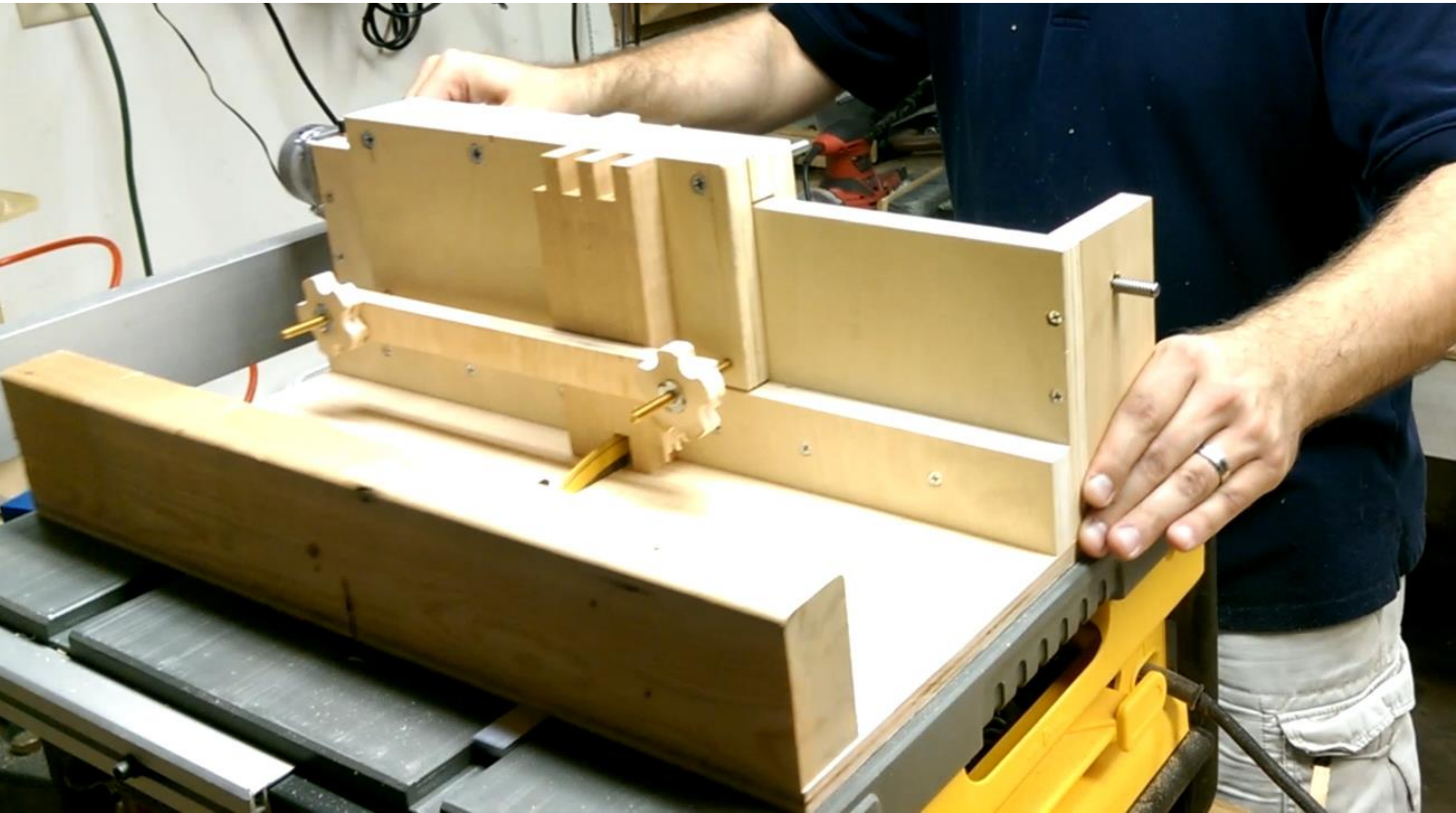
Running C# on my Table Saw

Raspberry Pi 3, .NET, and a Web Server



Ben Brandt

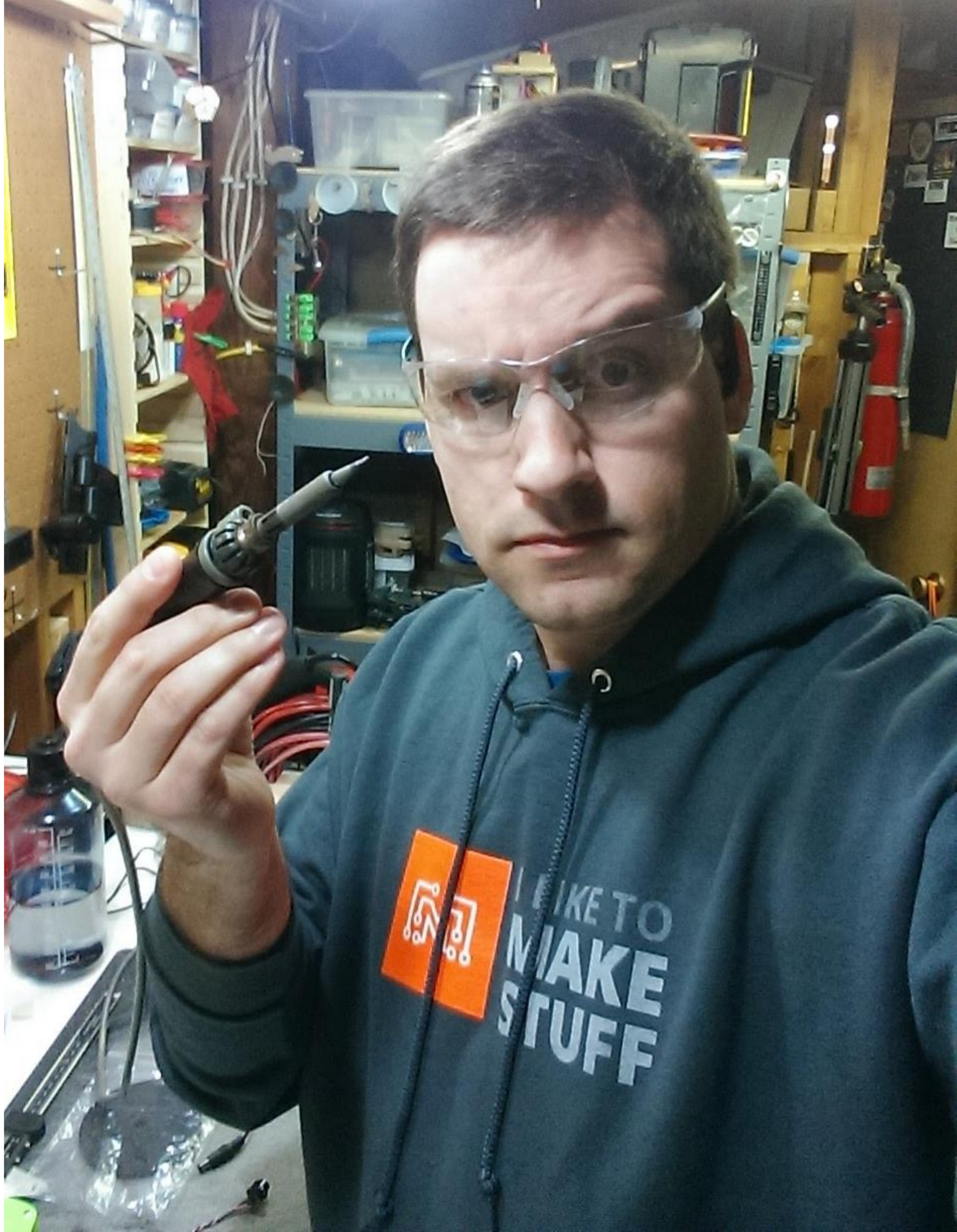
Husband & Father

Manufacturing Engineer

Microsoft Developer

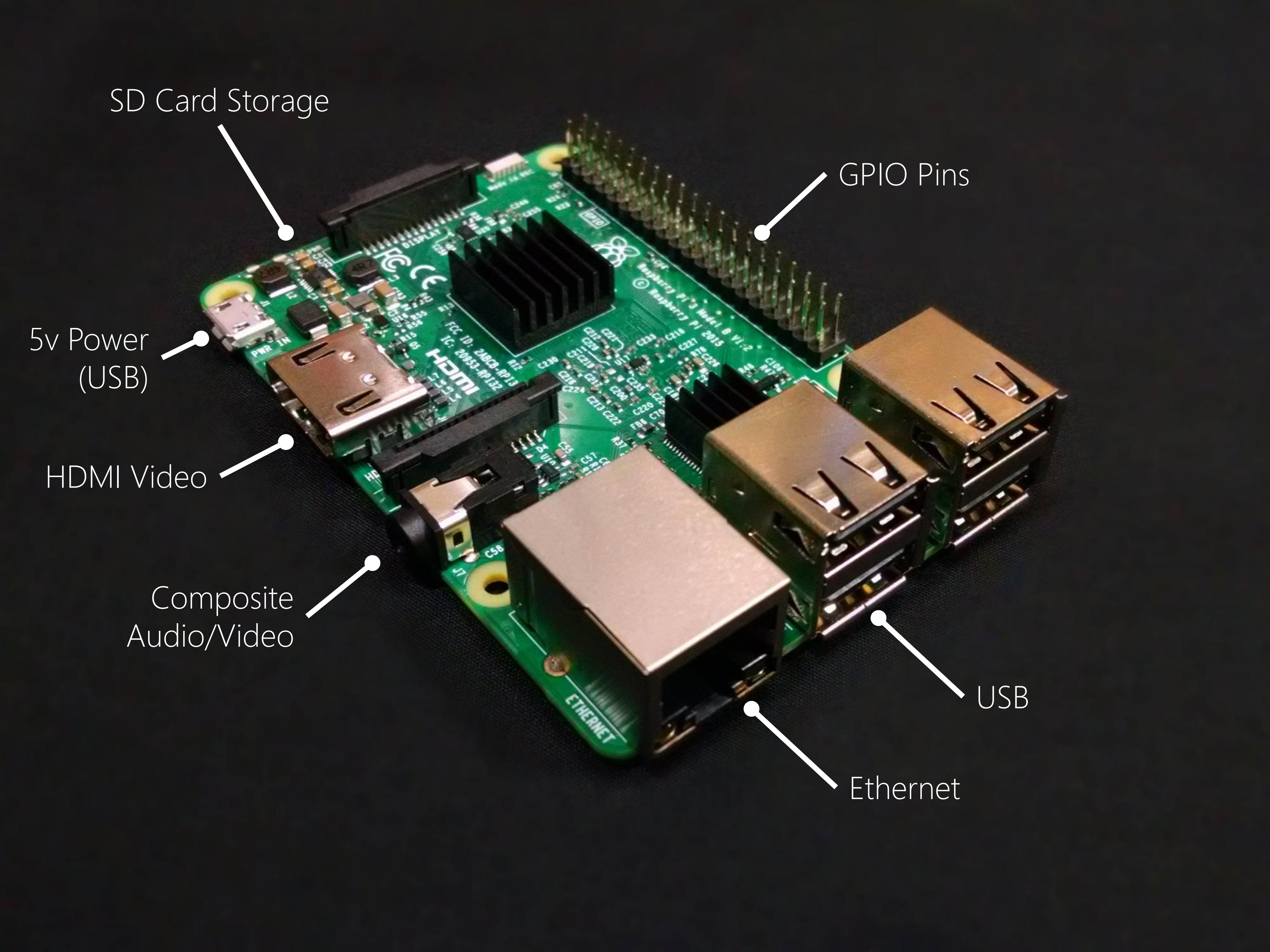
YouTube "Maker"

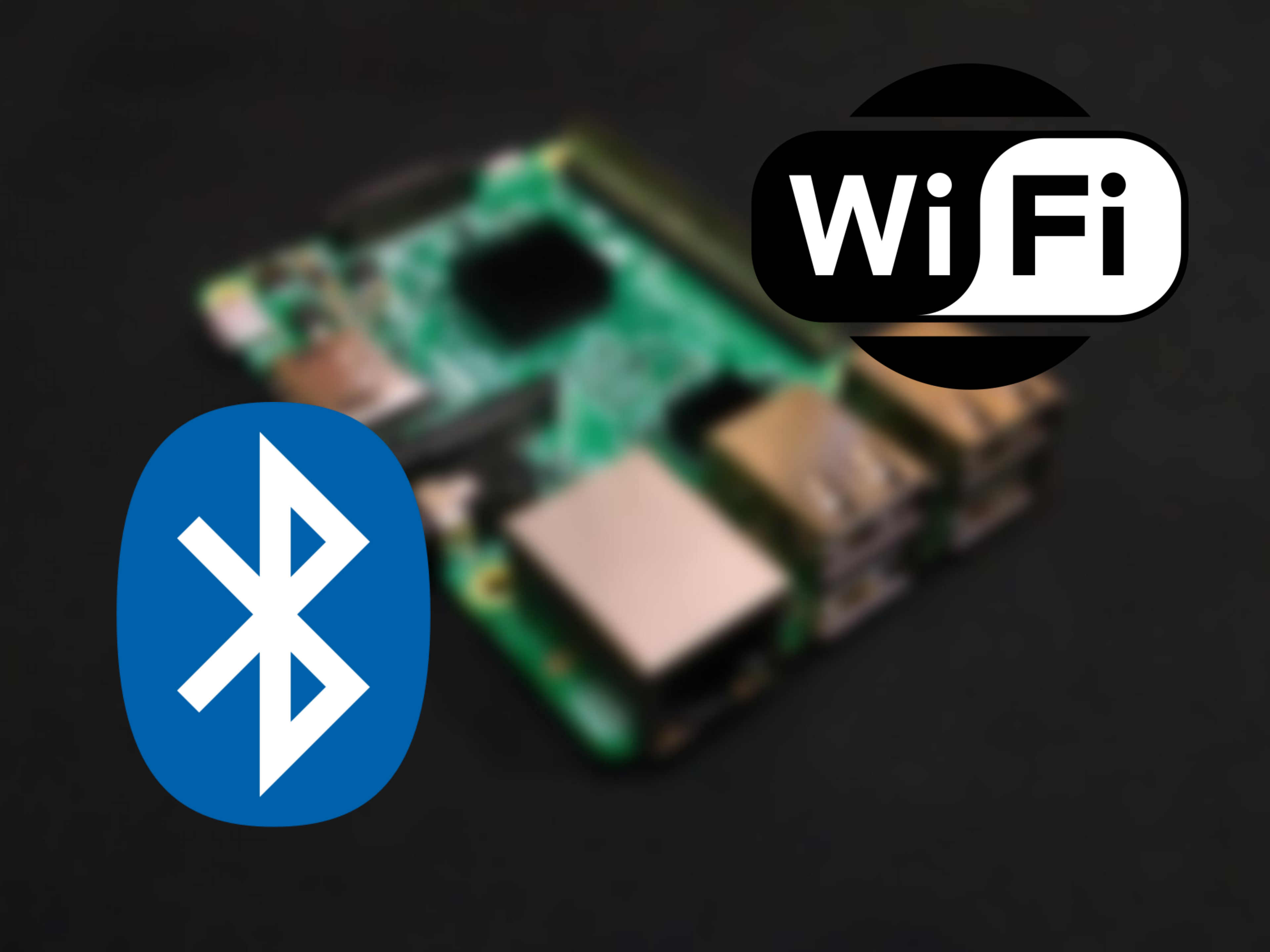
www.B2Builds.com



Raspberry Pi

DISPLAY
PWR IN
HDMI
Raspberry Pi 3 Model B V1.2
© Raspberry Pi 2015
FCC ID: 2ABCB-RPI32
IC: 20953-RPI32
ETHERNET
GPIO


