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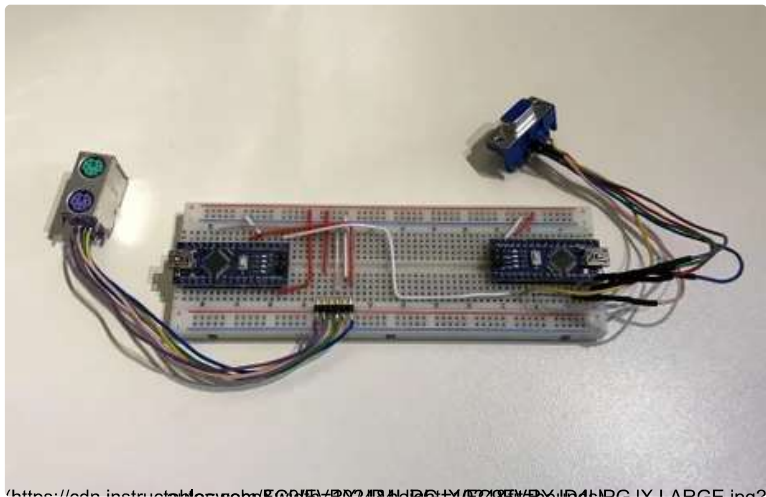
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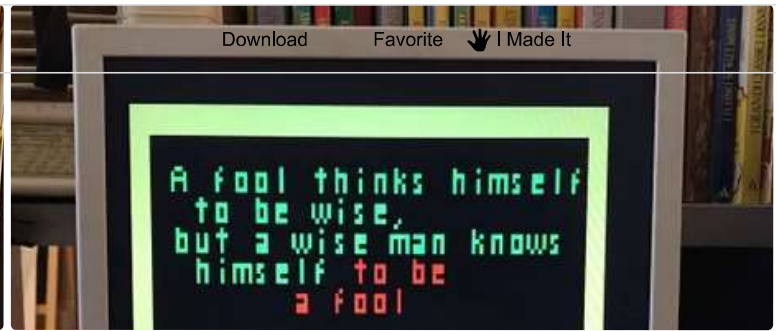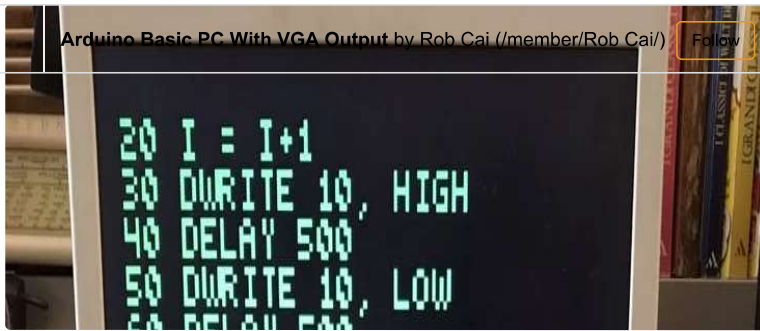
Arduino Basic PC With VGA Output

By Rob Cai (/member/Rob+Cai/) in Circuits (/circuits/) > Arduino (/circuits/arduino/projects/)   57,517   279   65   Featured

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Arduino VGA PC running BASIC

▶

(/member/Rob%20Cai/)
By **Rob Cai**
(/member/Rob%20Cai/)

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In my previous Instructable I have shown how to build a retro 8-bit computer running BASIC, by means of two Arduino, and with an output signal in B&W for a TV screen.

Now I will show how to build the same computer, but with the output signal in **color for a VGA monitor!**

You can input the variables and the BASIC program with a PS2 keyboard, and it generates the output for a VGA monitor with a text resolution of 24 columns x 10 rows of 5x6 pixels characters, in four colors. You can see it in action in the upper video. The program can then be saved on the Arduino EEPROM, and you can still control the I/O pins directly via Basic dedicated commands.

This project can also be used to print simple text messages on the monitor, as shown in the third picture in this page.

One Arduino is the "master", and it runs Tiny Basic Plus, a C implementation of Tiny Basic, with a focus on support for Arduino. It also control a PS2 keyboard. The output is then sent via the serial port to the second Arduino which generates the VGA output thanks to the VGAx library.

