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Microsoft® .NET | Gadgeteer

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Microsoft .NET Gadgeteer

A new way to create electronic devices

Nicolas Villar
Microsoft Research Cambridge, UK

What is .NET Gadgeteer?

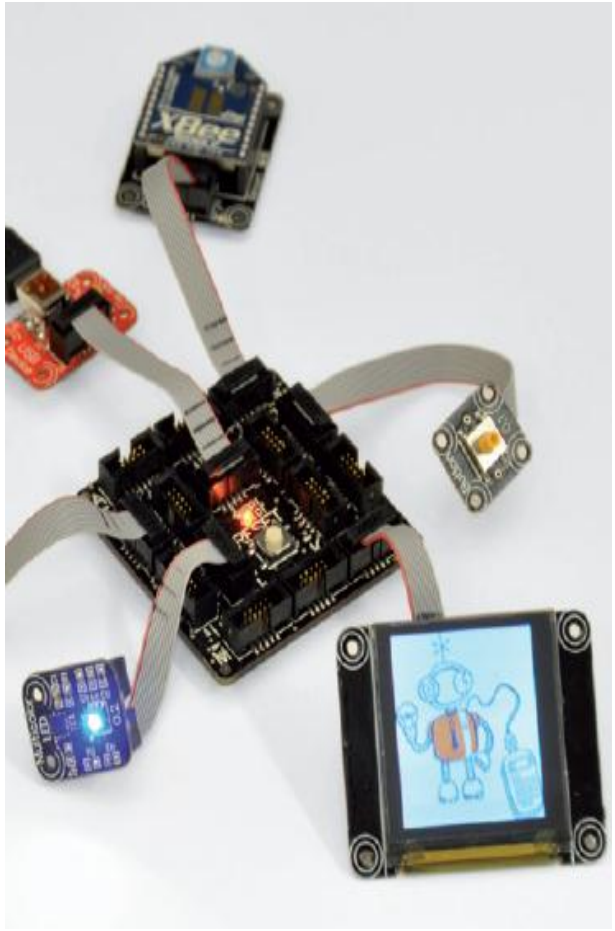
- .NET Gadgeteer is a new toolkit for quickly constructing, programming and shaping new small computing devices (*gadgets*)
- Takes you from *concept* to *working device* quickly and easily

Driving principle behind .NET Gadgeteer

- Low threshold
  - Simple gadgets should be very simple to build
- High ceiling
  - It should also be possible to build sophisticated and complex devices

The three key components of .NET Gadgeteer

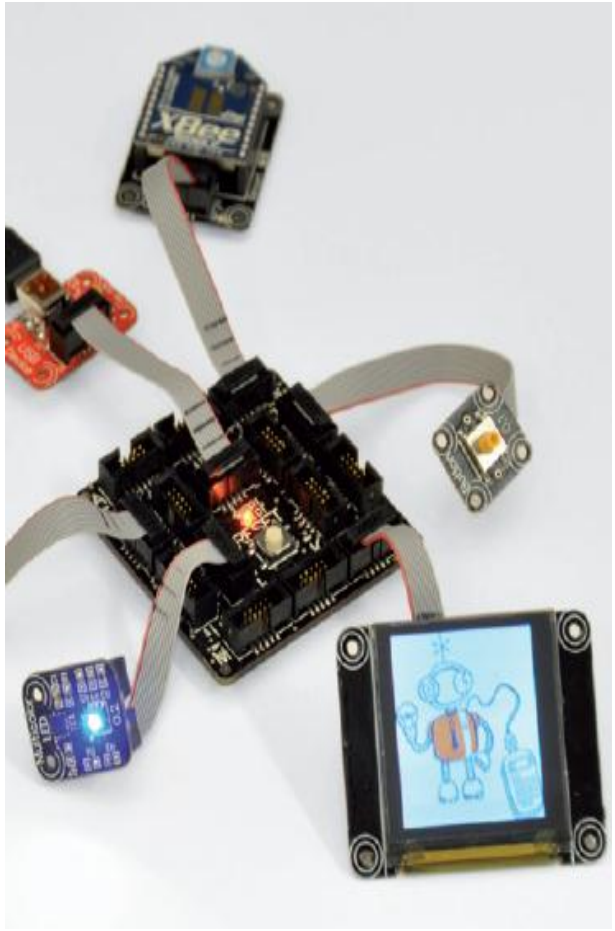
Modular Hardware



The three key components of .NET Gadgeteer

Modular Hardware

Object-Oriented Programming



```
void ProgramStarted()
{
    // Initialize GTM.Modules and ev
    myButton = new GTM.Button(GTM.Bu
    myLed = new GTM.MulticolorLED(GT

    myButton.

    // Do one
    Debug.Pri
}
```

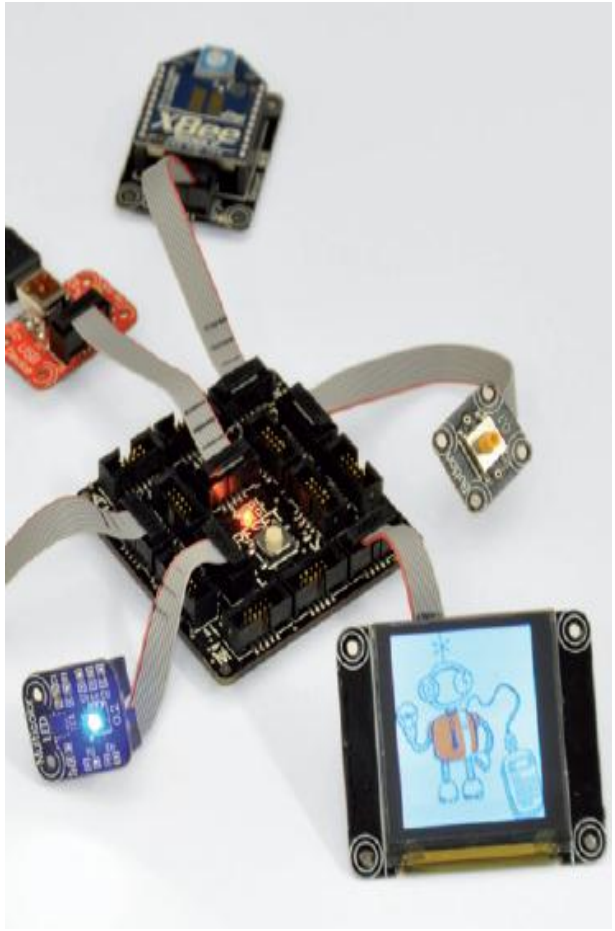
ButtonPressed
ButtonReleased
DebugPrintEnabled
Equals
GetHashCode
GetType
IsPressed
ToString

