

CAD Development

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of
Bachelor of Technology
(Computer Science and Engineering)



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Mandeep Singh

Abstract

This project is based on hatching implementation Computer-aided design (CAD) software. In this project we have to fill the closed object with different color and different patterns. Hatching is used in many CAD software to fill object with different shades. Also, this project is completely open source and is made using C++ and the entire code is available to the user as and when required. There is also Complete developer Documentation as well as User manual alongwith it and using it a lot easier.

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CHAPTER 1

INTRODUCTION TO ORGANISATION



Figure 1.1: Guru Nanak Dev Engineering College

I had my Six Weeks Industrial Training at TCC-Testing And Consultancy Cell, GNDEC Ludhiana. Guru Nanak Dev Engineering College was established by the Nankana Sahib Education Trust Ludhiana. The Nankana Sahib Education Trust i.e NSET was founded in memory of the most sacred temple of Sri Nankana Sahib, birth place of Sri Guru Nanak Dev Ji. With the mission of Removal of Economic Backwardness through Technology Shiromani Gurudwara Parbandhak

Committee i.e SGPC started a Poly technical was started in 1953 and Guru Nanak Dev Engineering College was established in 1956.

NSET resolved to uplift Rural areas by admitting 70% of students from these rural areas ever year. This commitment was made to nation on 8th April, 1956, the day foundation stone of the college building was laid by Dr. Rajendra Prasad Ji, the First President of India. The College is now ISO 9001:2000 certified.

Guru Nanak Dev Engineering College campus is spread over 88 acres of prime land about 5 Km s from Bus Stand and 8 Km s from Ludhiana Railway Station on Ludhiana-Malerkotla Road. The college campus is well planned with beautifully laid out tree plantation, pathways, flowerbeds besides the well maintained sprawling lawns all around. It has beautiful building for College, Hostels, Swimming Pool, Sports and Gymnasium Hall Complex, Gurudwara Sahib, Bank, Dispensary, Post Office etc. There are two hostels for boys and one for girls with total accommodation of about 550 students. The main goal of this institute is:

- To build and promote teams of experts in the upcoming specialisations.
- To promote quality research and undertake research projects keeping in view their relevance to needs and requirements of technology in local industry.
- To achieve total financial independence.
- To start online transfer of knowledge in appropriate technology by means of establishing multipurpose resource centres.

1.1 Testing and Consutancy Cell

My Six Weeks Institutional Training was done by me at TCC i.e Testing And Consultancy Cell, GNDEC Ludhiana under the guidance of Dr. H.S.Rai Dean Testing and Consultancy Cell. Testing and Consultancy Cell was established in the year 1979 with a basic aim to produce quality service for technical problems at reasonable and affordable rates as a service to society in general and Engineering fraternity in particular.

Consultancy Services are being rendered by various Departments of the College to the industry, Sate Government Departments and Entrepreneurs and are extended in the form of expert advice in design, testing of materials & equipment, technical surveys, technical audit, calibration of instruments, preparation of technical feasibility reports etc. This consultancy cell of the college has given a new dimension to the development programmers of the College. Consultancy projects of over Rs. one crore are completed by the Consultancy cell during financial year 2009-10.

Ours is a pioneer institute providing Consultancy Services in the States of Punjab, Haryana, Himachal, J&K and Rajasthan. Various Major Clients of the Consultancy Cell are as under:

- Northern Railway, Govt. of India
- Indian Oil Corporation Ltd.



Figure 1.2: Testing and Consultancy Cell

- Larson & Turbo.
- Multi National Companies like AFCON & PAULINGS.
- Punjab Water Supply & Sewage Board
- Power Grid Corporation of India.
- National Building Construction Co.
- Punjab State Electricity Board.
- Punjab Mandi Board.
- Punjab Police Housing Corporation.
- National Fertilizers Ltd.
- GLADA, Ludhiana

2.1 Introduction to L^AT_EX

L^AT_EX, I had never heard about this term before doing this project, but when I came to know about its features, found it excellent. L^AT_EX (pronounced /letk/, /letx/, /ltx/, or /ltk/) is a document markup language and document preparation system for the T_EX typesetting program. Within the typesetting system, its name is styled as L^AT_EX.



Figure 2.1: Donald Knuth, Inventor Of T_EX typesetting system

Within the typesetting system, its name is styled as L^AT_EX. The term L^AT_EX refers only to the language in which documents are written, not to the editor used to write those documents. In order to create a document in L^AT_EX, a .tex file must be created using some form of text editor. While most text editors can be used to create a L^AT_EX document, a number of editors have been created specifically for working with L^AT_EX.