The idea to use one or more Arduino to create an old style PC running a dialect of Basic is not new but, as far as I know, none of them has a color output. In some projects available on the net, people used LCD displays, while in others, to allow the use of monitors, it has been used the TVout library, which is B&W. Furthermore in many of these projects special shields or hardware has to be build. Here you need just two Arduino, few resistors and the connector for the PS2 keyboard and the monitor, as shown in the above pictures.
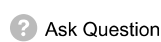
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/

Step 1: Build the Arduino Master With TinyBasic and PS2 Keyboard

TinyBasic Plus and the VGAx library work for **Arduino IDE 1.6.4**.

First download it from the Arduino official web page. If you have a newer versions on your PC, the best is to download it in .zip format and uncompress them on your PC. Click this link (https://www.arduino.cc/download_handler.php?f=/arduino-1.6.4-windows.zip) to download the Windows version.

You need then the **PS2keyboard library**. You can find it at the bottom of this page. Just uncompress it and copy the PS2keyboard folder in: arduino-1.6.4\libraries

Finally, in this page, download the file: **TinyBasicPlus_PS2_VGAx.ino**, uncompress and upload it on your Arduino.

This is a variation of the standard TinyBasic Plus where i have added the PS2 library and modified the code to accept the variables from it.

More details on TiniBasic Plus and tutorials can be found at this link (https://github.com/BleuLlama/TinyBasicPlus).

If there are no problems, and compatibility issues, Tiny Basic is already running. You can test it trough a serial monitor in your PC. For this purpose I use PuTTY (https://www.putty.org/), but many other programs are available.

You have to set the correct COM port (it is the same you find in the Arduino IDE) and **baud rate = 4800**

Here you can already test some program in Basic just by typing them with your PC keyboard (NB later on I will show how to connect the PS2 keyboard directly to the Arduino).

Try for instance:

10 PRINT "Hello, World!"

20 GOTO 10

RUN

You can then stop the infinite loop just by typing ctrl+c.

Note that this combination will not work for the PS2 keyboard.

In the next step I will show how to connect the PS2 keyboard to Arduino.

TinyBasicPlus_PS2_V Download (https://cdn.instructables.com/ORIG/FD7/LLBX/JD4US92J/FD7LLBXJD4US92J.ino)
(https://cdn.instructables.com/ORIG/FD7/LLBX/JD4US92J/FD7LLBXJD4US92J.ino)
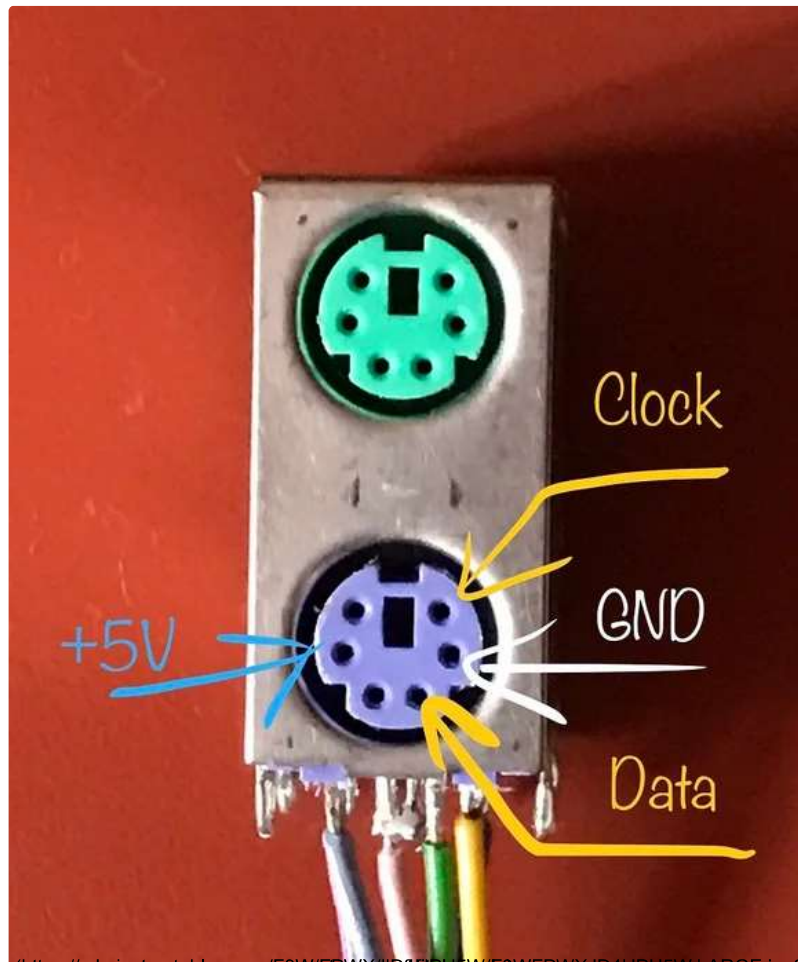
/