SD Card Storage
GPIO Pins
5v Power (USB)
HDMI Video
Composite Audio/Video
USB
Ethernet


WiFi

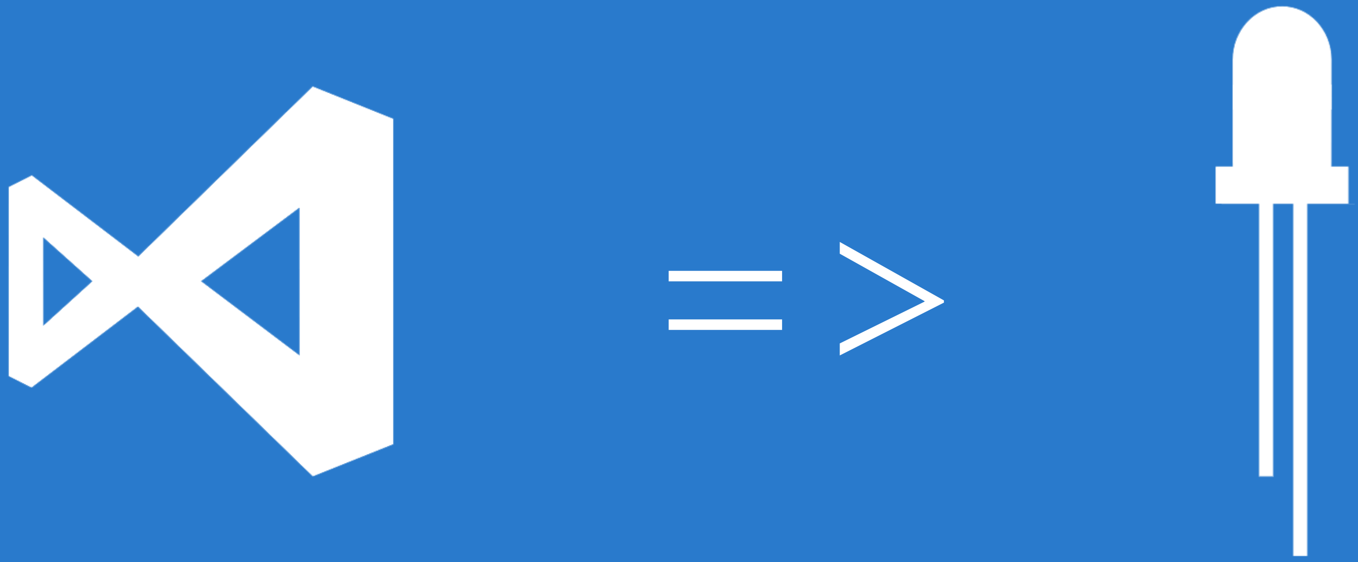
Windows on Raspberry Pi

Windows 10 IoT Core

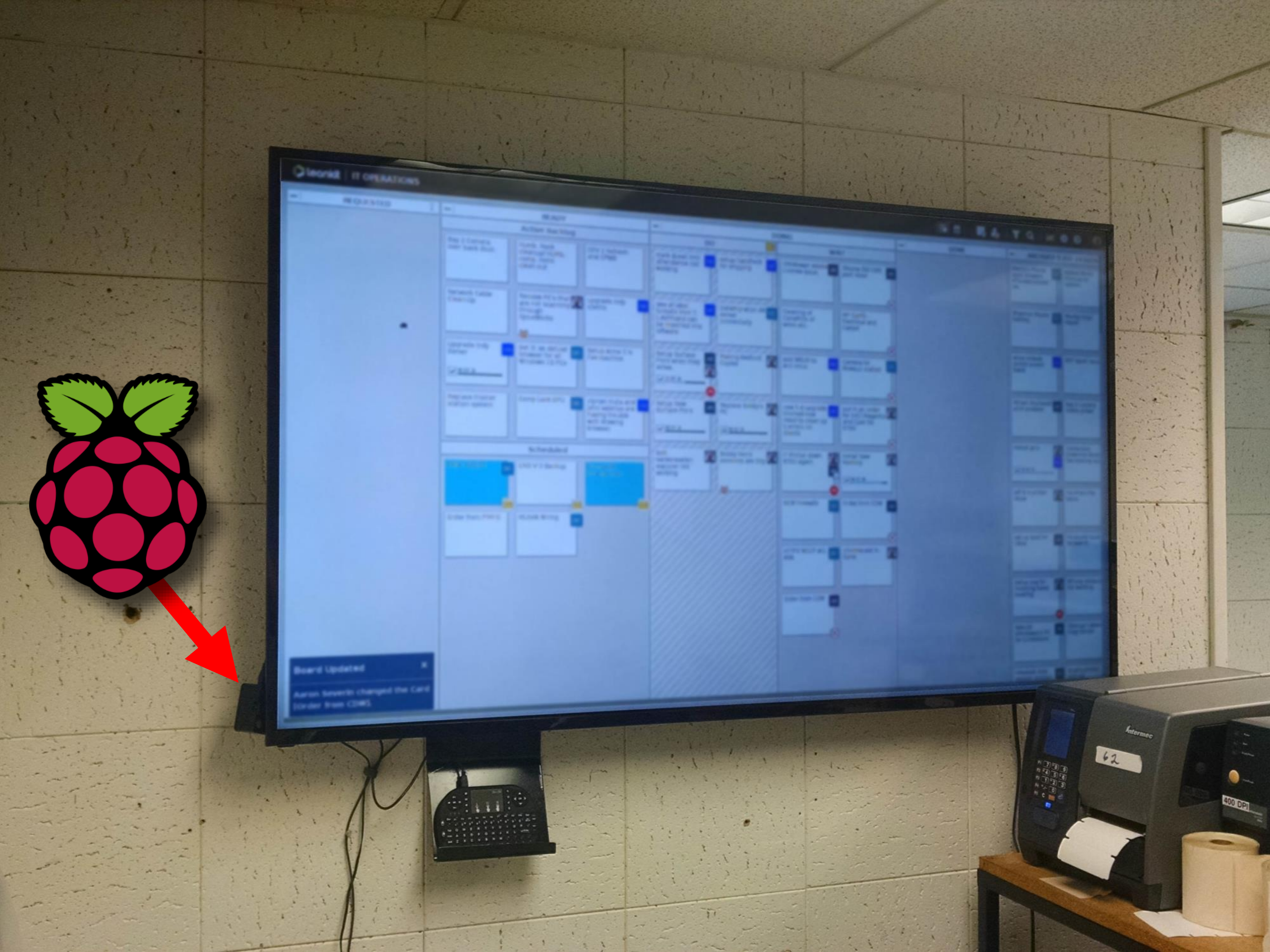
Windows 10 IoT Core

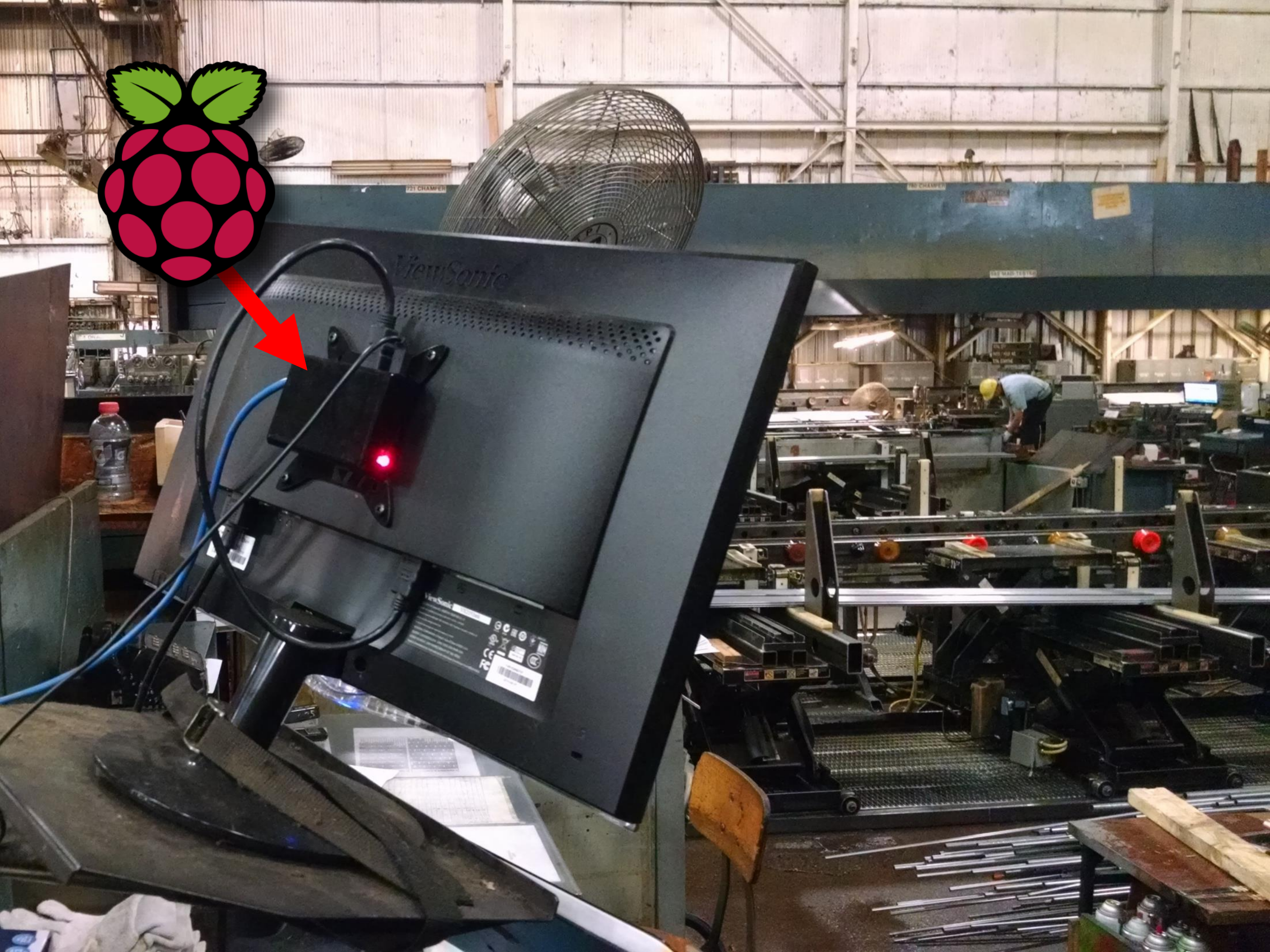
+

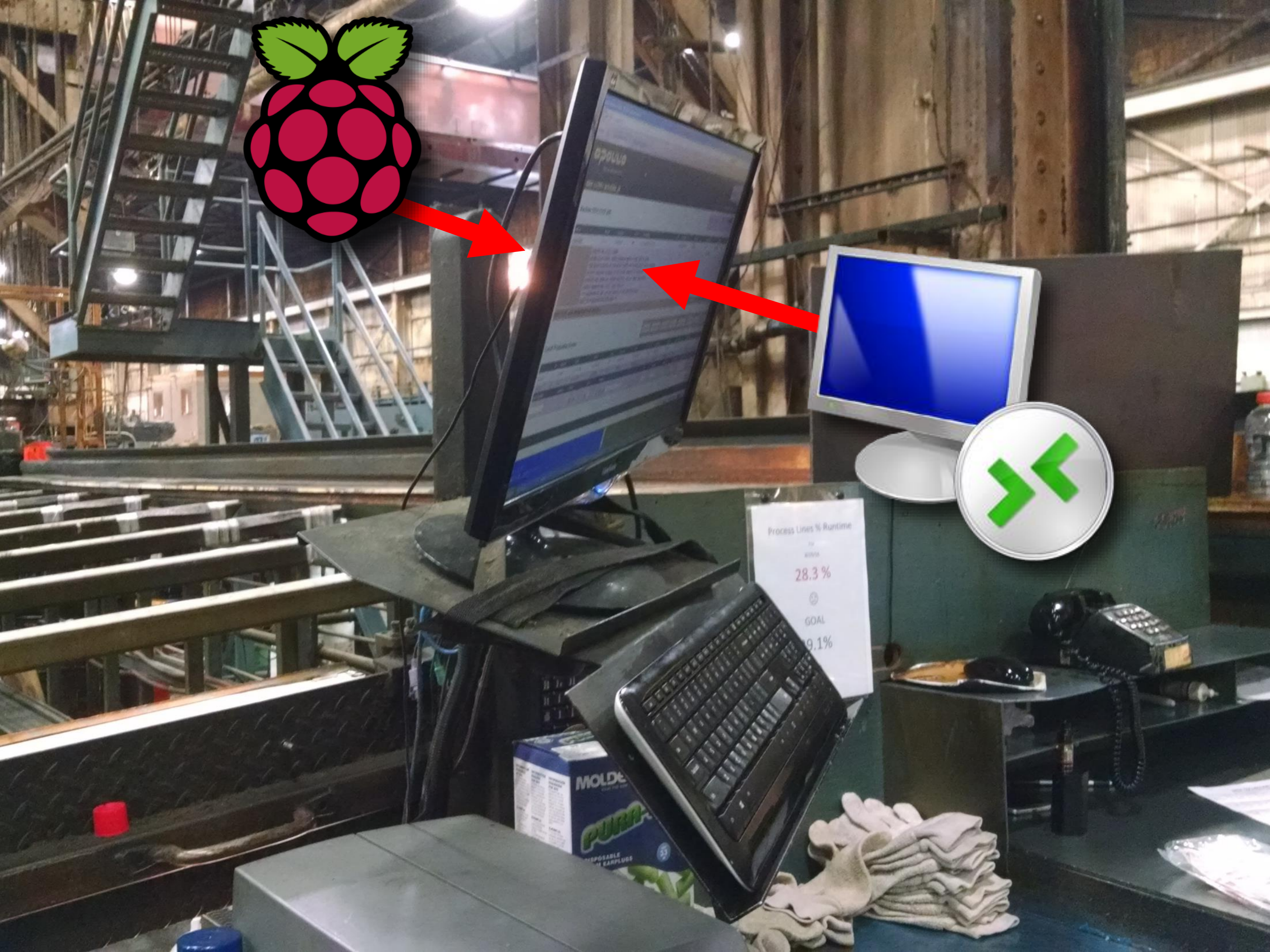
Universal Windows Platform (UWP) apps

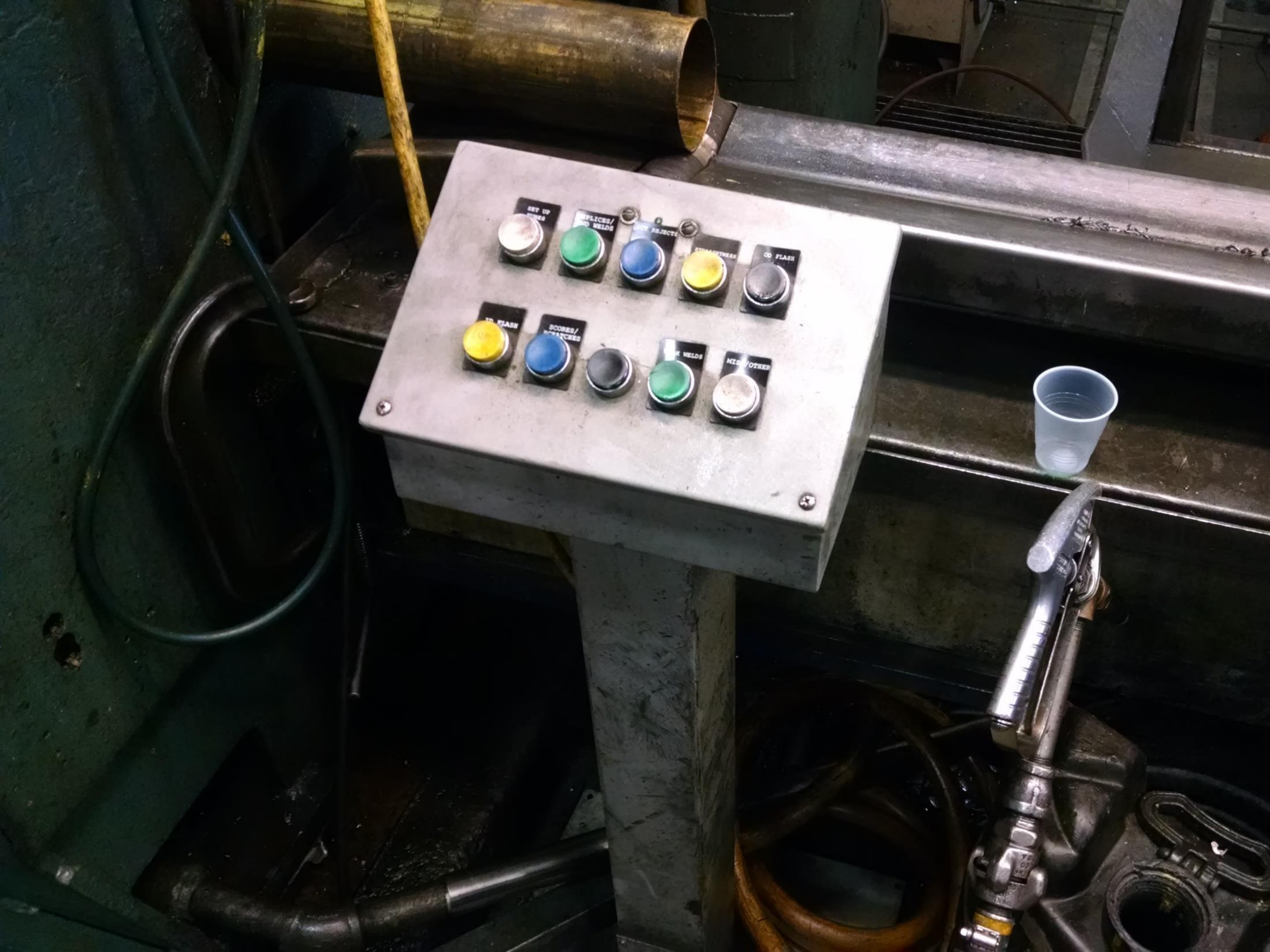


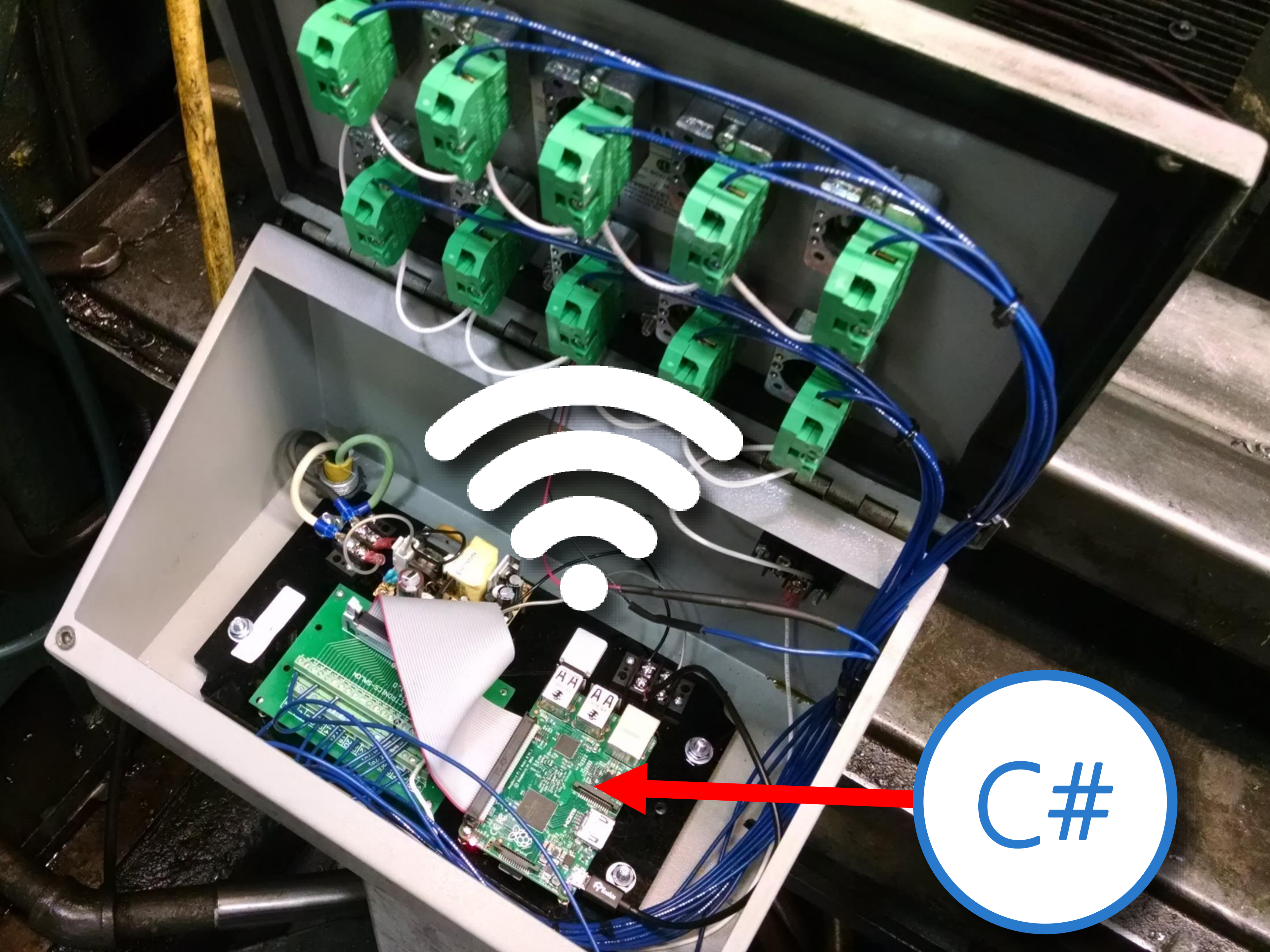
Business Applications

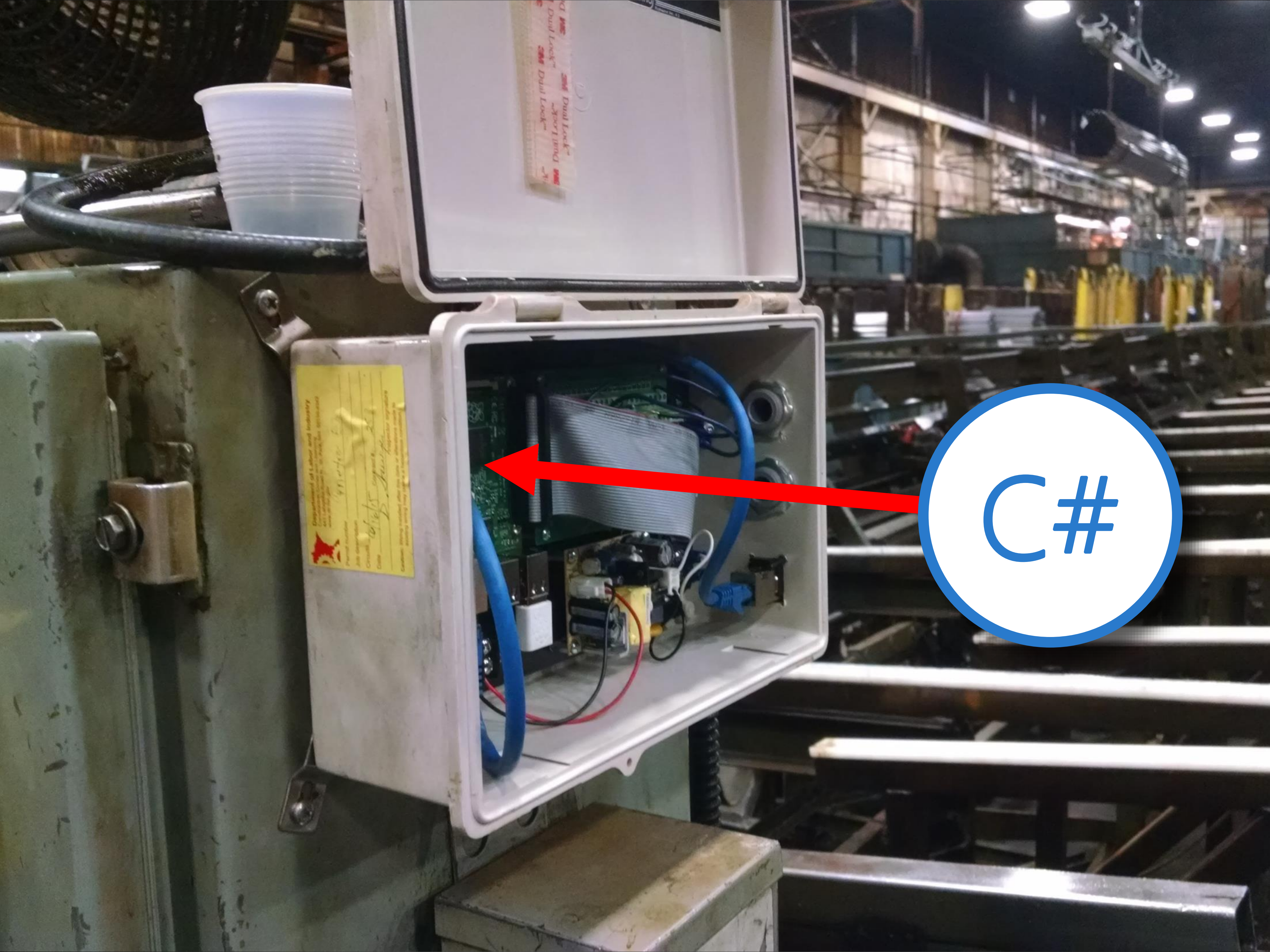

leankit | IT OPERATIONS
REQUESTED
READY
Action Backlog
Scheduled
Board Updated
Intermec
62
400 DPI


ViewSonic