The three key components of .NET Gadgeteer

Modular Hardware

Object-Oriented Programming

Digital Design and Rapid Manufacture



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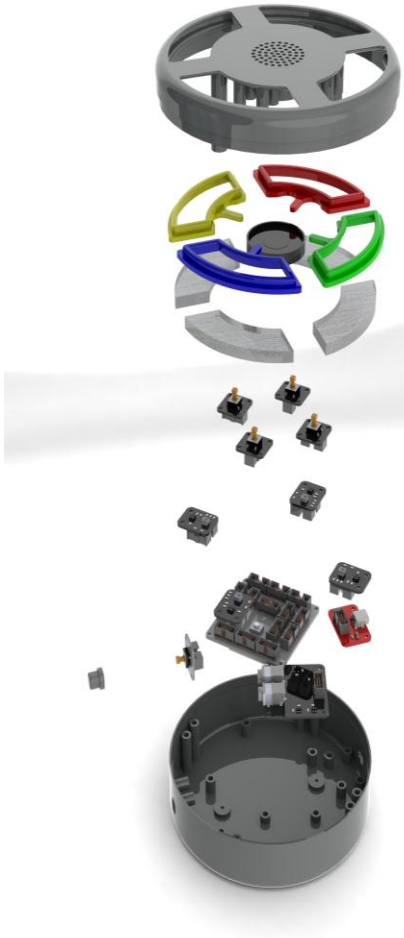


Some background

- We originally built Gadgeteer as a tool for ourselves (in Microsoft Research) to make it easier to prototype new kinds of devices
- We believe the ability to prototype effectively is key to successful innovation

Some background

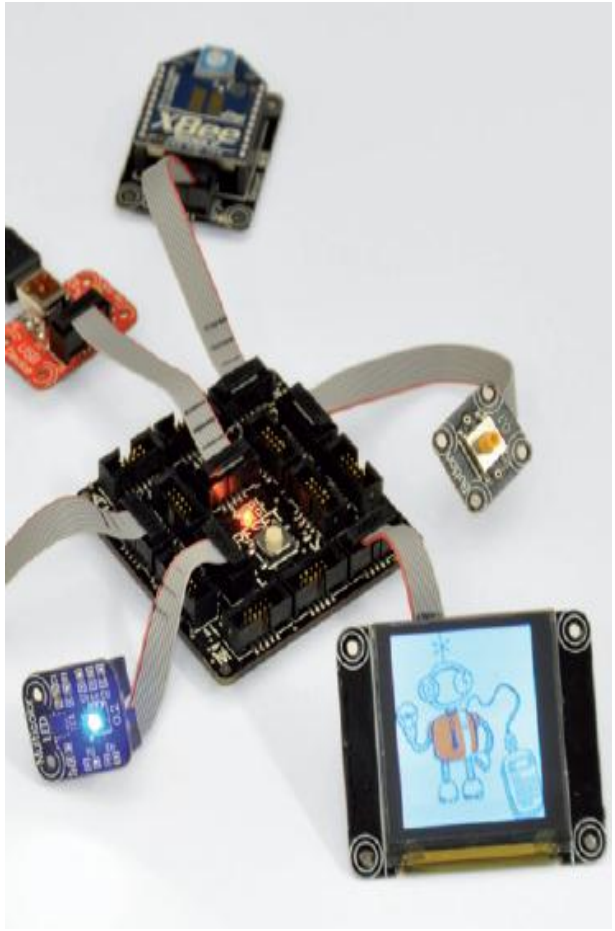
- Gadgeteer has proven to be of interest to other researchers – but also hobbyists and educators
- With the help of colleagues from all across Microsoft, we are working on getting Gadgeteer out of the lab and into the hands of others