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Step 2: Connect the PS2 Keyboard to the Master Arduino

I got all the informations and library from this Instructable.
(https://www.instructables.com/id/Connect-PS2-Keyboard-to-Arduino/)

Essentially you need to connect the folowing four pins:

- keyboard Data to Arduino pin 8,
- keyboard IRQ (clock) to Arduino pin 3;
- you need to connenct GND and +5V as well.

I got an old PS2 female connector from a broken PC motherboard. You can simply unsold it with a heat gun.

In the picture shown in this step, you can find the function of the needed pins of the PS2 connector.
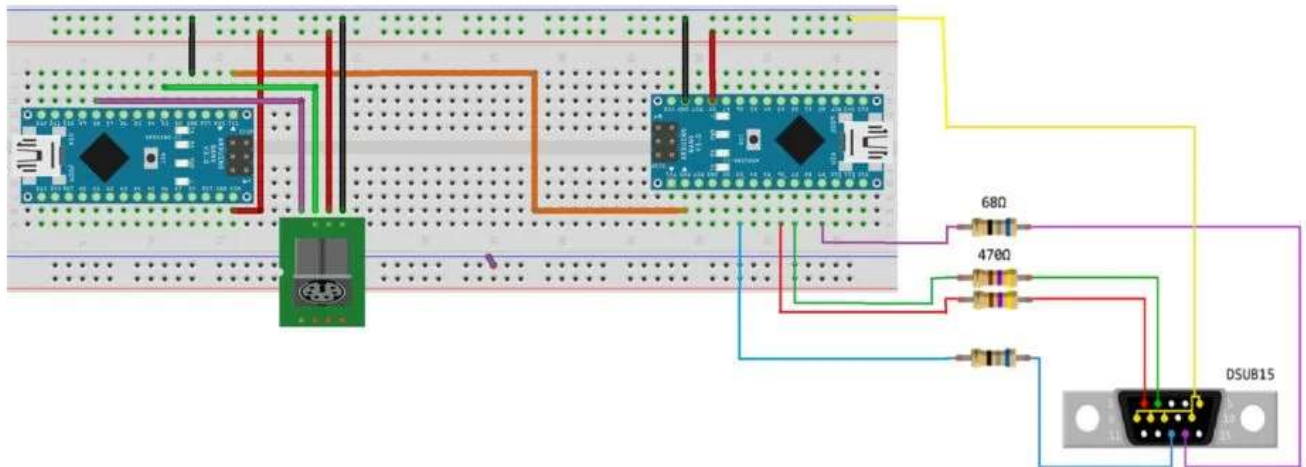
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(https://cdn.instructables.com/F5A/KEBL/ID4USZHD/F5AKEBLID4USZHD.LARGE.jpg?auto=webp&width=1024&height=1024&fit=bounds)

First download **VGAx-PC.ino** code at the bottom of this page and copy it on your PC in a directory with the same name.

Download the **VGAx library** from this link (https://github.com/smaffer/vgax) on GitHub. The easiest way is to copy it in the Arduino software subfolder named "libraries", to be immediately recognized.

IMPORTANT: this library works for **Arduno IDE 1.6.4** but it is not fully compatible with elder or newer versions.

Upload the VGAx-PC.ino in your second Arduino board (I tested it for the Nano version but the Uno should work as well).

A warning for low available memory is normal. If you do not have other errors everything is ok and you can immediately start to build your own 8-bit PC.

