Beer Automation

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On Tap Today

- To Drink
  - Oatmeal Brown Porter
  - Simplified Arduino-based access control
    - Press button – receive beer
  - Mini jockey-box system w/ CO_2 charger for mobile serving options

- To Learn
  - Selecting A Fridge
  - Access Control
  - Cool Stuff
  - Troubleshooting
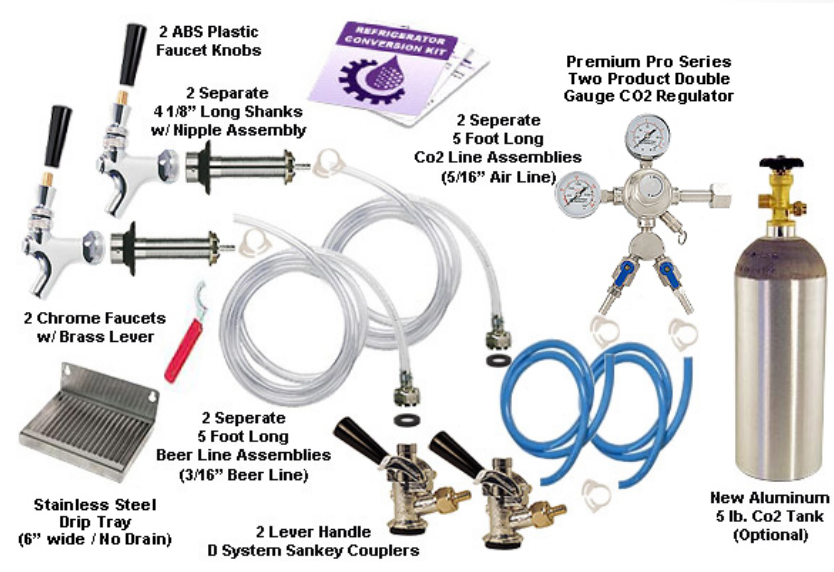 - Other Controllers

Choosing a Fridge

Choosing a Fridge

- How much room do you have?
- How much beer & how are you serving it?
  - Some Mini-Fridges aren't big enough for 2 corny kegs
- Do you want room for cold glasses or bottles?
- Budget
- Style!

Conversion Kits

- About $300 for through-door
  - Add another $100 for a tap tower
- Flexibility on style, materials
- Bring-your-own-fridge ($150)

2 ABS Plastic Faucet Knobs

REFRIGERATOR CONVERSION KIT

Premium Pro Series Two Product Double Gauge CO2 Regulator

2 Separate 4 1/8" Long Shanks w/ Nipple Assembly

2 Seperate 5 Foot Long Co2 Line Assemblies (5/16" Air Line)

2 Chrome Faucets w/ Brass Lever

2 Seperate 5 Foot Long Beer Line Assemblies (3/16" Beer Line)

Stainless Steel Drip Tray (6" wide / No Drain)

2 Lever Handle D System Sankey Couplers

New Aluminum 5 lb. Co2 Tank (Optional)

Pre-Built Kegerators

- Can be very cost-effective, about $100 premium over all-new parts

- Can be built in an hour

- Some commercial kegerators cut costs by using cheap lines, small tanks & fittings. Watch out!

Fittings

- Commercial beer uses Sanke fittings
- Homebrew uses pin or ball-lock fittings
- Quick Disconnects allow you to swap out fittings
  - May clog if you don't filter beer

A Coupler   D Coupler   G Coupler   M Coupler   S Coupler   U Coupler

PIN LOCK POST   BALL LOCK POST

PIN LOCK DISCONNECT   BALL LOCK DISCONNECT

Why Add Access Control?

- Kegerator is in uncontrolled location
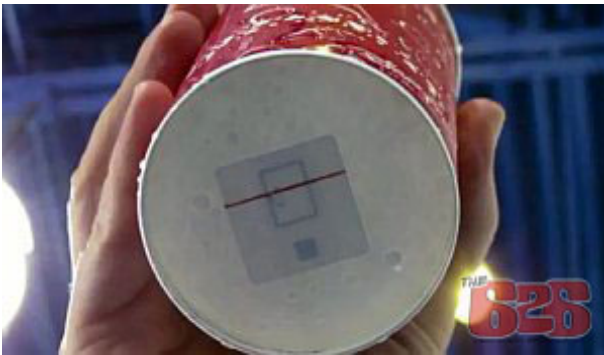
- Beer is not free

- Never want to run out of beer

Access Control Components

- ID Reader
  - RFID, HID Badge, etc.
- Controller
  - Arduino + PC, Raspberry Pi

