Electrical Training

Week 3: Motors, GitHub

Agenda

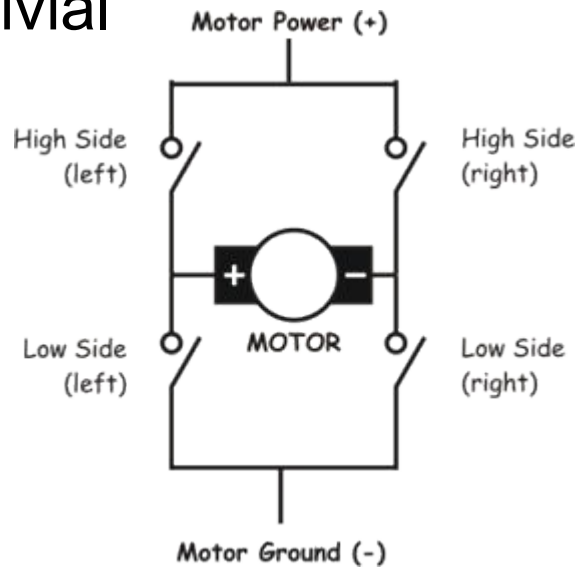
- Motor basics
- Controlling BDC and BLDC motors
- GitHub

Motors - Types (DC)

- DC & AC motors
  - We only care about DC
- Brush**ed** DC
  - low life & efficiency
  - cheap & easy to control
  - Watch (0:00 - 3:00) & (17:36 - 21:51)
- Brush**less** DC
  - long life & efficiency
  - more money
  - hard to control
  - Watch Part 1
  - Watch Part 2 (3:40 - 5:45)

Motors - Brushed DC Control

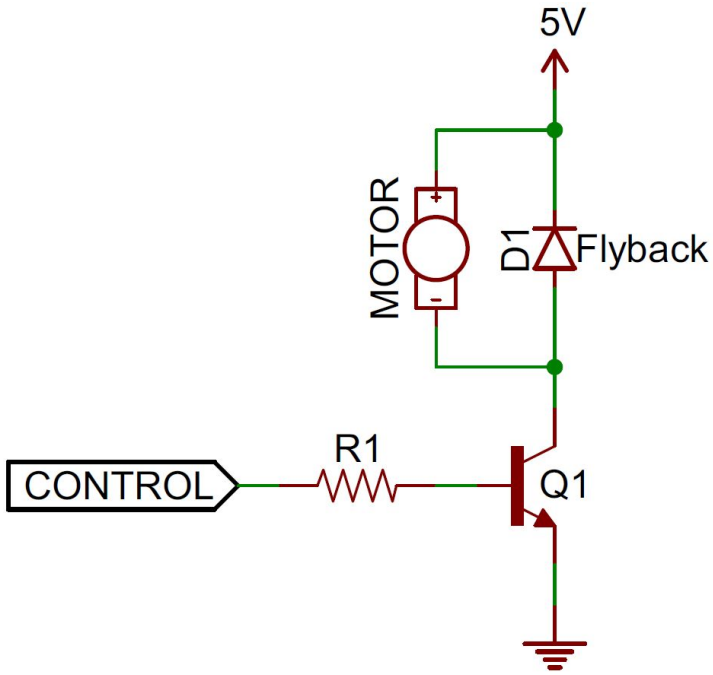
- Spinning brush**ed** DC motors are trivial
  - Apply a voltage across terminals
  - Bidirectional control using *H bridge*
- Non-ideal for anything requiring precise control
- Speed controlled by PWM



- Additional reference
  - https://learn.sparkfun.com/tutorials/motors-and-selecting-the-right-one/dc-brush-motors---the-classic

BDC Motor Drive Characteristics

- Voltage <-> Speed
- Current <-> Torque
- Backwards EMF
  - Flyback, freewheel diode



Motors - Brushless DC Control

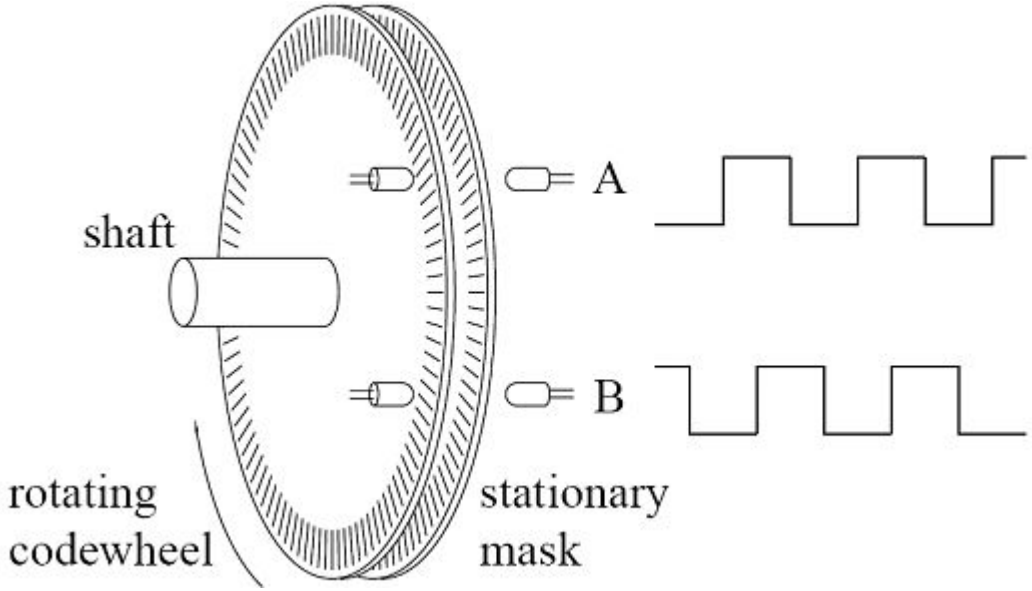
- Can not control without dedicated hardware logic
  - This means spinning a brushless DC motor (BLDC) requires the use of a microcontroller or other low-level computing interface
- Must know the motor's position at all time
  - Hall sensors can read magnetic field from motor windings
- Can use encoders to determine precise position
  - Different types of encoders, *rotary encoders* used here
  - https://en.wikipedia.org/wiki/Rotary_encoder