For this you need:

- two Arduino Uno Rev. 3 or two Arduino Nano 3.x (ATmega328)
- a DSUB15 Connector, i.e. a VGA female connector or a VGA cable to be cut.
- resistors: 2 x 68 Ohm and 2 x 470 Ohm
- a PS2 female connector
- wires
- facultative: a breadboard or a strip board

The schematic is reported at the top of this step. An example of a finished "console" is shown in the introductive step.

The same schematic, with an higher resolution, is reported in a compressed file at the bottom of this step.
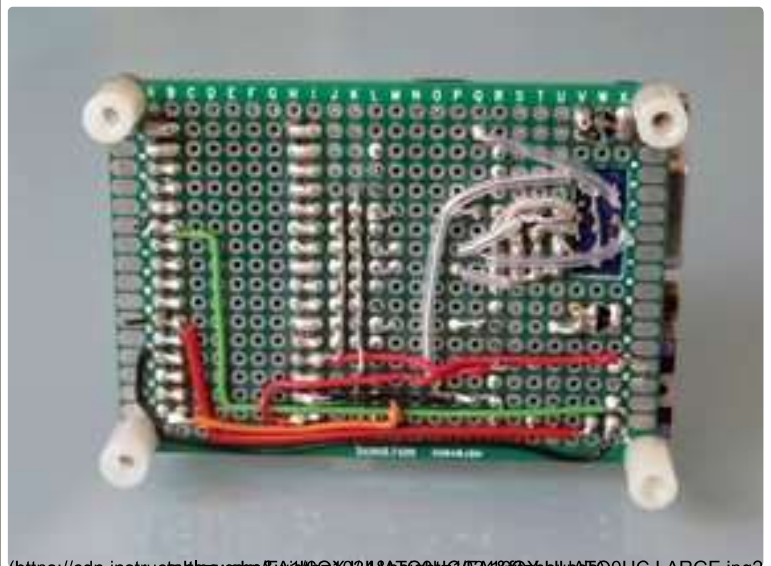
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Step 4: Optional: Using a PCB

You can also build this *Basic VGA PC* using a small PCB. You can take inspiration from the pictures in this step or you can even print your own board.

I used two female header strips with 15 holes for the video output Arduino, while for the master I used two strips with doble holes. In this way I can use the external ones to insert the contacts of other projects componets, that can be driven directly with Basic code. I also added in the center to leftover strips, one conncted to 5 V and the other for GND.

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Step 5: Final Comments and Acknowledgments

My main aknowledgement goes to Sandro Maffiodo aka *Smaffer*, the creator of the awesome **VGAx library**.

Many thanks also to the authors of **TinyBasic Plus**:

- Tiny Basic 68k - Gordon Brandly
- Arduino Basic / Tiny Basic C - Michael Field
- Tiny Basic Plus - Scott Lawrence

Thanks also to "djsadeepa", the author of the Instructable for the connection of the **PS2 keyboard**.

To all the people interested in this project: if you have troubles, do not hesitate to ask suggestions in the comments.

If you succeed, please write a comment too or share a picture of the device you build.

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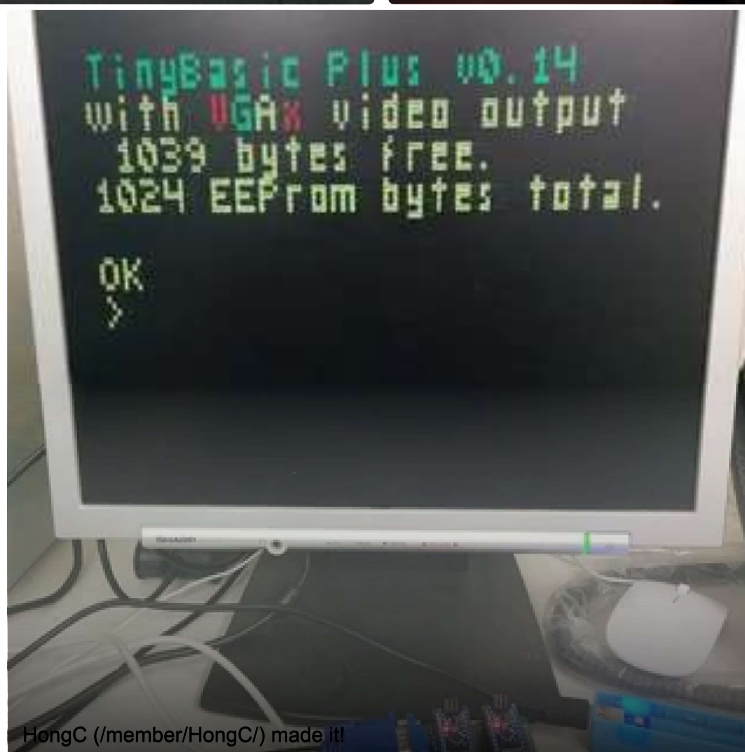
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3 People Made This Project!