- Relays & Solenoids
- Displays
- Software
  - OTS or Home-Grown

ID Reader

- Uniquely identify a drinker

- Consider something that emulates a USB keyboard

- RFID (Radio Frequency IDentification) tags are small and can be placed on mugs

RFIdeas 80581AKU - $165
Waterproof keypad - $15

RFID Tag on a plastic cup

Controller

- Proliferation of consumer-grade prototyping platforms has made these projects far more accessible
  - Easy to program & maintain
  - Support your inputs and outputs
- Arduino + PC
- Raspberry Pi
- Intel Edison & Others

Arduino + PC

The Arduino is a prototyping board using the ATMega chip and both analog and digital interfaces

- Inexpensive
- Easy to program 'sketches', C or C++
  - like language
- Easy to extend with 'shields'
- Lots of community support
- Limited capability means you need a computer to support data logging and display

Raspberry Pi

A single-board computer running Linux on an ARM chip. It has power to spare, but only supports digital I/O

- Can be written in anything, usually Python
- Powerful enough to hold all aspects of your kegerator
- Full Linux stack means it needs updating, there is a lot more to learn to maintain it

Relays and Solenoids

- A Solenoid is an electrically-operated valve. Typically they run at 12vdc or 120vac – much higher than the controller's 5vdc

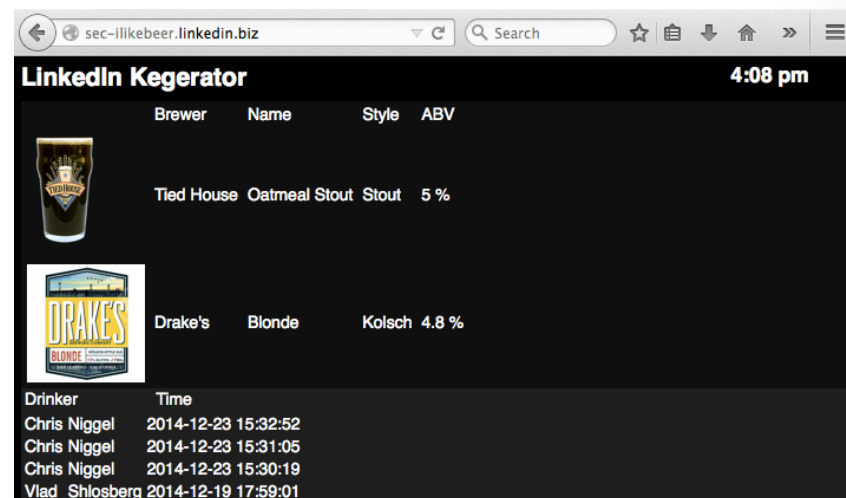- A Relay allows a low-power system to switch a high-power system
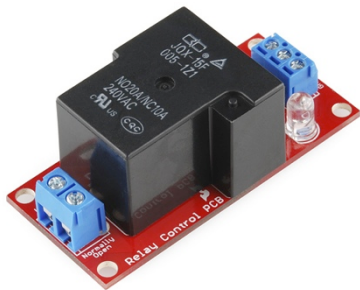
Sparkfun "beefcake" relay - $8
Food-grade solenoid - $86

Displays

- You can collect data with your system, why not display it?
  - On-tap screen
  - Web-based display

7" TFT monitor - $25

Off-The-Shelf Software

- Kegbot (kegbot.org)
  - Long-running project – the grandaddy of them all
  - Complex, written in Python, hard to extend (unless you're a software engineer)
  - Custom-made hardware makes installing easy
- KegDuino (makezine.com)
  - Arduino-only (cheap!)
  - Doesn't provide access control or logging

Home-Built Software

- Mine (beer.blastzone.net)
  - Well-documented
  - Self-supported
  - Easy to extend
  - Per-drinker credits
- Yours?

```
#unlock taps
#               GPIO.output(relay0_pin, True)
#               GPIO.output(relay1_pin, True)

#               time.sleep(10)

#               GPIO.output(relay0_pin, False)
#               GPIO.output(relay1_pin, False)

#Print log
                no_of_credits = no_of_credits -1
                print("Badge Read: " +read_in +" credits remaining: " +str(no_of_credits))
#write drink entry
                cur.execute("INSERT INTO drink VALUES(0," +"'" +read_in +"','" +str(datetime.now())
    +"')")
                cur.execute("UPDATE drinkers SET credits = " +str(no_of_credits) +" where card_no =
    '" +read_in +"'")
                con.commit()
            #endif
        else:
            print("Badge " +read_in +" not found or problem reading.")
        #endif rowcount
    read_in = ''
```

Extending your Kegerator

Nothing is worse than running out of beer!

