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Figure 1

- Personalise colours to represent trends in your graph
- Ch allows you to visualise complicated functions in three dimensions with small amounts of code
- Easily customise your graph with keys, titles, and labels for clear identification

EASY GRAPHICAL PLOTTING IN C/C++

You'll Need

Raspberry Pi with C-STEMbian installed magpi.cc/ 2p3JUNP

Utilise data visualisation to better understand problems in maths, science, and engineering

As the saying goes, a picture is worth a thousand words. Graphical plotting is useful for visualisation and understanding many problems in maths, science, and engineering. In this article, we will learn how to write programs for graphical plotting.

A user-friendly integrated development environment, ChIDE provides the simplest possible solution for two- and three-dimensional graphical plotting within the framework of C/C++. It removes many of the hassles associated with programming in C by using the C/C++ interpreter, Ch.

Ch is a superset of C with many high-level extensions. It can run C code without compilation. All of the tools necessary to visualise data are available on C-STEMbian, a freely available operating system for Raspberry Pi.

C-STEMbian is a superset of Raspbian and includes several tools that provide a user-friendly environment for computing, robotics, and cyber-physical systems.

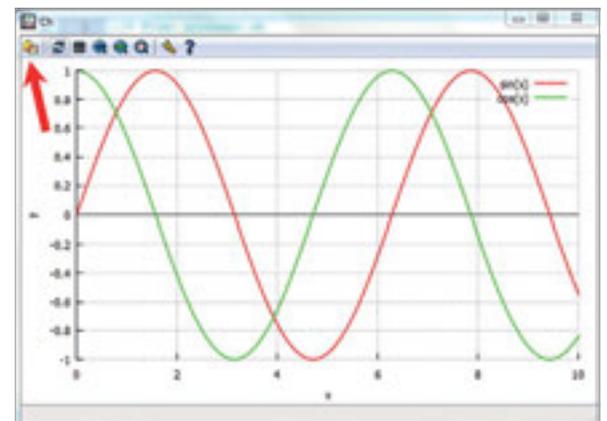
Plotting expressions

Ch code allows you to quickly and easily produce a plot from any expression imaginable. In this program, `plotexpr.ch`, we will plot the sine function. The relation represented in a mathematical expression can

be plotted by using the member function `plot.expr()` in the plotting class `CPlot`.

Saving a plot

Unlike in a graphing calculator, plots in Ch can be copied and pasted easily into other applications such as a Word file. In Windows, a displayed plot can be copied to the clipboard first, then pasted to other programs such as a Word document or PowerPoint, to print out or for a project report. Clicking the first



Above Copy your plot by clicking the first menu on the toolbar, as shown by the red arrow

FIND ADDITIONAL RESOURCES

Check out the freely available programs and textbooks in the 'Code in Curriculum' section of C-STEM Studio for additional ideas and help.

PERSONALISE GRAPHS

There are several member functions of the plotting class `CPlot` to create and manipulate plots. For example, with `plotLineStyle(". ")`, it is simple to make a dotted-line plot and with `plot.legend("Graph Name")`, it is easy to create a legend for your plots.

menu on the toolbar on the upper left corner of the plot will copy the plot to the clipboard. The plot in the clipboard can then be pasted into other programs.

Plotting in 3D

Ch even allows for plotting in 3D. With small amounts of code, users can create elaborate graphs. For example, the graph of $z = \sin((x^2+y^2)^{1/2}) / (x^2+y^2)^{1/2}$ is plotted in less than 20 lines of code in `hatplot.ch` (shown in **Figure 1**).

Personalising your graph

Plots in Ch can be designed with different line colours, styles, and widths. Use the following member functions to customise a plot:

`plot.lineStyle("style")`

Input style "-" for a dashed line or "." for a dotted line

`plot.pointStyle("style")`

For scatter plots, input styles such as "x" for cross-shaped points or alternatively "d" for diamond-shaped points

`plot.strokeColor("color")`

Input colours such as "red" or "purple"

`plot.strokeWidth(width)`

Input a number of pixels, such as "2" or "5" to set the width of a line

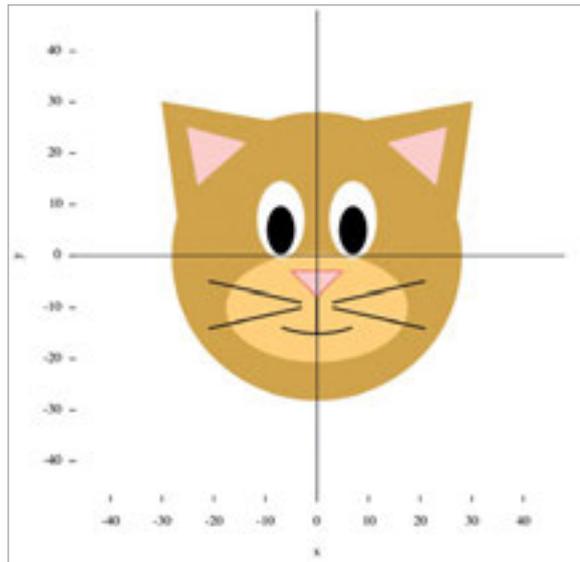
`plot.fillColor("color")`

Input a colour name or RGB value to fill the interior of plotted shapes

`plot.fillOpacity("color")`

Input a decimal to set the opacity of filled shapes. When the opacity is 0, the object is completely transparent; when it's 1, the filled colour is solid

Using these functions and those to plot different shapes, such as `plot.circle`, `plot.triangle`, and



Language

>CH

NAME:

`plotexpr.ch`,
`hatplot.ch`,
`recorddistance.ch`,
`drawcat.ch`

DOWNLOAD:

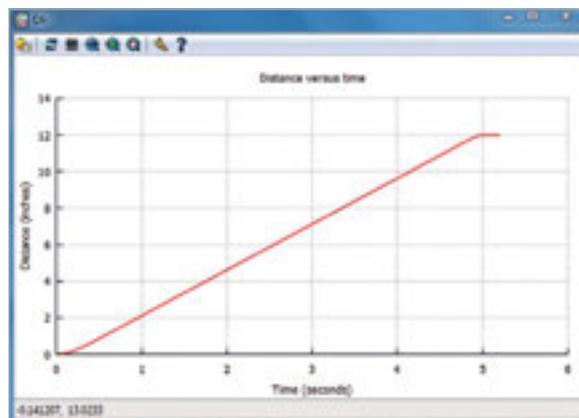
`magpi.cc/QBWVSJ`

Figure 2 Create unique drawings with Ch code

`plot.arc`, it is easy to create unique drawings with Ch code. For example, easily draw a cat with multiple colours and shapes in `drawcat.ch` (see **Figure 2**).

Plotting motion of a robot

With C-STEM Studio, it is simple to write a program to receive data from hardware, such as a Mindstorms NXT/EV3 robot, in real time. The ability to record and process real-time data is a powerful tool with multiple applications in robotics. It aids in the understanding of how a robot is functioning so that we can improve upon that robot's design. In the next program, `recorddistance.ch`, we will plot the distance values of robot travelled versus time with real-time data. Configure your Mindstorms to the Vehicle Configuration, connect to the robot, and run the program.



Above Observe the performance of hardware using real-time data

ChIDE provides endless opportunities for data visualisation. With the simplicity of Ch, the ability to create spectacular plots in only a couple of lines of code is completely possible. To explore more of ChIDE and the customisation options to visualise data on ChIDE, download C-STEMbian to your Raspberry Pi.