arne-hf (/member/arne-hf/) made it!

mrGman123 (/member/mrGman123/) made it!

HongC (/member/HongC/) made it!

Did you make this project? Share it with us!

I Made It!

Recommendations

(/id/Digi-Comp-I-Redux/)

Digi-Comp I Redux (/id/Digi-Comp-I-Redux/)

by megardi (/member/megardi/) in Circuits (/circuits/)

(/id/Wearable-Tech-Wallet/)

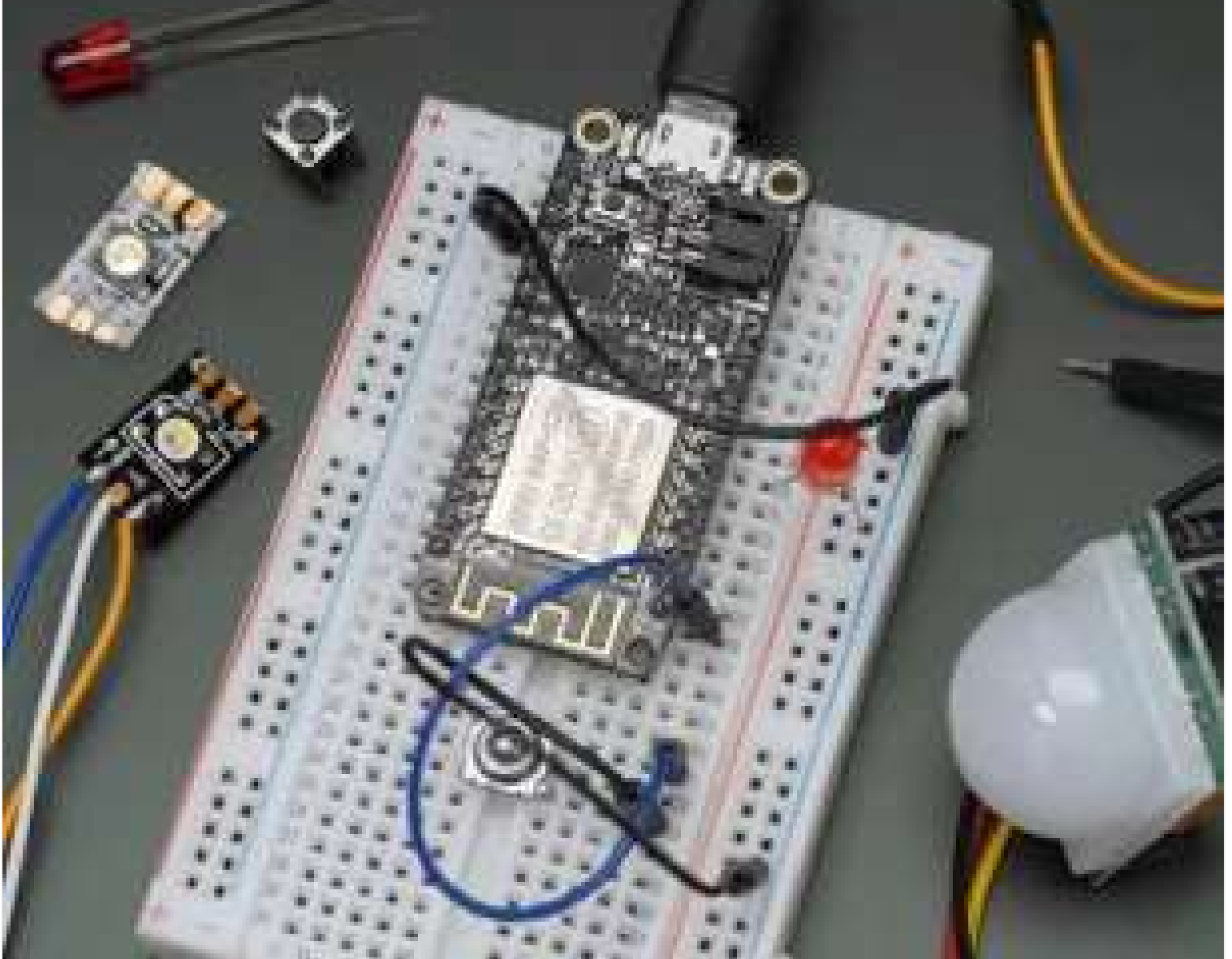Wearable Tech Wallet (/id/Wearable-Tech-Wallet/)

