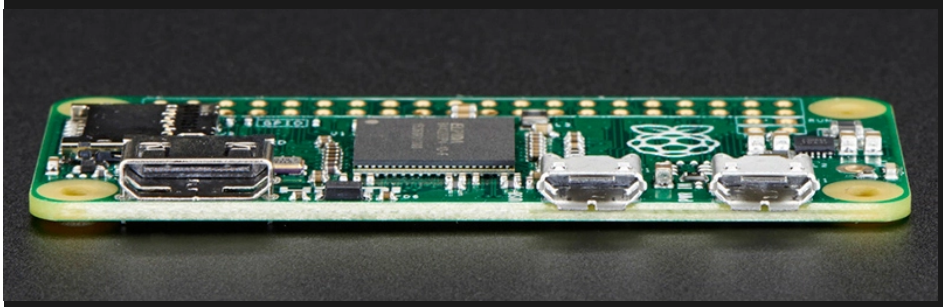
TURNING THE PI ZERO INTO A USB GADGET

by: Brian Benchoff

39 Comments

December 27, 2015



The Raspberry Pi Zero is limited, or so everyone says, and everyone is trying to cram a USB hub and WiFi adapter on this tiny, tiny board. One thing a lot of people haven't realized is that the Raspberry Pi Zero comes with a USB OTG port, meaning it can function as a USB device rather than a USB host. This means the Raspi can become a serial device with just a USB cable, an Ethernet device, MIDI device, camera, or just about anything else you can plug into a USB port. Adafruit has your back with a tutorial for using the USB OTG port as a serial and Ethernet interface, and the possible applications are extremely interesting.

The only requirement for using the USB OTG port for device applications is an update to the kernel. This is easily installed by dumping a few files on an SD card and a employing bit of command line wizardry. The simplest example is setting up the Pi Zero as a USB serial device, allowing anyone to log into a serial console on the Pi with just a USB cable.

A slightly more interesting application is setting up the Pi as an Ethernet gadget. This effectively tunnels all the networking on the Pi Zero through a USB cable and a separate computer. The instructions are extremely OS-specific, but the end result is the same: you can `apt-get` on a Pi Zero to your heart's desire with a new kernel loaded onto the SD card and a USB cable.

This experimentation is just scratching the surface of what is possible with the OTG port on the Pi Zero. MIDI devices are easy, and with a ton of GPIOs, the Pi Zero itself could become a very interesting musical instrument. Want the Pi Zero to be a storage device? That's easy too. The USB Gadget will end up being one of the most exciting uses for the Pi Zero, and we can't wait to see what everyone will come up with next.

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Tagged Pi, raspberry pi, Raspberry Pi Zero, Raspi, usb, USB Gadget, usb otg

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39 THOUGHTS ON "TURNING THE PI ZERO INTO A USB GADGET"

jack says:
December 27, 2015 at 1:17 pm

Masstorage is possible?

Reply Report comment

addidis says:
December 27, 2015 at 1:51 pm

Trying to make this as simple as i can, yes, it is basically a hex word that determines what class the device is. Another decides the subclass etc.

On this level the only difference between HID(human interface device class) , or MSD (mass storage device class) is a few bytes called descriptors.

Reply Report comment

addidis says:
December 27, 2015 at 1:56 pm

CDC class for the serial stuff they mention most likely. Any of these protocols are good reading to see how it works, usb complete the book by jan axelson is the next place to go if you wanna become an expert.

Reply Report comment

tekkieneet says:
December 27, 2015 at 3:51 pm

It is a bit more than a few bytes in the descriptor. The commands are different and the data transfer are different: HID uses interrupt transfer and MSD uses Bulk transfer.

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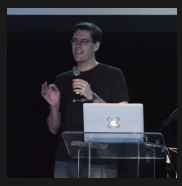
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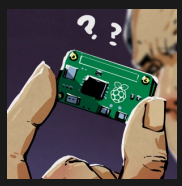
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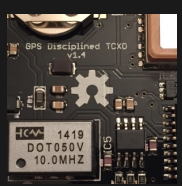
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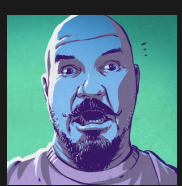
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addidis says:
December 27, 2015 at 4:14 pm

in most reasonable usb stacks this is all handled by switches in code. Just flip a flag and you are set. But you need to actually look up the descriptors. Not many people write their own usb stacks and need to worry about that.