Some background

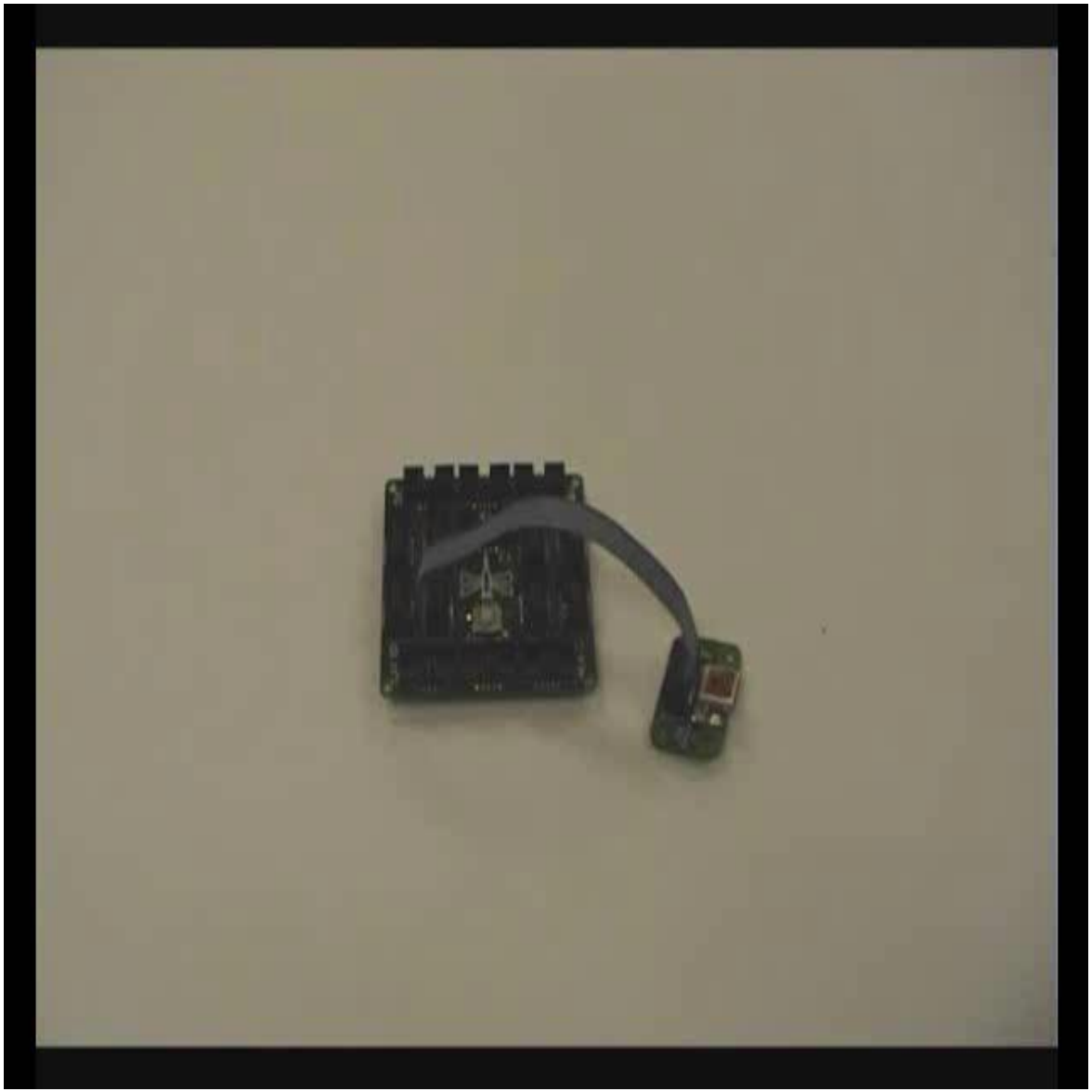
- Nicolas Villar, James Scott, Steve Hodges
  Microsoft Research Cambridge
- Kerry Hammil
  Microsoft Research Redmond
- Colin Miller
  Developer Division, Microsoft Corporation
- Scarlet Schwiderski-Grosche, Stewart Tansley
  Microsoft Research Connections
- **The Garage @ Microsoft**