L^AT_EX is most widely used by mathematicians, scientists, engineers, philosophers, linguists, economists and other scholars in academia. As a primary or intermediate format, e.g., translating

DocBook and other XML-based formats to PDF, \LaTeX is used because of the high quality of typesetting achievable by \TeX . The typesetting system offers programmable desktop publishing features and extensive facilities for automating most aspects of typesetting and desktop publishing, including numbering and cross-referencing, tables and figures, page layout and bibliographies.

\LaTeX is intended to provide a high-level language that accesses the power of \TeX . \LaTeX essentially comprises a collection of \TeX macros and a program to process \LaTeX documents. Because the \TeX formatting commands are very low-level, it is usually much simpler for end-users to use \LaTeX .

2.2 Typesetting

\LaTeX is based on the idea that authors should be able to focus on the content of what they are writing without being distracted by its visual presentation. In preparing a \LaTeX document, the author specifies the logical structure using familiar concepts such as chapter, section, table, figure, etc., and lets the \LaTeX system worry about the presentation of these structures. It therefore encourages the separation of layout from content while still allowing manual typesetting adjustments where needed.

```
\documentclass[12pt]{article}
\usepackage{amsmath}
\title{\LaTeX}
\date{}
\begin{document}
  \maketitle
  \LaTeX{} is a document preparation system
  for the \TeX{} typesetting program.
  \par
   $E=mc^2$ 
\end{document}
```

\LaTeX

August 10, 2013

\LaTeX is a document preparation system for the \TeX typesetting program.
 $E = mc^2$

Figure 2.2: \LaTeX output of above program.

3.1 Introduction

The term computer graphics includes almost everything on computers that is not text or sound. Today almost every computer can do some graphics, and people have even come to expect to control their computer through icons and pictures rather than just by typing. Here in our lab at the Program of Computer Graphics, we think of computer graphics as drawing pictures on computers, also called rendering. The pictures can be photographs, drawings, movies, or simulations pictures of things which do not yet exist and maybe could never exist. Or they may be pictures from places we cannot see directly, such as medical images from inside your body. Computer graphics is now used in various fields; for industrial, educational, medical and entertainment purposes. The aim of computer graphics is to visualize real objects and imaginary or other abstract items. In order to visualize various things, many technologies are necessary and they are mainly divided into two types in computer graphics: modeling and rendering technologies.

3.2 Introduction to CAD

Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. CAD is also used for the accurate creation of photo simulations that are often required in the preparation of Environmental Impact Reports, in which computer-aided designs of intended buildings are superimposed into photographs of existing environments to represent what that locale will be like were the proposed facilities allowed to be built. Computer Aided Drafting describes the process of creating a technical drawings with the use of computer software. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications

through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print or machining operations. CAD software uses either vector based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects.

Today there are very few aspects of our lives not affected by computers. Practically every cash or monetary transaction that takes place daily involves a computer. In many cases, the same is true of computer graphics. Whether you see them on television, in newspapers, in weather reports or while at the doctors surgery, computer images are all around you. A picture is worth a thousand words is a well known saying and highlights the advantages and benefits of the visual ation of our data. We are able to obtain a comprehensive overall view of our data and also study features and areas of particular interest. A range of tools and facilities are available to enable users to visualize their data, and this document provides a brief summary and overview. Computer graphics can be used in many disciplines. Charting, ations, Drawing, Painting and Design, Image Processing and Scientific Visualization are some among them. Computer graphics is concerned with all aspects of producing images using a computer. It concerns with the pictorial synthesis of real or imaginary objects from their computerbased models.

CAD often involves more than just shapes. As in the manual drafting of Technical and Engineering Drawings, the output of CAD must convey information, such as material, processes,dimensions and tolerances, according to applicationspecific conventions. CAD may be used to design curves and figures in twoDimensional(2D) space; or curves, surfaces, and solids in three dimensional(3D) space.CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetic, and many more. CAD is also widely used to produce Computer animation for special Effects in movies,advertising and technical manuals. The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.The design of geometric model for object shapes, in particular, is occasionally called Computer Aided Geometric Design (CAGD).While the goal of automated CAD systems is to increase efficiency, they are not necessarily the best way to allow newcomers to understand the geometrical principles of Solid Modeling.

