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Applications Note

Systems Biology

canvasDesigner2: An enhanced interactive publication-quality composite figure designing tool

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Abstract

Summary: We developed the 2nd generation of a feature-rich bioinformatics and systems biology figure design tool that takes high-resolution images in various formats, mainly SVG to produce one multi-panel publication-quality composite figure in both PDF and interactive HTML formats.

Availability: The tool and detailed user guide are available at https://baohongz.github.io/canvasDesigner2 while the source code is provided at https://github.com/baohongz/canvasDesigner2.

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Supplementary information: Supplementary materials are available at https://bit.ly/2TeLB5M.

1 Introduction

Scalable Vector Graphics (SVG) is an Extensible Markup Language (XML)-based vector image format, scalable to any resolutions without blurry pixelization as in other popular image formats, such as png, gif and jpg. This format has become one of the most broadly used image outputs adopted by many data analysis tools in computational biology field, notably R (R Core Team , 2014) and ggplot2 (Wickham, H, 2016). In addition, SVG is usually set as the default image output by many JavaScript-based plotting libraries like D3 (Bostock, M. et al., 2011) and bioinformatics tools such as Coral (Metz KS. et al., 2019), and rendered naturally by modern web browsers, such as Chrome, Firefox, Safari and MS Edge.

Composing multi-panel high resolution plots, such as those presented in Figure 1, usually poses a challenge for scientists with modest programming skills after gathering individual plots from various sources. User-friendly commercial tools such as Microsoft Power Point could be a viable option to arrange such plots, but these tools either cannot deal with complex pathway diagram in SVG format, or render this format in low resolution, sometimes even in malformed appearance as shown in Fig. s2.

Continuing on the previous attempt of making a web-based interactive figure designing tool (Zhang, B., 2018), we expanded input formats beyond only SVG in canvasDesigner2 (Fig. s1) as acquiring such format might be unfeasible in certain circumstances such as scanning gel images, and improved usability tremendously by implementing advanced features detailed in methods section.

2 Methods

Flexible text input: Regular characters plus built-in Emoji and symbols from Chrome browser can be added as titles and fully formatted in various font families, styles, sizes, shades, and colors by using an advanced online editor. Moreover, text boxes with flexible sizes can be placed freely on the canvas as the text input of paragraphs (Fig. s3).

Versatile image formats: Besides SVG format, canvasDesigner2 supports other popular image formats including png, gif and jpg as input. For other formats like pdf, some free tools such as Inkscape (https://inkscape.org) or pdf2svg (https://bit.ly/2NVtj6E) could be used to convert them to one of acceptable formats, preferably SVG.