Motors - Brushless DC Control

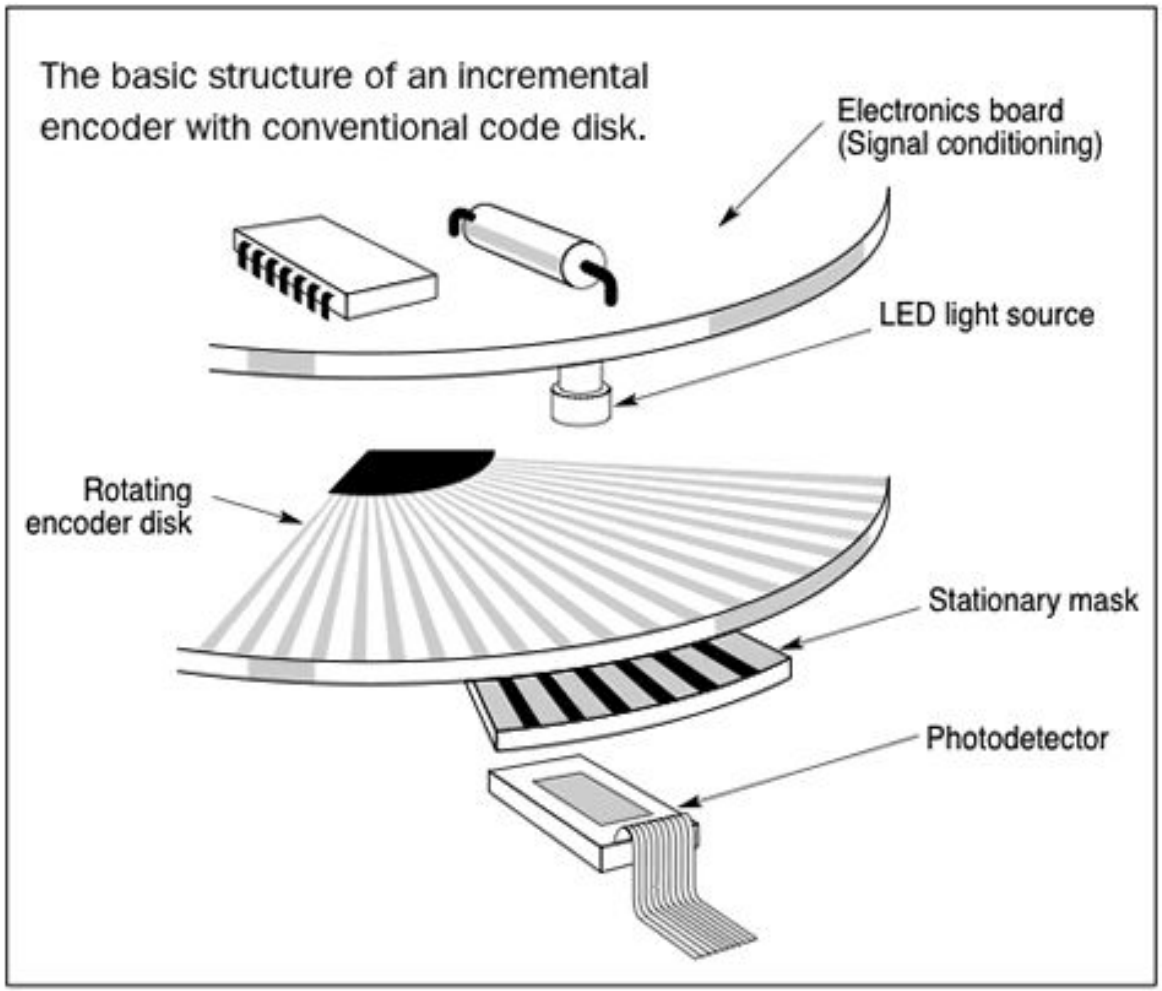
- A real world example: RoboCup motors
  - Hardware level controls written in Verilog
  - https://github.com/RoboJackets/robocup-software/tree/robot2015-firmware/firmware/robot2015/src-fpga
- Additional reference
  - https://learn.sparkfun.com/tutorials/motors-and-selecting-the-right-one/brushless-motors---more-power

Quadrature Encoders

- Output signals delayed by 90 degrees
- Can tell in which direction the motor is spinning
- Optical or Inductive



Example: Optical Encoder



(In use by IGVC)