First key component of .NET Gadgeteer

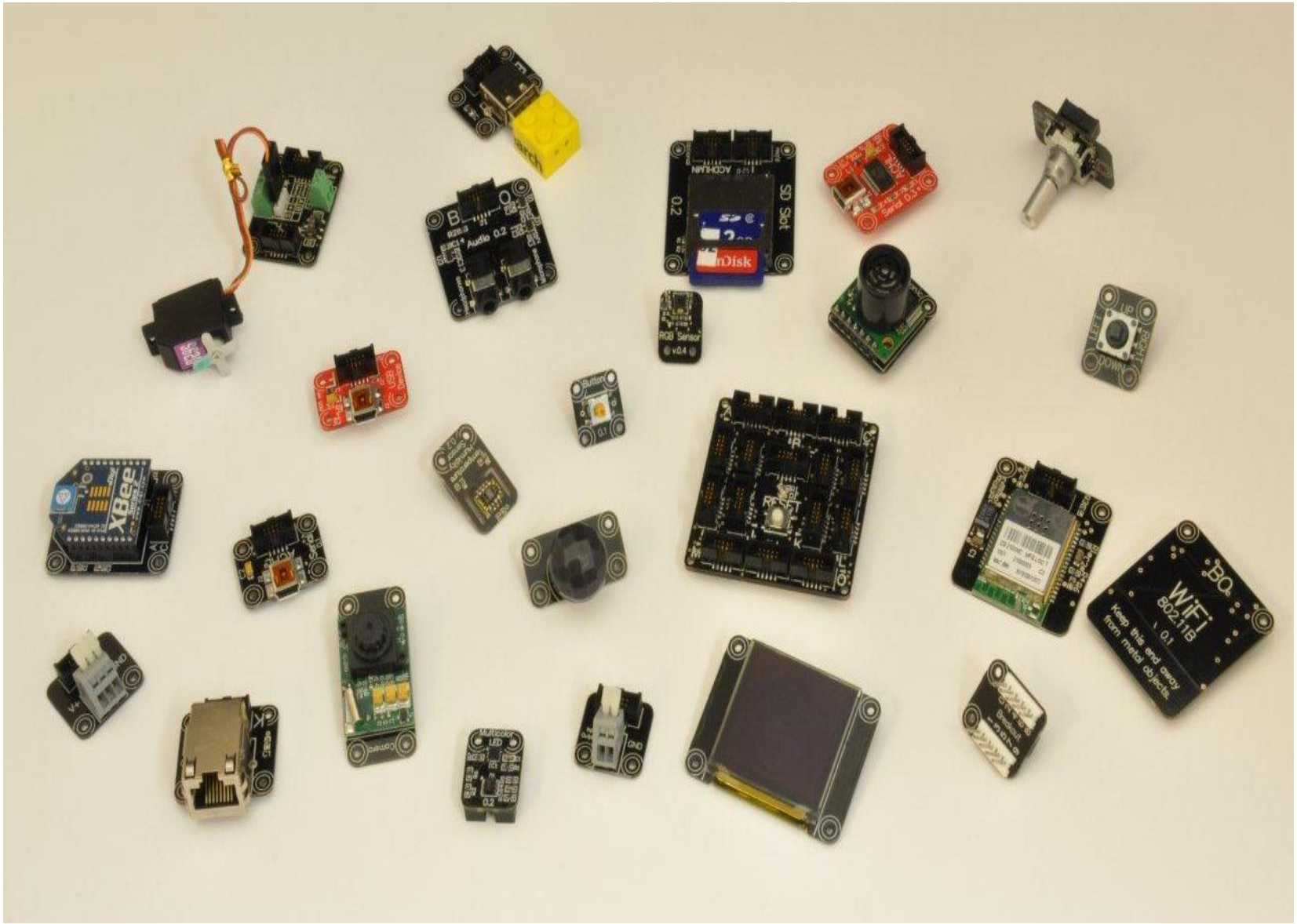
Modular Hardware



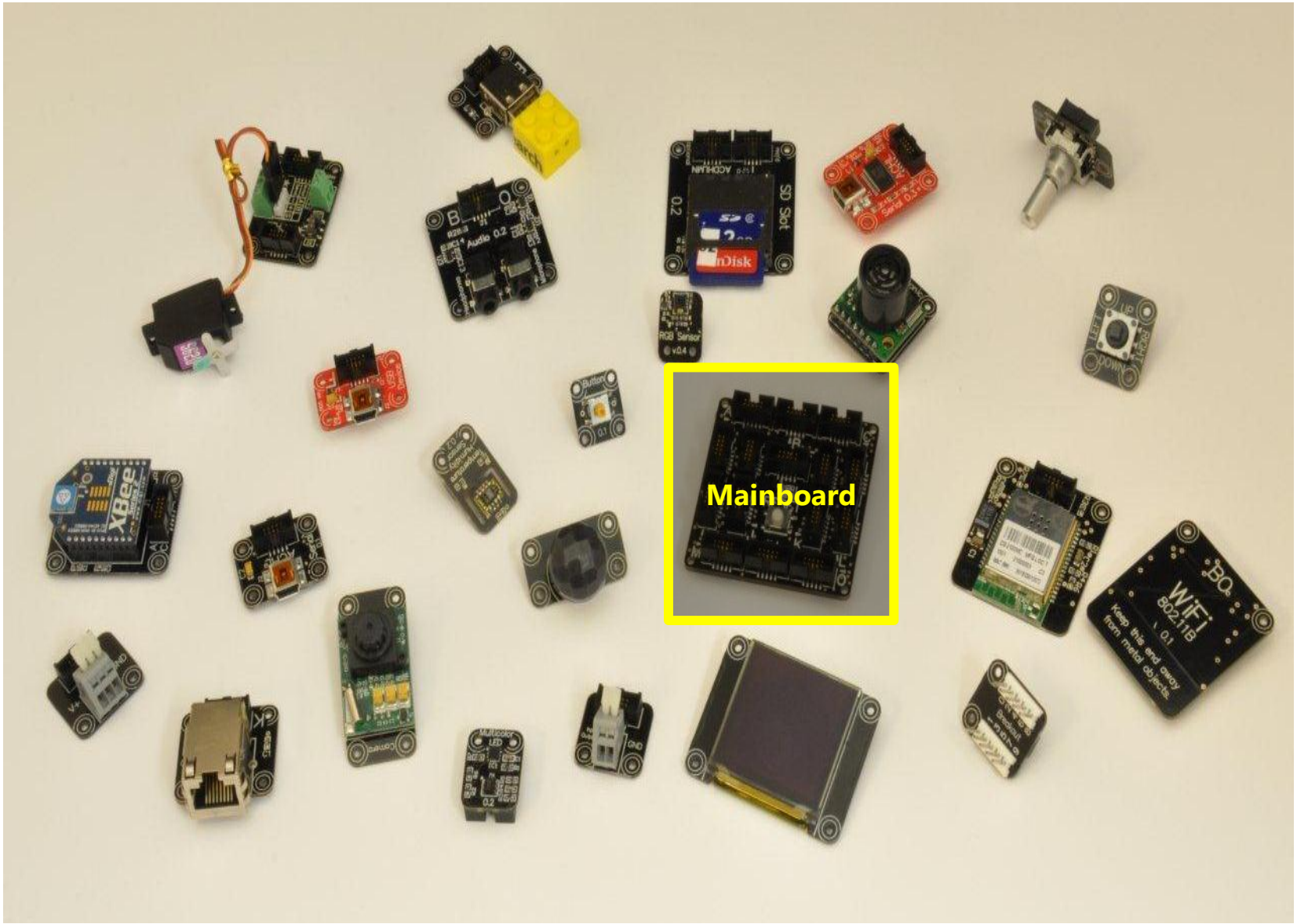
Quick example: Building a digital camera