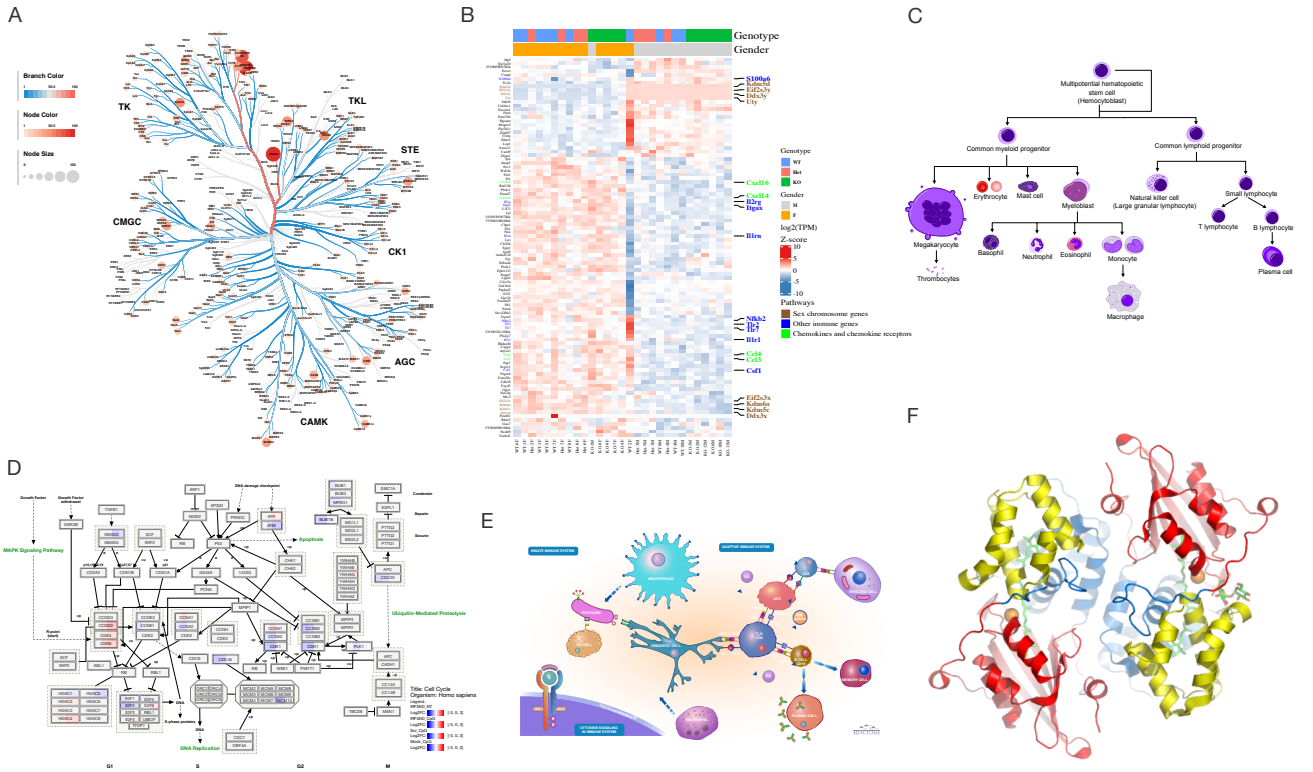


Figure 1. High-resolution plots generated by various tools are arranged by the online tool, canvasDesigner2. Unless specified, the source plot is in SVG format. A) Human kinome tree generated by Coral web app (https://unc.live/2SqKj7s); B) Gene expression heatmap by R package ComplexHeatmap (https://bit.ly/2tZX3sq); C) Blood cell lineage from Wikimedia commons (https://bit.ly/2UPGTwx); D) Human cell cycle pathway diagram from WikiPathways (https://bit.ly/2SqRo8b); E) Human immune system illustration from Reactome (https://bit.ly/2Sp1ENX); F) Protein 3D structure ribbon form in png format by Pymol (https://pymol.org).

Stylesheets conflict: Since the scope of stylesheet definition used to style elements in SVG file is always global, it causes formatting issue when multiple SVG files are pulled together to the design canvas (Fig. s4). To overcome the shortcoming, the tool intelligently converts style definitions into inline styles applied to each targeting element individually and stores it locally before removing these from globally scoped stylesheets.

Image transparency: White background in SVG file is optionally removable to make it transparent so that plots can be overlaid onto each other to create compelling art as illustrated in Fig. s5.

Vertical stacking: Each image is attached with a stacking control button. Desired stacking order is attainable by moving these buttons around (Fig. s6) that provides additional dimension for creative design.

Interactive HTML output: The finished work can be saved as a self-contained HTML file with required JavaScript code embedded for easy sharing by email or GitHub like content hosting services as exemplified at https://bit.ly/2SsDmCS.

3 Summary

CanvasDesigner2 incorporated significant improvements including advanced text input, image transparency, flexible stacking, and stylesheet localization to increase the usability of the open-source tool. It enables non-programmers to assemble individual plots and narratives into an eye-catching figure for publication or even comprehensive story-telling infographic showcased at https://bit.ly/38hKZ3N.

Conflict of Interest: none declared.

