



# MCT432 Hybrid Control Systems

lab I

Experimenting Magnetic / Optical Encoder





MEET  
OUR  
TEAM



# MEET OUR TEAM



**FARID TOLBAH**

*Professor*

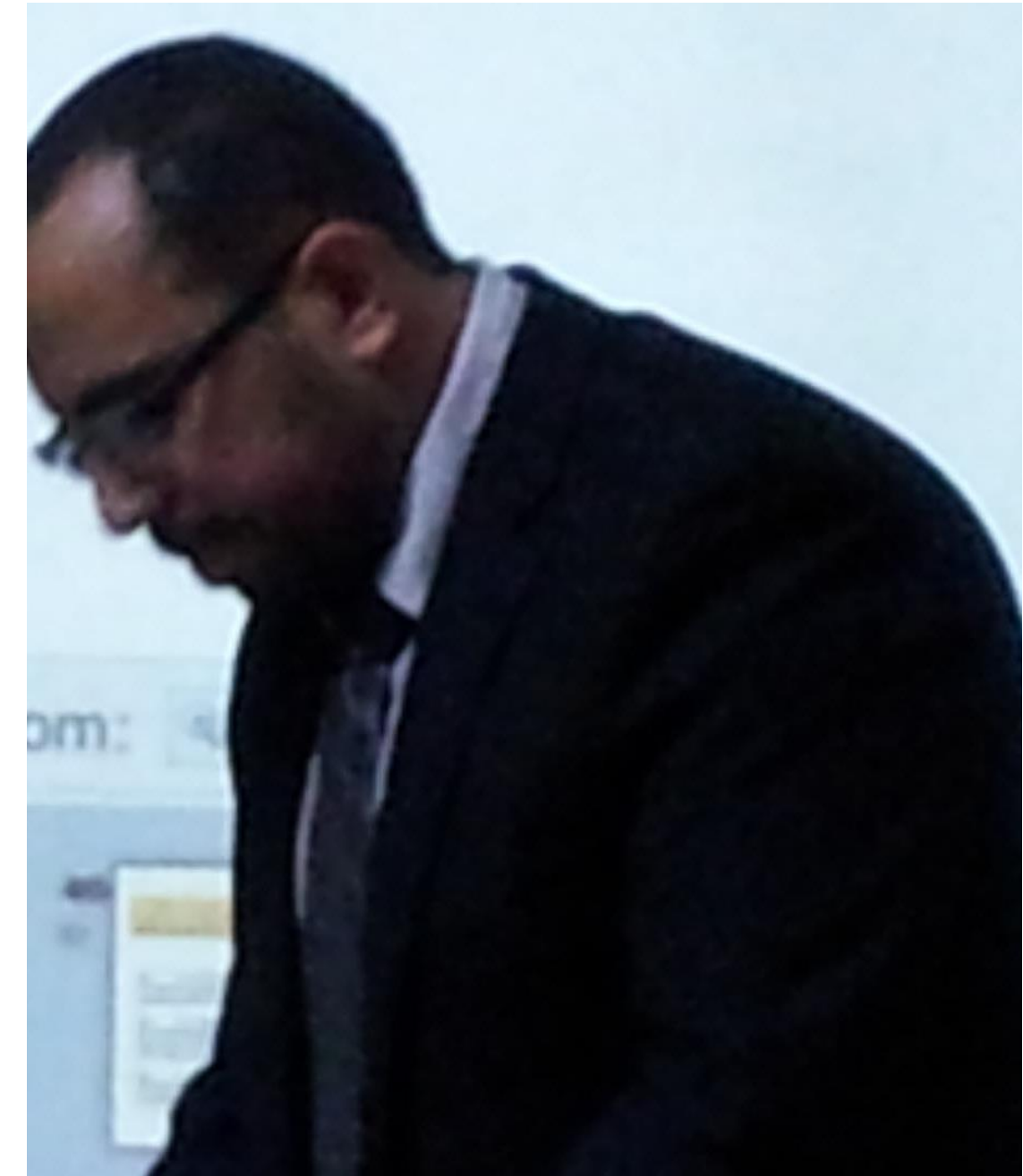
- Core curriculum.
- Lab orientation.
- Selection of tutorial exercises.



**DIAA EMAD**

*Assistant Lecturer*

- Tutorials and assignments.



**WALEED EL-BADRY**

*Assistant Lecturer*

- Design of lab experiments.

# Agenda!

1.

2.

3.

4.

Lab Agenda

# AGENDA

MONDAY

October 10, 2016

A stylized orange calendar icon with a white page showing the year 2016 in grey text.