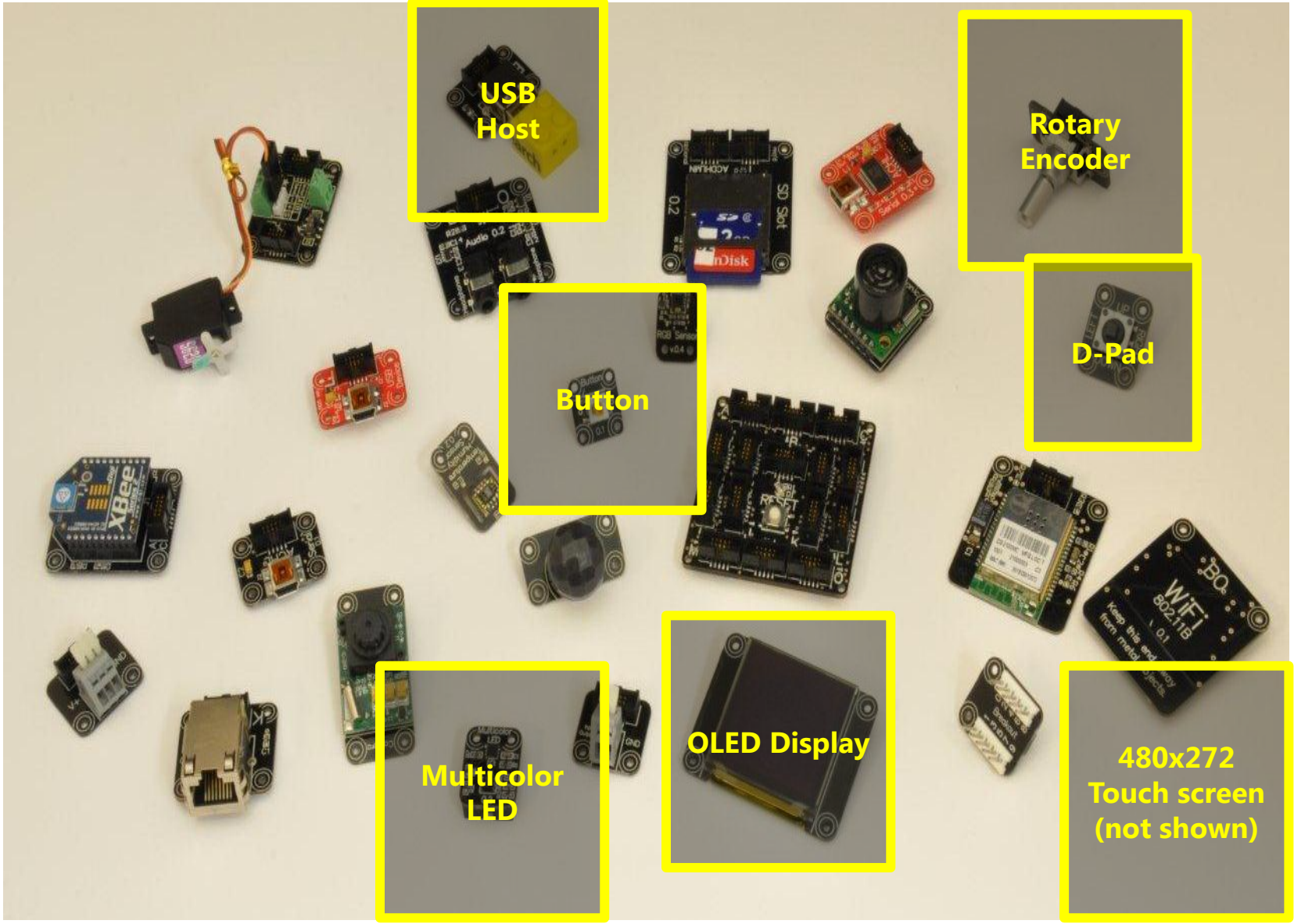
Some existing hardware modules



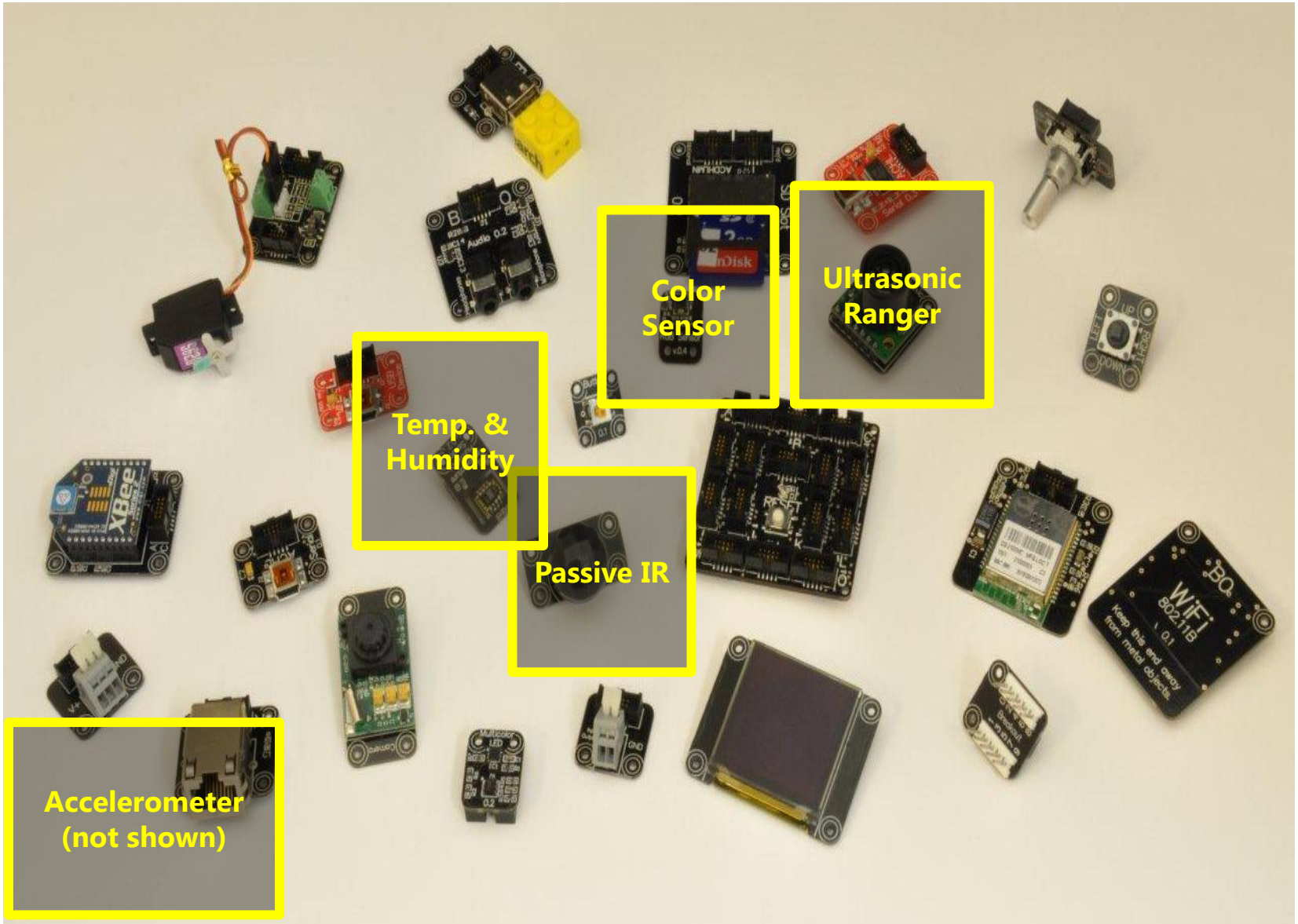