References

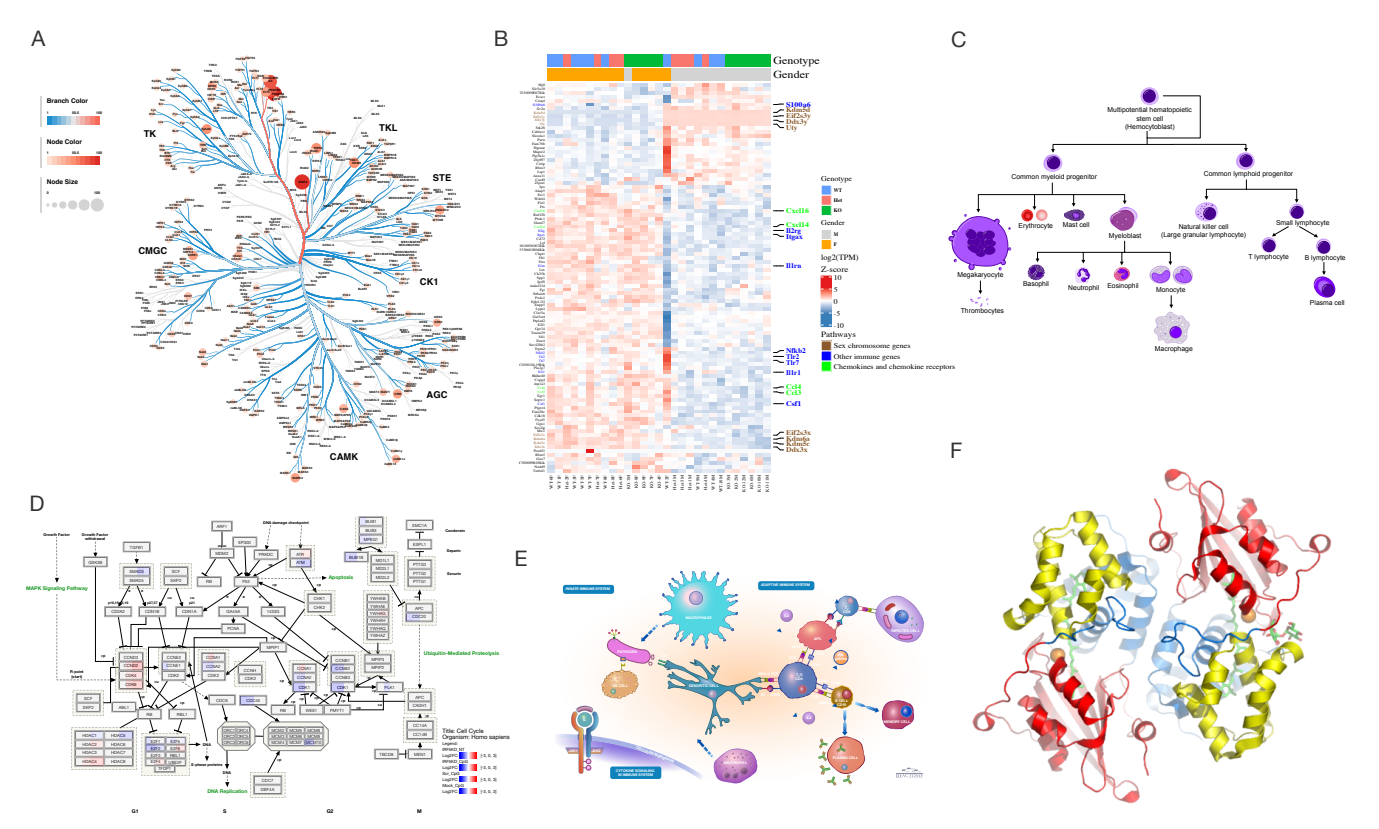
R Core Team (2014) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org.

Wickham, H. (2016) ggplot2: Elegant Graphics for Data Analysis. *Springer-Verlag* New York.

Bostock, M. et al. (2011) D^3: data-driven documents. *IEEE Trans. Vis. Comput. Graph*. 17, 2301–2309.

Metz KS. et al. (2019) Coral: Clear and Customizable Visualization of Human Kinome Data. *Cell Syst.* 26;7(3):347-350.

Zhang, B. et al. (2018) canvasDesigner: a versatile interactive high-resolution scientific multi-panel visualization toolkit. *Bioinformatics.* 34(19):3419-3420.


A
Branch Color
Node Color
Node Size
TK
TKL
STE
CMGC
CK1
AGC
CAMK
B
Genotype
Gender
S100a6
Kdm3a
Eif2s3y
Ddx3y
Uty
Cxcl16
Cxcl14
Il2rg
Ilgax
Il1rn
Nfkb2
Tlr2
Tlr7
Il1r1
Ccl4
Ccl3
Csf1
Eif2s3x
Kdm6a
Kdm5c
Ddx3x
Genotype
WT
Het
KO
Gender
M
F
log2(TPM)
Z-score
10
5
0
-5
-10
Pathways
Sex chromosome genes
Other immune genes
Chemokines and chemokine receptors
C
Multipotential hematopoietic stem cell (Hemocytoblast)
Common myeloid progenitor
Common lymphoid progenitor
Erythrocyte
Mast cell
Myeloblast
Natural killer cell (Large granular lymphocyte)
Small lymphocyte
T lymphocyte
B lymphocyte
Plasma cell
Megakaryocyte
Thrombocytes
Basophil
Neutrophil
Eosinophil
Monocyte
Macrophage
D
MAPK Signaling Pathway
Apoptosis
Ubiquitin-Mediated Proteolysis
DNA Replication
Title: Cell Cycle
Organism: Homo sapiens
G1
S
G2
M
E
F