2016

☒ Importance of Encoders

☒ Types of Encoders

☒ Reading 2-Channels Magnetic Encoder



# AGENDA

MONDAY

October 10, 2016



2016

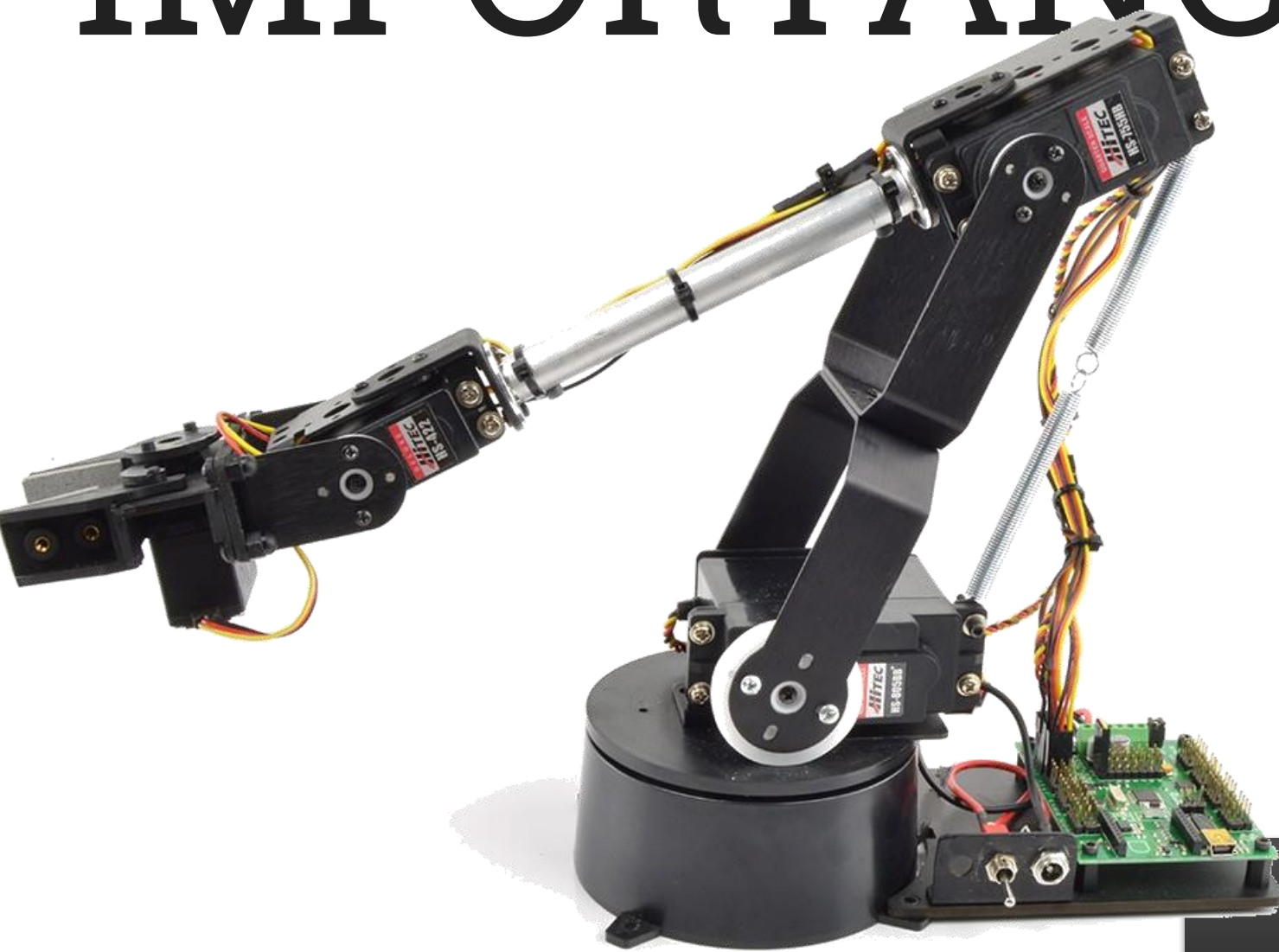
☒ Importance of Encoders

**Its rule in Mechatronics Design**

☒ Types of Encoders

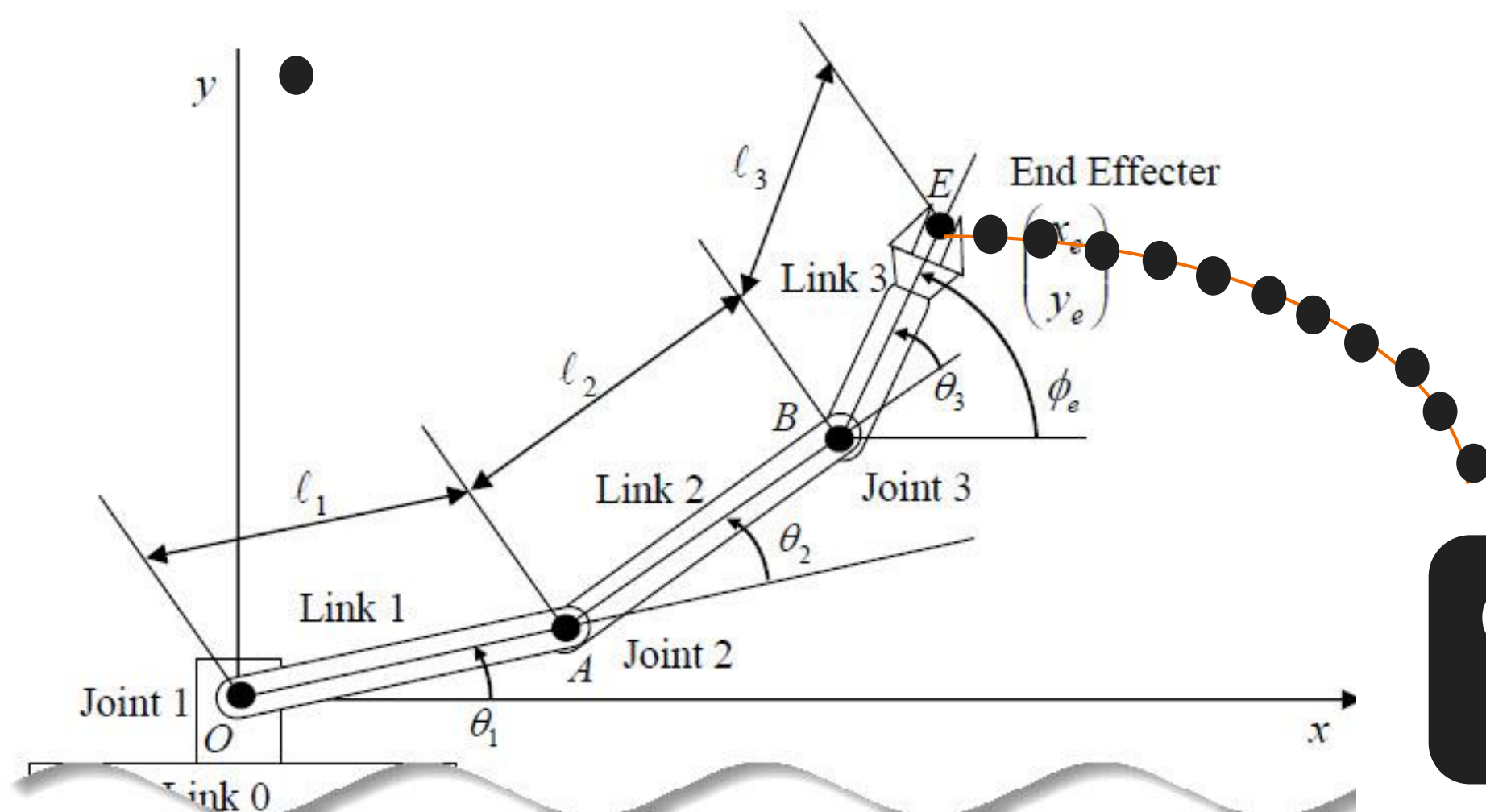
☒ Reading 2-Channels Magnetic Encoder

# IMPORTANCE OF ENCODERS

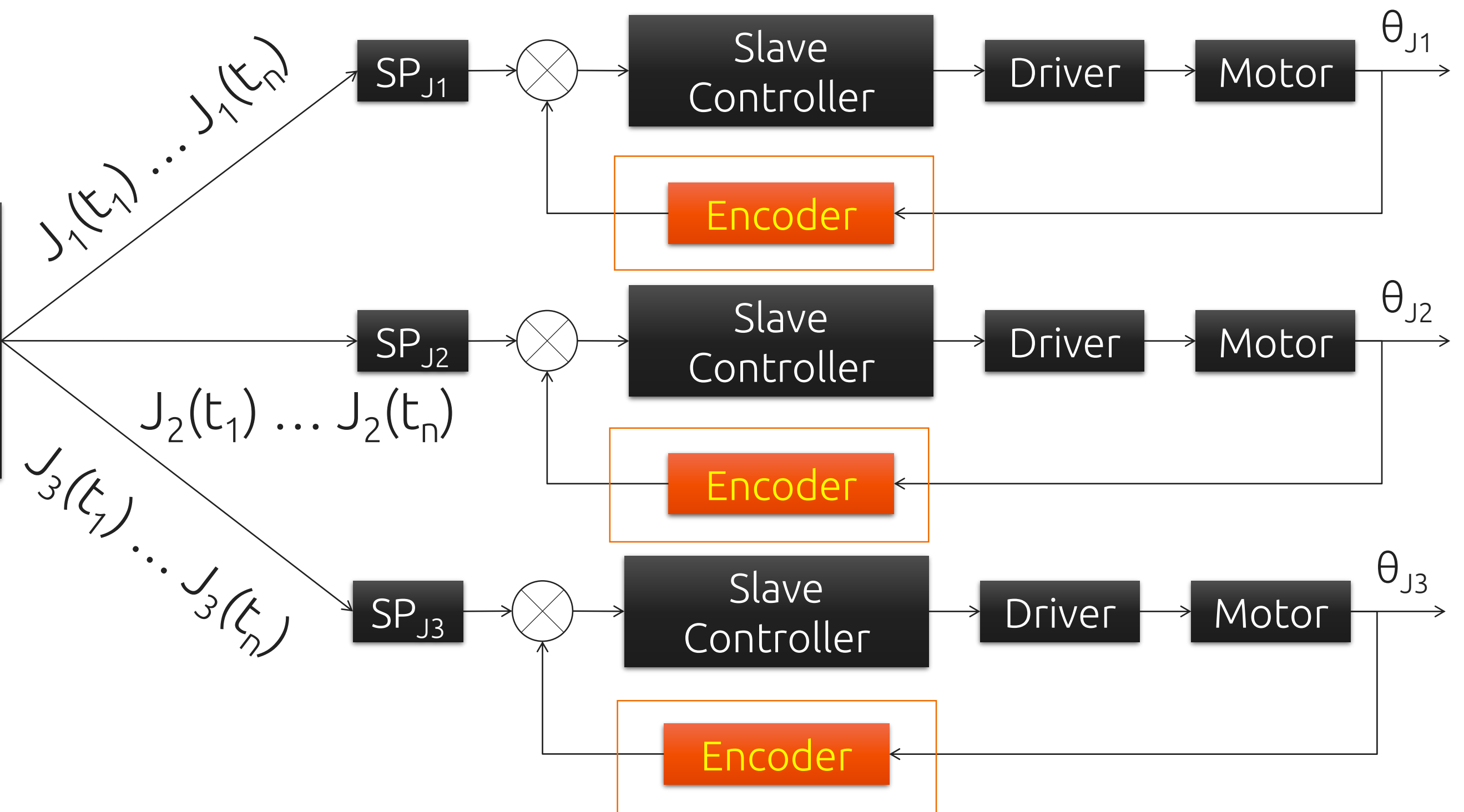


## Master Controller

- Solving Inverse Kinematics
- **Generating** trajectory intermediate angles for each joint ( $J_i$ )

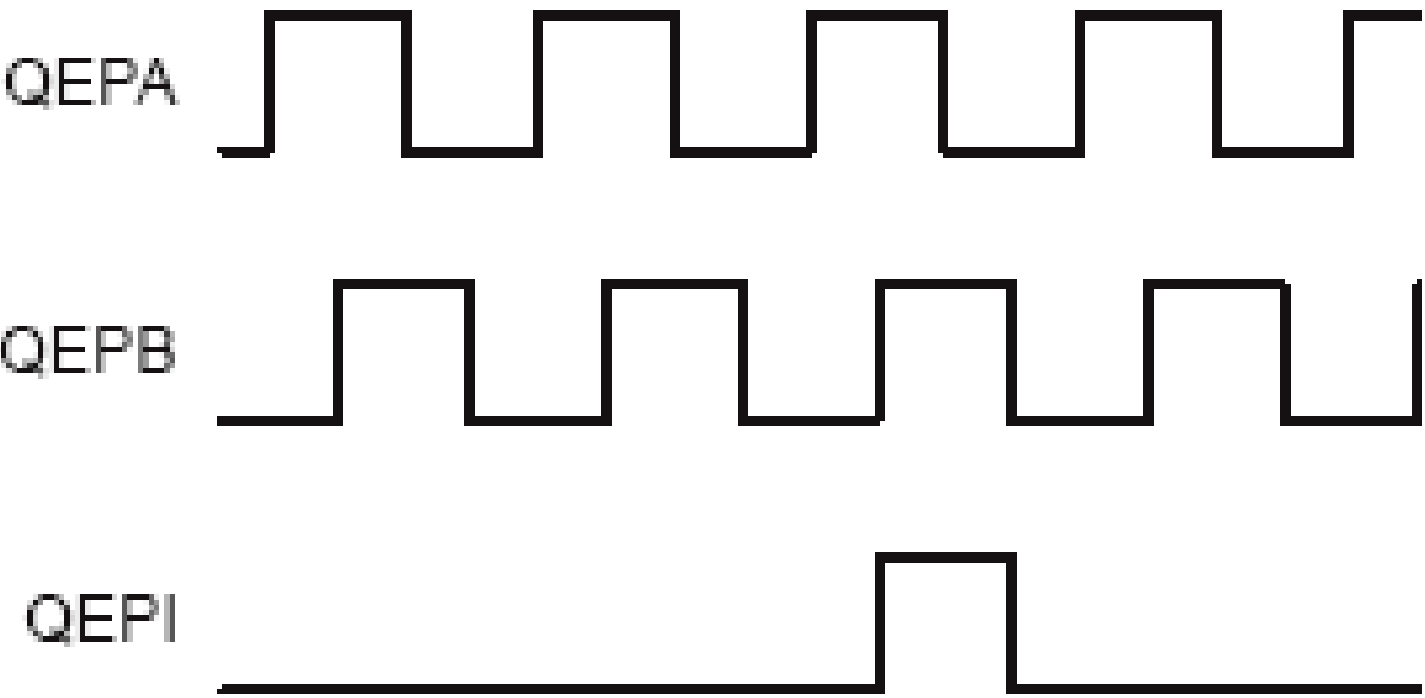
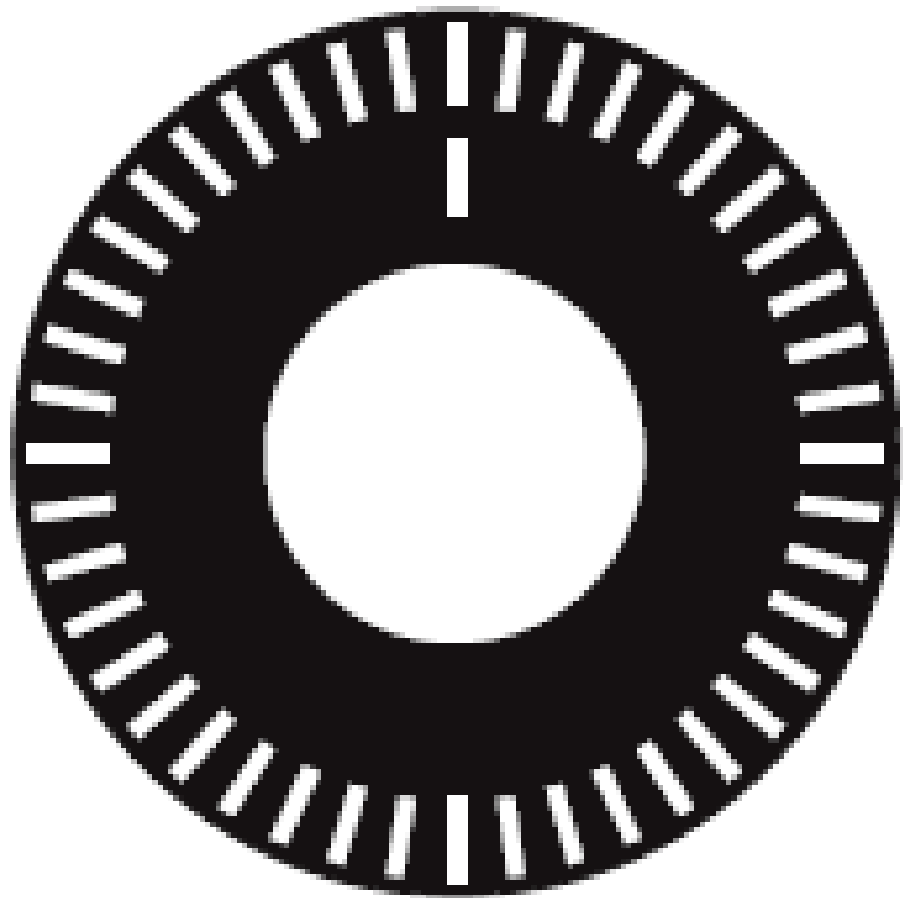
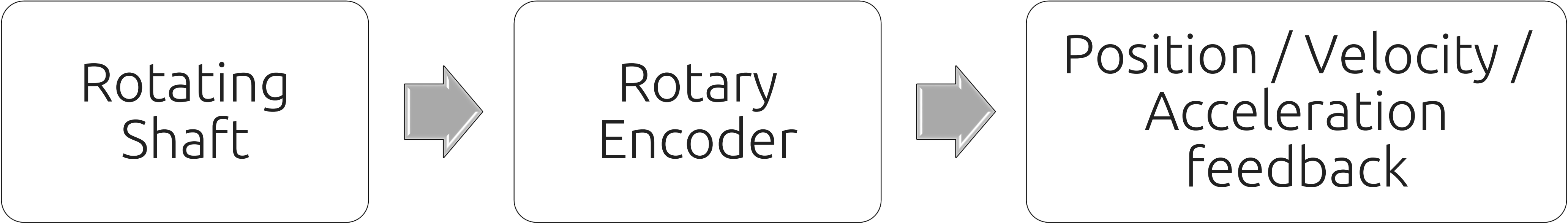


Generated trajectory points



**Why motion control for multiple axes is best to be carried in parallel?**  
**Hint (time . scalability)**

# IMPORTANCE OF ENCODERS





# AGENDA

MONDAY

October 10, 2016

A stylized orange calendar icon with a white page in the center displaying the year '2016' in a light blue font. The calendar has four tabs at the top and a dark orange shadow at the bottom.