Mainboard: Core processing unit



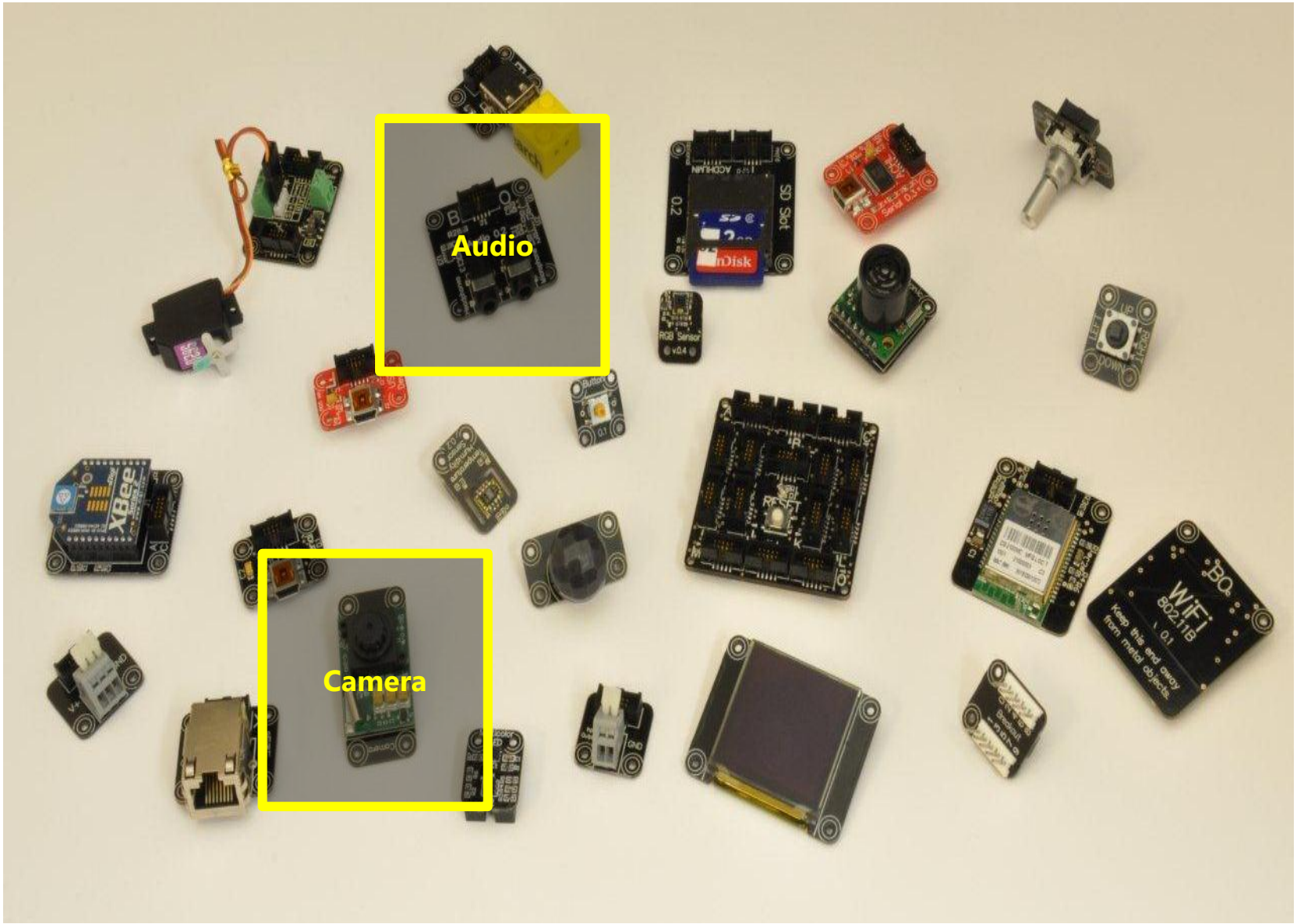
