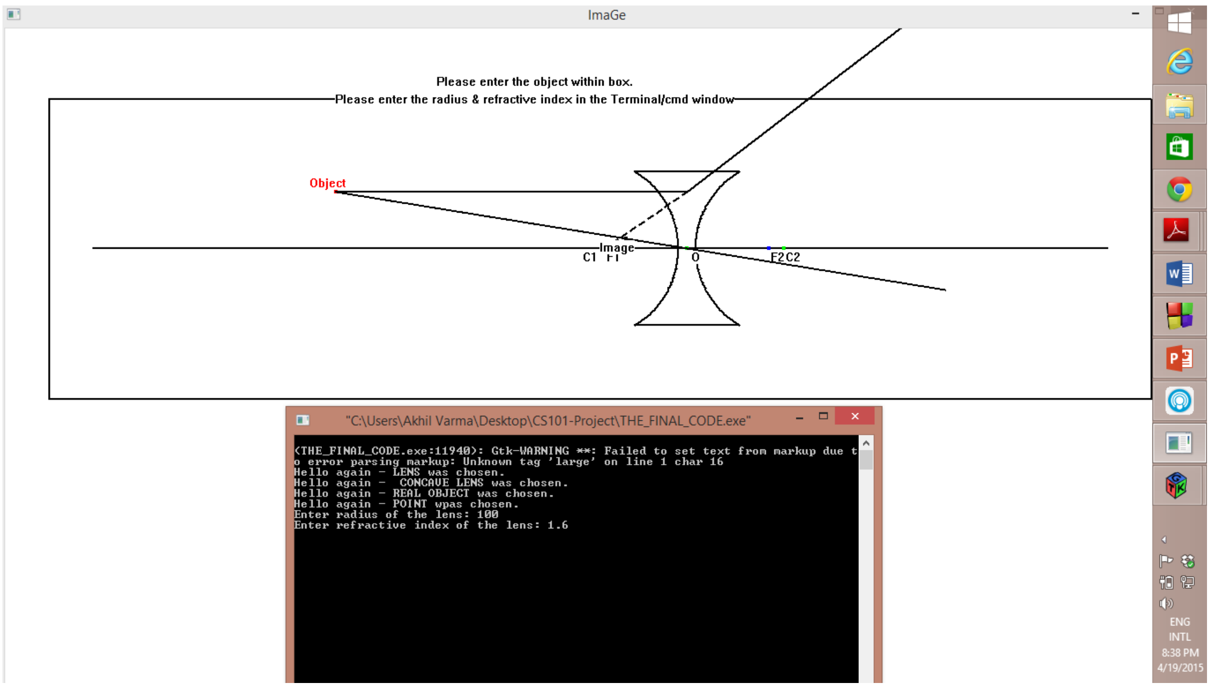
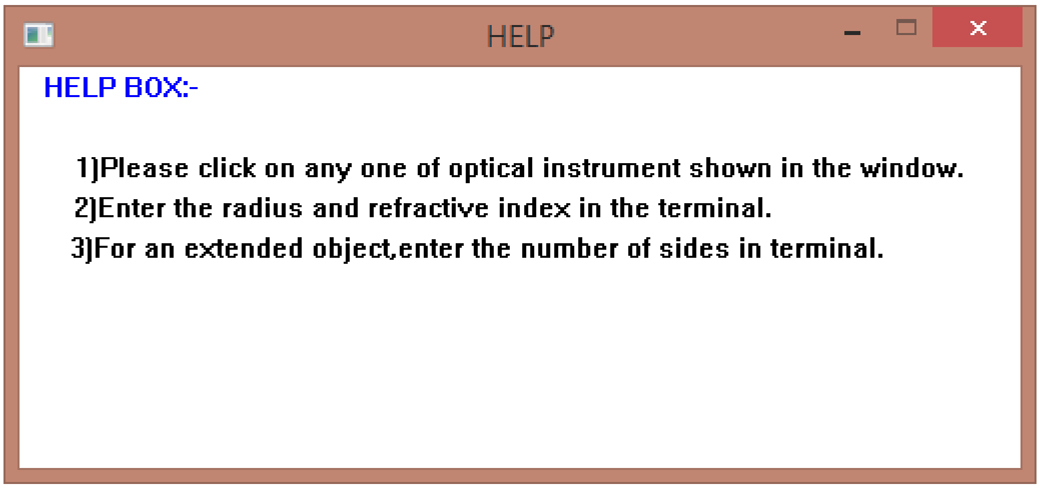