☒ Importance of Encoders

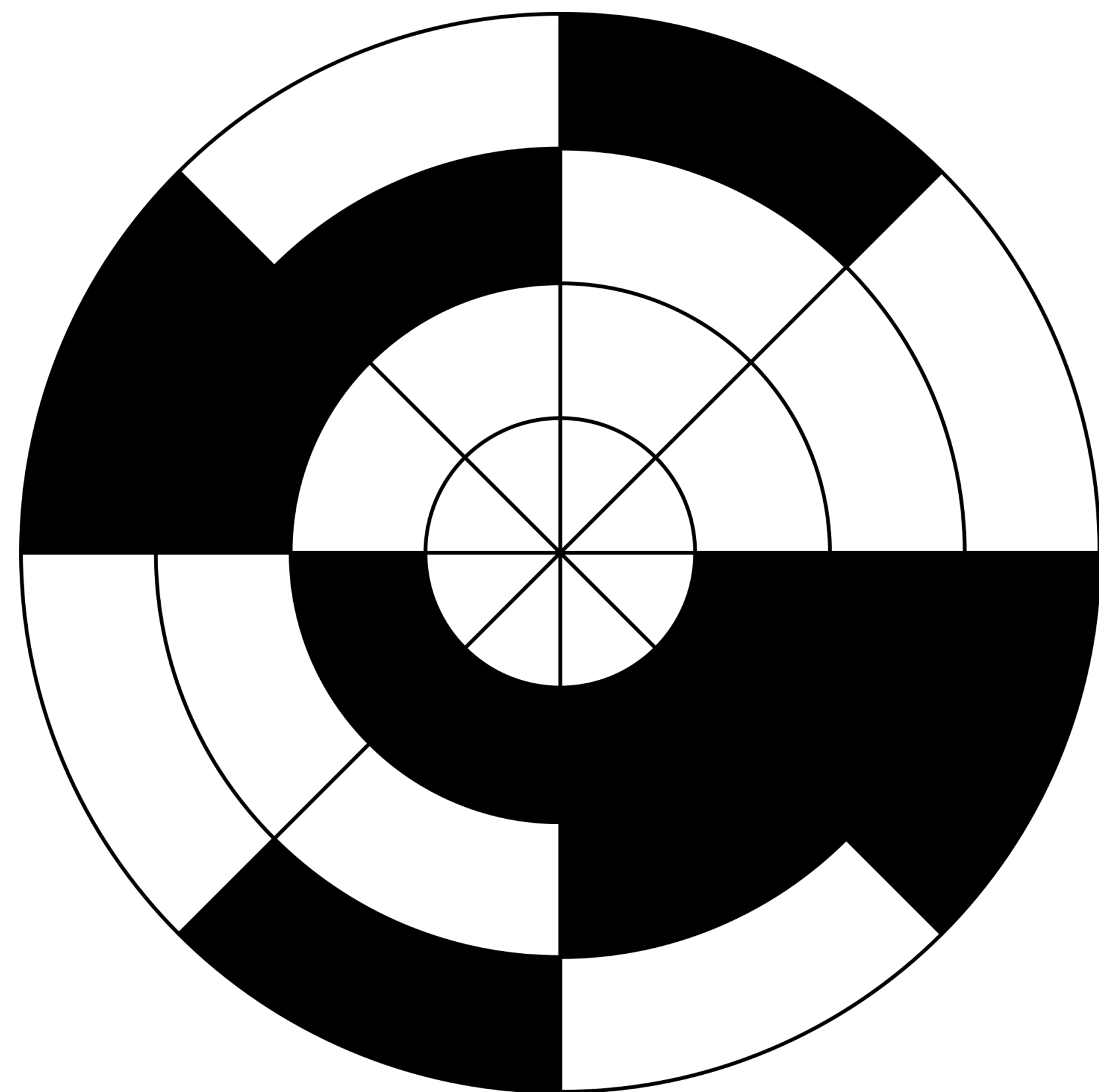
☒ Types of Encoders

**How encoder works**

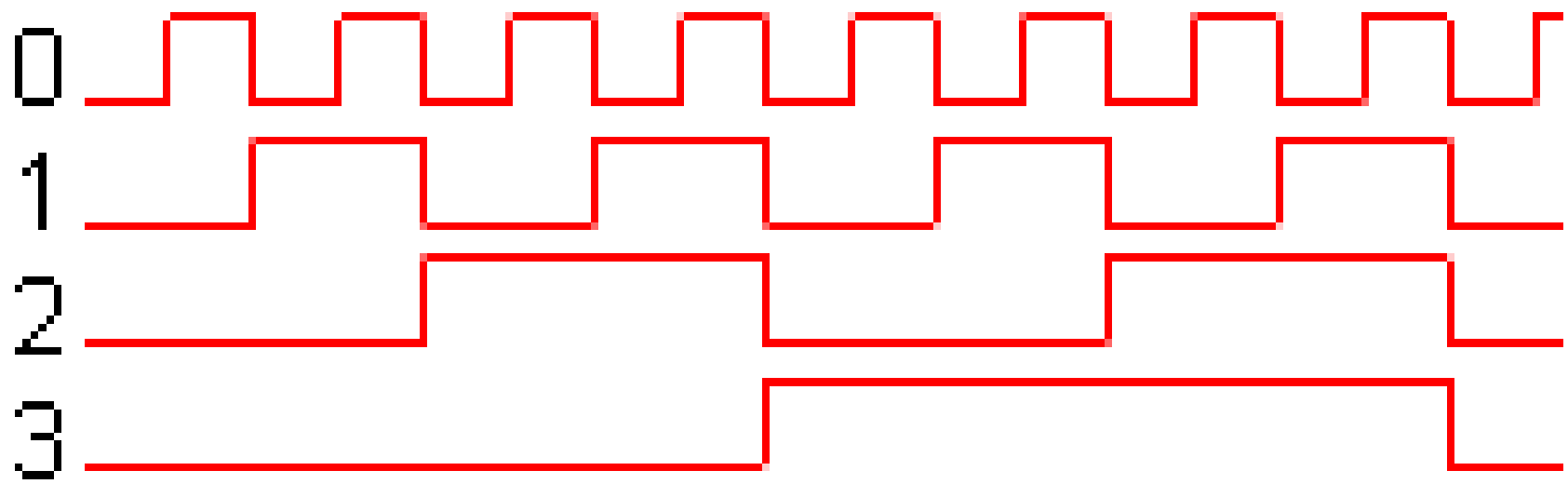
☒ Reading 2-Channels Magnetic Encoder



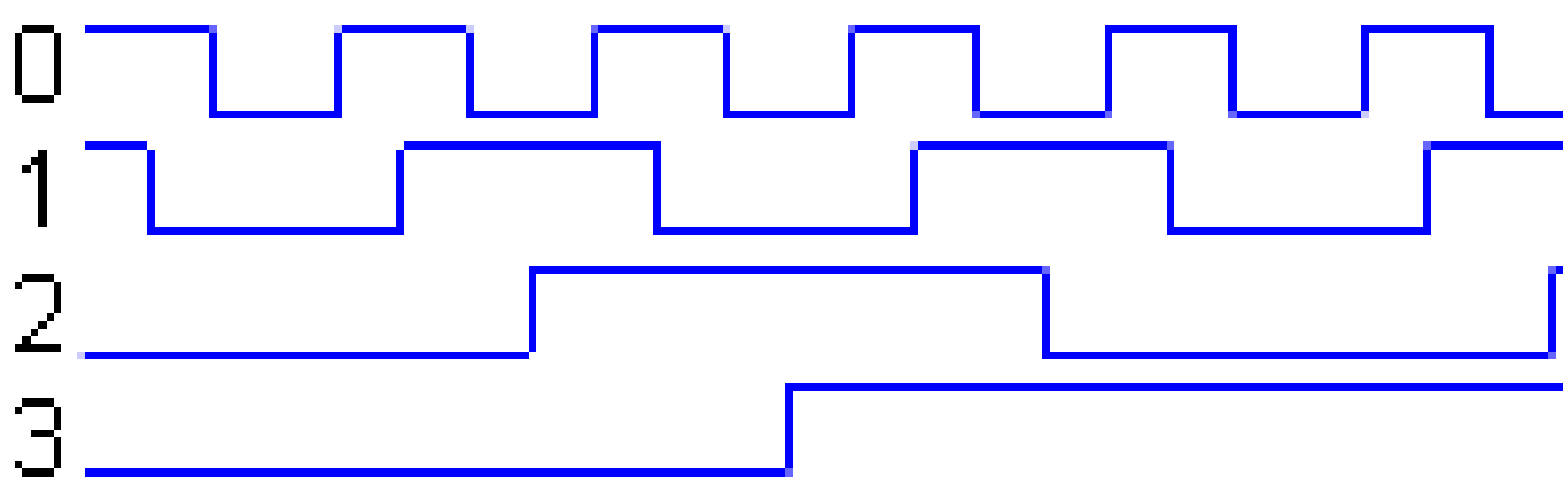
# TYPES OF ROTARY ENCODERS



Binary Code Output



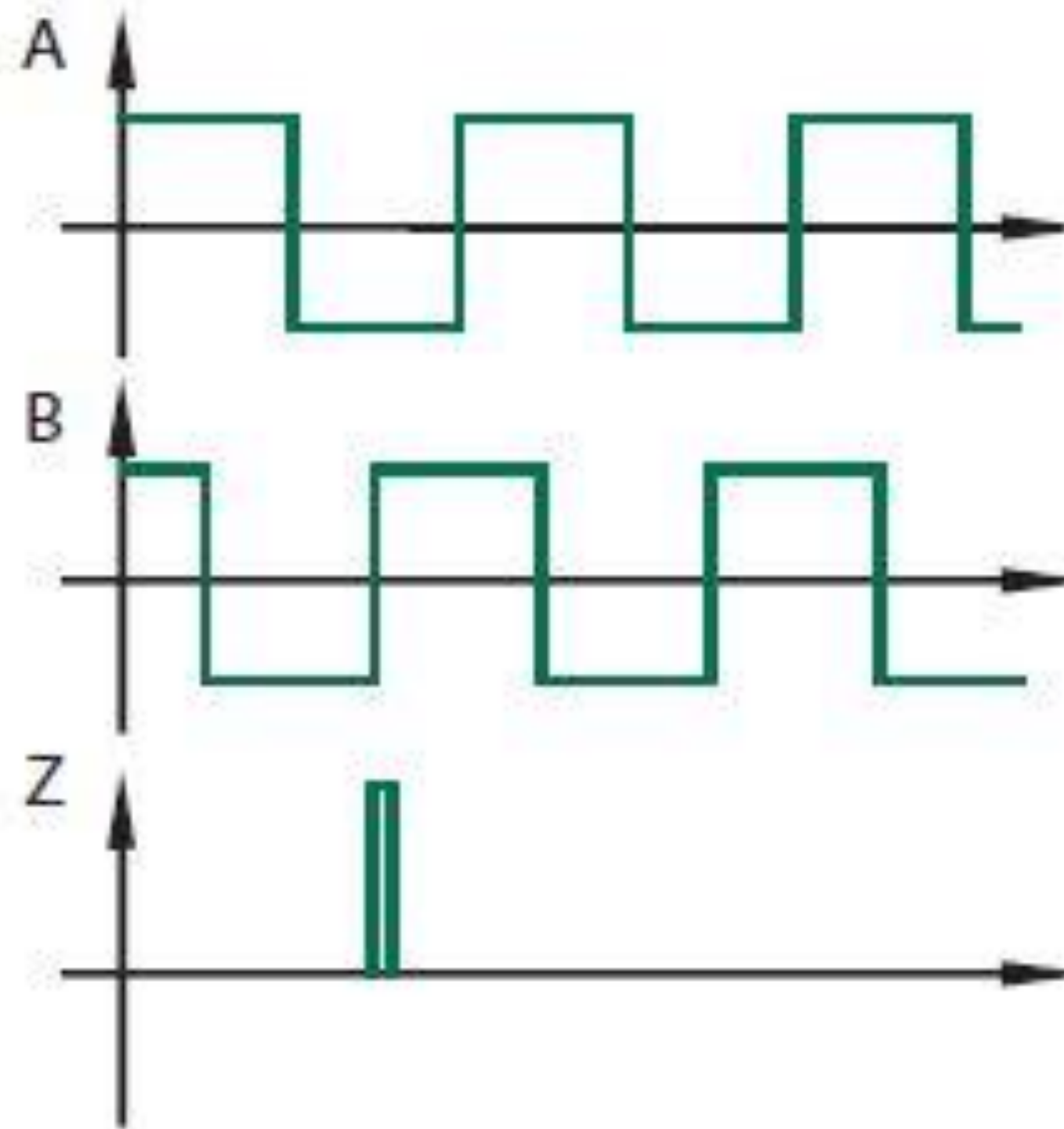
Gray Code Output