Process Lines % Runtime
28.3 %
GOAL
9.1%

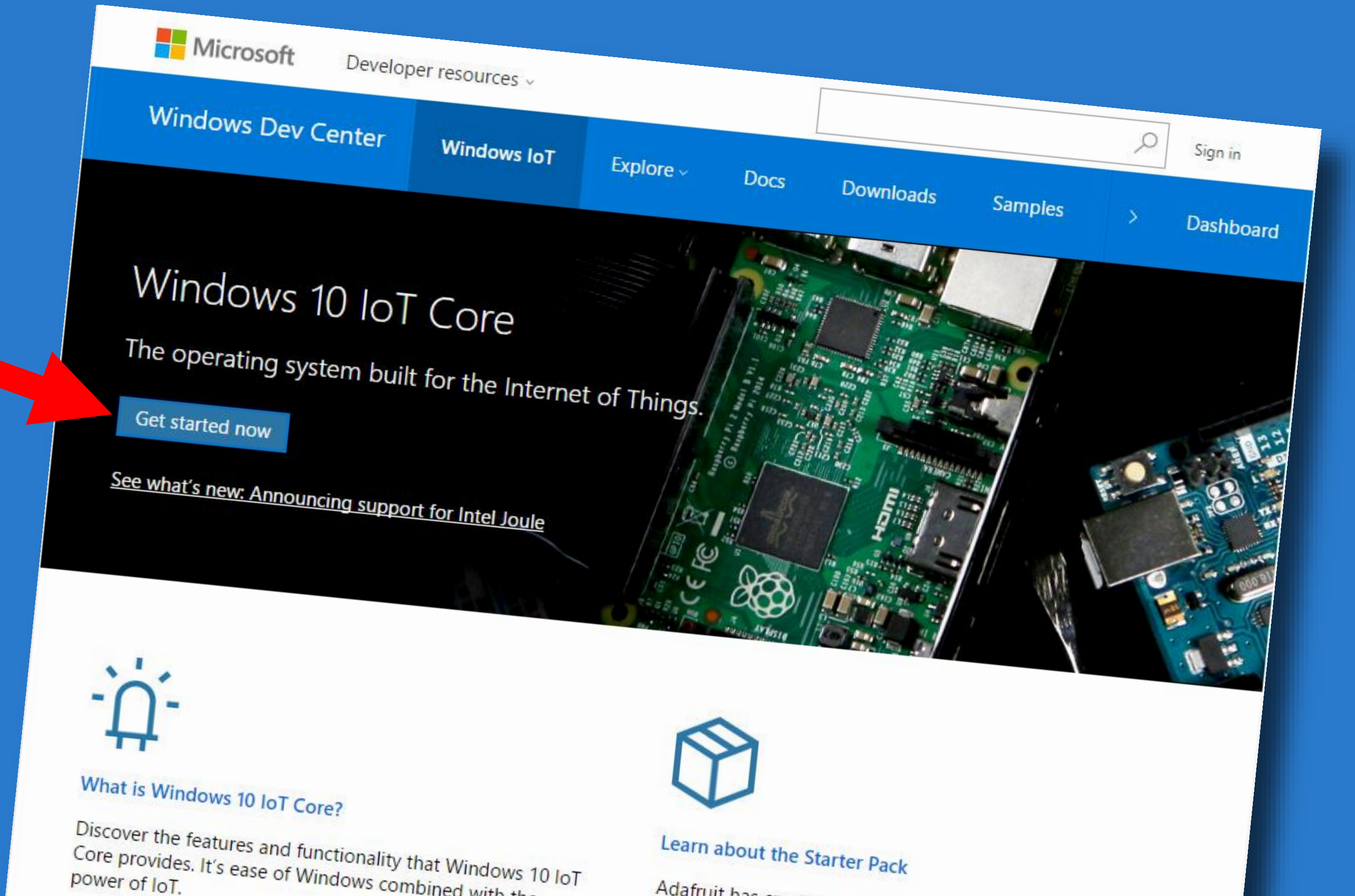

SET UP
SPLICES/
REJECTS
OD FLASH
SCORES/
WELDS
/OTHER


C#


C#

Raspberry Pi Setup

www.**WindowsOnDevices**.com



Microsoft Developer resources
Windows Dev Center | Windows IoT | Explore | Docs | Downloads | Samples | Dashboard | Sign in

Windows 10 IoT Core

The operating system built for the Internet of Things.

Get started now

See what's new: Announcing support for Intel Joule

What is Windows 10 IoT Core?

Discover the features and functionality that Windows 10 IoT Core provides. It's ease of Windows combined with the power of IoT.