I explore LibreCad Source Code. LibreCAD is Free and Open Source CAD Software.LibreCAD is a fully comprehensive 2D CAD application that you can download and install for free. There is a large base of satisfied LibreCAD users worldwide, and it is available in more than 20 languages and for all major operating systems, including Microsoft Windows, Mac OS X and Linux (Debian, Ubuntu, Fedora, Mandriva, Suse ...). Librecad is an application for computer aided design (cad) in two dimensions (2d). with librecad you can create technical drawings such as plans for buildings, interiors, mechanical parts or schematics and diagrams.

The app is great for industrial designers, but anyone who wants to learn how to make 2D CAD drawings will like this program. For a free software, LibreCAD gives you a lot of tools to work with. New users will be able to create basic drawings, while advanced users can make engineering plans with 5the software. Layers can be added, ideal for complex drawings. The provided tools are sufficient for producing high precision drawings. You can start drawings from scratch. But it is also easy to put in splines, ellipses, arcs, lines and circles. A single item can have several iterations. For instance, you have 4 modes for a rectangle parameter. The different shapes can be combined easily. LibreCAD also has a powerful zoom tool that lets you look at models at different distances. This is essential for designers who are going to make lifesize copies of a drawing. There are three

tabs above the working area. The first tab is for changing color, useful for layer definition. The other tab is for changing size and the third for workspace customization.

LibreCAD also has grids which are extremely useful for those new to CAD. Once you have made the basic object, you can customize it in many ways. Scaling is particularly easy here. Also worth mentioning here is the "Explode text into letters" effect. It is a special feature that will come in handy ations. LibreCAD allows you to put horizontal or vertical restrictions on completed models. Relative zeros may be locked, useful for ending and starting points. All in all, it is powerful, free CAD application. You can download, install and distribute LibreCAD freely, with no fear of copyright infringement.

3.2.1 Introduction to LibreCAD

LibreCAD is a fully comprehensive 2D CAD application that you can download and install for free. There is a large base of satisfied LibreCAD users worldwide, and it is available in more than 20 languages and for all major operating systems, including Microsoft Windows, Mac OS X and Linux (Debian, Ubuntu, Fedora, Mandriva, Suse ...). LibreCAD is an application for computer aided design (cad) in two dimensions (2d). with libreCAD you can create technical drawings such as plans for buildings, interiors, mechanical parts or schematics and diagrams.

The app is great for industrial designers, but anyone who wants to learn how to make 2D CAD drawings will like this program. For a free software, LibreCAD gives you a lot of tools to work with. New users will be able to create basic drawings, while advanced users can make engineering plans with the software. Layers can be added, ideal for complex drawings. The provided tools are sufficient for producing high precision drawings. You can start drawings from scratch. But it is also easy to put in splines, ellipses, arcs, lines and circles. A single item can have several iterations. For instance, you have 4 modes for a rectangle parameter.

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LibreCAD's features:

- It's free no worry about license costs or annual fees.
- No language barriers it's available in a large number of languages, with more being added continually.
- GPLv2 public license you can use it, customize it, hack it and copy it with free user support 15and developer support from our active worldwide community and our experienced developer team.

- LibreCAD is an Open Source communitydriven project: development is open to new talent and new ideas, and our software is tested and used daily by a large and devoted user community; you, too, can get involved and influence its future development.
- LibreCAD is an Application for Computer Aided Design (CAD) in two dimension (2D). With LibreCAD you can create technical drawings such as plans for building, interiors, mechanical parts or schematics and diagrams.

How it started? LibreCAD started as a project to build CAM capabilities into the community version of QCad for use with a Mechmate CNC router. LibreCAD is a version of QCad CE ported to Qt4. Since QCad CE was built around the outdated Qt3 library, it had to be ported to Qt4 before additional enhancements. This gave rise to CADuntu.

The project was known as CADuntu only for a couple of months before the community decided that the name was inappropriate. After some discussion within the community and research on existing names, CADuntu was renamed to LibreCAD.

Porting the rendering engine to Qt4 proved to be a large task, so LibreCAD initially still depended on the Qt3 support library. The Qt4 porting was completed eventually during the development of 2.0.0 series, thanks to our master developer Rallaz, and LibreCAD has become Qt3 free except in the 1.0.0 series.