Absolute Encoder



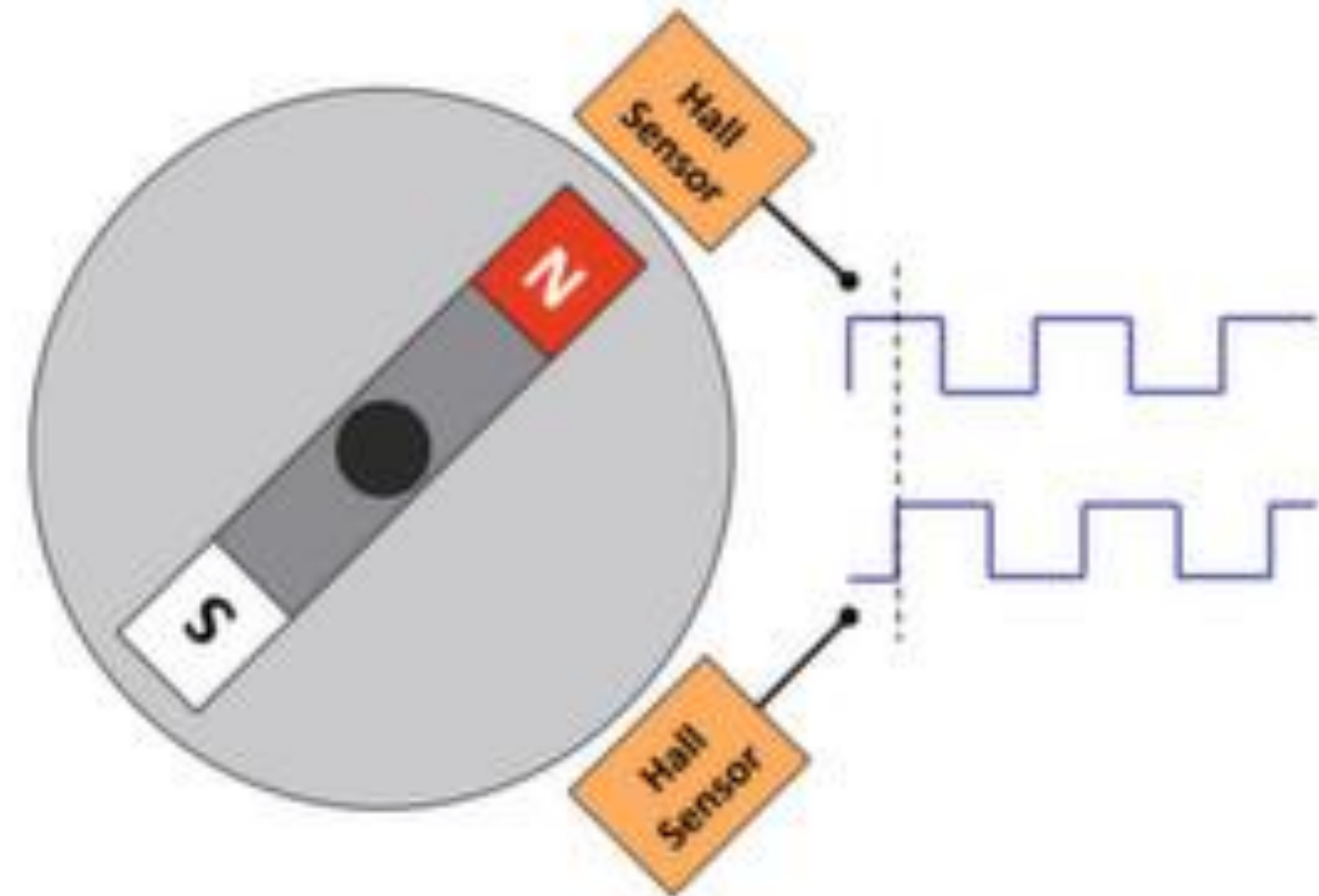
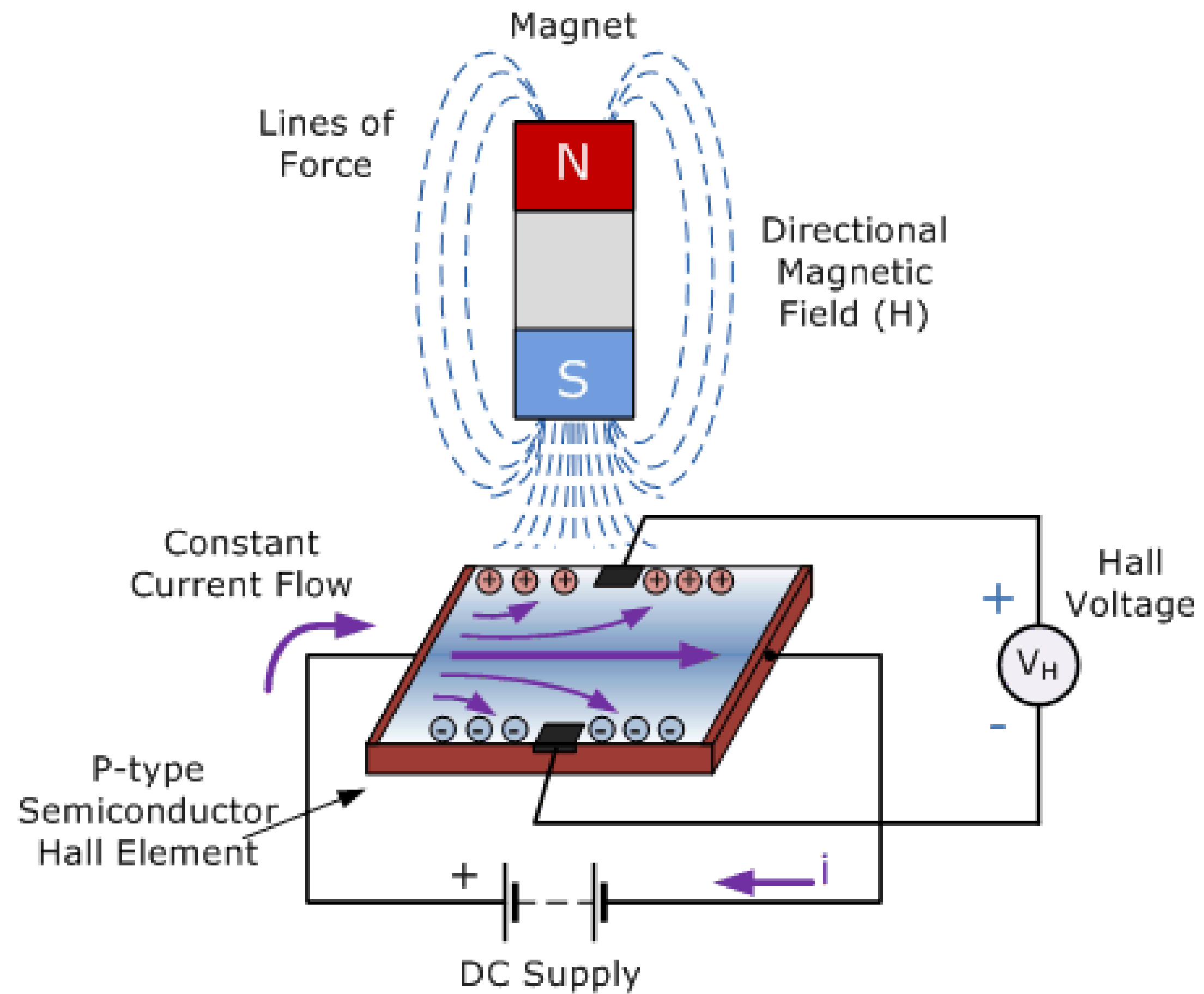
# TYPES OF ROTARY ENCODERS



Incremental Encoder



# TYPES OF ROTARY ENCODERS



Hall / Magnetic Encoder



# AGENDA

MONDAY

October 10, 2016

A stylized orange calendar icon with a white page showing the year 2016 in grey text.