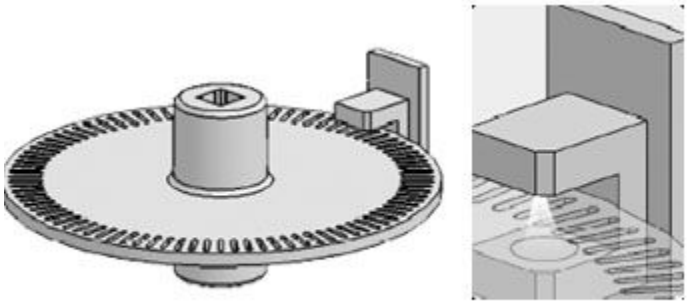


Figure 2. Optical shaft encoder disk

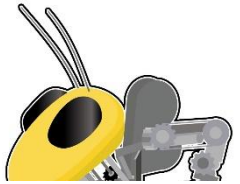
Motors - Additional Resources

- Additional reference showing more motor types
  - https://learn.sparkfun.com/tutorials/motors-and-selecting-the-right-one/introduction
- Video detailing the electromagnetics of motors
  - https://www.youtube.com/watch?v=wAftcXm45ho

GitHub

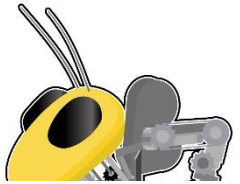
GitHub

- Version control service that uses Git
  - Tracks changes made to files in a **repository**
- You can update the version of the files locally by **committing** them
- You can **sync** files by **pushing** them onto a **remote** server
- You can prototype by creating a **branch** from a project
- Once you are done testing your branch, you can **merge** it with the **master branch** (this is known as a **pull** request)



Filter repositories

Get started by adding a repository.



Filter repositories

Options...

About GitHub Desktop...

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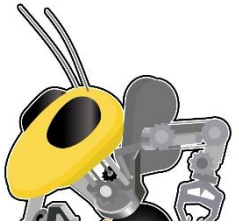


Filter repositories

Options

Accounts

You're not signed in to any accounts. Add a GitHub account for quick access to your repositories or add a GitHub Enterprise account to access repositories on your corporate network.

+ Add account

Configure git

danbudanov

danbudanov@gmail.com

This will be used in the commits you create. Keep in mind that if you publish commits, anyone will have access to this email.
This will change your global gitconfig.

Appearance

Light

Dark

Clone path

C:\Users\Daniil\Documents\GitHub Browse

Create and clone new repositories into this directory by default.

Scan for repositories

Find repositories on your hard drive.

Default shell

Cmd

Git Bash

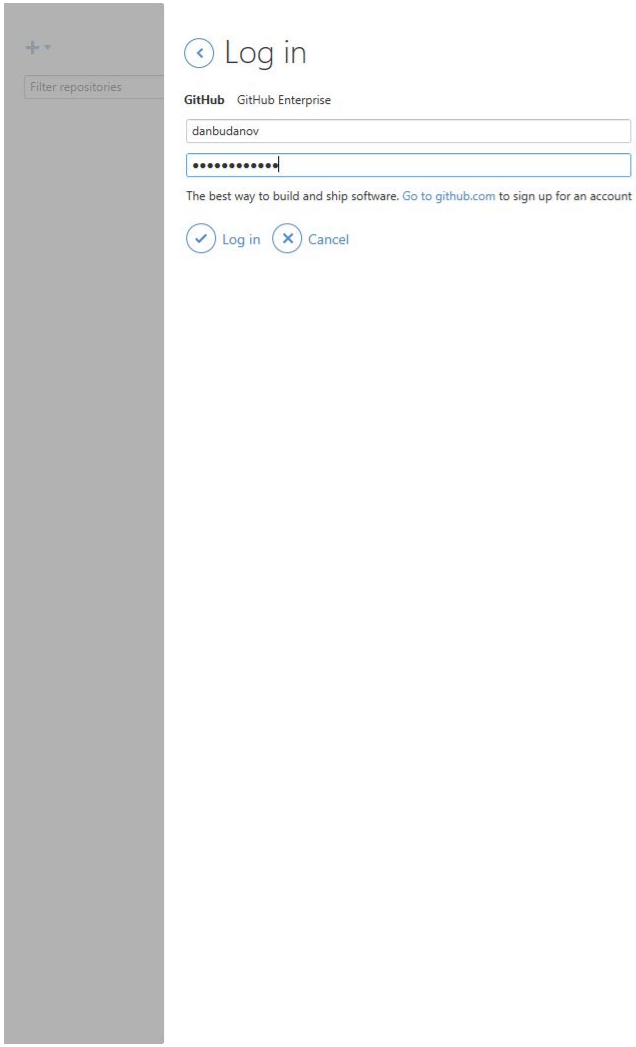
PowerShell

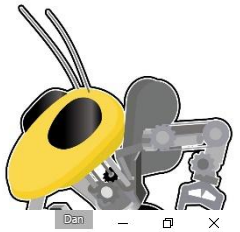
Custom

Privacy

Help us improve by sending anonymous usage data

Save Cancel


Filter repositories
Log in
GitHub
GitHub Enterprise
danbudanov
The best way to build and ship software. Go to github.com to sign up for an account
Log in
Cancel



RoboJackets/electrical-tr

GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training

This repository Search Pull requests Issues Gist

RoboJackets / electrical-training

Unwatch 12 Unstar 4 Fork 1

Code Issues 0 Pull requests 0 Projects 0 Pulse Graphs Settings

No description or website provided. — Edit

34 commits 1 branch 0 releases 4 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