ImaGe
Please enter the object within box.
Please enter the radius & refractive index in the Terminal/cmd window
Object
Image
C1
F1
O
F2
C2
"C:\Users\Akhil Varma\Desktop\CS101-Project\THE_FINAL_CODE.exe"
ENG
INTL
8:38 PM
4/19/2015

```
(THE_FINAL_CODE.exe:11940): Gtk-WARNING **: Failed to set text from markup due t
o error parsing markup: Unknown tag 'large' on line 1 char 16
Hello again - LENS was chosen.
Hello again -  CONCAVE LENS was chosen.
Hello again - REAL OBJECT was chosen.
Hello again - POINT wpas chosen.
Enter radius of the lens: 100
Enter refractive index of the lens: 1.6
```

VII. Help Box:



HELP BOX:-

1)Please click on any one of optical instrument shown in the window.
2)Enter the radius and refractive index in the terminal.
3)For an extended object,enter the number of sides in terminal.

VIII. Info Box:

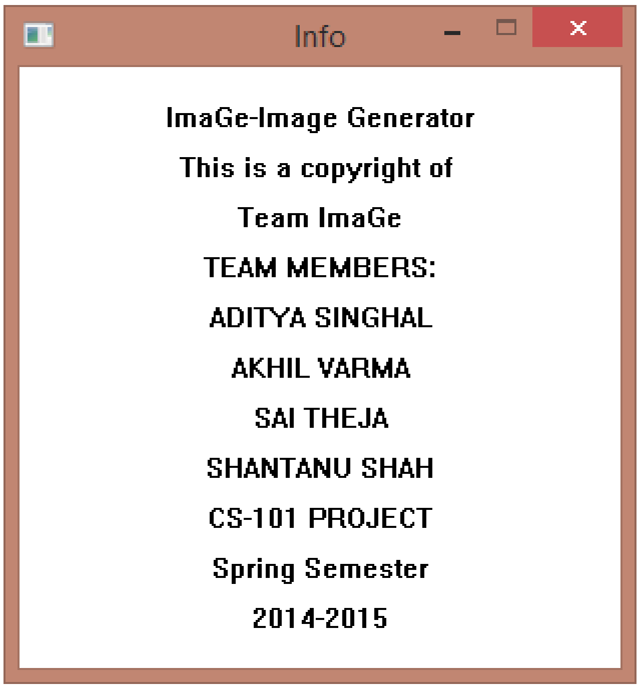


ImaGe-Image Generator

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CS-101 PROJECT

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2014-2015

5. Discussion of system :

- ❖ What worked as per plan?
    1. Proper image formation: The image is formed by sowing the intersection of various construction lines, not from the mirror formula. This point was stressed upon in the SRS.
    2. Display of Help and Info box: In case the user gets stuck he/she can click on the help box to get further instructions. The info box displays the information and credentials of the software.
- ❖ What we added more than discussed in SRS?
    1. Display of instrument properties window using GTK+ code.
- ❖ Changes made in plan:
    1. We initially planned to use only simplecpp graphics library. But, executing two Canvas window is not possible using this library in Windows OS. Since we had stated in our SRS that the software will be compatible to Windows OS, Ubuntu OS and Mac OS, we had to revert to use another graphics library. The above shortcomings were satisfied by using GTK+ graphics library.

6. Future Works:

a) One major step would be allowing the user to draw the extended object freely in Ms Paint and then generating the corresponding image.

b) Another step is to introduce medias having different refractive indices on both sides of the lens.

c) One more step is about providing the user an option to create an account through which he/she can keep a track of all the work that has been done till now and save his progress thereafter.

d) The lens can have different radii of curvature for its two surfaces.

7.Conclusions:

Our work can be generalised as a “ray diagram” for objects placed in front of a lens or a mirror. It is a very important tool for students to get a deep vision and understanding into the basics of optics.

8. References:

Following are the links for downloading and installing full version IDE code::blocks and GTK.

a) IDE code::blocks :

http://www.cse.iitb.ac.in/~ranade/simplecpp/

b) GTK :

http://www.gtk.org/download/

c) www.stackoverflow.com

d)www.developer.gnome.org/gtk/