Reply Report comment

Andrew says:
December 27, 2015 at 10:53 pm

In the Linux stack which we're talking about here, you don't manipulate the descriptors, you just load the usb-f-mass-storage module instead of the usb-f-hid module. And if you had to manipulate the descriptors then you'd be at a level where you'd need to implement a completely different behaviour for the mass storage device to work.

Report comment

jack says:
December 27, 2015 at 10:14 pm

Much more insteresting is Masstorage emulated device with extra features.
Such like: Emulated USBdongle/(SD or HDD) with ethernet do media players or STB without LAN port
or really strong encrypted disk. (many comercial disks with encryption have backdoors :P like xored password in WD HDDs)
Another idea is device which has 2 connections STB is recording TV stream (exlusive access read+write)
and another device(only reading) for example TV is reading/playing other content in same time.
I am missing long time low power consumption device like this. It's possible only with LAN devices :(

isostick.com project emulating masstorage with AVR32 processor.

Reply Report comment

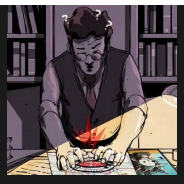
mcfroogle says:
December 27, 2015 at 1:17 pm

Would be interesting to see if the PI Zero could be used as a PC controller. giving quite a bit of customisation. add a couple of sliders and some switches and you've got a pretty solid flight sim panel or something along those lines.

Reply Report comment

addidis says:
December 27, 2015 at 1:52 pm

in this case a duino is a better , easier , more accessible choice imho.



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julien gave a skull to PowerBlade.

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al1 wrote a comment on project log warpcore live at #32c3.

Sachin started following Hackaday Prize Worldwide New Delhi.

esot.eric wrote a comment on project log

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Dave says:
December 27, 2015 at 1:57 pm

Or a Digispark Pro.

Reply Report comment

Danny says:
December 27, 2015 at 2:08 pm

Or a regular Digispark from China for $1.20 (including shipping) running V-USB-
https://www.obdev.at/products/vusb/index.html

Reply Report comment

KDM says:
December 27, 2015 at 4:00 pm

Or MSP430F5529 or comparable with USB, capsense, RTC and ....

Reply Report comment

CRImier says:
December 27, 2015 at 1:39 pm

Ain't that possible with a Pi A/A+?

Reply Report comment

Xark says:
December 27, 2015 at 2:26 pm

My understanding is it is not, because the SoC USB OtG port on those is already directly hooked into a USB hub chip (with Ethernet).

Reply Report comment

chango says:
December 27, 2015 at 2:40 pm

Not on the A/A+. The SoC USB goes right to the jack.

Reply Report comment

CRImier says:
December 27, 2015 at 3:03 pm

You're mistaken, that's why I said A/A+ – they don't have a USB hub chip.

Reply Report comment

Xark says:

MemType Beta Christmas present!.

pandeykamal13526 gave a skull to Automated Irrigation System.

julien gave a skull to The KiCAD Central.

Sachin has followed a list.

December 27, 2015 at 10:07 pm

Yes, correct about no hub on A/A+, but still not wired up as OtG USB port like on Zero. Maybe this could be hacked around, I'm not sure.

Reply Report comment

CRImier says:
December 28, 2015 at 12:41 am

Care to explain the wiring differences?

Reply Report comment

untitled (@untitled86) says:
December 27, 2015 at 2:19 pm

Actual high res USB camera? Most webcams are horrible. Maybe make an interface to a DSLR or point and shoot?

Reply Report comment

hdlipg says:
December 27, 2015 at 4:19 pm

Logitech has some nice HD webcams

Reply Report comment

chango says:
December 27, 2015 at 2:40 pm

Beaglebone says hi.