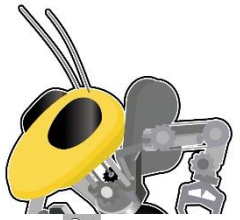
danbudanov files test commit Latest commit c8801a7 20 minutes ago

code	added markdown for upload to Attiny84	18 days ago
github_tutorial	files test commit	20 minutes ago
slides	added wk 2 slides	6 days ago
training-pcb	Merge remote-tracking branch 'origin/master'	17 days ago
.gitignore	Ignore Zip	13 days ago
README.md	blah blah blahhhh!! :)	a month ago

README.md

RoboJackets Electrical Training

Electrical training information, schedule, project, and other resources



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Clone with HTTPS Use SSH

Use Git or checkout with SVN using the web URL.

https://github.com/RoboJackets/electrical-

Open in Desktop Download ZIP

Clone RoboJackets/electrical-training to your computer and use it in GitHub Desktop.

README.md

RoboJackets Electrical Training

Electrical training information, schedule, project, and other resources

github-windows://openRepo/https://github.com/RoboJackets/electrical-training

Search the web and Windows

ENG 7:27 PM 10/2/2016

RoboJackets/electrical-t

GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training

This repository Search

External Protocol Request

Google Chrome needs to launch an external application to handle github-windows: links. The link requested is github-windows://openRepo/https://github.com/RoboJackets/electrical-training.

The following application will be launched if you accept this request:

GitHub

If you did not initiate this request, it may represent an attempted attack on your system. Unless you took an explicit action to initiate this request, you should press Do Nothing.

Remember my choice for all links of this type.

Launch Application | Do Nothing

RoboJackets / electrical-training

Unwatch 12 | Unstar 4 | Fork 1

Code | Issues 0 | Pull requests 0 | ettings

No description or website provided. — Edit

34 commits | 4 contributors

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

Clone with HTTPS | Use SSH

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Open in Desktop | Download ZIP

Clone RoboJackets/electrical-training to your computer and use it in GitHub Desktop.

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README.md

RoboJackets Electrical Training

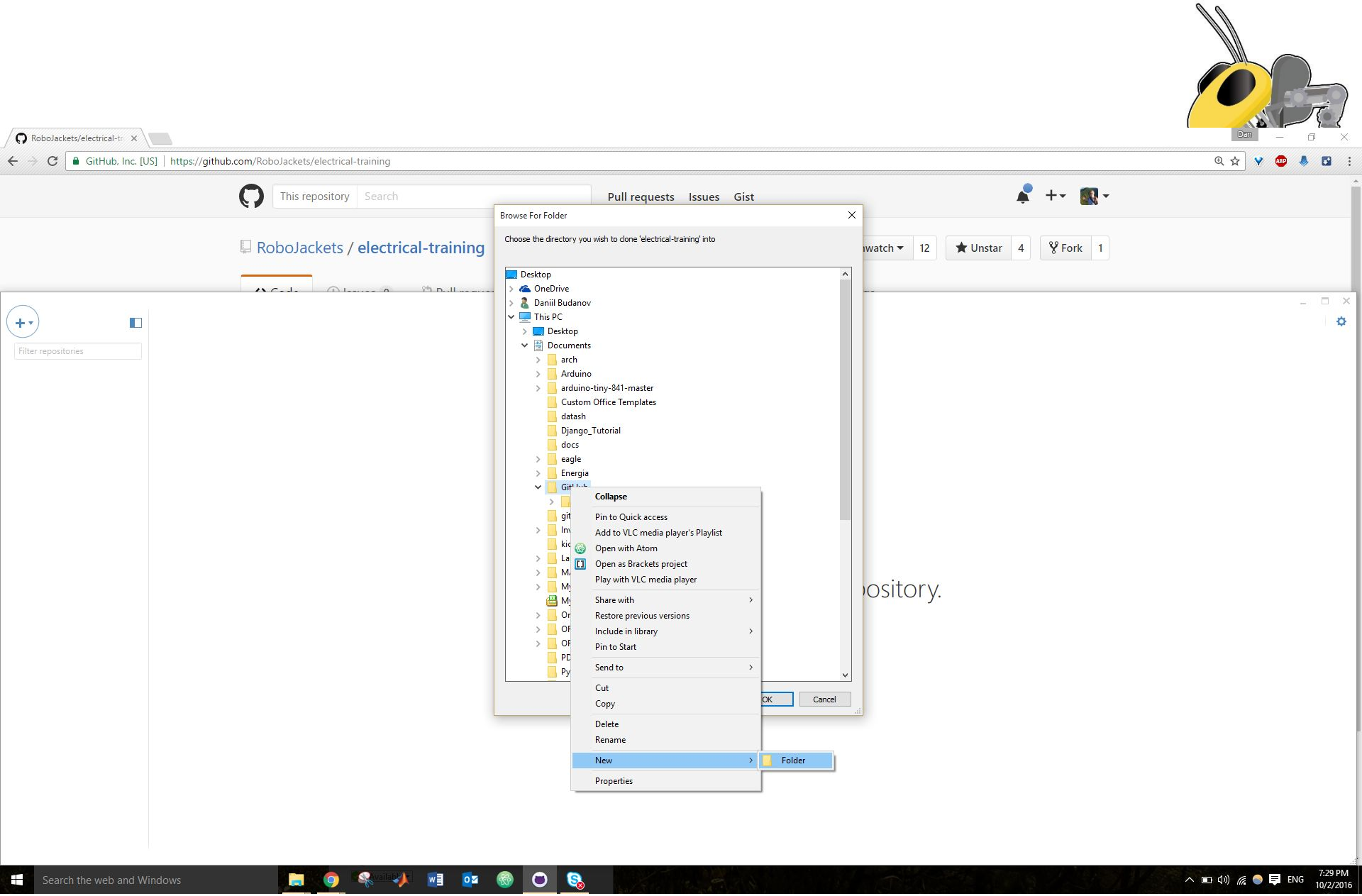
Electrical training information, schedule, project, and other resources