☒ Importance of Encoders

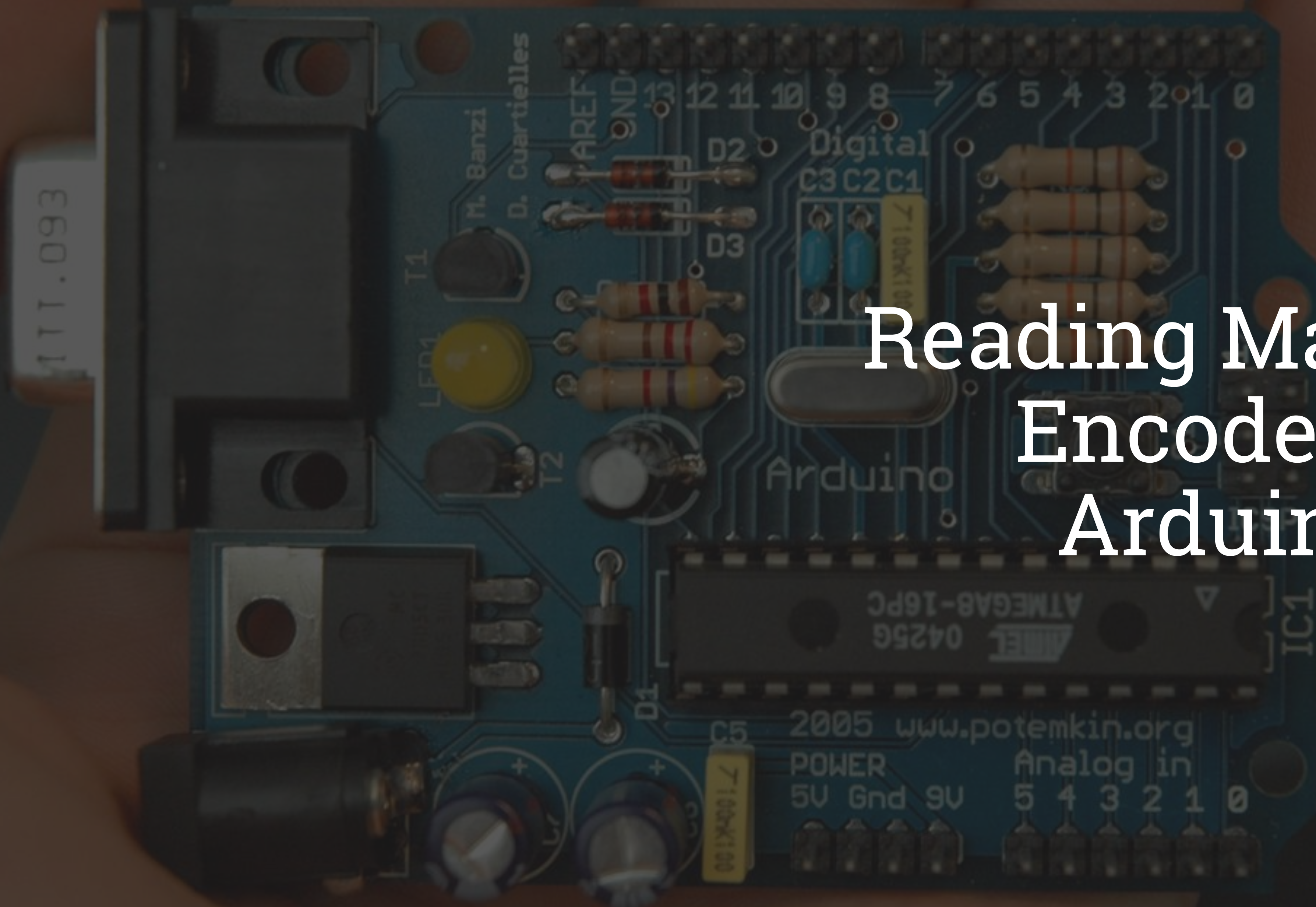
☒ Types of Encoders

☒ Reading 2-Channels Magnetic Encoder

**let's get into code**

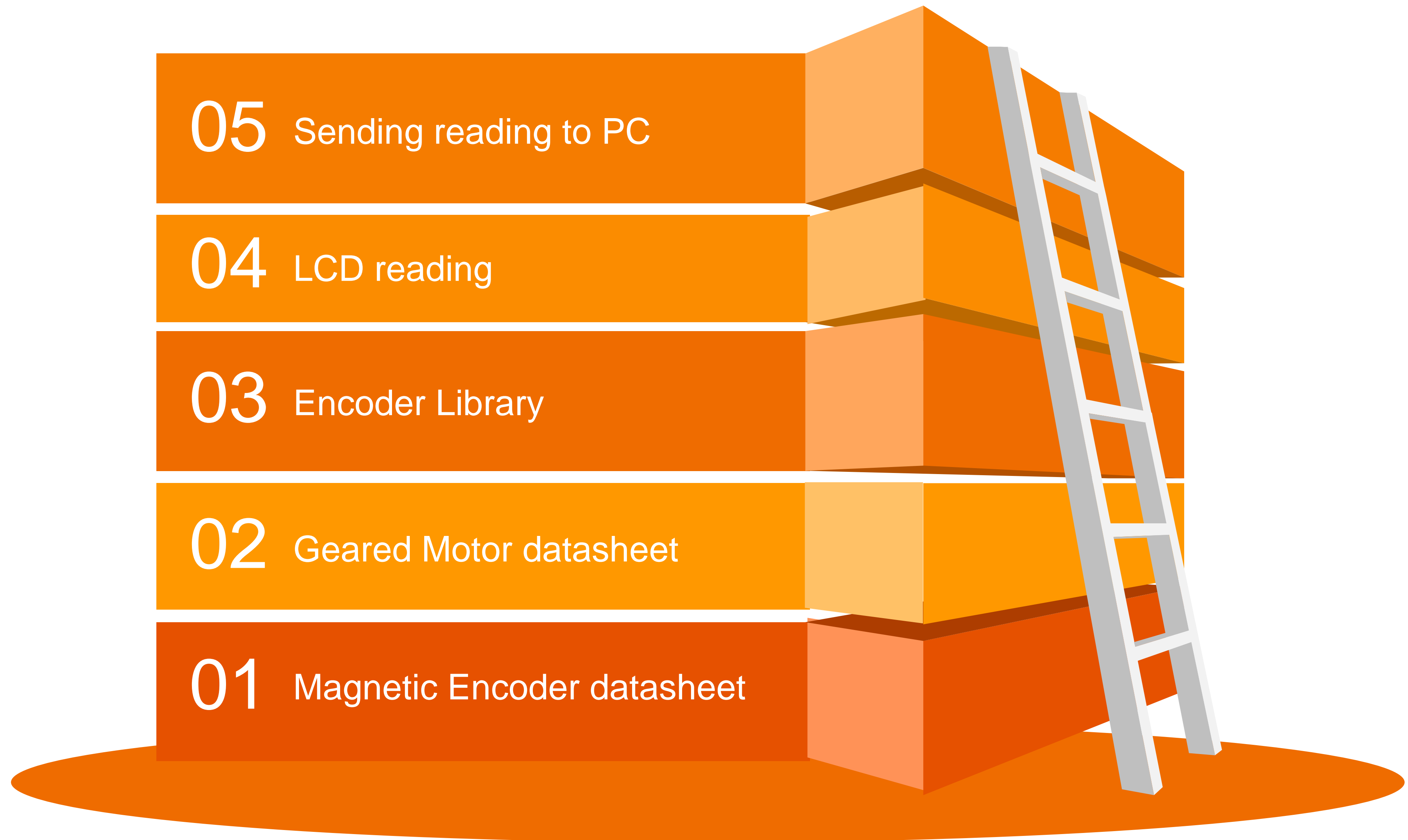


# Reading Magnetic Encoder using Arduino UNO



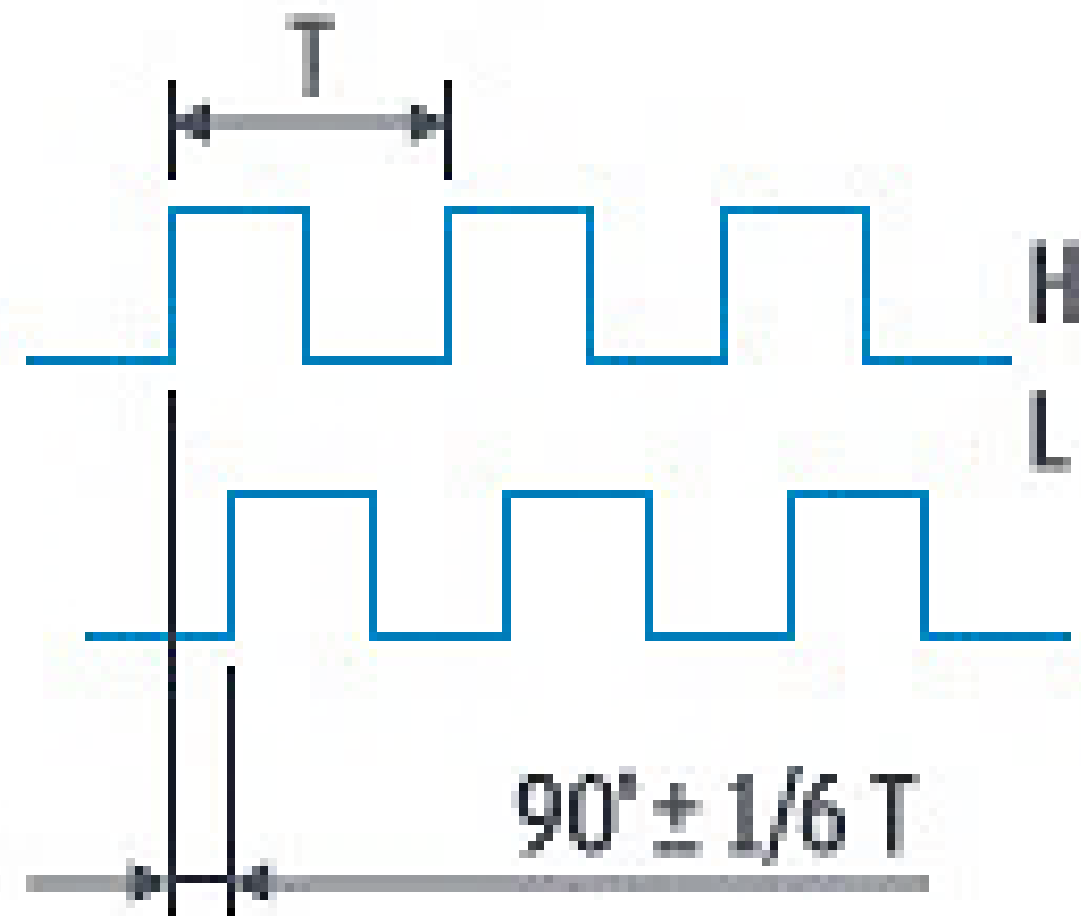


# LEARNING PLAN





# MAGNETIC ENCODER



## Two Channel Encoder Connections

1. Black : - Motor
2. Red : + Motor
3. Brown : Hall Sensor Vcc
4. Green : Hall Sensor GND
5. Blue : Hall Sensor A Vout
6. Purple : Hall Sensor B Vout

## Magnetic Encoder

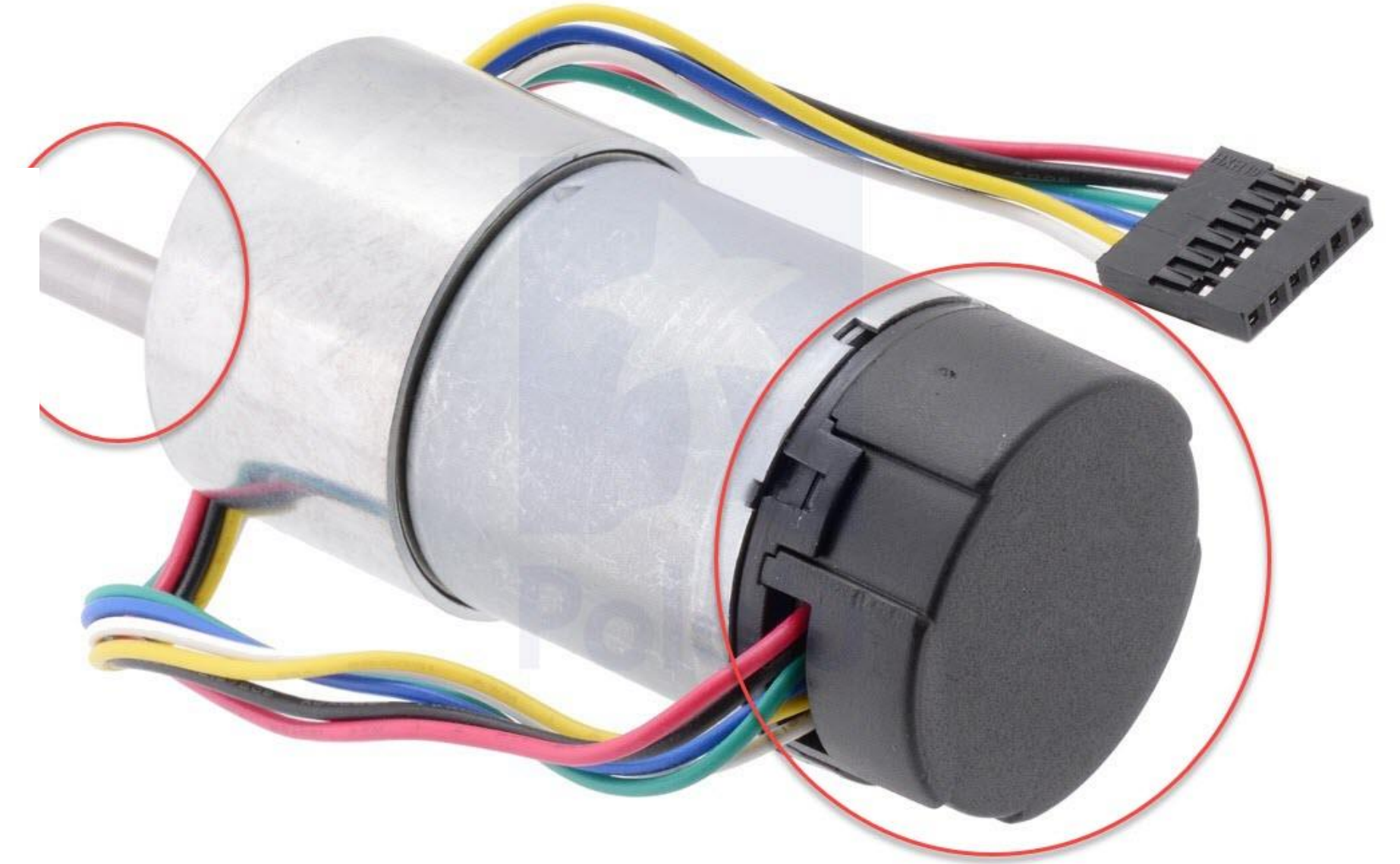
- 3.3 V – 20 V
- 2-Channels
- 6 poles

What's the number of pulses per revolution / channel?

Can we increase the encoder resolution? XOR?

# GEARED DC MOTOR

3. Mechanical characteristic	
3.1 Reduction ratio	1/19.225



## Advantages of Gear Reduction

- Boosting torque.
- Enhancing encoder resolution

*Resolution ?*

$$\text{Encoder (PPR)} = 6 (\text{poles}) \times 2 (\text{channels}) \times 19 \text{ Reduction Ratio}$$

*Encoder (PPR)  $\cong$  231*

*Error theoretical and practical?*

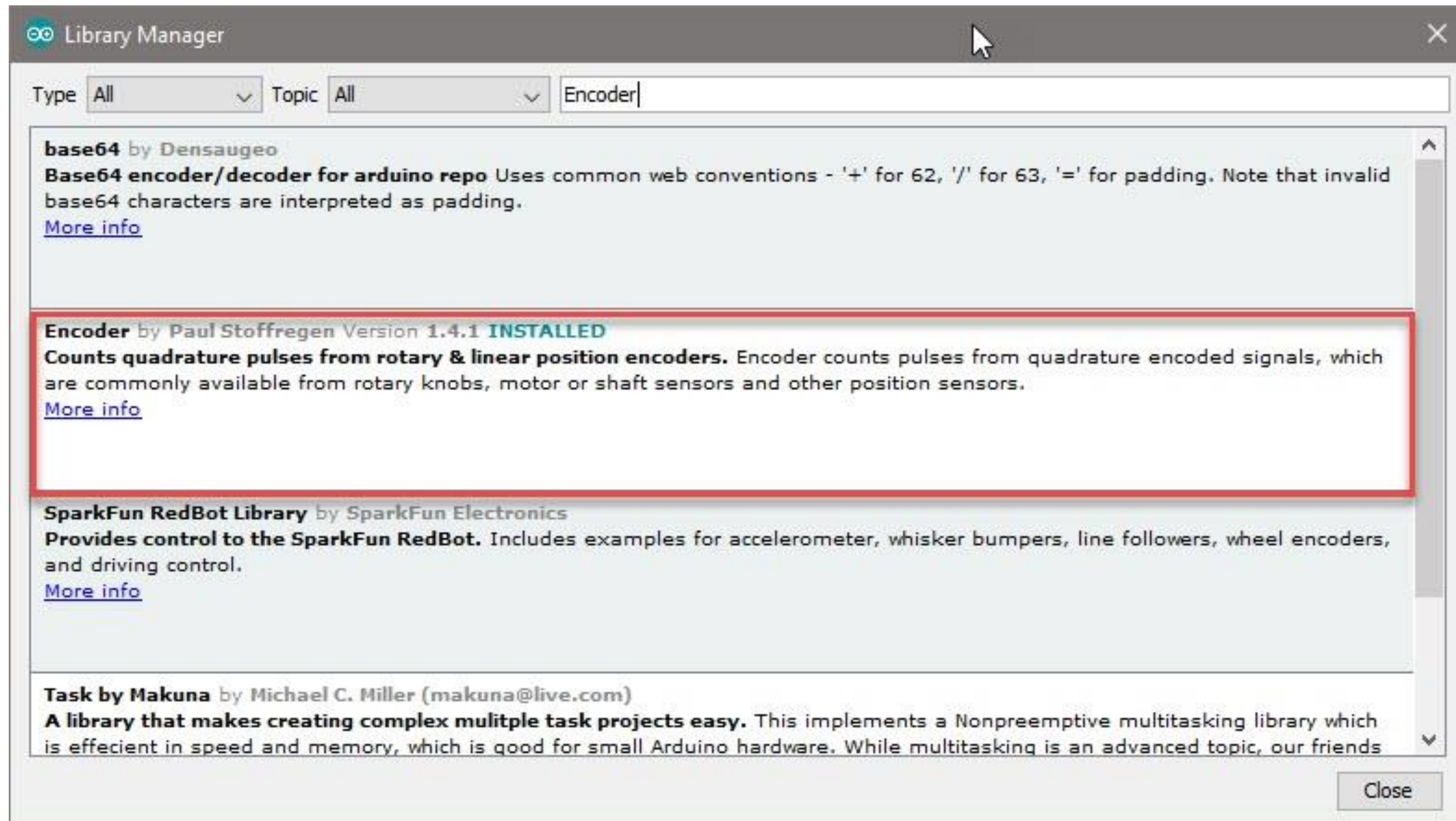




# ARDUINO ENCODER LIBRARY



# ARDUINO ENCODER LIBRARY





# ARDUINO ENCODER COMMANDS

```
#include <Encoder.h>
```

Encoder library

```
const int encaPin=2;  
const int encbPin=3;
```

encoder channels on  
interrupt pins. *why?*

Create encoder object

```
Encoder myEnc(encbPin, encaPin); // for high performance  
void setup()
```