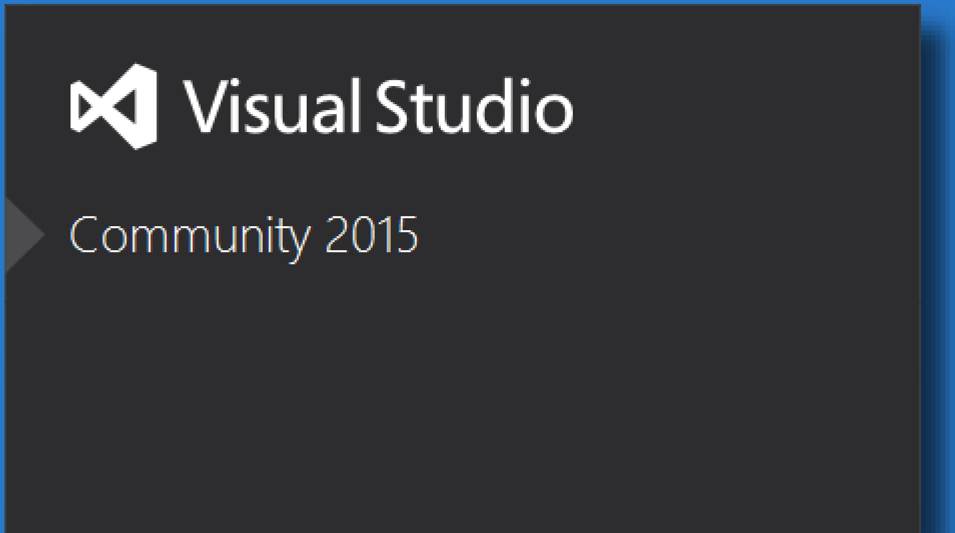
Learn about the Starter Pack

Adafruit has

Development Environment

Windows 10

+

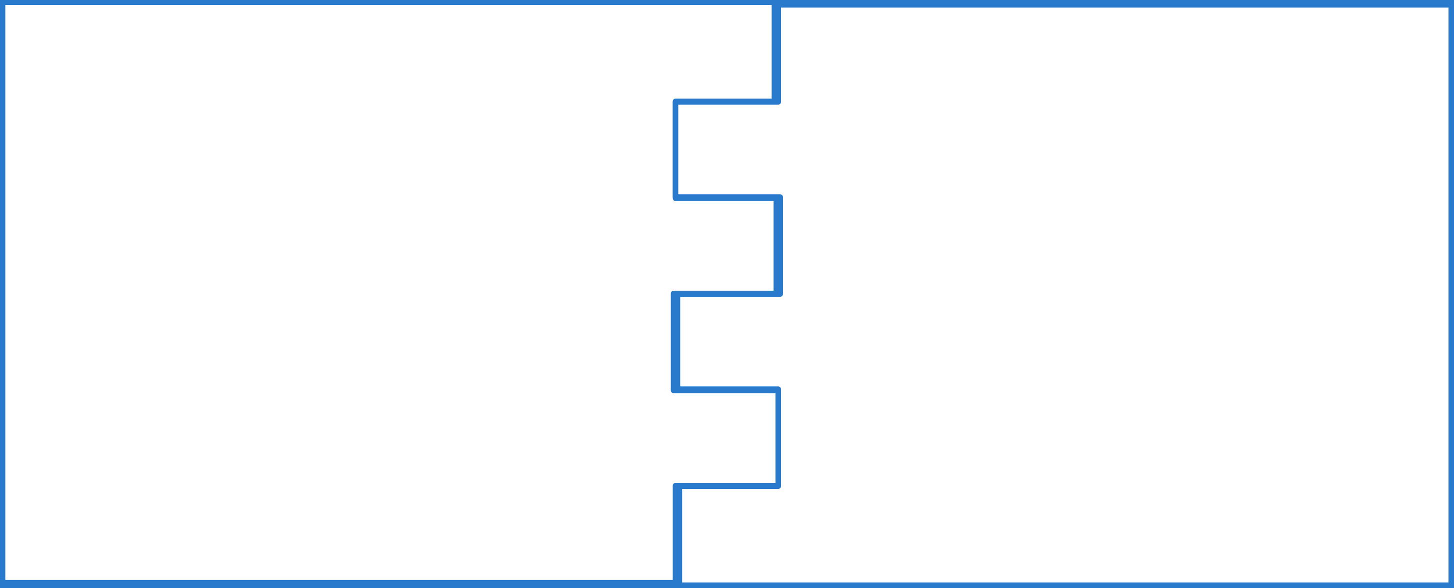

Visual Studio

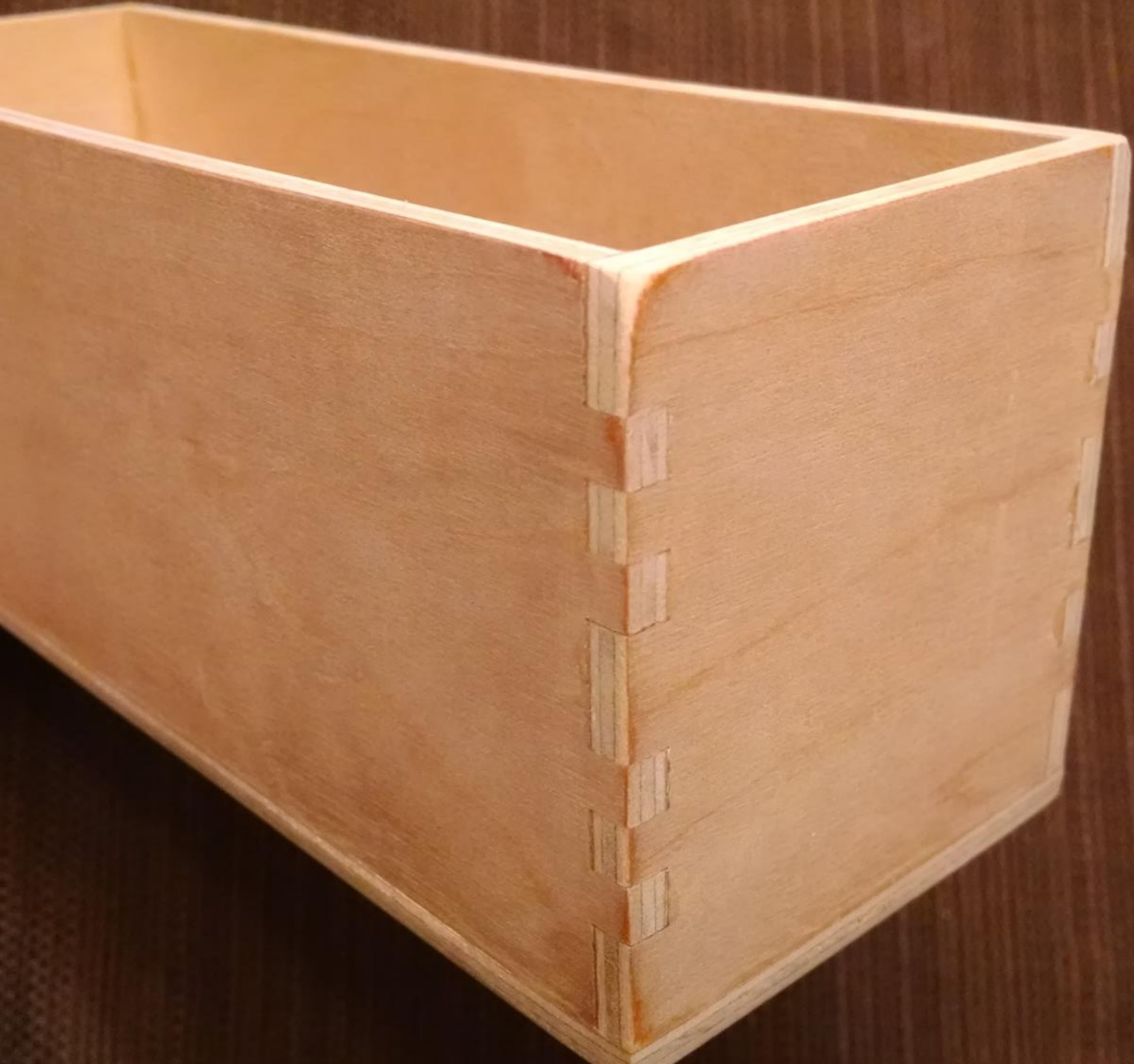
Community 2015

C#

Building a Box Joint Jig

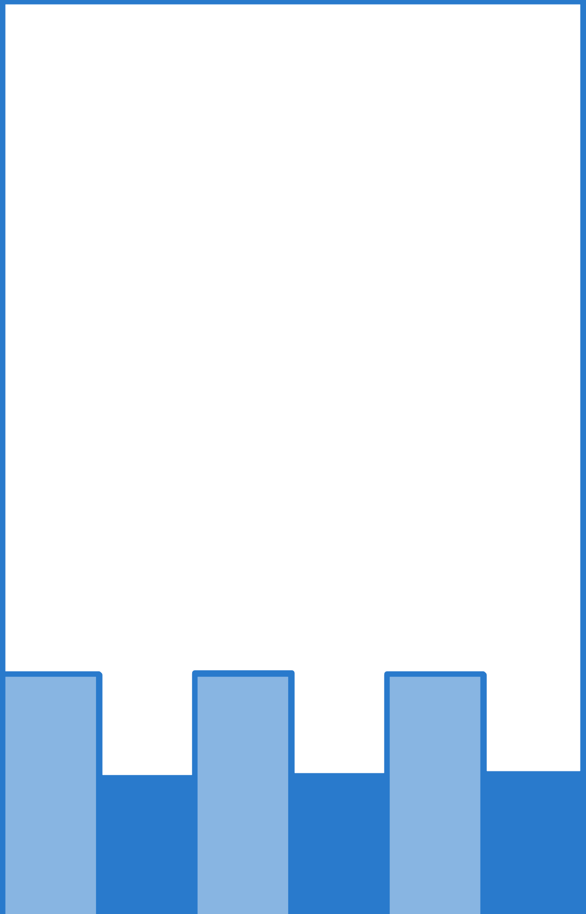
Box Joint





Cutting Box Joints

Usually cut with a wide (“dado”) saw blade

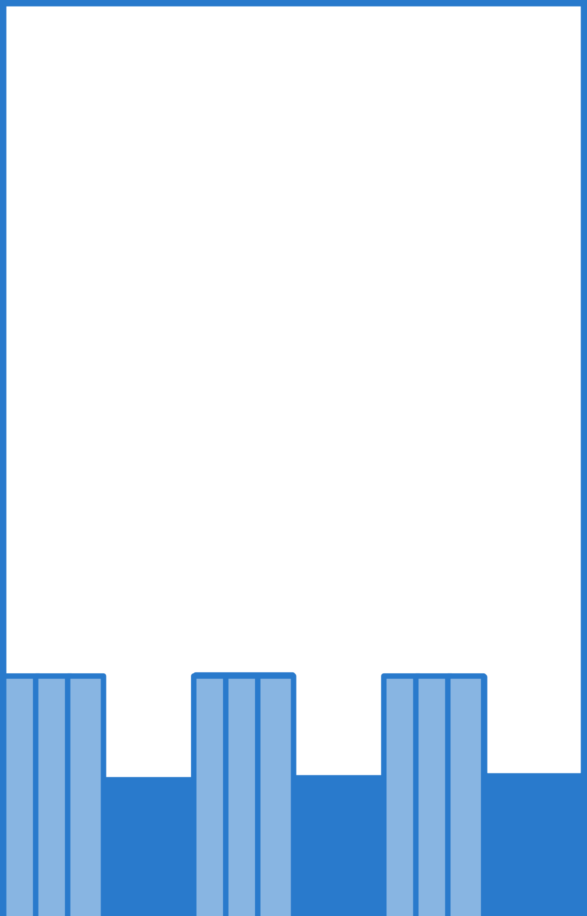


My Table Saw

* only supports a normal narrow blade

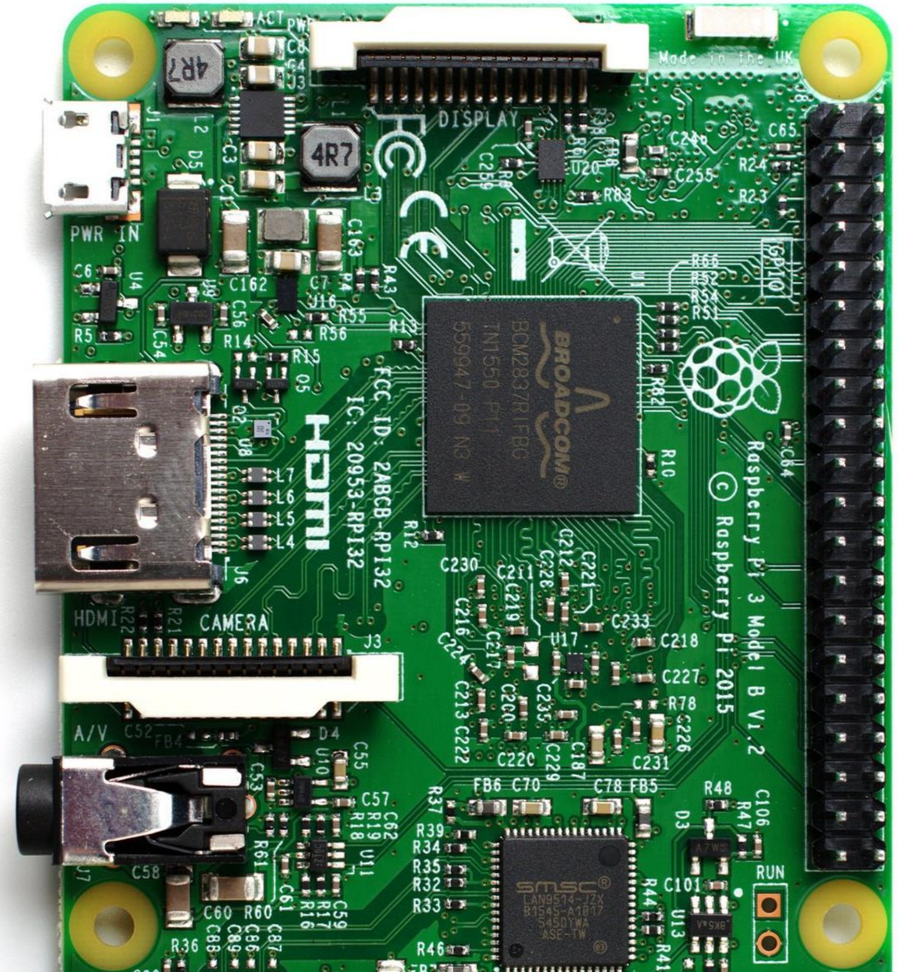
Cutting Box Joints

Normal blade requires many precision cuts



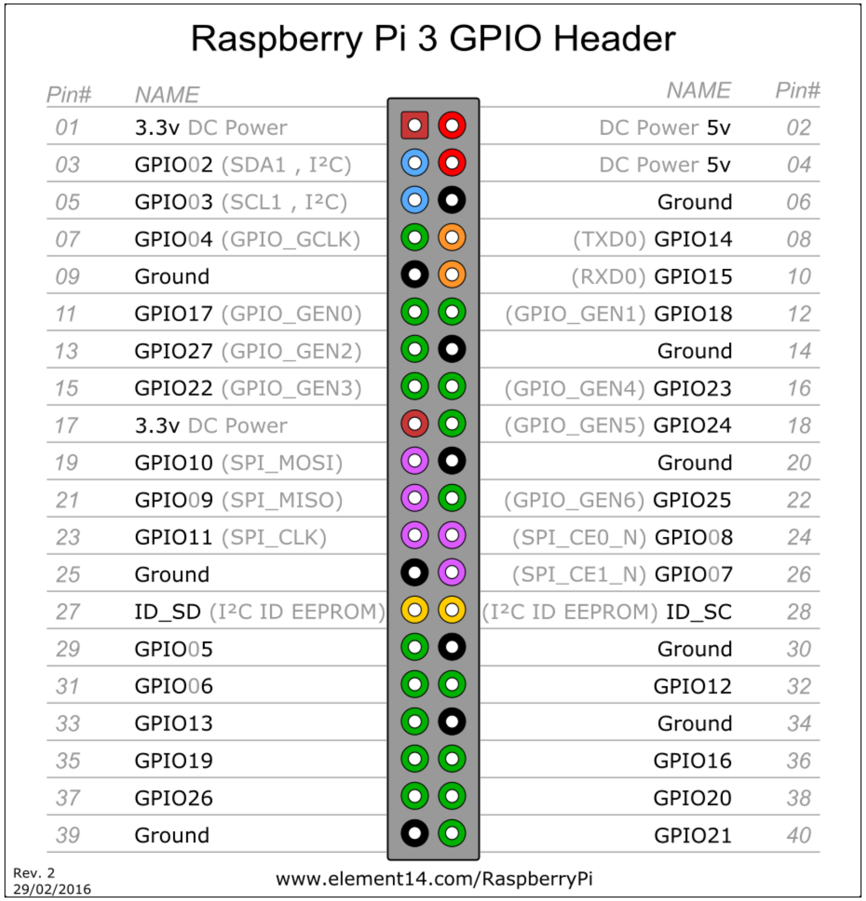
GPIO

General purpose Input & Output



GPIO

General purpose Input & Output



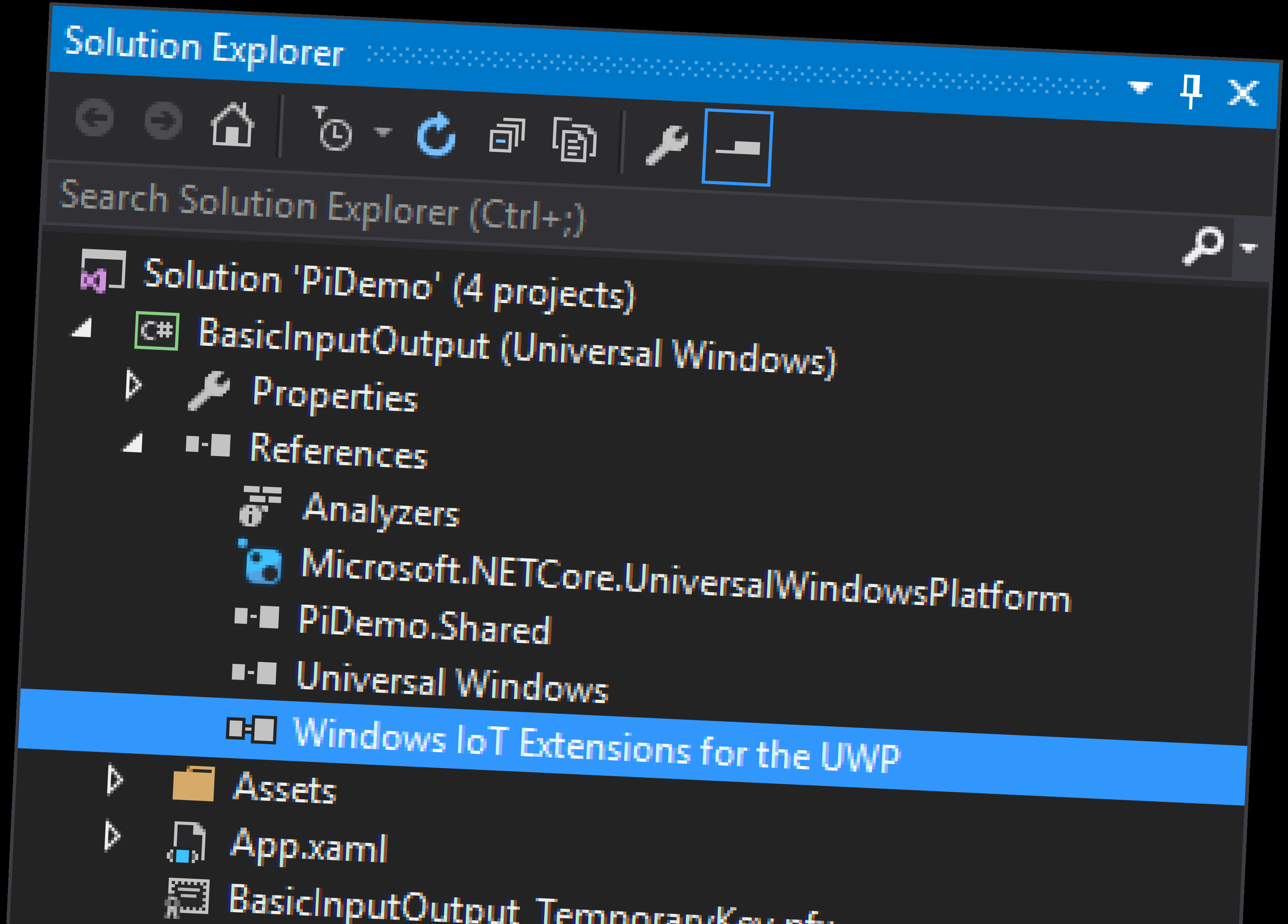
Raspberry Pi 3 GPIO Header

Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1 , I²C)	DC Power 5v	04
05	GPIO03 (SCL1 , I²C)	Ground	06
07	GPIO04 (GPIO_GCLK)	(TXD0) GPIO14	08
09	Ground	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	Ground	14
15	GPIO22 (GPIO_GEN3)	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	Ground	20
21	GPIO09 (SPI_MISO)	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	(SPI_CE0_N) GPIO08	24