Browse For Folder

Choose the directory you wish to clone 'electrical-training' into

- Desktop
  - OneDrive
  - Daniil Budanov
  - This PC
    - Desktop
    - Documents
      - arch
      - Arduino
      - arduino-tiny-841-master
      - Custom Office Templates
      - datash
      - Django_Tutorial
      - docs
      - eagle
      - Energia
      - GitHub
        - robocup-software
      - github_slides
      - Inventor
      - kicker
      - LabVIEW Data
      - MATLAB
      - My Digital Editions
      - My Shapes
      - OneNote Notebooks
      - ORS_2016
      - ORS_2016_old
      - PDF Architect
      - Python Scripts

OK Cancel


RoboJackets/electrical-tr
GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training
This repository
Search
Pull requests
Issues
Gist
RoboJackets / electrical-training
Unstar 4
Fork 1
Filter repositories
Browse For Folder
Choose the directory you wish to clone 'electrical-training' into
Desktop
OneDrive
Daniil Budanov
This PC
Desktop
Documents
arch
Arduino
arduino-tiny-841-master
Custom Office Templates
datash
Django_Tutorial
docs
eagle
Energia
Collapse
Pin to Quick access
Add to VLC media player's Playlist
Open with Atom
Open as Brackets project
Play with VLC media player
Share with
Restore previous versions
Include in library
Pin to Start
Send to
Cut
Copy
Delete
Rename
New
Folder
Properties
OK
Cancel
Search the web and Windows
ENG
7:29 PM
10/2/2016

Browse For Folder

Choose the directory you wish to clone 'electrical-training' into

- Desktop
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      - OneNote Notebooks
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      - ORS_2016_old
      - PDF Architect

OK Cancel

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This repository Search Pull requests Issues Gist

RoboJackets / electrical-training

Unwatch 12 Unstar 4 Fork 1

Filter repositories

electrical-training

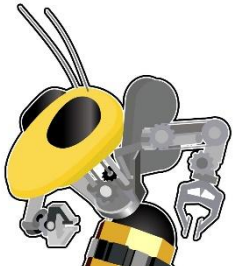
Cloning electrical-training

Resolving deltas: 100% (89/89), done.

Search the web and Windows

ENG 7:30 PM 10/2/2016

RoboJackets www.robojackets.org



master ▾ | Changes | History | Pull request | Atom

Filter repositories

electrical-training

Compare ▾ | Sync

master

- files test commit — 24 minutes ago by Daniil Budanov
- added wk 2 slides — 5 days ago by Daniil Budanov
- Ignore Zip — 12 days ago by gtrosawa
- slides week 1 — 13 days ago by Daniil Budanov
- Merge remote-tracking branch 'origin/master' — 17 days ago by Evan Peterson
- Training board minor fixes for RGB led — 17 days ago by Evan Peterson — 3
- Fixed RGB LED Footprint — 17 days ago by gtrosawa — 3
- added markdown for upload to Attiny84 — 17 days ago by Daniil Budanov
- began arduino code directory — 17 days ago by Daniil Budanov — 4
- Silkscreen Optimization — 1 month ago by gtrosawa — 2
- Optimized a Few Traces — 1 month ago by gtrosawa
- Removed the Series Resistor Instead — 1 month ago by gtrosawa — 2
- Eliminated Redundant Pull-Up Resistor — 1 month ago by gtrosawa — 2
- Adding Ignore List — 1 month ago by gtrosawa
- Adding Reference Design — 1 month ago by gtrosawa — 2
- Fix library files — 1 month ago by petersonev — 3
- Minor pcb routing changes — 1 month ago by petersonev

files test commit

Daniil Budanov c8801a7 | GitHub | Revert | Collapse all

github_tutorial\file.txt

```
@@ -0,0 +1,36 @@
+Files
+ft. Evan P
+
+This is a file
+A file is this
+Github is fun
+We aren't done
+RoboJackets
+Makes files
+With
+    make file
+When the files compile
+Files compiling makes me smile
+And I smile with style
+Because I make my files with proper style
+Those against me are in denial
+
+Throwing the circuits into a pile
+All of the bugs will be exiled
+Because I squish them
+Compiler errors I dish them
+
+Synthesized some Verilog for an FPGA
+Making the files made me say "Yay"
+Fools who use VHDL are astray
+Programmable logic all the way
+
+Made some low pass filters
+Because the high frequency noise causes disruptions
+But the binary files are full of corruption
+And my digital systems require interruptions
+Yeah
+    Interruptions
+Yeah
+    Interruptions come from interrupts
+Yeah
```

github_tutorial

File Home Share View

Pin to Quick access | Copy | Paste | Cut | Copy path | Paste shortcut — Clipboard

Move to | Copy to | Delete | Rename — Organize

New folder | New item | Easy access — New

Properties | Open | Edit | History — Open

Select all | Select none | Invert selection — Select

This PC › Documents › GitHub › electrical-training › electrical-training › github_tutorial

Search github_tut...