# ARDUINO ENCODER COMMANDS

```
void loop()
```

```
{
```

```
int newPosition = myEnc.read(); // Reading encoder position
```

```
myEnc.write(0);
```

Reset counter after each  
revolution

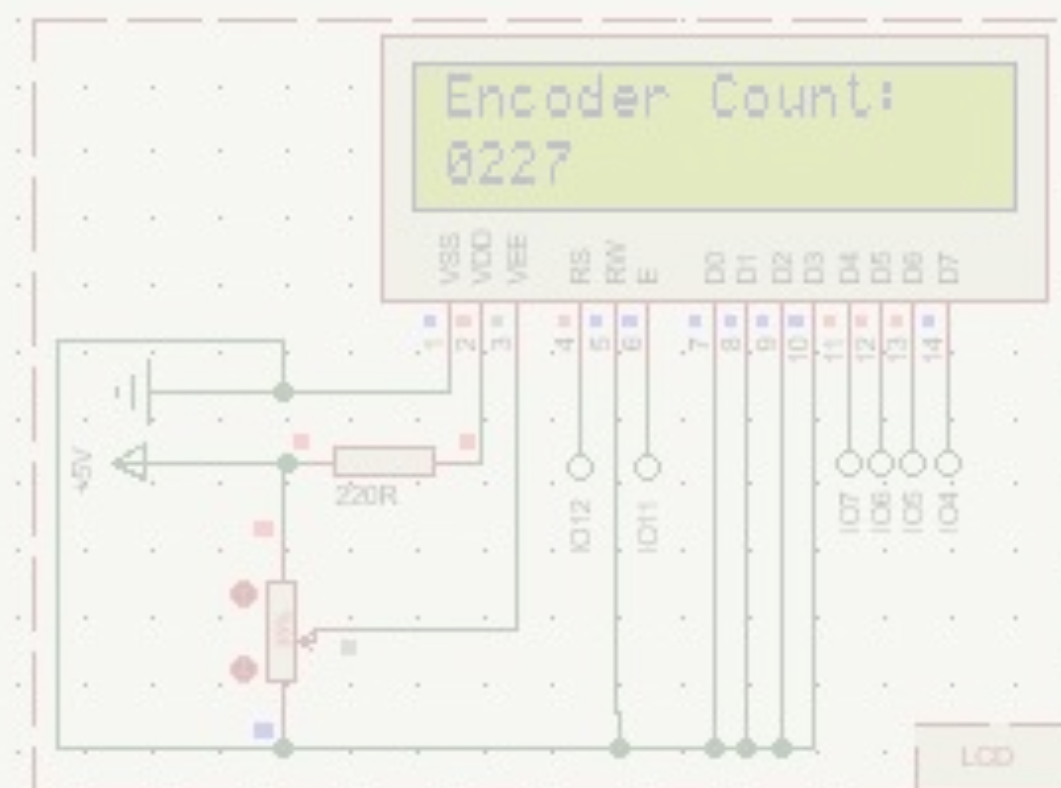
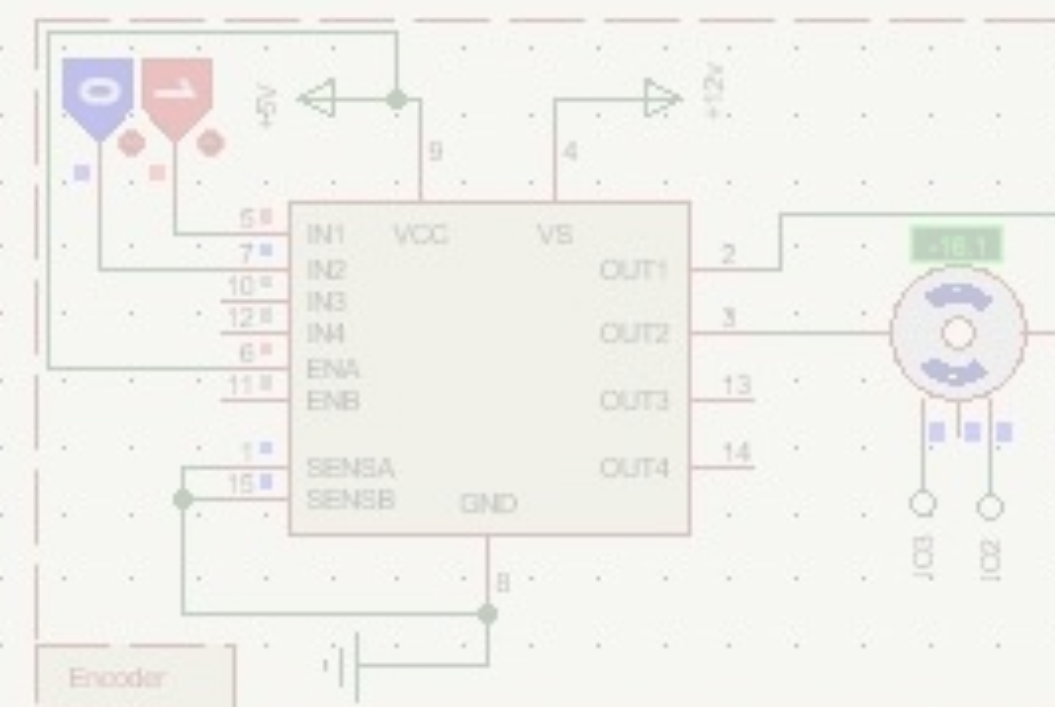
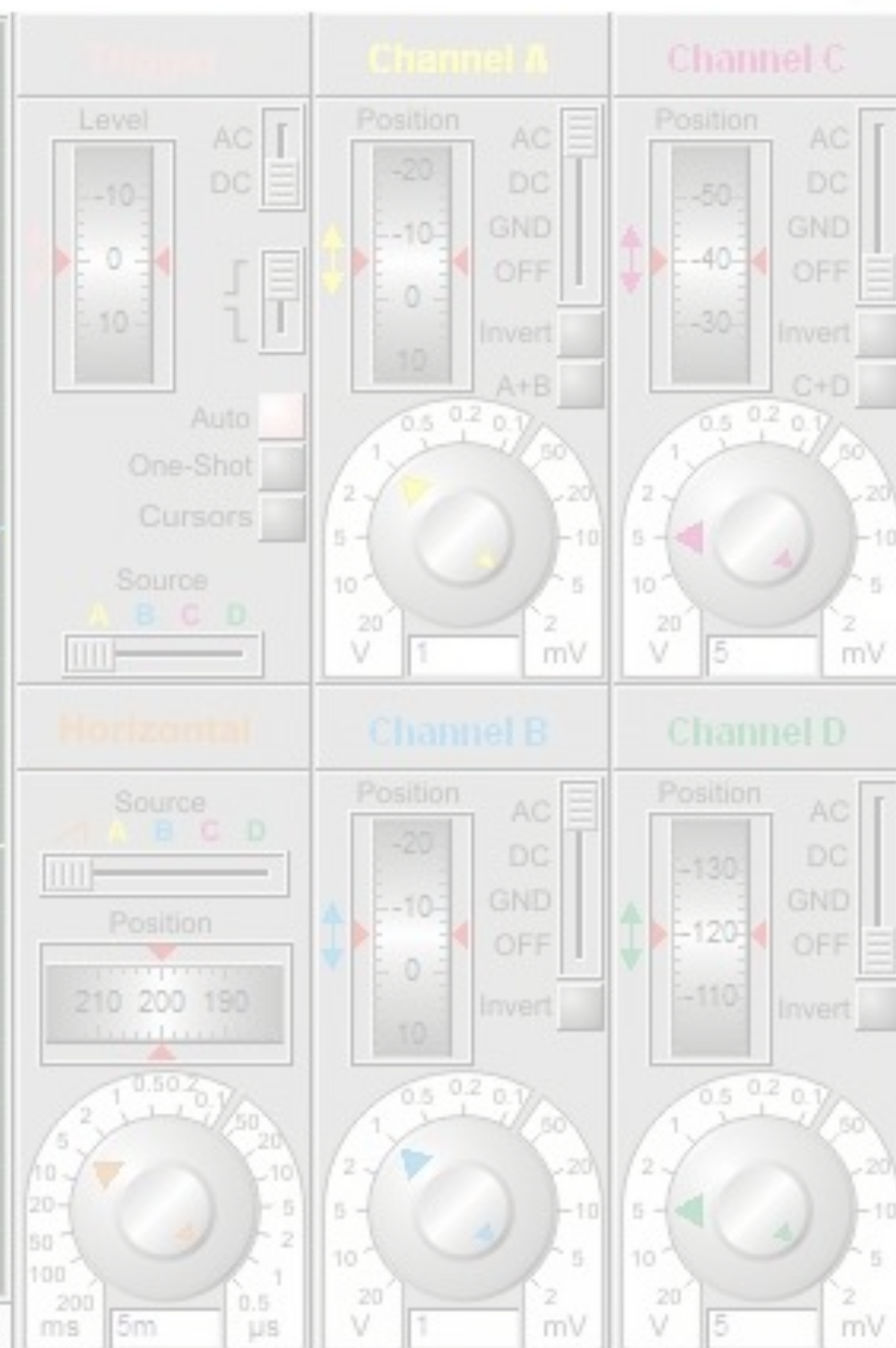
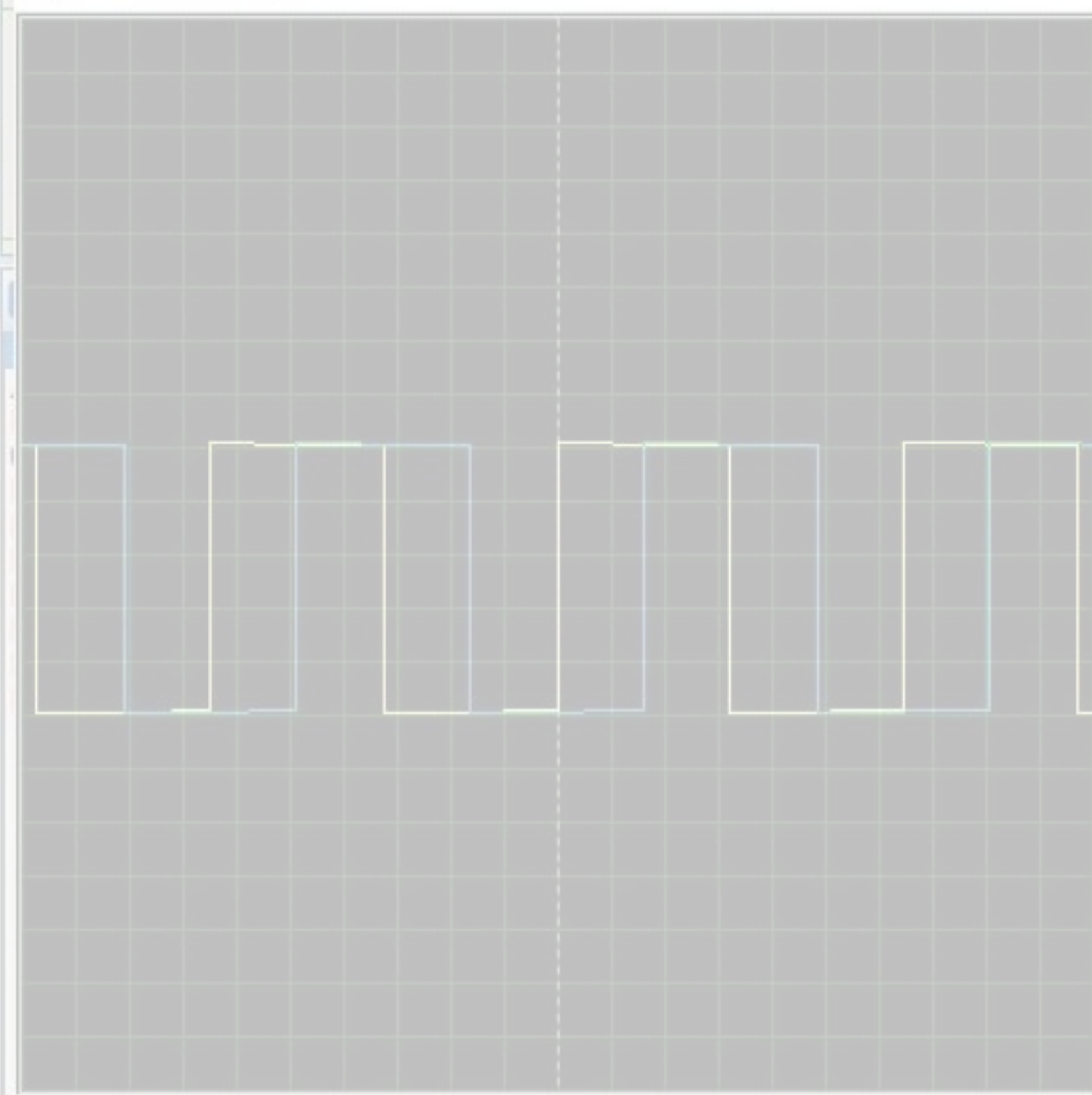
Read encoder count  
(counter running in background)  
(ISR)

```
}
```