User interface modules



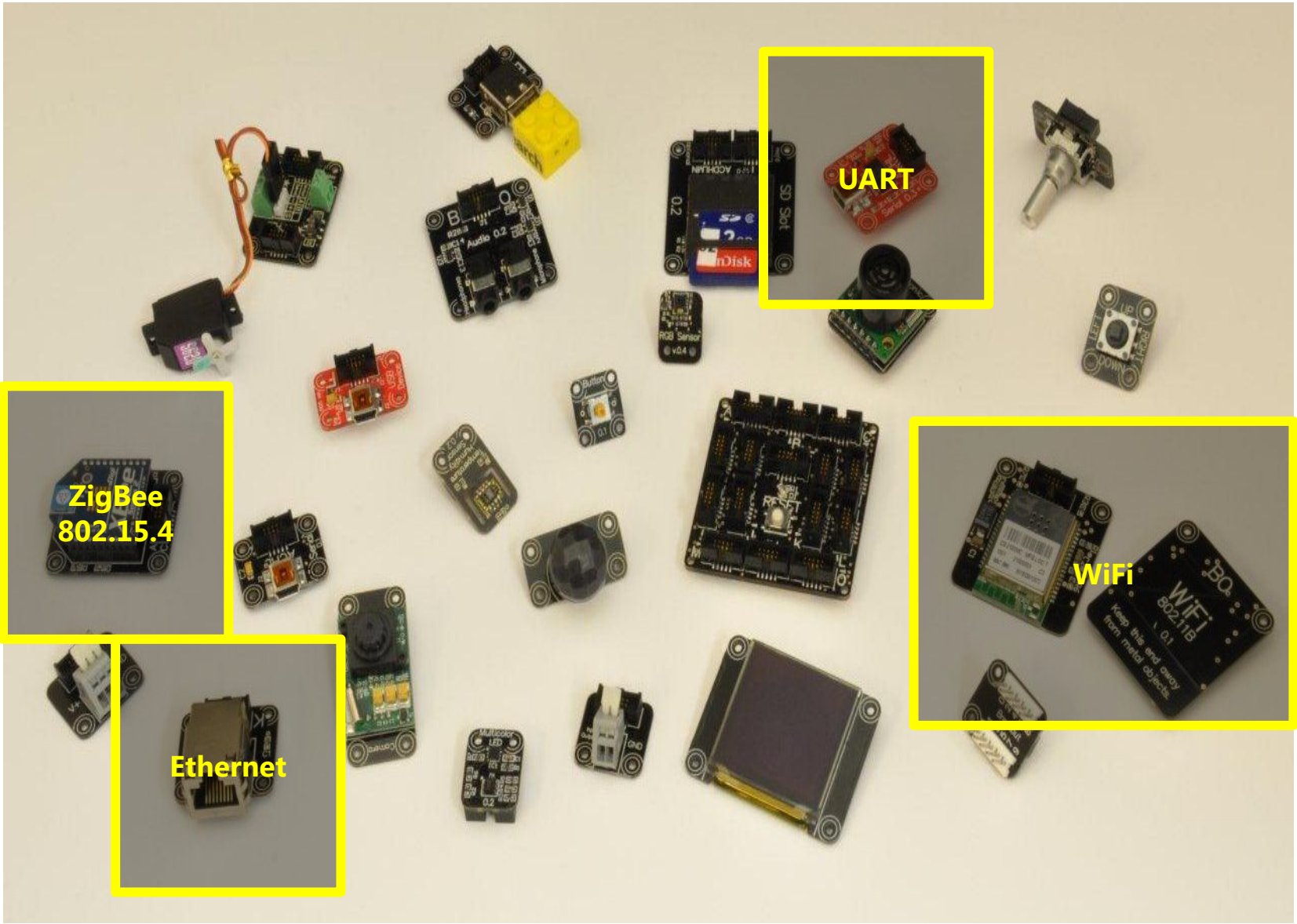
Sensor modules



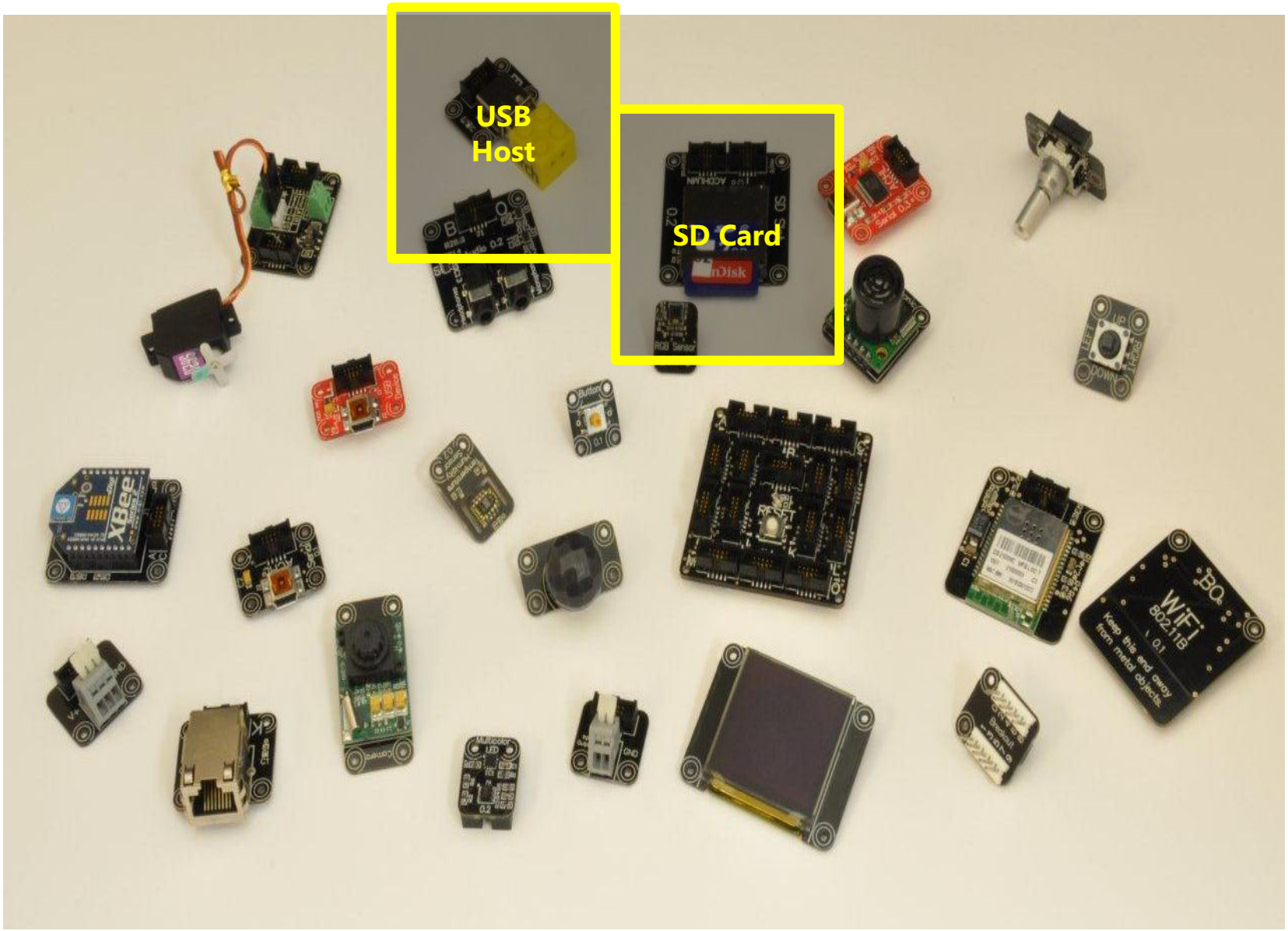