by MargenauMaker (/member/MargenauMaker/) in Arduino (/teachers/projects/?subjects=arduino)

Ultimate Dry Ice Machine - Bluetooth Controlled, Battery Powered and 3D Printed. (/id/Ultimate-Dry-Ice-Machine-Bluetooth-Controlled-Batt/)

by DIY Machines (/member/DIY%20Machines/) in Arduino (/circuits/arduino/projects/)

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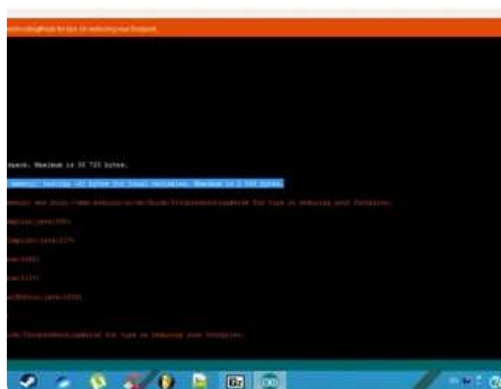
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65 Discussions

(/member/paF2208/)   paF2208 (/member/paF2208/) 2 months ago

Reply   ⌃ Upvote

Hi Rob! It's me again :P. Now I can load code TinyBasicPlus_PS2_VGAx in Arduino but on check step IDE give me this error (screenshot). Which variables I can comment or delete frome code?

(https://cdn.instructables.com/F4T/602T/K0CP0ZZR/F4T602TK0CP0ZZR.LARGE.jpg?
auto=webp&&frame=1&width=1024&fit=bounds)

4 replies ⌄

(/member/simaopintocorreia/)   simaopintocorreia (/member/simaopintocorreia/)
Question   2 months ago

Answer   ⌃ Upvote

My IDE goes in error and say this :

Arduino: 1.6.4 (Windows XP), Placa:"Arduino Uno"
Opções de compilação alteradas, compilando tudo
O rascunho usa 14.036 bytes (43%) do espaço de armazenamento do programa. O máximo é 32.256
bytes.
Variáveis globais usam 2.129 bytes (103%) de memória dinâmica, restando -81 bytes para variáveis
locais. O maximo é 2.048 bytes.
processing.app (http://processing.app).debug.RunnerException: Memória insuficiente: veja
http://www.arduino.cc/en/Guide/Troubleshooting#size
(http://www.arduino.cc/en/Guide/Troubleshooting#size) para sugestões sobre como reduzir a sua
pegada.
at processing.app (http://processing.app).debug.Compiler.size(Compiler.java:338
(http://compiler.java:338))
at processing.app.debug.Compiler.build (http://processing.app.debug.Compiler.build)
(Compiler.java:117 (http://compiler.java:117))
at processing.app.Sketch.build (http://processing.app.Sketch.build)(Sketch.java:1162
(http://sketch.java:1162))
at processing.app (http://processing.app).Sketch.exportApplet(Sketch.java:1180
(http://sketch.java:1180))
at processing.app (http://processing.app).Sketch.exportApplet(Sketch.java:1166
(http://sketch.java:1166))
at processing.app (http://processing.app).Editor$DefaultExportHandler.run(Editor.java:2487
(http://editor.java:2487))
at java.lang.Thread.run (http://java.lang.Thread.run)(Thread.java:745 (http://thread.java:745))
Memória insuficiente: veja http://www.arduino.cc/en/Guide/Troubleshooting#size
(http://www.arduino.cc/en/Guide/Troubleshooting#size) para sugestões sobre como reduzir a sua
pegada.
Este relatório teria mais informação com
"Mostrar output verboso durante a compilação"
ativo em Ficheiro > Preferências