3.2.1.1 Downloading Source Code

Fired up the terminal because you need to install the qt4 development libraries, tools, compiler and git.

```
$ sudo apt-get install g++ gcc make git-core libqt4-dev qt4-qmake libqt4-help qt4-dev-tools  
libboost-all-dev libmuparser-dev libfreetype6-dev  
$ sudo apt-get build-dep libreCAD
```

clone the git repository of LibreCADcin Desktop (You can use any Directory)

```
$ git clone https://github.com/LibreCAD/LibreCAD.git
```

Now you can run qmake (or qmake-qt4) to create a makefile and run make to compile LibreCAD. Make sure that you are in the folder (LibreCAD).

```
$ cd LibreCAD  
$ qmake-qt4 libreCAD.pro  
$ make
```

libreCAD.pro is a project file. qmake creates a makefile. Make command will compile the project. Compiling LibreCAD might take awhile, depending on the speed of your computer, but just let it run until it finishes.

To finally run LibreCAD, execute the following commands:

```
$ cd unix  
$ ./libreCAD
```

3.3 Introduction to Qt

Qt Creator is a complete IDE for creating applications with Qt Quick and the Qt application framework. Qt is designed for developing applications and user interfaces once and deploying them across several desktop and mobile operating systems. One of the major advantages of Qt Creator is that it allows a team of developers to share a project across different development platforms (Microsoft Windows, Mac OS X, and Linux) with a common tool for development and debugging. In addition, UI designers can join the team by using Qt Quick tools for creating fluid user interfaces in close cooperation with the developers. The main goal for Qt Creator is meeting the development needs of Qt Quick developers who are looking for simplicity, usability, productivity, extendibility and openness, while aiming to lower the barrier of entry for newcomers to Qt Quick and Qt. The key features of Qt Creator allow UI designers and developers to accomplish the following tasks:

- Get started with Qt Quick application development quickly and easily with examples, tutorials, and project wizards.
- Design application user interface with the integrated editor, Qt Quick Designer, or use graphics software to design the user interface and use scripts to export the design to Qt Quick Designer.
- Develop applications with the advanced code editor that provides new powerful features for completing code snippets, refactoring code, and viewing the element hierarchy of QML files.
- Build and deploy Qt Quick applications that target multiple desktop and mobile platforms, such as Microsoft Windows, Mac OS X, Linux, Symbian, MeeGo, and Maemo.
- Debug JavaScript functions and execute JavaScript expressions in the current context, and inspect QML at runtime to explore the object structure, debug animations, and inspect colors.
- Profile your Qt Quick applications with the QML Profiler. You can inspect binding evaluations, signal handling, and painting operations when running QML code. This is useful for identifying potential bottlenecks, especially in the evaluation of bindings.
- Deploy applications to mobile devices and create application installation packages for Symbian and Maemo devices that can be published in the Ovi Store and other channels.
- Easily access information with the integrated contextsensitive Qt Help system.
- It has different modes such as Welcome, edit debug, design, analyze and help

3.4 Working with Qt Creator

Qt Creator meets its design goals of simplicity, ease of use, and productivity by relying on the concept of modes. These adapt the user interface to the different application development tasks at hand. When developers start Qt Creator, it opens to the Welcome mode, where they can open tutorials and example projects or start the project wizard to create their own projects.

Each mode has its own view that shows only the information required for performing a given task, and provides only the most relevant features and functions related to it. As a result, the