25	Ground	(SPI_CE1_N) GPIO07	26
27	ID_SD (I²C ID EEPROM)	(I²C ID EEPROM) ID_SC	28
29	GPIO05	Ground	30
31	GPIO06	GPIO12	32
33	GPIO13	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

Rev. 2
29/02/2016

www.element14.com/RaspberryPi

Accessing GPIO From Code



Solution 'PiDemo' (4 projects)
BasicInputOutput (Universal Windows)
Properties
References
Analyzers
Microsoft.NETCore.UniversalWindowsPlatform
PiDemo.Shared
Universal Windows
Windows IoT Extensions for the UWP
Assets
App.xaml
BasicInputOutput_TemporaryKey.pfx

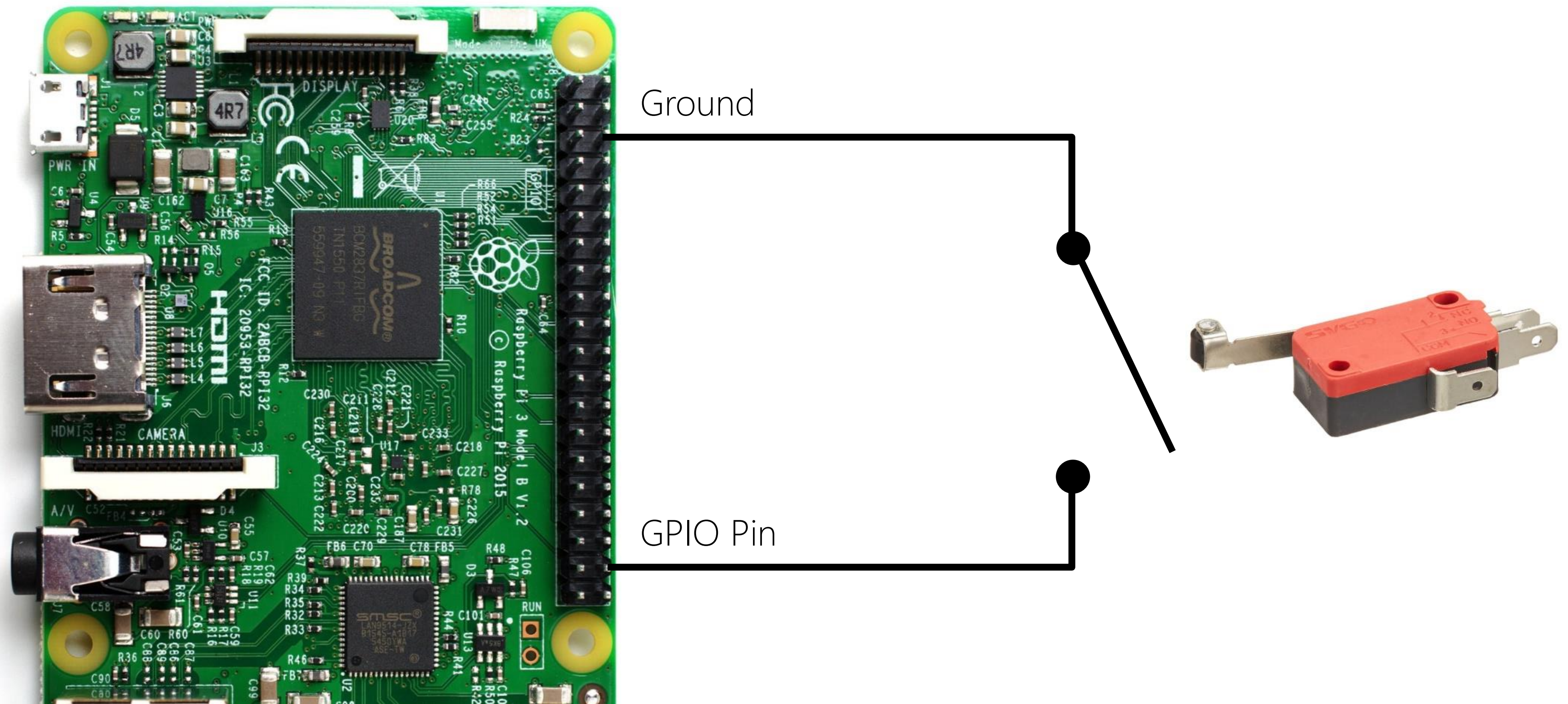
Initializing Pins

```
Windows.Devices.Gpio.GpioPin
```

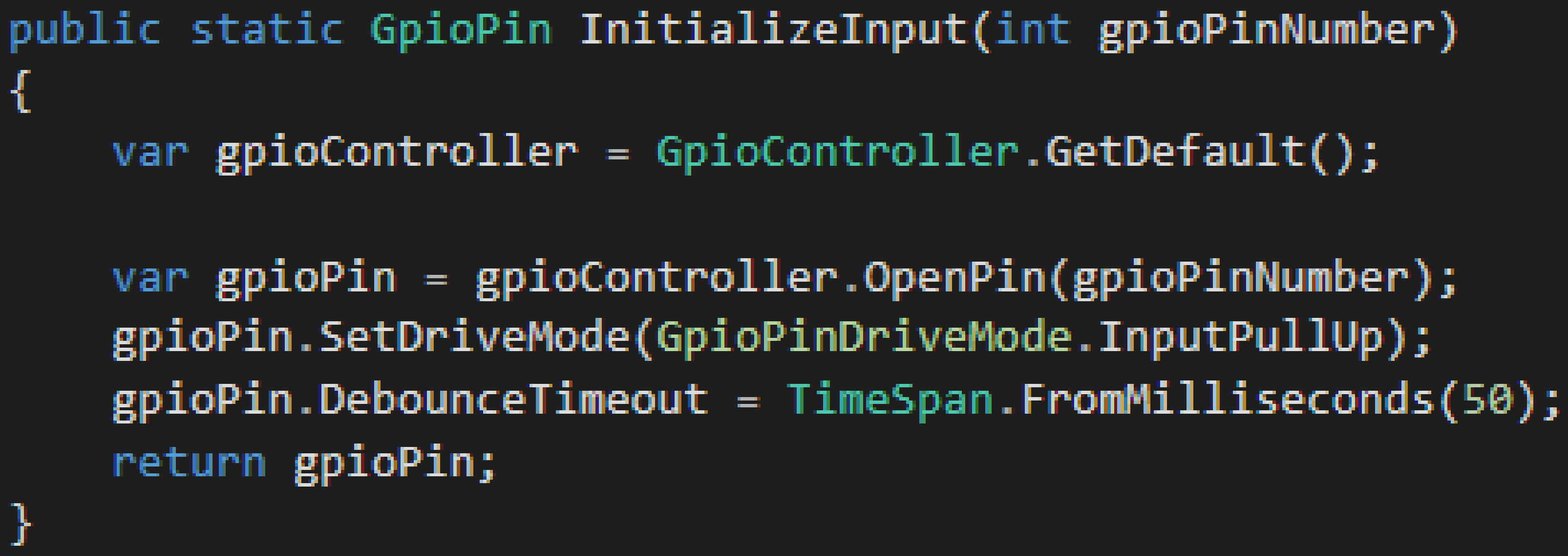
- Set up your pins once
- Keep your pin variables referenced

GPIO

Input



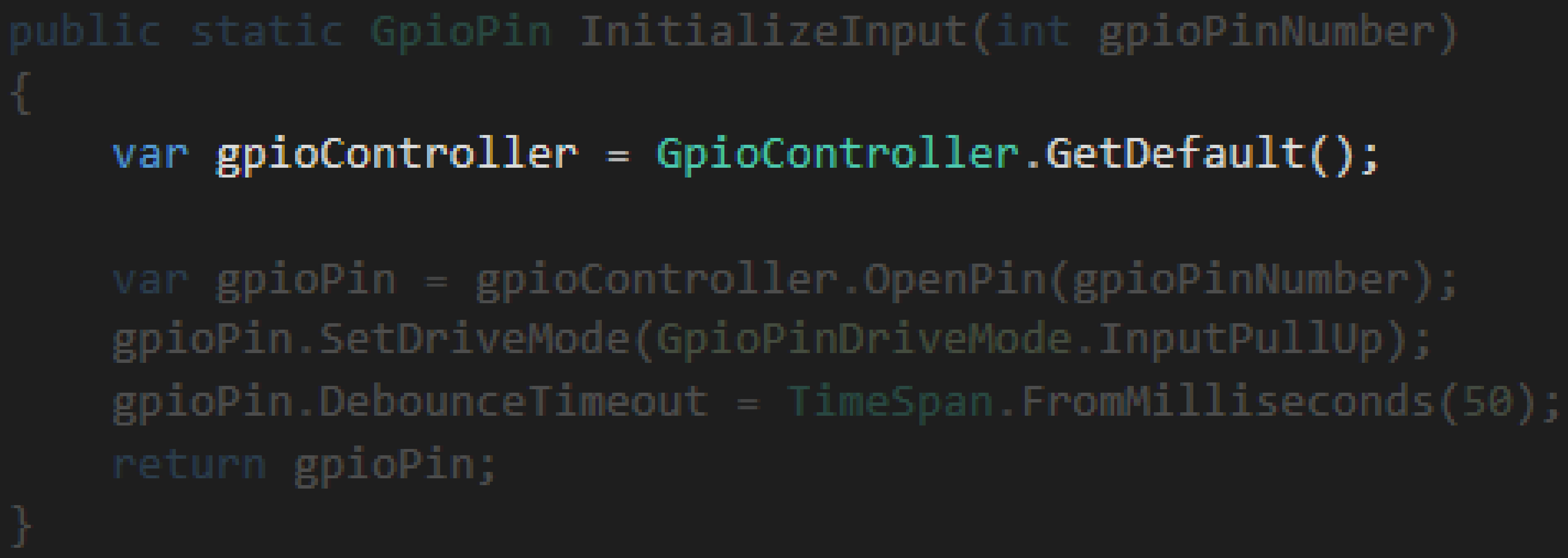
Initializing Pins: Input



```
public static GpioPin InitializeInput(int gpioPinNumber)
{
    var gpioController = GpioController.GetDefault();

    var gpioPin = gpioController.OpenPin(gpioPinNumber);
    gpioPin.SetDriveMode(GpioPinDriveMode.InputPullUp);
    gpioPin.DebounceTimeout = TimeSpan.FromMilliseconds(50);
    return gpioPin;
}
```