- Quick acces
- OneDrive
- This PC
  - Desktop
  - Documen
  - Download
  - Music
  - Pictures
  - Videos
  - OS (C:)
  - Data1 (D:)
  - Data2 (E:)
- Network

file

1 item

file - Notepad

File Edit Format View Help

```
Files
ft. Evan P

Beat: https://www.youtube.com/watch?v=Bad46A7tvnI

This is a file
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Makes files
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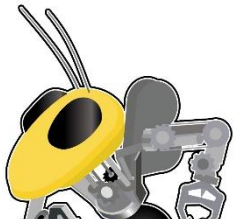

master ▾ | Changes ● | History | Pull request | Atom

Filter repositories

electrical-training

Compare ▾ | Sync

master

1 change

github_tutorial\file.txt

github_tutorial\file.txt

```
@@ -1,6 +1,8 @@
 Files
 ft. Evan P
 
+Beat: https://www.youtube.com/watch?v=Bad46A7tvnI
+
 This is a file
 A file is this
 Github is fun
```

Summary

Description

Commit to master

master ▾ | Changes ● | History | Pull request | Atom

Filter repositories

electrical-training

Compare ▾ | Sync

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This is a summary of my changes

I dropped in some sick beatz

Commit to master

master | Changes | History | Pull request | Atom

Filter repositories

electrical-training

Compare | Sync

master

This is a summary of my changes
just now by danbudanov

Revert "This is a summary of my changes"
2 minutes ago by danbudanov

This is a summary of my changes
2 minutes ago by danbudanov

files test commit
38 minutes ago by Daniil Budanov

added wk 2 slides
6 days ago by Daniil Budanov

Ignore Zip
12 days ago by gtrosawa

slides week 1
13 days ago by Daniil Budanov

Merge remote-tracking branch 'origin/master'
17 days ago by Evan Peterson

Training board minor fixes for RGB led
17 days ago by Evan Peterson 3

Fixed RGB LED Footprint
17 days ago by gtrosawa 3

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began arduino code directory
17 days ago by Daniil Budanov 4

Silkscreen Optimization
1 month ago by gtrosawa 2

Optimized a Few Traces
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Removed the Series Resistor Instead
1 month ago by gtrosawa 2

Eliminated Redundant Pull-Up Resistor
1 month ago by gtrosawa 2

This is a summary of my changes

danbudanov 1e7d500

GitHub | Revert | Collapse all

I dropped in some sick beatz

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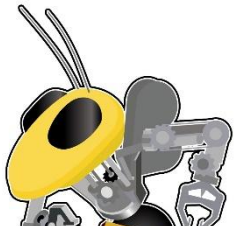
...  ...  @@ -1,6 +1,8 @@
 1    1   Files
 2    2   ft. Evan P
 3    3
      4  + Beat: https://www.youtube.com/watch?v=Bad46A7tvnI
      5  +
 4    6   This is a file
 5    7   A file is this
 6    8   Github is fun
```

Undo Created commit: 'This is a summary of my changes'



master | Changes | History | Pull request | Atom

Filter repositories

electrical-training

Syncing

master

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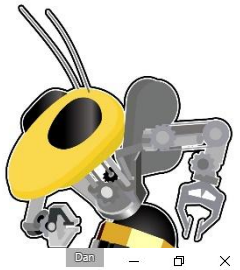

RoboJackets/electrical-tr | This is a summary of my

GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training/commit/1e7d50067f2732ee9ba3c3261e971ba1d3bfc22c

This repository Search Pull requests Issues Gist

RoboJackets / electrical-training

Unwatch 12 Unstar 4 Fork 1

Code Issues 0 Pull requests 0 Projects 0 Pulse Graphs Settings

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I dropped in some sick beatz

Browse files

master

danbudanov committed a minute ago 1 parent b6031d6 commit 1e7d50067f2732ee9ba3c3261e971ba1d3bfc22c

Showing 1 changed file with 2 additions and 0 deletions. Unified Split

2 github_tutorial/file.txt View

```
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 Files
 ft. Evan P
 
+Beat: https://www.youtube.com/watch?v=Bad46A7tvnI
+
 This is a file
 A file is this
 Github is fun
```

0 comments on commit 1e7d500

Lock conversation

Write Preview

Leave a comment

master ▾ | Changes | History | Pull request | Atom

Filter repositories

electrical-training

Name: example branch

From branch: master ▾

Branch will be created as example-branch

Create new branch

Sync

Revert "This is a summary of my changes"
5 minutes ago by danbudanov

This is a summary of my changes
5 minutes ago by danbudanov

files test commit
41 minutes ago by Daniil Budanov

added wk 2 slides
6 days ago by Daniil Budanov

Ignore Zip
12 days ago by gtrosawa

slides week 1
13 days ago by Daniil Budanov

Merge remote-tracking branch 'origin/master'
17 days ago by Evan Peterson

Training board minor fixes for RGB led
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added markdown for upload to Attiny84
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Silkscreen Optimization
1 month ago by gtrosawa