Reply Report comment

m_pan says:
December 27, 2015 at 3:32 pm

BeagleBone says "gimme 700% more cash"

Reply Report comment

neophile says:
December 27, 2015 at 4:34 pm

Good point. BB is bigger, more powerful, more expensive, more capable. For many purposes, this is enough; if it isn't, a BB(B) is a great alternative.

Reply Report comment

chango says:
December 27, 2015 at 4:59 pm

Very true, though the extra USB host on the BBB is great for USB protocol analysis

Reply Report comment

jack324 says:
December 27, 2015 at 3:35 pm

Idea: use it as a password manager. It's got a relatively strong cpu, so encryption shouldn't be too big of an issue, especially if it's just encrypting and decrypting passwords on the fly. I would make a break out board with a small number pad and an enter key. There would also bee two leds, one red, one green.

When you plug the pi in it appears as just a generic keyboard, and the red light appears. You type in your pin and hit enter. The light turns green. Then you punch in a number corresponding to the password you need and hit the enter button. The green led flashes as it "types" out the password into whatever password prompt you have open on the PC. Then it locks it self again so you don't have to worry about forgetting it plugged in and unlocked.

Reply Report comment

neophile says:
December 27, 2015 at 4:34 pm

It would also be a nice base for something like a Mooltipass.

Reply Report comment

Mike Lu says:
December 27, 2015 at 3:41 pm

A great use case could be emulating a USB optical drive from ISO files stored on the SD card. That would be very helpful as existing ISO to USB drive solutions might not work with some "special" images.

Reply Report comment

Richard says:
December 27, 2015 at 3:54 pm

That is a very cool idea.

Reply Report comment

neophile says:
December 27, 2015 at 4:35 pm

Don't isosticks already do that?

Reply Report comment

Mike Lu says:
December 27, 2015 at 5:01 pm

They cost quite a bit more than a Raspberry Pi Zero, a BeagleBone Black, or even a Dragonboard 410c.

Reply Report comment

omegatotal says:
December 27, 2015 at 5:14 pm

yes they do, and this would be really helpful but I dont want to have to keep swapping out the uSD all the time, wish the pi's had a sata port :/

Reply Report comment

Chris says:
December 27, 2015 at 4:14 pm

You guys should really talk more about gadgetfs, the greatest usb gadget driver for this crowd. The ability to emulate usb devices in any language!

Reply Report comment

bthy says:
December 27, 2015 at 4:14 pm

the main problem i still see with this (otg gadget) is that the SD image still gets corrupted if powered down unexpectedly, we really, really need a distro that runs live from memory-only or is otherwise resistant to this.

Reply Report comment

ironiridis says:
December 27, 2015 at 4:32 pm

Literally nothing requires you to have a read-write filesystem on your SD card. Boot Linux with an initramfs embedded into the kernel image.

You can treat the SD essentially as NVRAM, if you want; one location should be an index, and you should have at least two "slots" for data in some fixed-size struct. Update data by writing a whole slot at once, sync, then update the index to point at the new slot. (In other words, if you want minimal redundancy, just keep two slots and alternate back and forth; otherwise do something more interesting if the slot or the index appear to be invalid, like scan for any "valid" slot in any of the known locations.) It's poor-mans journaling.

Reply Report comment

neophile says:
December 27, 2015 at 4:50 pm

They exist, and though I haven't seen one on raspi yet, I doubt it would take that much work.

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Wretch says:
December 27, 2015 at 5:16 pm

OpenWRT?

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Galane says:
December 27, 2015 at 4:19 pm

So can it be used as an Ethernet to USB adapter, with a USB to RS232-C adapter, to connect something like a TI-99/4A to a LAN?

Reply Report comment

Tynan says:
December 27, 2015 at 4:19 pm

Could this be used as a bus pirate / ft232h / tiny bit dingus?

Reply Report comment

julien says:
December 27, 2015 at 6:15 pm

BeagleBone has had this feature for years now and its one of the reasons i will still choose the BBB for projects. Not sure why this didnt come about sooner :P

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