Initializing Pins: Input



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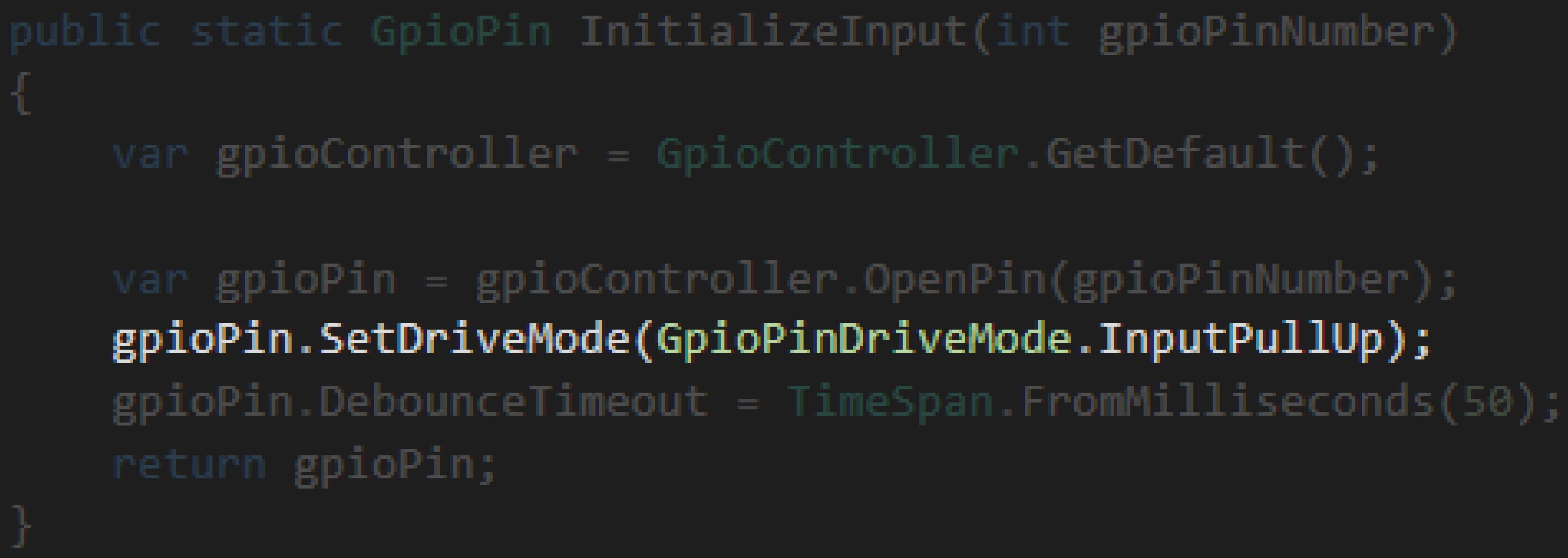
```

Initializing Pins: Input



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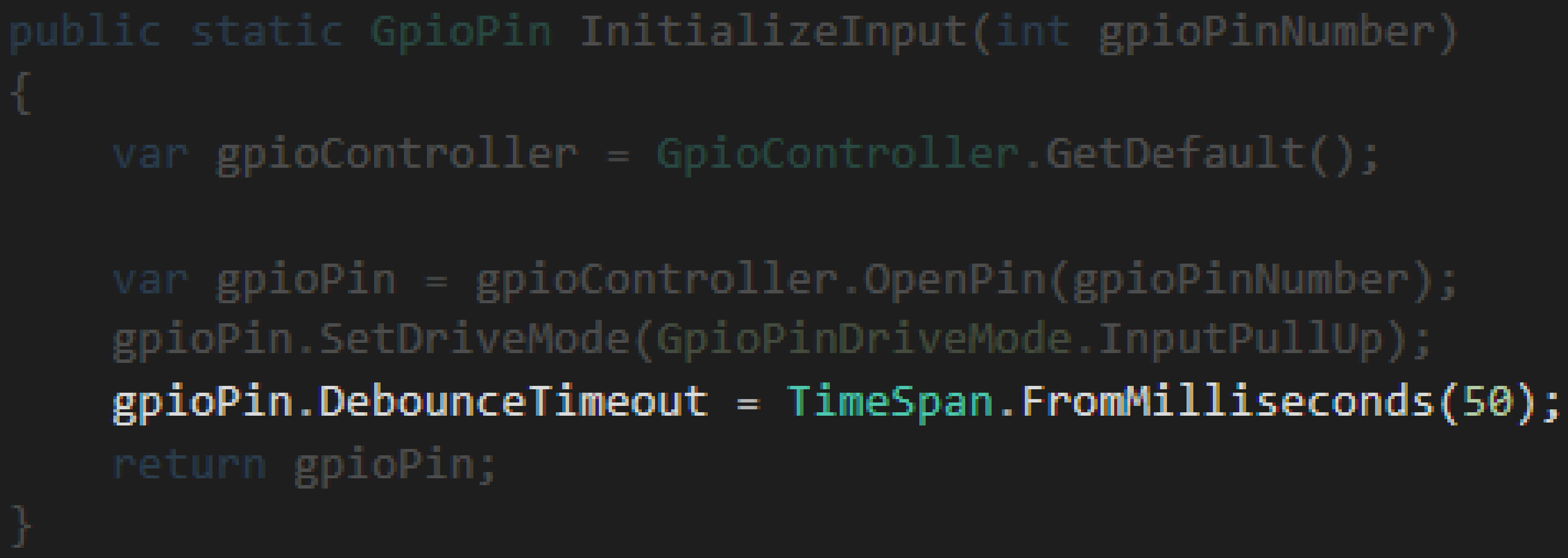
```

Initializing Pins: Input



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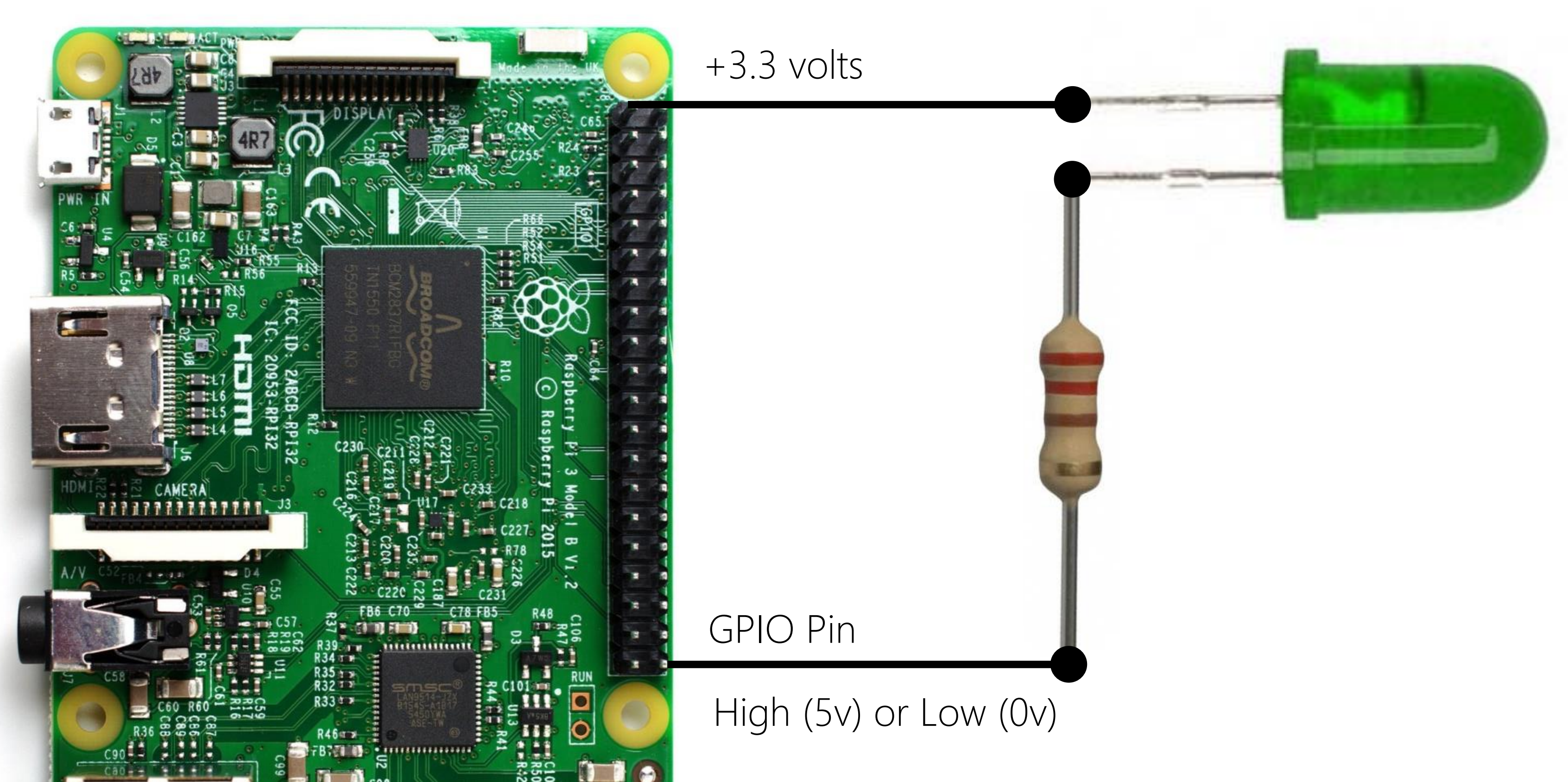
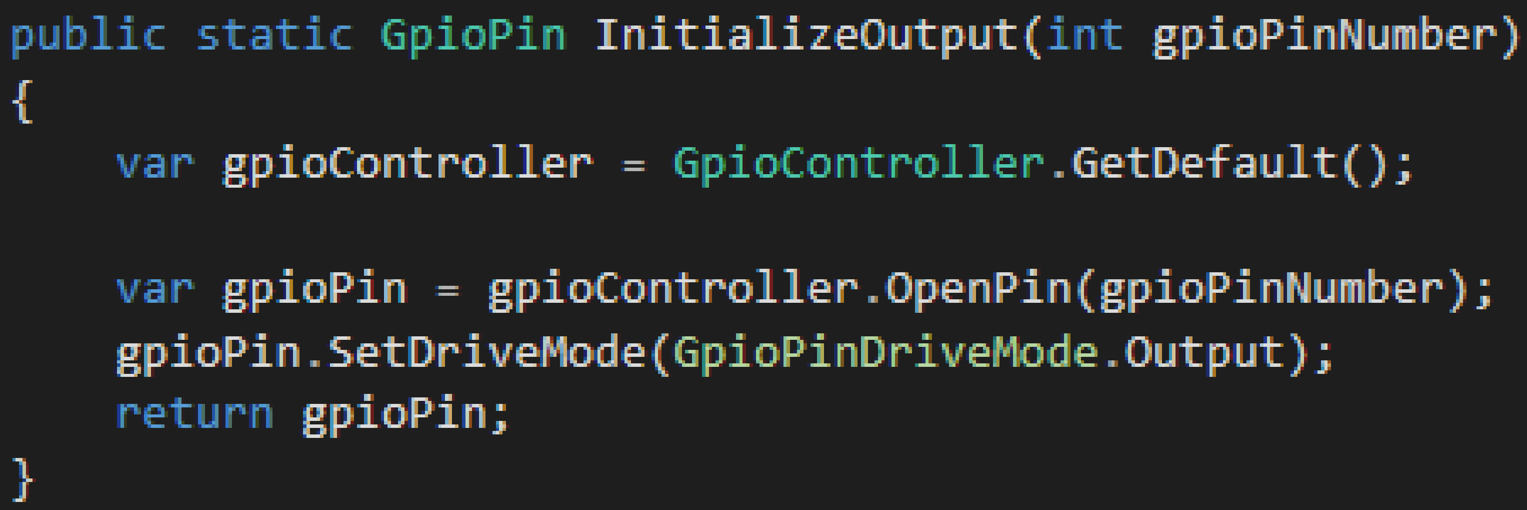
```

GPIO

Output



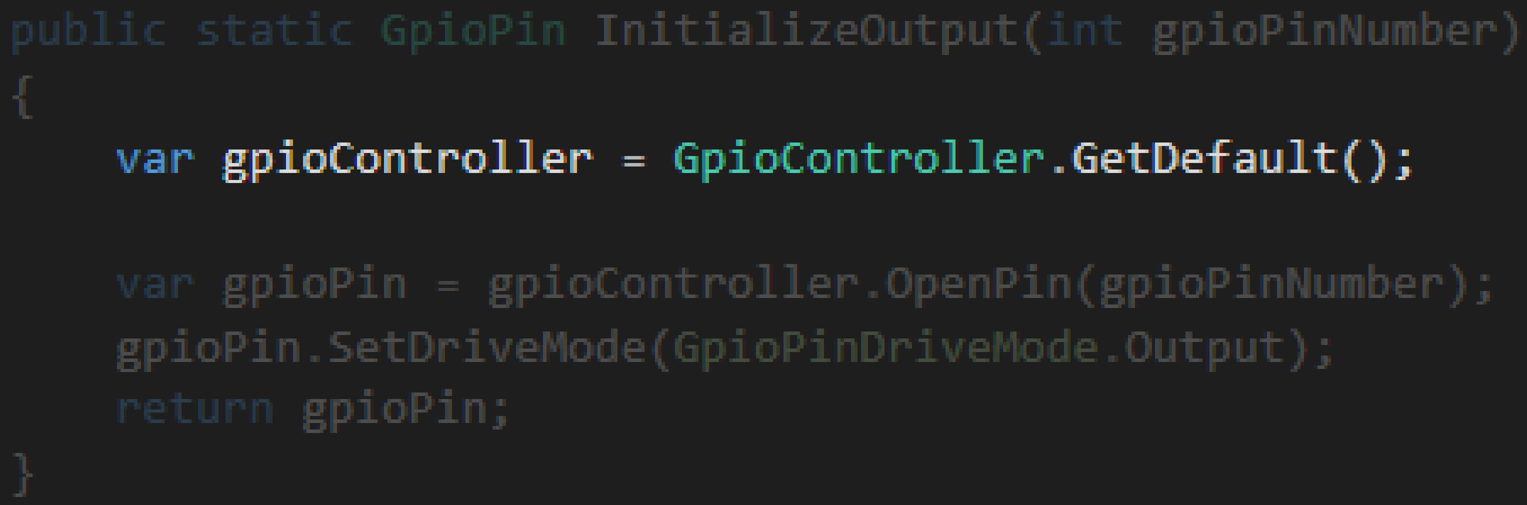
Initializing Pins: Output