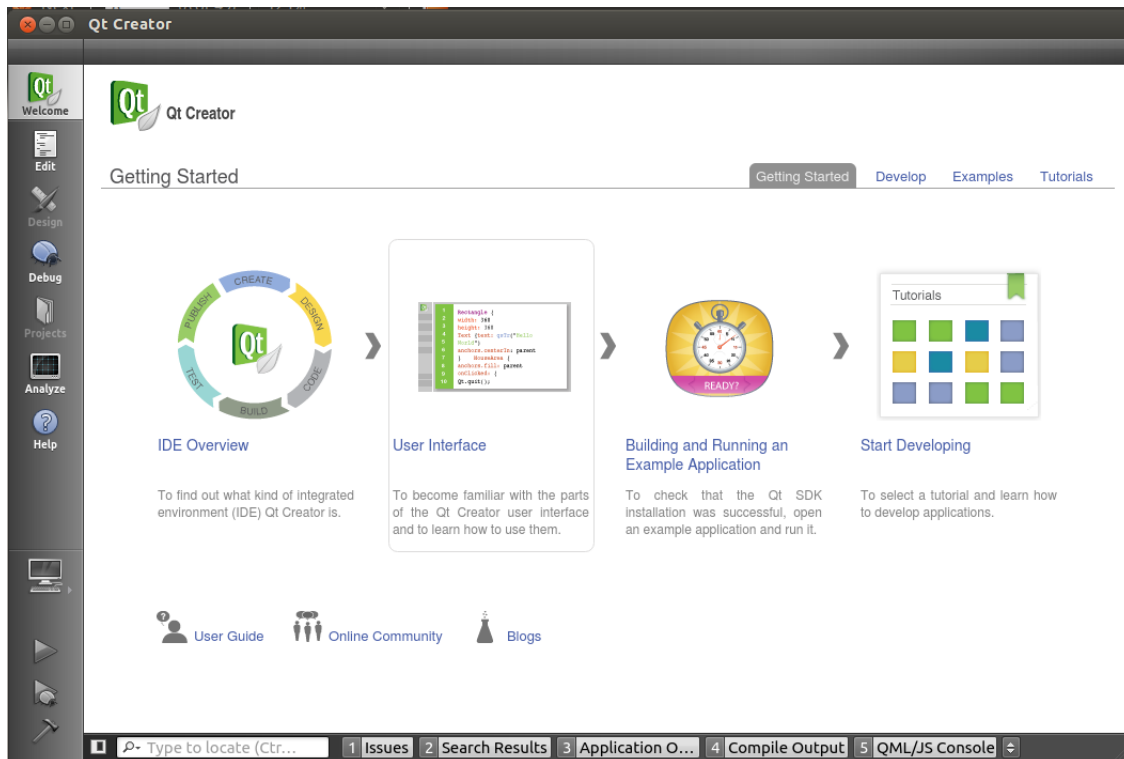


Figure 3.1: Welcome screen of Qt Creator

majority of the Qt Creator window area is always dedicated to actual application development tasks. Users can employ the mode selector to switch to a Qt Creator mode. The following image displays an example application in Edit mode and Design mode.



Figure 3.2: Welcome mode in Qt



Figure 3.3: Edit mode in Qt

3.4.1 Creating Projects

To be able to build and run applications, Qt Creator needs the same information as a compiler would need. This information is specified in the project build and run settings. Setting up a new project in Qt Creator is aided by a wizard that guides the user stepbystep through the project creation process. In the first step, the user selects the type of project from the categories. When