3 answers ⌄

(/member/robojeron/)   robojeron (/member/robojeron/)   Question   2 months ago

Answer   ⌃ Upvote

Quick question have you attempted to substitute the VGA program for an adafruit shield? If not would you consider that feasible to downsize even that much further? I have to unos yet I'm concerned that I can't pull something like this off simply due to my own inexperience.
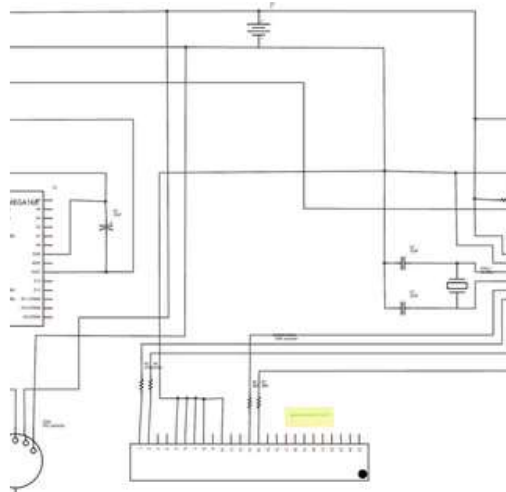
(/member/simaopintocorreia/) simaopintocorreia (/member/simaopintocorreia/) 3 months ago

Reply   Upvote

If I make my own arduinos ,I can make the circuit in just one board with only components.

(https://cdn.instructables.com/F9L/JOYS/JZ2Z6AN1/F9LJOYSJZ2Z6AN1.LARGE.jpg?
auto=webp&&frame=1&width=1024&height=1024&fit=bounds)

(/member/tucktin32/) tucktin32 (/member/tucktin32/) Question   6 months ago on Introduction

Answer   Upvote

I plan to build but most of my projects have no crystals and run at 8 mega hertz is it needed to have full 16 for vga output

1 answer ⌄

(/member/mr.mike.hawkey/) mr.mike.hawkey (/member/mr.mike.hawkey/) Question   3 months ago

Answer   Upvote

I love this project and built it on breadboard as you first did. Now I'm trying to build a permanent version using the same techniques as you did.
Do you have a description of what the jumpers do in your circuit?
I can see a couple of possibilities...
(1) They allow you to select the colour palette being used,
(2) they allow you to link or unlink the RESET lines of the Arduinos.
Do you have an updated schematic that includes these jumpers?

Given the price of custom PCBs these days, I am also looking at the possibility of laying out a PCB and getting it manufactured to allow easy construction.

The memory and resolution of this particular BASIC computer are limited, so I am also toying with the idea of modifying it to use STM32 "Blue Pills", which are faster and have more memory. They allow a higher resolution of VGA output, but because they are 3.3V devices they would need to include level shifters to allow interfacing to the external devices.

(/member/KushagraK7/) KushagraK7 (/member/KushagraK7/) Question   3 months ago

Will it work if I connect the Arduino board to an HDMI input TV using a VGA to HDMI convertor?

2 answers ⌄

(/member/Yves-rene/)   Yves-rene (/member/Yves-rene/) 4 months ago   Reply   ▲ Upvote

Hi. The First Project with Color Output. I love it :) very good work.
Is it possible to get Video out (via cinch) instead of the vga Output? Did this Basic Interpreter include graphical Commands, like draw line or circle? Many thanks :)

(/member/divyansh1/)   divyansh1 (/member/divyansh1/)   Question   7 months ago

Answer   ▲ Upvote

Hey cool project I'm trying to upload the Tiny basic on main arduino uno but it says not enough memory, please HELP!!

1 answer ⌄

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