```csharp
public static GpioPin InitializeOutput(int gpioPinNumber)
{
    var gpioController = GpioController.GetDefault();

    var gpioPin = gpioController.OpenPin(gpioPinNumber);
    gpioPin.SetDriveMode(GpioPinDriveMode.Output);
    return gpioPin;
}
```

Initializing Pins: Output



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    gpioPin.SetDriveMode(GpioPinDriveMode.Output);
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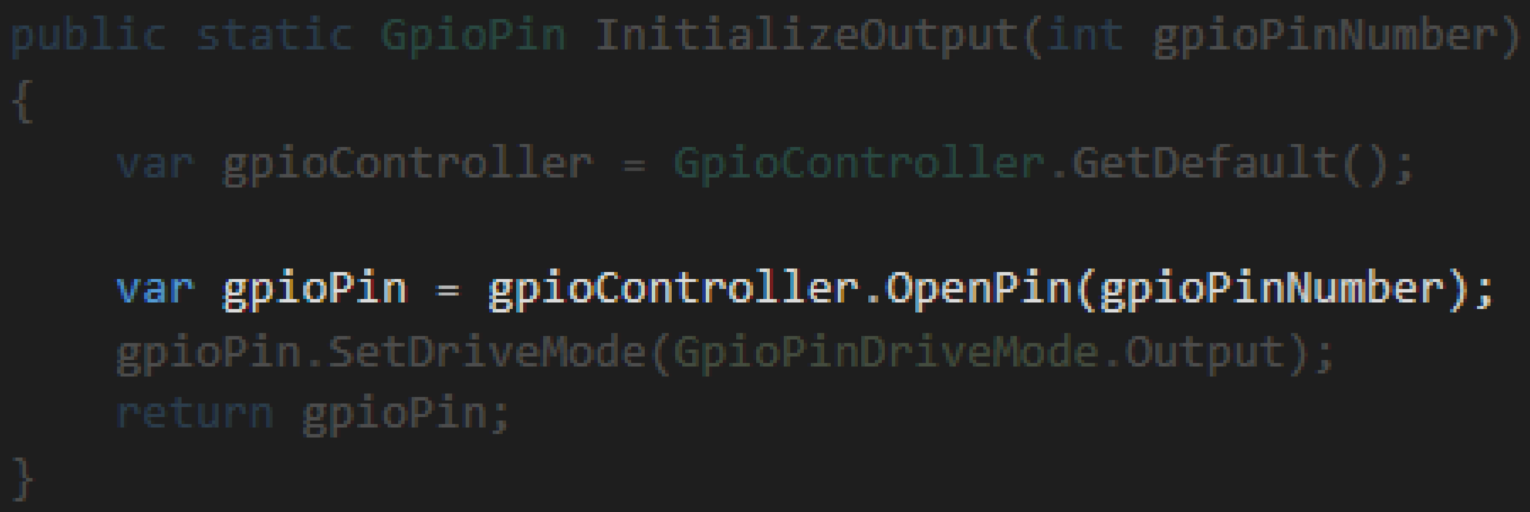
}
```

Initializing Pins: Output



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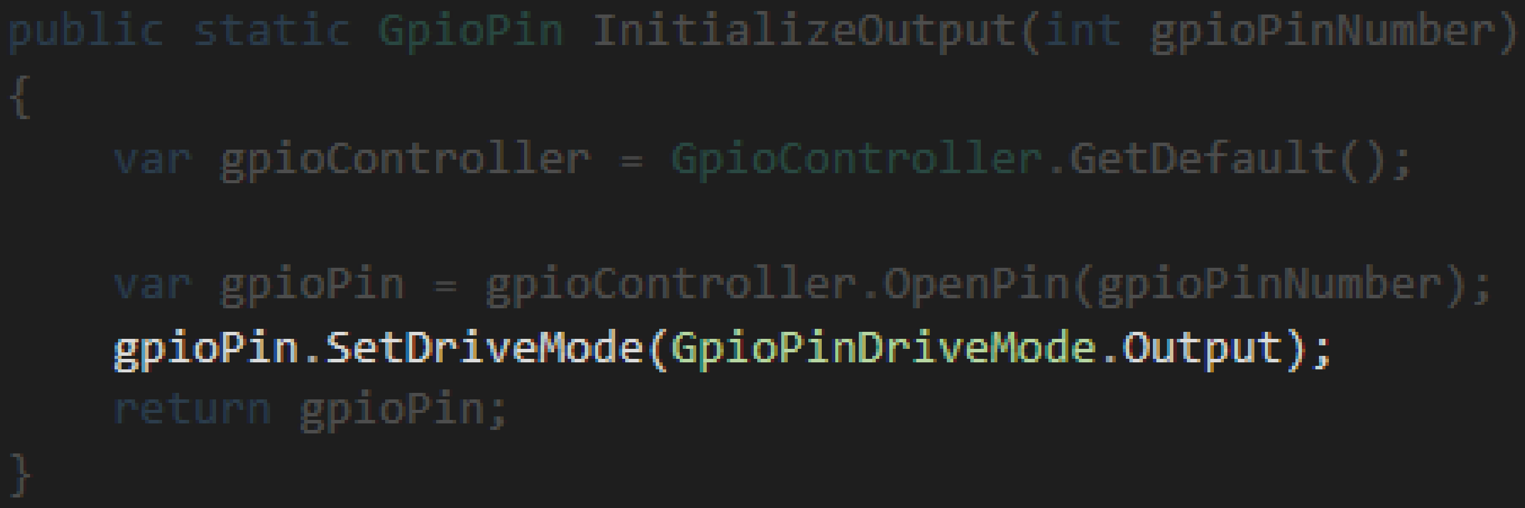
Initializing Pins: Output



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public static GpioPin InitializeOutput(int gpioPinNumber)
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    var gpioPin = gpioController.OpenPin(gpioPinNumber);
    gpioPin.SetDriveMode(GpioPinDriveMode.Output);
    return gpioPin;
}
```
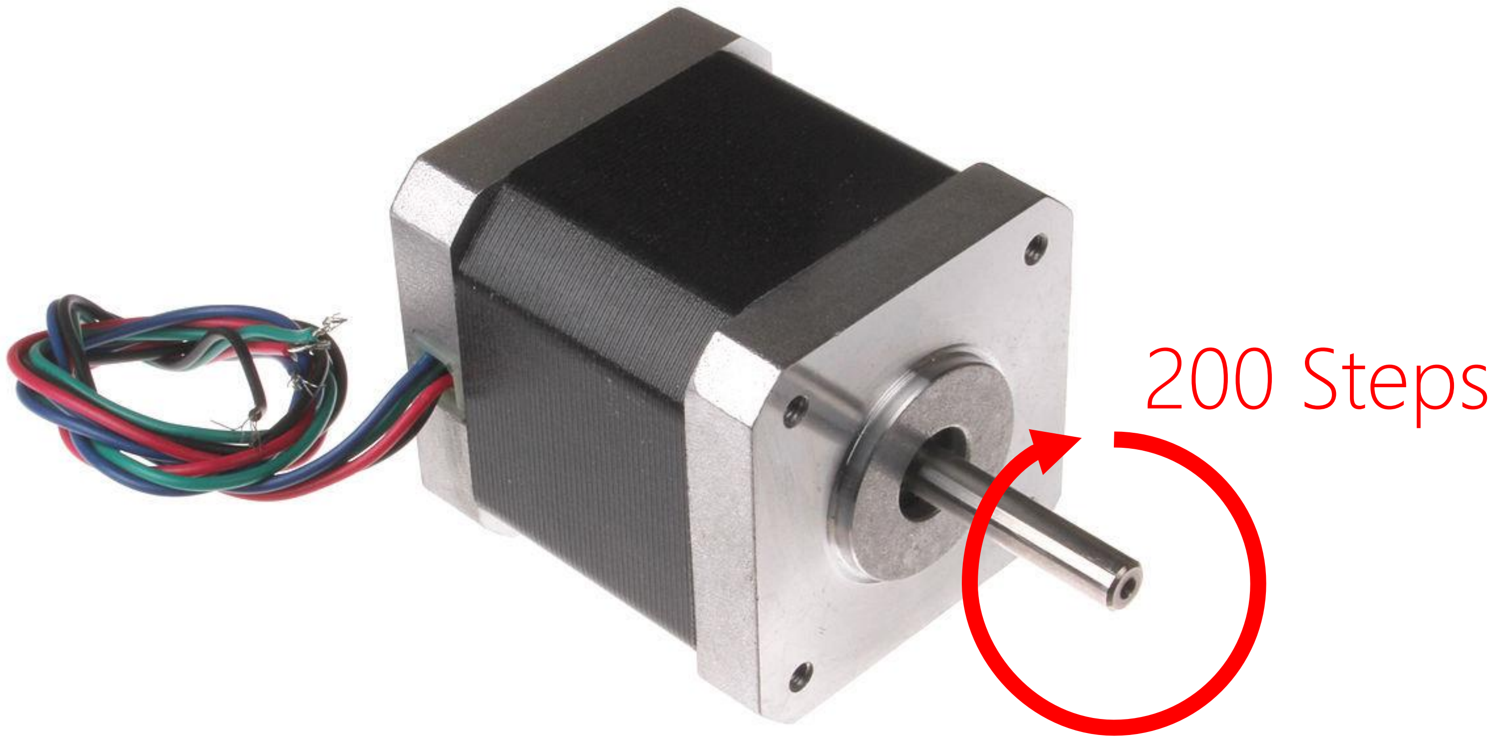

Motion Control

Lead Screw

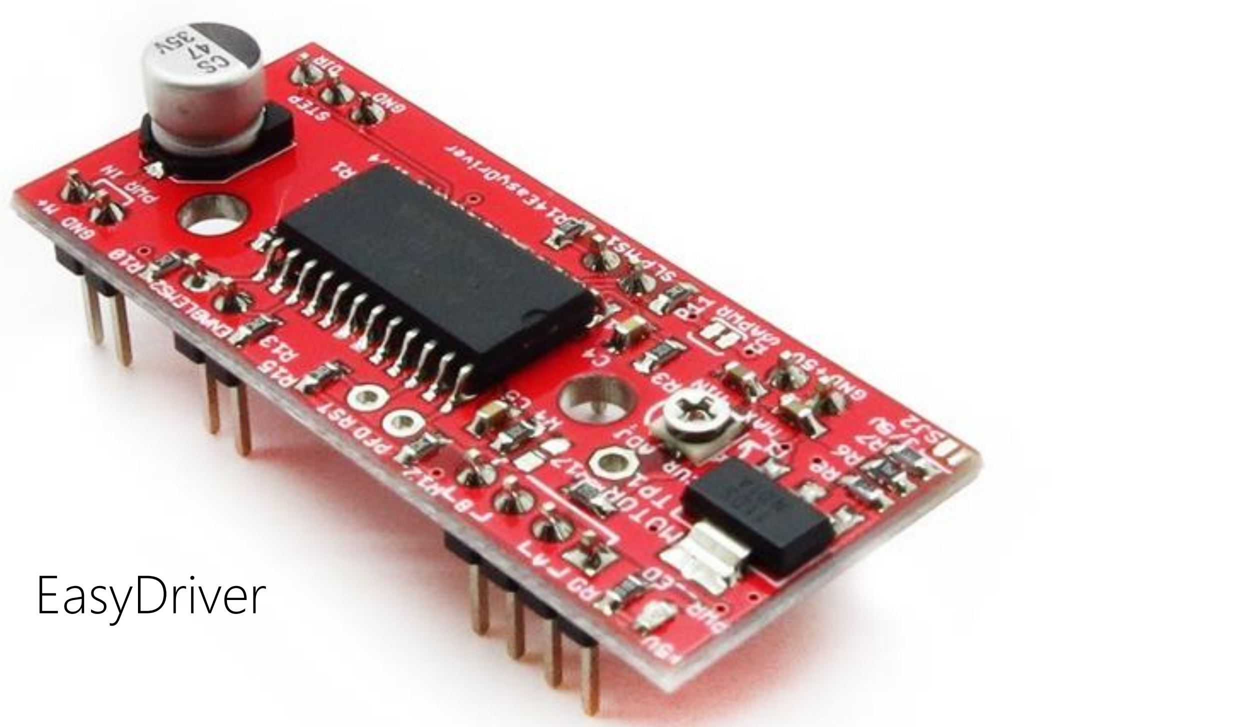
Motion Control

Stepper Motor



Motion Control

Stepper Motor Driver

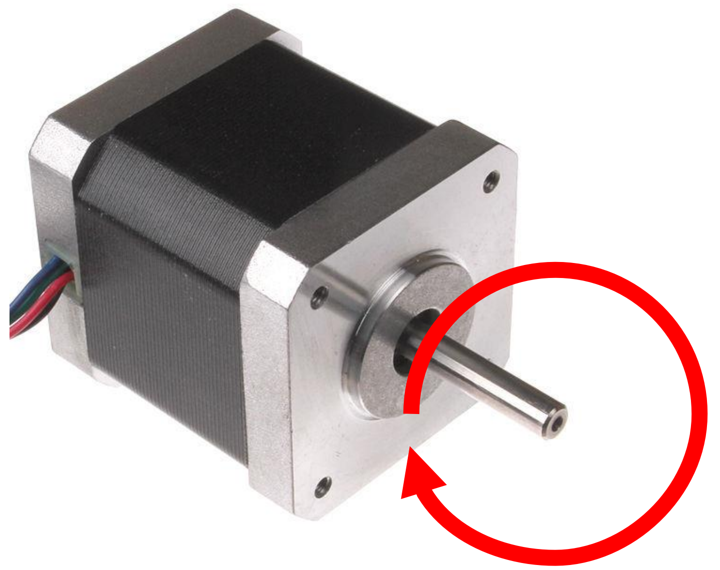


EasyDriver

Motion Control

Stepper Motor Driver

1/8 Micro-stepping



1600 Positions

Stepping the Motor

```
for (int i = 0; i < steps; i++)
{
    stepPin.Write(GpioPinValue.High);

    await Task.Delay(1);

    stepPin.Write(GpioPinValue.Low);
}
```

Stepping the Motor

```
for (int i = 0; i < steps; i++)
{
    stepPin.Write(GpioPinValue.High);

    await Task.Delay(1);

    stepPin.Write(GpioPinValue.Low);
}
```

Stepping the Motor

1600 steps

```
for (int i = 0; i < steps; i++)
{
    stepPin.Write(GpioPinValue.High);

    await Task.Delay(1);

    stepPin.Write(GpioPinValue.Low);
}
```

x 1 millisecond each

~~= 1.6 seconds~~

25 seconds ?

Stepping the Motor