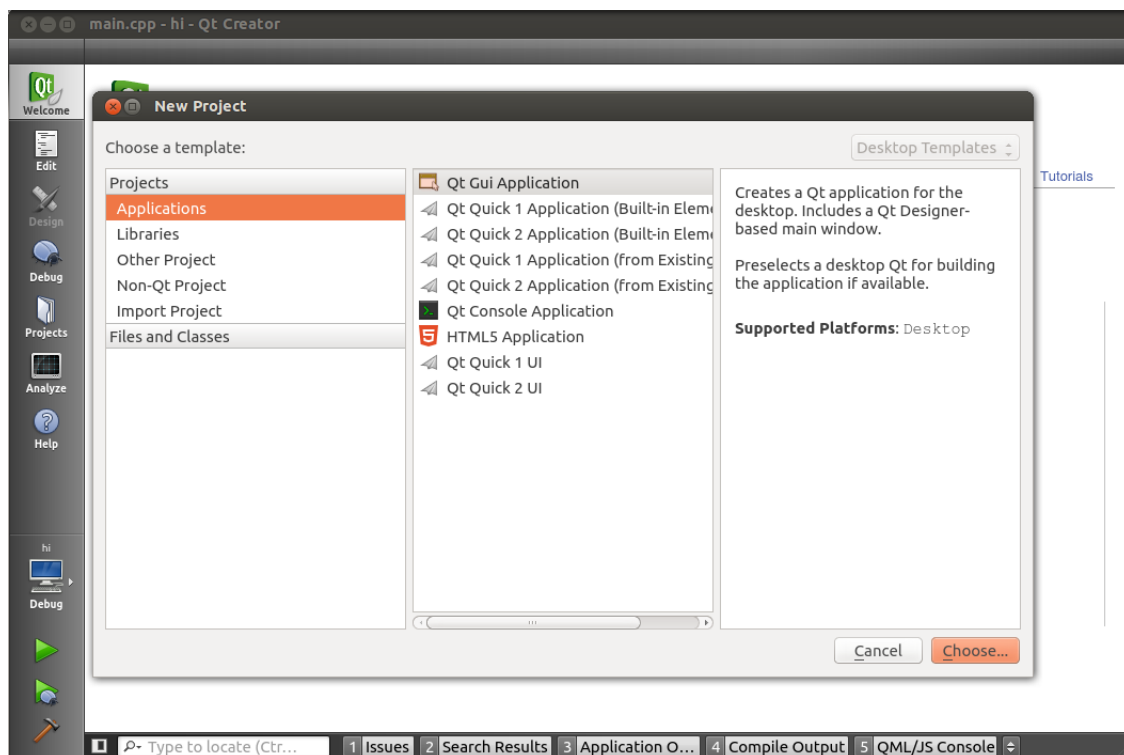


Figure 3.4: New file or project in Qt

creating Qt Quick Projects, the user can select either Qt Quick UI or Qt Quick Application. A Qt Quick UI project contains a single QML file that defines the main view of the application. UI designers can use it to create an application user interface and review it in the QML Viewer, without having to build the application. UI designers do not need to have the development environment installed on their computers to create and run this type of projects. Developers can build Qt Quick applications and deploy them on mobile target platforms. For example, they can create signed Symbian Installation System (SIS) packages or Debian packages for this type of project. Developers can use readymade Qt Quick Components for Symbian and MeeGo Harmattan that allow them to create applications with a native look and feel for the selected mobile platform. The components are delivered as part of Qt SDK. A Qt Quick UI project can be easily converted into

a Qt Quick application by using the Qt Quick application wizard to import the main QML file in the Qt Quick UI project. The wizard prompts developers to enter the settings needed for a particular type of project.

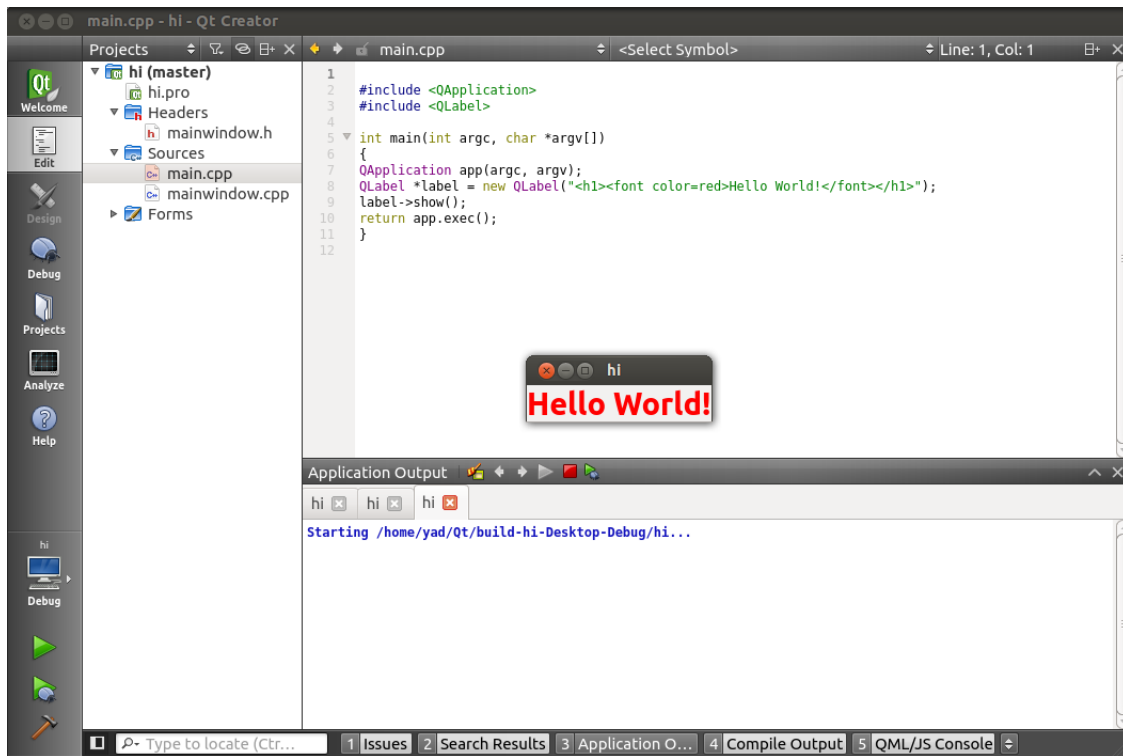


Figure 3.5: Project to print hello word

When the steps have been completed, Qt Creator automatically generates the project with required headers, source files, user interface descriptions and project files, as defined by the wizard. Not only does the wizard help new users get up and running quickly, it also enables more experienced users to streamline their workflow for the creation of new projects. The convenient user interface makes it easier to ensure that a project begins with the correct configuration and dependencies. Specifically, the Qt Quick application wizard allows developers to create projects that they can deploy on mobile devices with a click of the run button.