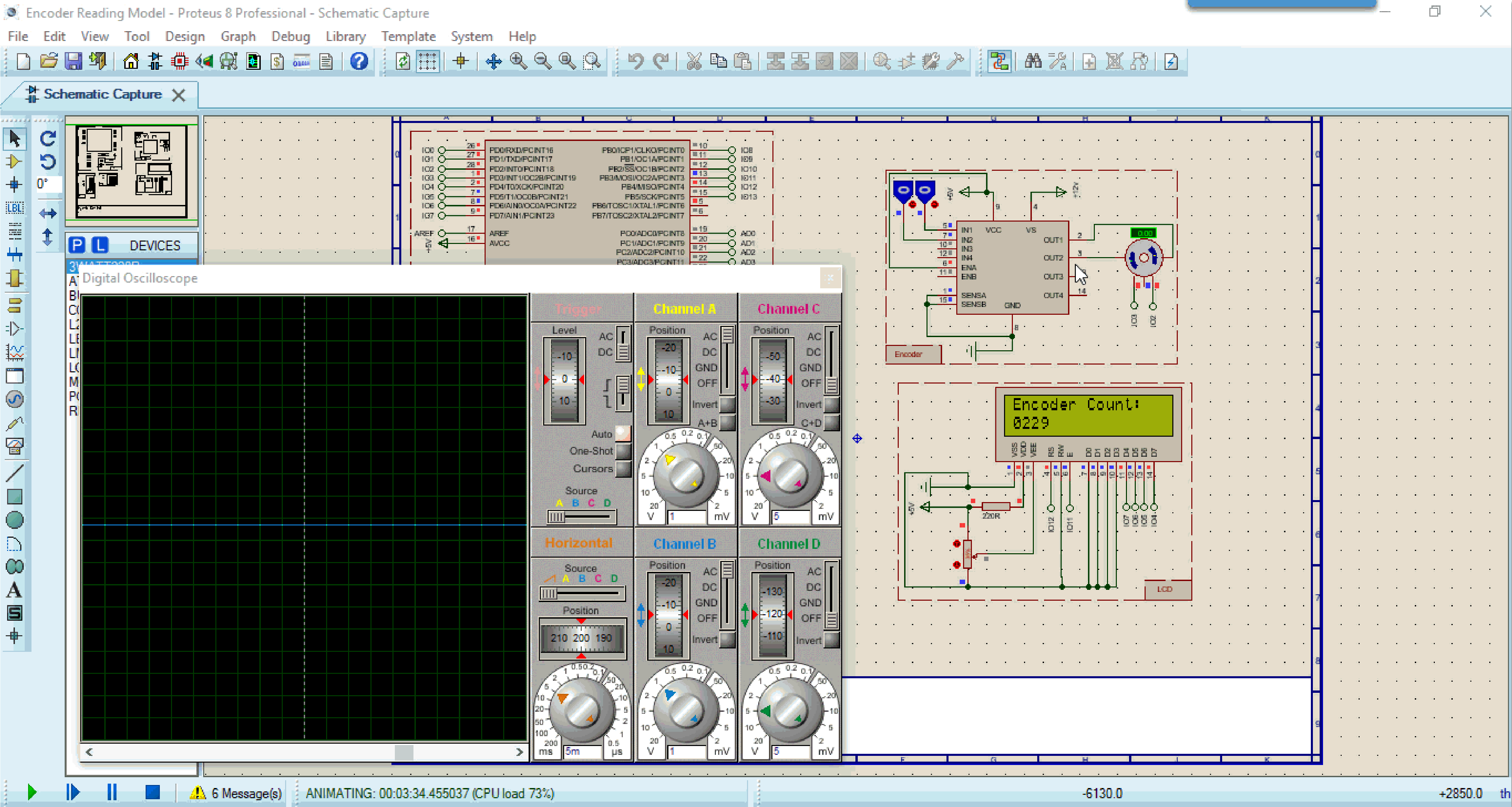
# SEE IT IN ACTION



Hybrid Control  
Reading Optical Encoder

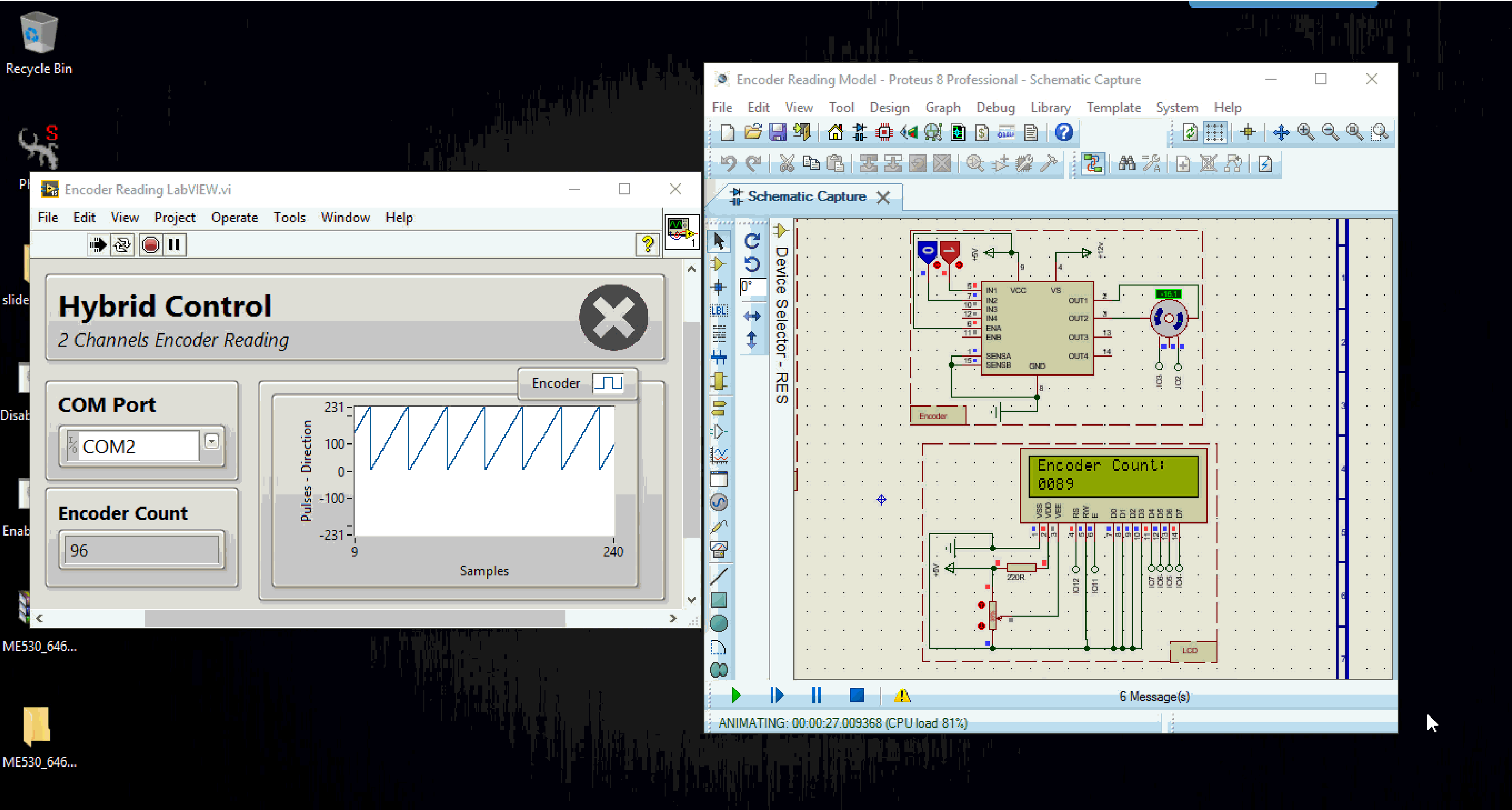


# ENCODER READING EMBEDDED





# Data Streaming to Another Device (PC)




Getting Lab Files


**github**  
**SOCIAL CODING**



# Create GitHub account

← → ↻ 🏠 **GitHub, Inc. [US] | https://github.com** ☆ 

📱 Apps 🌐 MUST Intranet 📄 Humanoid Robot Lab 📁 Engineering 📁 Premium



## How people build software

Millions of developers use GitHub to build personal projects, support their businesses, and work together on open source technologies.

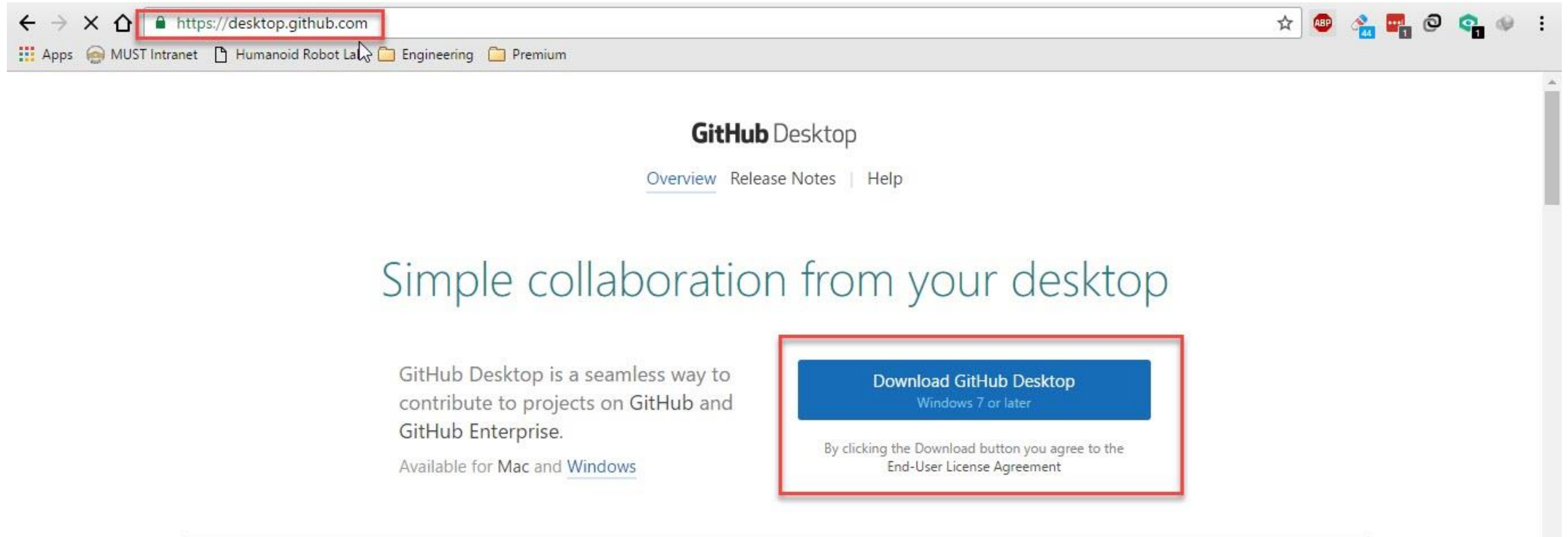
Use at least one letter, one numeral, and seven characters.