```
for (int i = 0; i < steps; i++)
{
    stepPin.Write(GpioPinValue.High);

    await Task.Delay(1);

    stepPin.Write(GpioPinValue.Low);
}
```

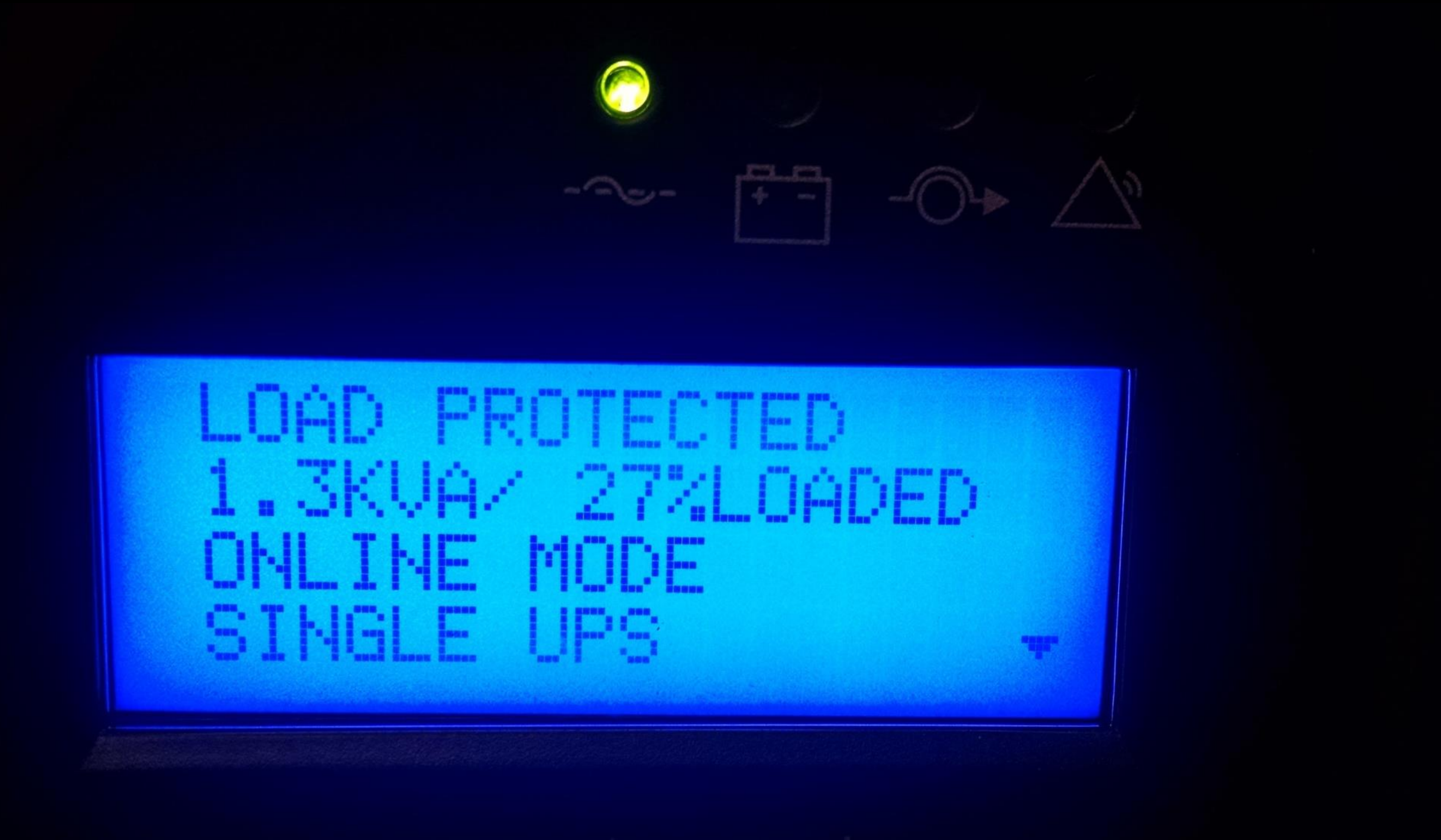
Async adds 15ms!

Stepping the Motor

```
var sw = new System.Diagnostics.Stopwatch();



for (int i = 0; i < steps; i++)
{
    stepPin.Write(GpioPinValue.High);

    sw.Start();
    while (sw.Elapsed.TotalMilliseconds < 1) { }
    sw.Reset();

    stepPin.Write(GpioPinValue.Low);
}
```

User Interface

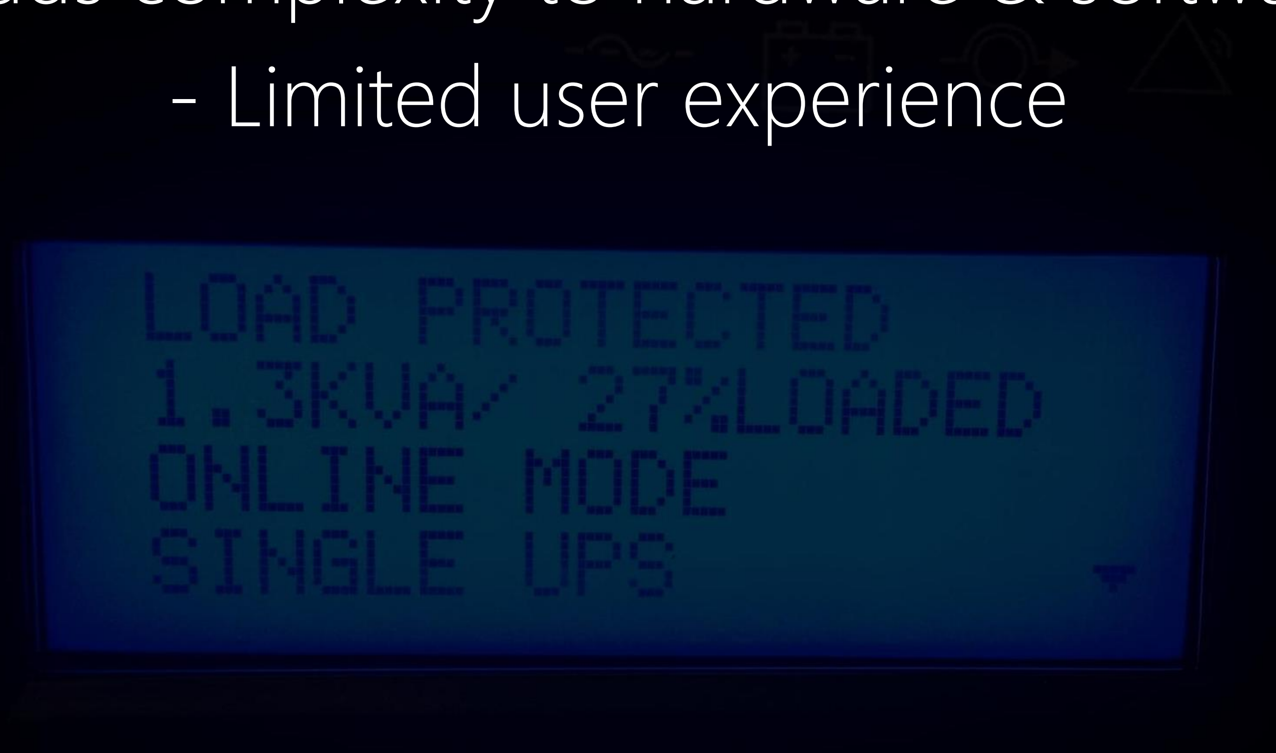
LCD Screen and Buttons?



User Interface

LCD Screen and Buttons?

- Adds complexity to hardware & software
- Limited user experience



LOAD PROTECTED
1.3KVA/ 27%LOADED
ONLINE MODE
SINGLE UPS

User Interface

Touch Screen?

User Interface

Touch Screen?

- Adds cost and complexity
- Not ideal for all situations

User Interface

Why not web based?

C# Web Server in UWP

?

C# Web Server in UWP

OWIN
Asp.Net

Build our own web server?

Restup

Open source .Net Web Server for UWP

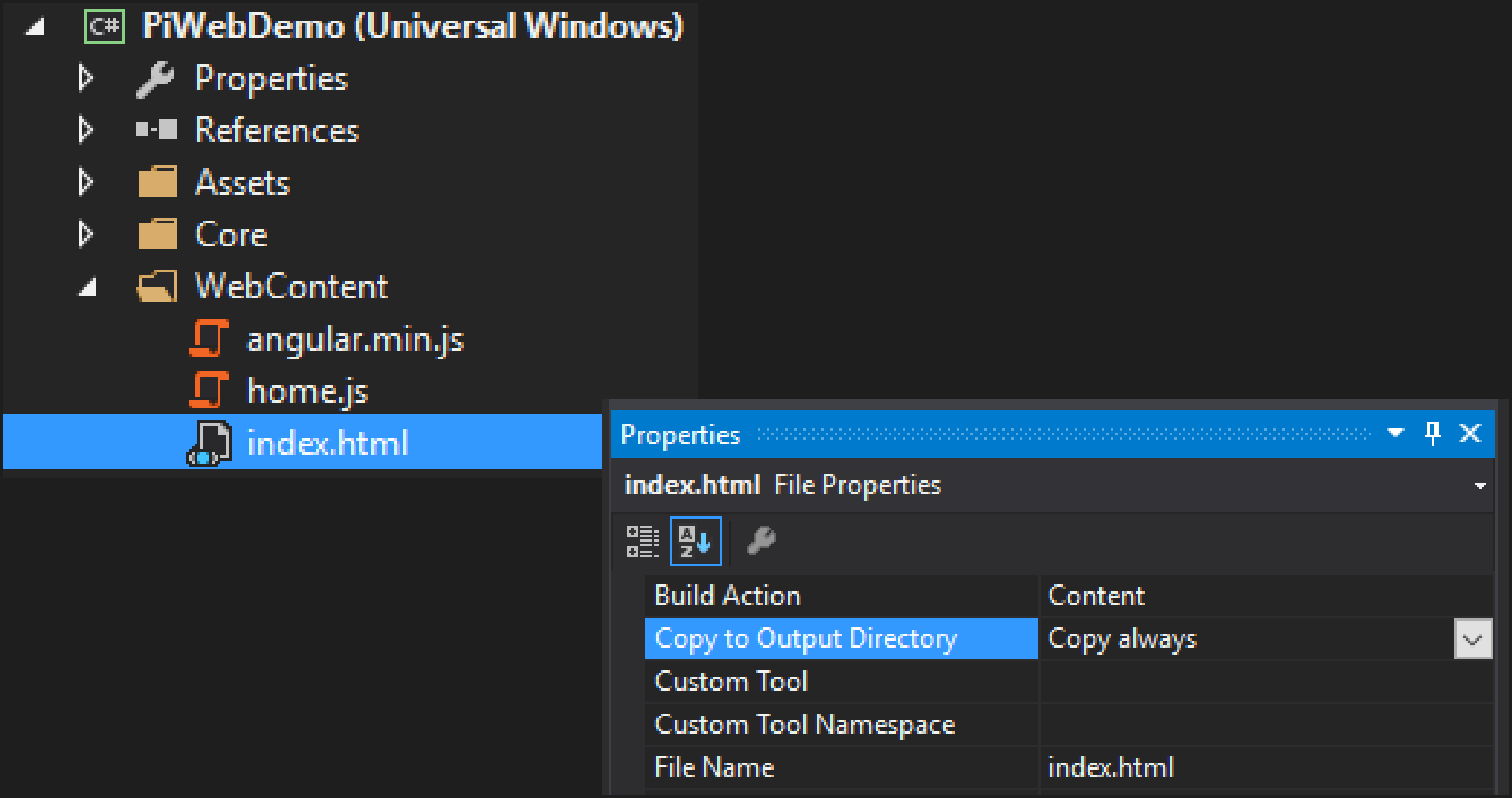
www.**nuget**.org/packages/**Restup**

Restup

Static files

JSON data

Serving Static Files



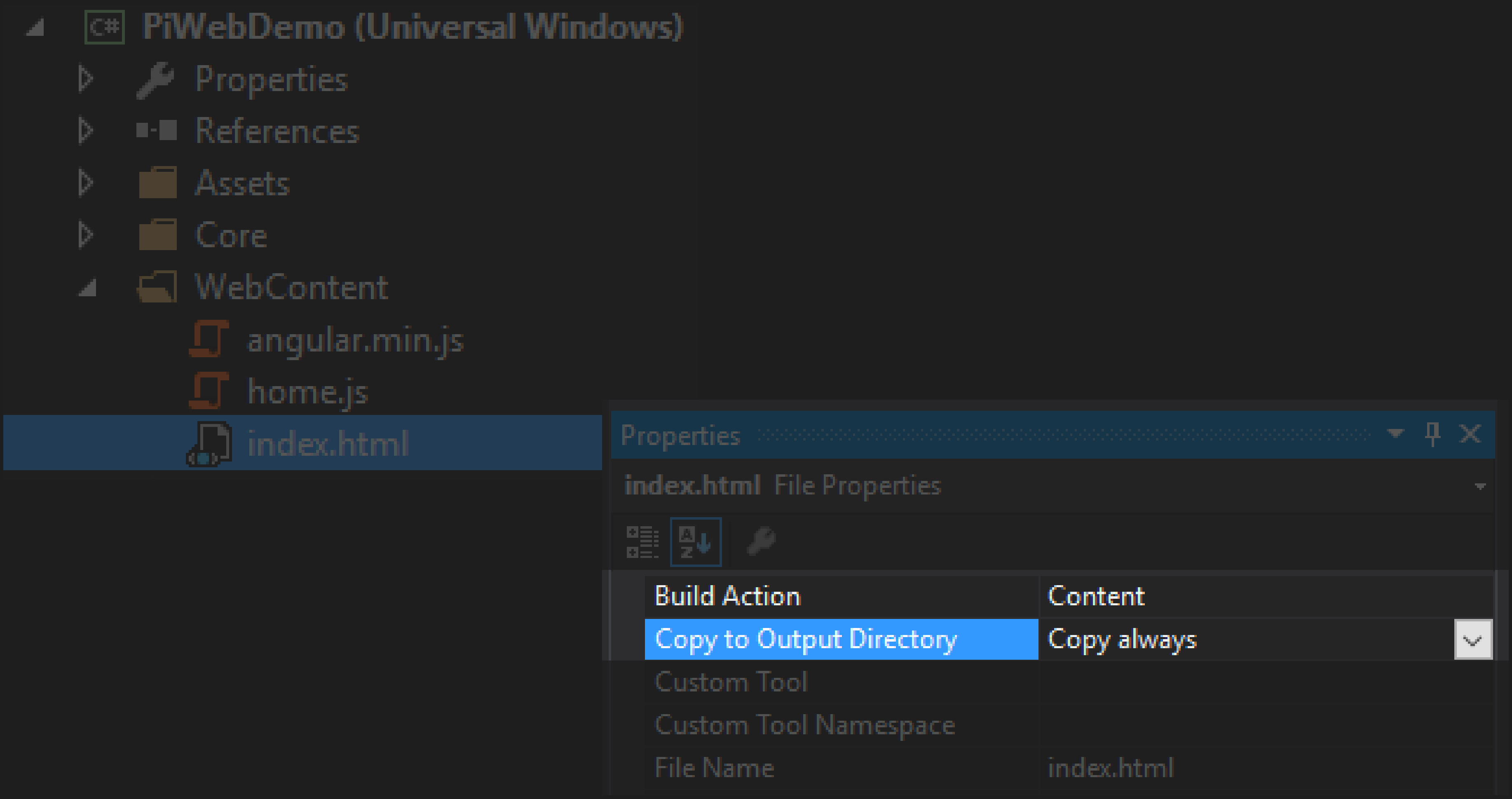
PiWebDemo (Universal Windows)
- Properties
- References
- Assets
- Core
- WebContent
  - angular.min.js
  - home.js
  - index.html

Properties

index.html File Properties

Build Action	Content
Copy to Output Directory	Copy always
Custom Tool	
Custom Tool Namespace	
File Name	index.html

Serving Static Files


PiWebDemo (Universal Windows)
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Properties

index.html File Properties

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Box Joint Jig & Code

Thank You

Ben Brandt

www.**B2Builds**.com

github.com/benbrandt22