- Load Cells can measure the weight of a keg ($25)
  - Difficult to calibrate
  - Need Analog input (ADC required for RPi, $14)
- Flow meters can measure beer as it is poured ($60)
  - Some people have complained of foam
  - Susceptible to electrical noise
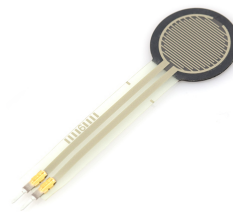
More Cool Stuff

- Temperature Sensors
  - DS18B20 is extremely easy to use ($4)
- Drinker alerts
  - Alert to a mailing list when multiple beers are poured, and never miss a party
  - Create per-tap access control for those expensive beers
  - Time-locks to keep drinkers honest
- Limited by your imagination
  - Bill or Credit Card readers, gift codes, twitter posts, anything…
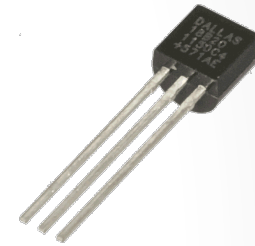
Total Cost

- Adding Raspberry Pi-based access control cost $550 and about 20 hours of work
  - $167 for the HID card reader
  - $175 for 2 food-grade solenoids
  - Great team-building project at work

Troubleshooting!

- Self-closing taps help prevent spilled beer ($40/ea)
- Heat vinyl lines in hot water & they'll install far easier
- Pressure-test your fittings at home with water before installation
- "Floating" or uncommon grounds make electronics unhappy
- Modular construction can help prevent foam

- **Keep it Simple**

Causes of Foamy Beer

- People don't know how to pour beer
  - Open the tap!
- Warm beer in lines
  - 3/16th inch line holds 1/6th oz per foot
  - A 50mm fan can keep your tap tower cool
- Obstructions causing turbulence
  - Check lines for kinks, loose fittings, or dirty tap
- Kegerator not balanced

Balancing a Kegerator

- Beer is best when bubbly – 2.4 vols CO2 is about 14psi
  - Gauge Pressure
- Beverage line has resistance, this is also measured in psi
  - Restriction Pressure
- When the Gauge Pressure almost equals Restriction Pressure, we have a nominal flow of 128oz/minute (8 seconds per pint), and a balanced system

Balancing a Kegerator

- Gauge Pressure: 14psi
- Serving Pressure: 1psi
- Line Resistance: 13psi
  - Need 6' of 3/16" Polyethylene tubing
  - or 26' of ¼" Polyethylene tubing

Line Type	Resistance (psi/ft)
3/16" ID vinyl	3
¼" ID vinyl	.85
3/16" ID Polyethylene	2.2
¼" ID Polyethylene	.5
3/8" OD Stainless	.2
5/16" OD Stainless	.5
¼" OD Copper	.1

Other Controllers

- Electronics can be used to overcomplicate other aspects of the beer lifecycle
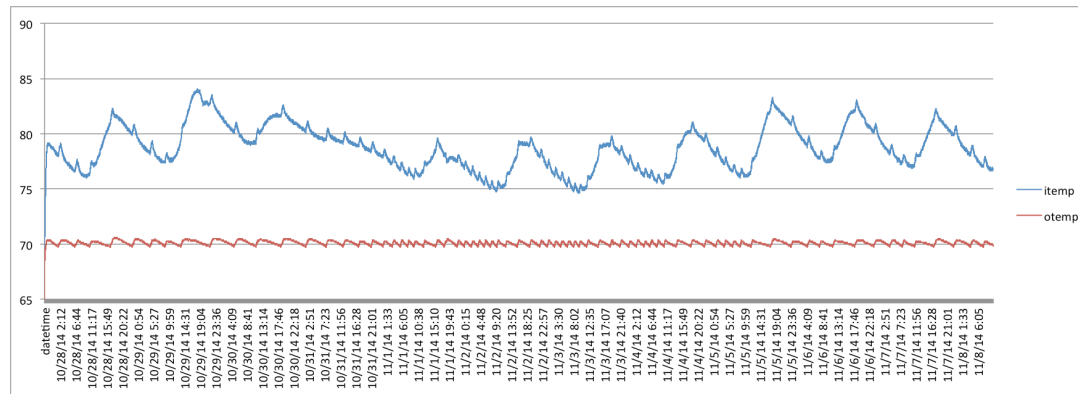
Brewtroller

- Open-source project for homebrewing automation
  - Temperature / heating control
  - Liquid level monitoring
  - Recipe-programmable from BeerSmith, etc.
- Project has been stale for a few years, restarted in Dec 2014

Fermentation Controllers

- Arduino-based fermentation controller provides data off-the-shelf controllers can't

Resources

- My site: http://beer.blastzone.net
- HomeBrewTalk automation forum: http://www.homebrewtalk.com/f235/
- http://www.kegerators.com
- http://www.micromatic.com
- *The Copper Tube Handbook* – Copper Development Association
- http://www.brewtroller.com