**Sign up for GitHub**

By clicking "Sign up for GitHub", you agree to our [terms of service](#) and [privacy policy](#). We'll occasionally send you account related emails.



# DOWNLOAD GITHUB DESKTOP





# GO TO

## <https://github.com/wbadry/MCT432-Hybrid-Control>

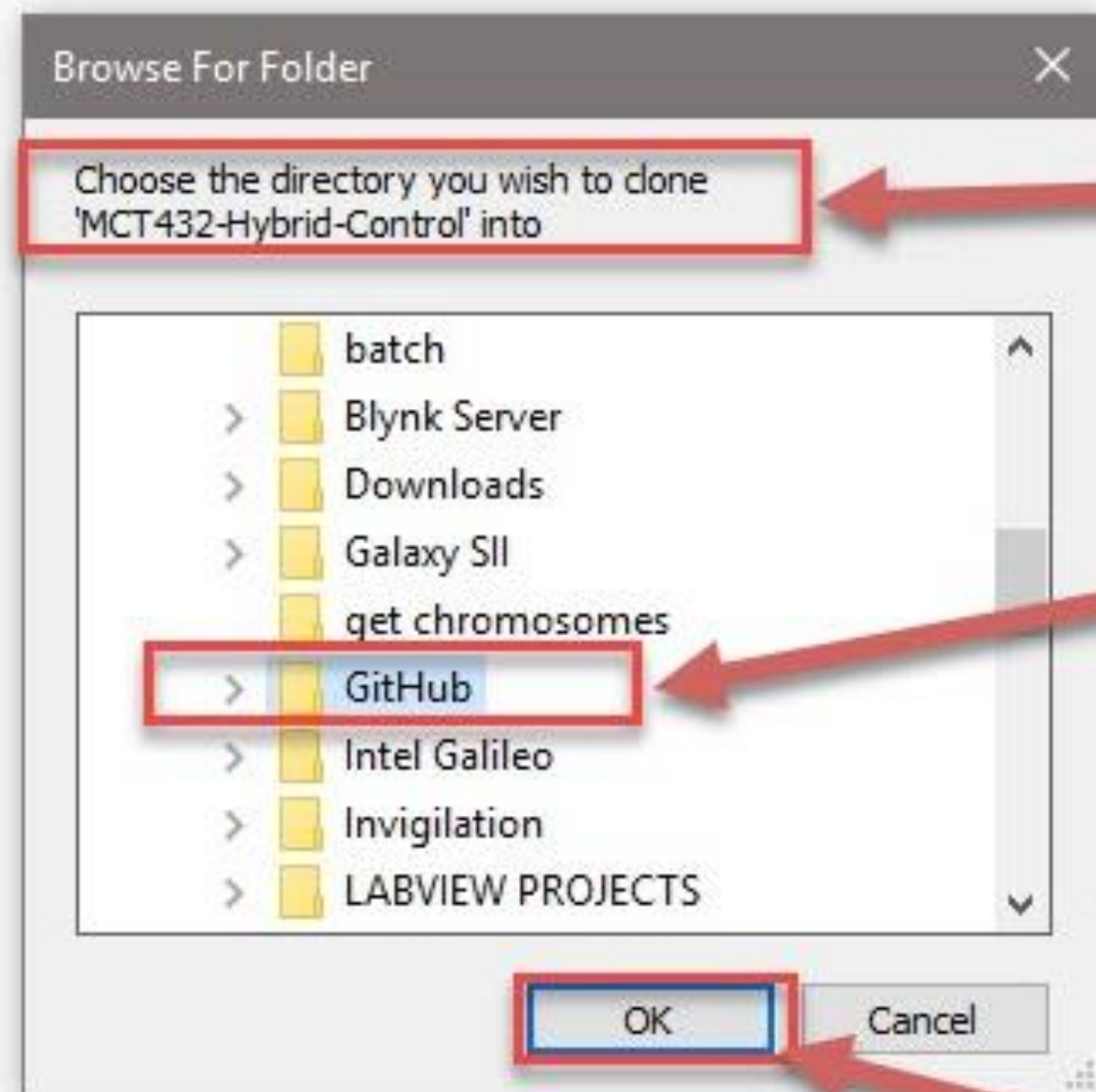
The screenshot shows the GitHub repository page for `wbadry / MCT432-Hybrid-Control`. The page is annotated with three red circles and numbers:

- 1**: Points to the browser's address bar, which contains the URL `https://github.com/wbadry/MCT432-Hybrid-Control`.
- 2**: Points to the **Clone or download** button in the repository header.
- 3**: Points to the **Open in Desktop** button in the clone dropdown menu.

The repository page displays the following information:

- Repository name: `wbadry / MCT432-Hybrid-Control` (Private)
- Unwatch: 1, Star: 0, Fork: 0
- Code, Issues (0), Pull requests (0), Projects (0), Wiki, Pulse, Graphs, Settings
- Repository description: Repository for lab presentations and exercises — Edit
- 2 commits, 1 branch, 0 releases, 1 contributor
- Branch: master, New pull request
- Create new file, Upload files, Find file, Clone or download
- Clone with HTTPS (selected), Use SSH
- Use Git or checkout with SVN using the web URL.
- URL: `https://github.com/wbadry/MCT432-Hybrid-Co`
- Open in Desktop (selected), Open in Visual Studio, Download ZIP
- Commit history: wbadry committed on GitHub Update README.md
- Files: README.md (Update README.md)
- Repository title: MCT432-Hybrid-Control
- Repository description: Repository for lab presentations and exercises

# SAVE IT ON YOUR LOCAL FOLDER



Cloned repository

Local folder

Repository selected

Click "OK"



# SYNC TO GET NEW FILES

The screenshot shows the GitHub web interface for the repository 'MCT432-Hybrid-Control'. The repository is selected in the left sidebar. The main area shows the 'master' branch with a 'Sync' button highlighted by a red box. A red arrow points from the 'Sync' button to a red text box that says 'Click to update when new contents are available'.

Filter repositories

- blynk-server
- CircularProgressBar
- LabVIEW-Courseware
- MATLAB-Control
- MCT-371-Automatic-Control
- MCT432-Hybrid-Control**
- MTE504-Mechatronics-II
- Project-NAO-Control
- SimpleTimer

Compare ▾

master

Update README.md  
4 hours ago by Waleed El-Badry

Initial commit  
4 hours ago by Waleed El-Badry

Update README.md  
Waleed El-Badry 630a6ac

GitHub Revert Collapse all

▼ README.md

...	...	@@ -1,2 +1,5 @@
1	1	# MCT432-Hybrid-Control
2	2	Repository for lab presentations and exercises
	3	+
	4	+ # 10-October-2016
	5	+ Lab 1 was added with Proteus, LabVIEW and Arduino files for reading 2 channels encoder.

Click to update when new contents are available

# COURSE INTERACTIVITY

The screenshot shows a web browser window displaying the GitHub repository page for 'wbadry / MCT432-Hybrid-Control'. The browser's address bar shows the URL 'https://github.com/wbadry/MCT432-Hybrid-Control/issues'. The repository name 'wbadry / MCT432-Hybrid-Control' is highlighted with a red box. The 'Issues' tab is selected, and the 'New issue' button is also highlighted with a red box. The main content area displays a message: 'For inquiries about course issue or inquiry, open new issue' in red text with a shadow effect, followed by a 'Welcome to Issues!' heading and a paragraph explaining the purpose of issues. The browser's taskbar at the bottom shows the file '2000px-GitHub.svg.png' and a 'Show all' button.

GitHub, Inc. [US] | <https://github.com/wbadry/MCT432-Hybrid-Control/issues>

Apps MUST Intranet Humanoid Robot Lab Engineering Premium

This repository Search Pull requests Issues Gist

wbadry / MCT432-Hybrid-Control Private

Unwatch 1 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Pulse Graphs Settings

Filters is:issue is:open Labels Milestones New issue

**For inquiries about course issue or inquiry,  
open new issue**

**Welcome to Issues!**

Issues are used to track todos, bugs, feature requests, and more. As issues are created, they'll appear here in a searchable and filterable list. To get started, you should [create an issue](#).

2000px-GitHub.svg.png Show all

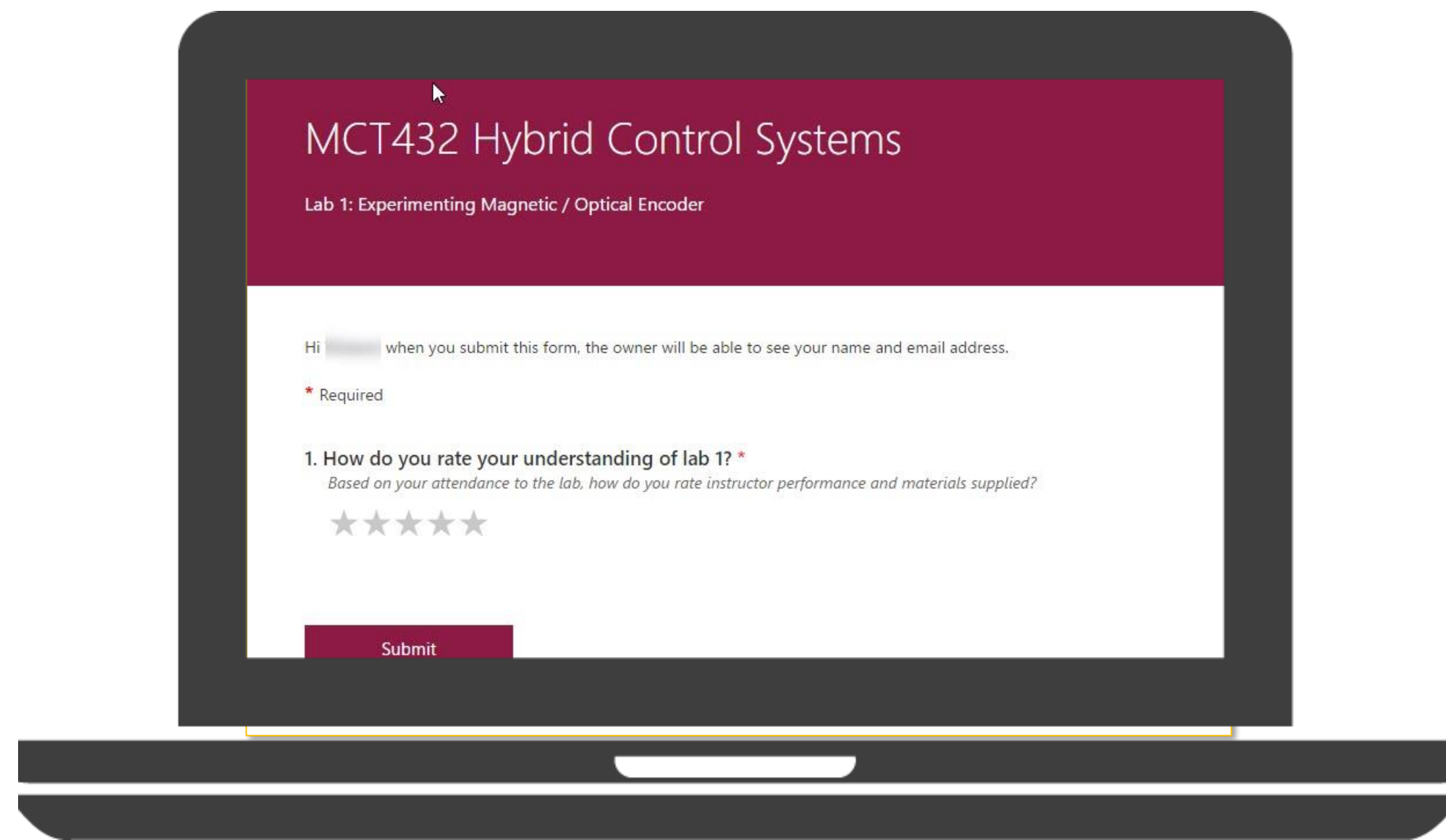


A person's hands are holding a white rectangular sign. The sign has the text "YOUR FEEDBACK MATTERS!" written in a bold, dark red, sans-serif font. The background is a blurred bokeh of various colors, including red, orange, green, and blue.

**YOUR  
FEEDBACK  
MATTERS!**



# YOUR OPINION MATTERS



LINK to rate lab 1

<https://goo.gl/H5n8BY>



THANK YOU