Optimized a Few Traces
1 month ago by gtrosawa

Removed the Series Resistor Instead
1 month ago by gtrosawa

Eliminated Redundant Pull-Up Resistor
1 month ago by gtrosawa

Adding Ignore List
1 month ago by gtrosawa

This is a summary of my changes

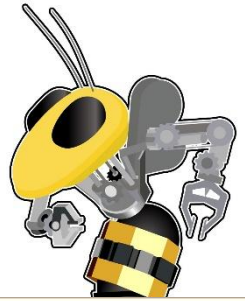
danbudanov 1e7d500

GitHub | Revert | Collapse all

I dropped in some sick beatz

github_tutorial\file.txt

```
@@ -1,6 +1,8 @@
 Files
 ft. Evan P
 
+Beat: https://www.youtube.com/watch?v=Bad46A7tvnI
+
 This is a file
 A file is this
 Github is fun
```



file - Notepad

File Edit Format View Help

```
Makes files
With
        make file
When the files compile
Files compiling makes me smile
And I smile with style
Because I make my files with proper style
Those against me are in denial

Throwing the circuits into a pile
All of the bugs will be exiled
Because I squish them
Compiler errors I dish them

Synthesized some Verilog for an FPGA
Making the files made me say "Yay"
Fools who use VHDL are astray
Programmable logic all the way

Made some low pass filters
Because the high frequency noise causes disruptions
But the binary files are full of corruption
And my digital systems require interruptions
Yeah
        Interruptions
Yeah
        Interruptions come from interrupts
Yeah
        Itty bitty interrupts
Yeah
        Gotta have them interrupts
Yeah
```

example-branch ▾ | Changes ● | History | Pull request | Atom

Filter repositories

electrical-training

Compare ▾ | Publish

example-branch

1 change

github_tutorial\file.txt

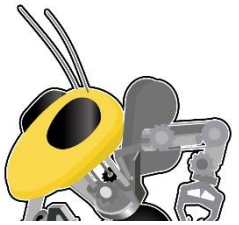
github_tutorial\file.txt

```
...  ...  @@ -36,3 +36,7 @@ Yeah
36   36   Yeah
37   37       Interruptions come from interrupts
38   38   Yeah
     39  +     Itty bitty interrupts
     40  + Yeah
     41  +     Gotta have them interrupts
     42  + Yeah
39   43   \ No newline at end of file
```

Added sweet new lines

Its all about the interrupts

Commit to example-branch



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example-branch

Added sweet new lines
just now by danbudanov

This is a summary of my changes
6 minutes ago by danbudanov

Revert "This is a summary of my changes"
8 minutes ago by danbudanov

This is a summary of my changes
8 minutes ago by danbudanov

files test commit
44 minutes ago by Daniil Budanov

added wk 2 slides
6 days ago by Daniil Budanov

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danbudanov 1f7dcfb | GitHub | Revert | Collapse all