3.4.2 Using Qt Quick Toolbars

When users edit QML code in the code editor, they specify the properties of QML components. For some properties, such as colors and font names, this is not a trivial task. For example, few people can visualize the color. To easily edit these properties, users can employ the Qt Quick Toolbars. When a component is selected in the code and a toolbar is available, a light bulb icon appears. Users select the icon to open the toolbar. Qt Quick Toolbar indicator and Qt Quick Toolbar for rectangles. It is used for inserting text, images, and animation. Qt Quick Toolbars are available for editing the properties of the following QML elements: Rectangles Text Images Animation

3.4.3 Deploying Applications to Mobile Devices

Qt Creator deploy configurations handle the packaging of the application as an executable and copying it to a location developers want to run the executable at. The files can be copied to a location in the file system of the development PC or a mobile device. To deploy files on mobile devices, developers must either connect the devices to the development PC or use the installation packages generated by Qt Creator. Qt Quick UI projects must be converted into Qt Quick applications for deployment on mobile devices. Qt Creator allows developers to create installation packages for Symbian, MeeGo, and Maemo devices that are suitable for publishing on Ovi Store.

3.4.4 Getting Help

From time to time, developers may need further information about a certain QML element, Qt class, function, or other part of the Qt API. All the Qt documentation and examples are accessible via the Qt Help plugin in Qt Creator. To view the documentation, the Help mode is used, where most of the window is devoted to the help text. While working with source code in Edit mode, the user can access context sensitive help by moving the text cursor to a Qt class or function and then press the F1 key. The documentation is displayed within a panel on the right side of the code editor, as shown in the following figure.

Qt Designer is a powerful crossplatform GUI layout and forms builder. It allows you to rapidly design and build widgets and dialogs using onscreen forms using the same widgets that will be used in your application. Forms created with Qt Designer are fullyfunctional, and they can be previewed so that you can ensure that they will look and feel exactly as you intended.