Its all about the interrupts

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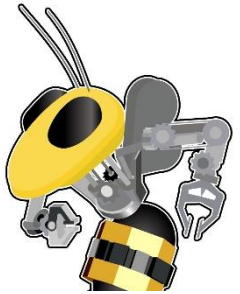
37   37       Interruptions come from interrupts
38   38   Yeah
     39 +     Itty bitty interrupts
     40 + Yeah
     41 +     Gotta have them interrupts
     42 + Yeah
39   43   \ No newline at end of file
```

Undo Created commit: 'Added sweet new lines'



example-branch | Changes | History | Pull request | Atom

Filter repositories

electrical-training

Syncing

example-branch

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just now by danbudanov

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GitHub Revert Collapse all

Its all about the interrupts

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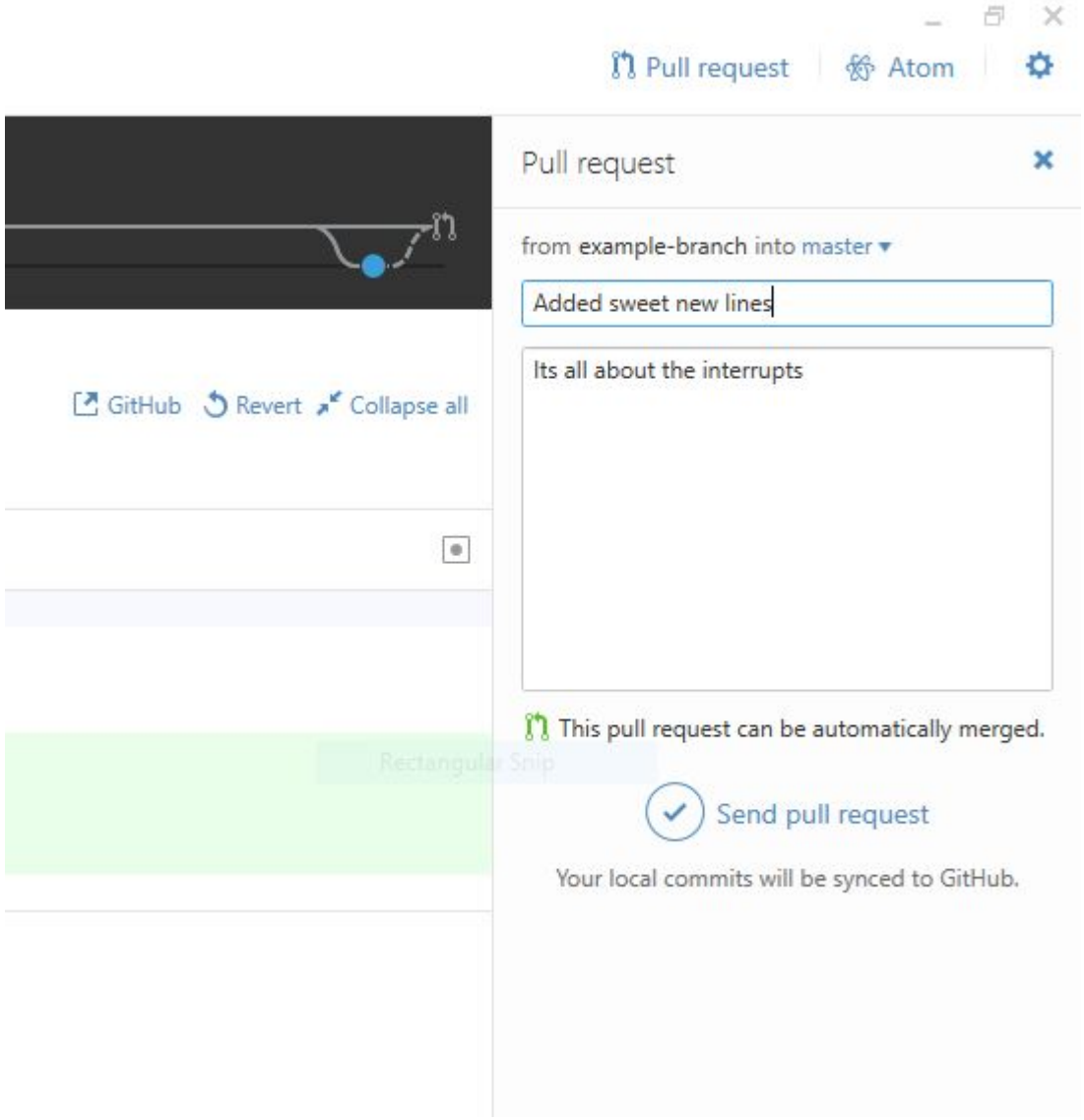

Pull request
Atom
Pull request
from example-branch into master
Added sweet new lines
Its all about the interrupts
GitHub
Revert
Collapse all
This pull request can be automatically merged.
Send pull request
Your local commits will be synced to GitHub.

Pull request created

Awesome work!

View it on GitHub

Added sweet new lines

GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training/pull/2

This repository Search Pull requests Issues Gist

RoboJackets / electrical-training

Unwatch 12 Unstar 4 Fork 1

Code Issues 0 Pull requests 1 Projects 0 Pulse Graphs Settings

Added sweet new lines #2

Edit

Open **danbudanov** wants to merge 1 commit into `master` from `example-branch`

Conversation 0 Commits 1 Files changed 1 +4 −0

danbudanov commented 43 seconds ago — RoboJackets member

Its all about the interrupts

Added sweet new lines ... 1f7dcfb

Add more commits by pushing to the **example-branch** branch on **RoboJackets/electrical-training**.

This branch has no conflicts with the base branch

Merging can be performed automatically.

Merge pull request — You can also open this in GitHub Desktop or view command line instructions.

Write Preview

Leave a comment

Attach files by dragging & dropping, selecting them, or pasting from the clipboard.

Projects
None yet

Labels
None yet

Milestone
No milestone

Assignees
No one—assign yourself

1 participant

Notifications
Unsubscribe
You're receiving notifications because you authored the thread.

Lock conversation

Add more commits by pushing to the `example-branch` branch on RoboJackets/electrical-training.

Merge pull request #2 from RoboJackets/example-branch

Added sweet new lines

Confirm merge Cancel

Write Preview

Milest

No mil

Assign

No one

1 parti

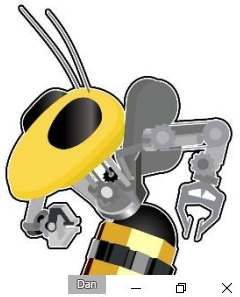
Notific

You're

Pull request successfully merged and closed

You're all set—the `example-branch` branch can be safely deleted.

Delete branch



RoboJackets/electrical-tr

GitHub, Inc. [US] | https://github.com/RoboJackets/electrical-training

This repository Search Pull requests Issues Gist

RoboJackets / electrical-training

Unwatch 12 Unstar 4 Fork 1

Code Issues 0 Pull requests 0 Projects 0 Pulse Graphs Settings

No description or website provided. — Edit

39 commits 1 branch 0 releases 4 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

danbudanov committed on GitHub Merge pull request #2 from RoboJackets/example-branch ... Latest commit 945ff76 32 seconds ago

code	added markdown for upload to Attiny84	18 days ago
github_tutorial	Added sweet new lines	3 minutes ago
slides	added wk 2 slides	6 days ago
training-pcb	Merge remote-tracking branch 'origin/master'	17 days ago
.gitignore	Ignore Zip	13 days ago
README.md	blah blah blahhhh!! :)	a month ago

README.md

RoboJackets Electrical Training

Electrical training information, schedule, project, and other resources

Git

- The Github Desktop client will suffice for most electrical work
- Members working with firmware will find the command-line **git** to be a much more powerful tool
- See an excellent overview of Git at:

http://rogerdudler.github.io/git-guide/