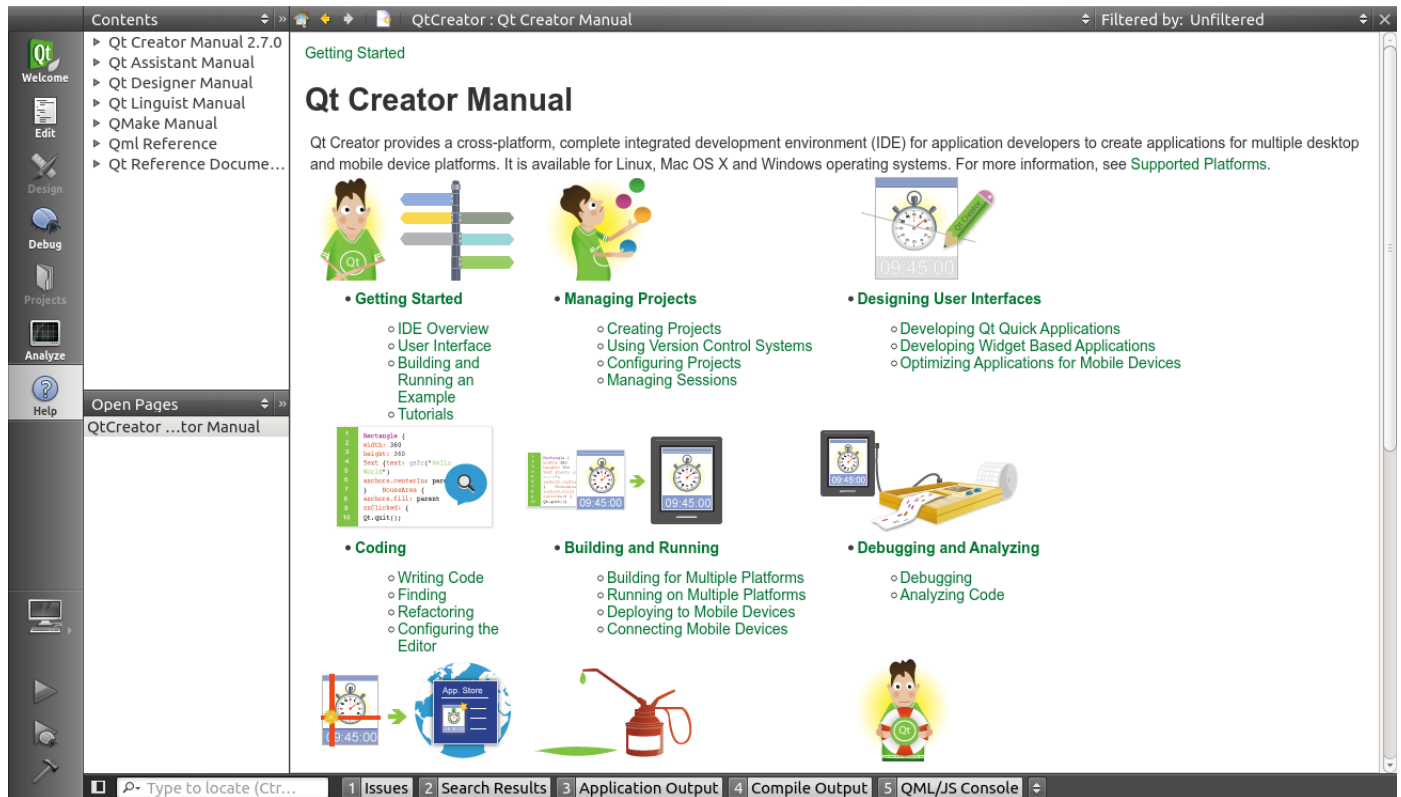


Figure 3.6: Displaying context sensitive Qt Help information

Features and Benefits

- Design user interfaces quickly with drag and drop functionality
- Customize widgets or choose from library of standard widgets
- Instantly preview forms in native look and feel
- Generate C++ or Java code from your interface prototypes
- Use Qt Designer with Visual Studio or Eclipse IDEs
- Build fullyfunctional user interfaces with Qts signals and slots

3.5 Introduction to Cairo Graphics Library

Cairo is a library for creating 2D vector graphics. It is written in the C programming language. Bindings for other computer languages exist. Python, Perl, C++, C#, Java. Cairo is a multiplatform library, it works on Linux, BSDs, and Mac OS.



Figure 3.7: Cairo Logo

Cairo supports various backends:

- X Window System
- Win32 GDI
- Mac OS X Quartz
- PNG
- PDF
- PostScript
- SVG

This means that we can use the library to draw on windows on Linux/BSDs, Windows, Mac OS and we can use the library to create PNG images, PDF files, PostScript files, and SVG files.

4.1 Text Editor using Qt

This text editor is made using Qt. Qt is the C++ framework. It has most used features that a text editor have. As my 6 weeks training project, I worked in Qt creator and made a text editor. Qt Creator is a complete IDE for creating applications with Qt Quick and the Qt application framework.

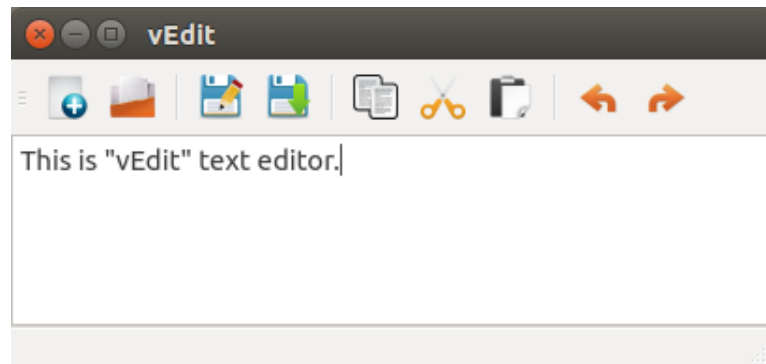


Figure 4.1: vEdit- The Text Editor

It has the following features:

- New File
- Open File
- Save File
- Save as File
- Copy
- Paste

- Cut
- Undo
- Redo

In this text editor we can make new text file and edit text. We can copy, cut and paste text easily. We can save and our text document in any location and open text document from any location.

4.1.1 Installation Guide

To install vEdit, you need to clone it from github. Open terminal and type:

```
git clone http://www.github.com/mandeeps708/vEdit.git
```

```
cd vEdit
```

```
qmake vEdit.pro
```

```
make
```

```
./vEdit
```

4.2 Design implementation using Lua scripting language

After working with libreCAD 3, I experimented with it by making some designs using Lua scripting language. In this project, I made several lua scripts and run it in LibreCAD to make various design. I make design of water tank and various logos and other impressive 2D design in LibreCAD using LUA programming language.

4.3 Hatching

This project also involves hatching implementation. To accomplish this, C++ and a graphics library named "Cairo" is used.

4.3.1 Introduction