Multimedia modules



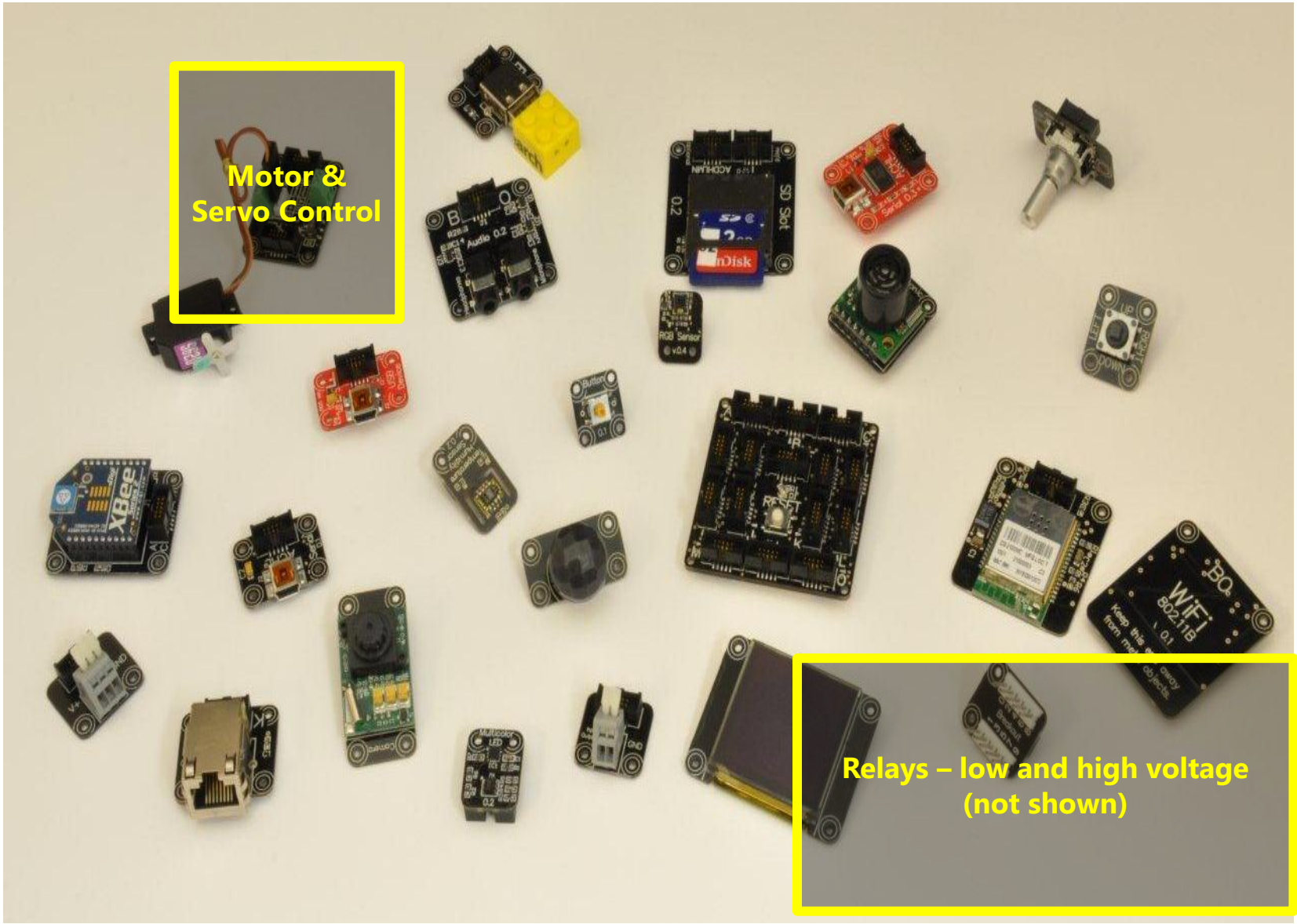
Networking modules



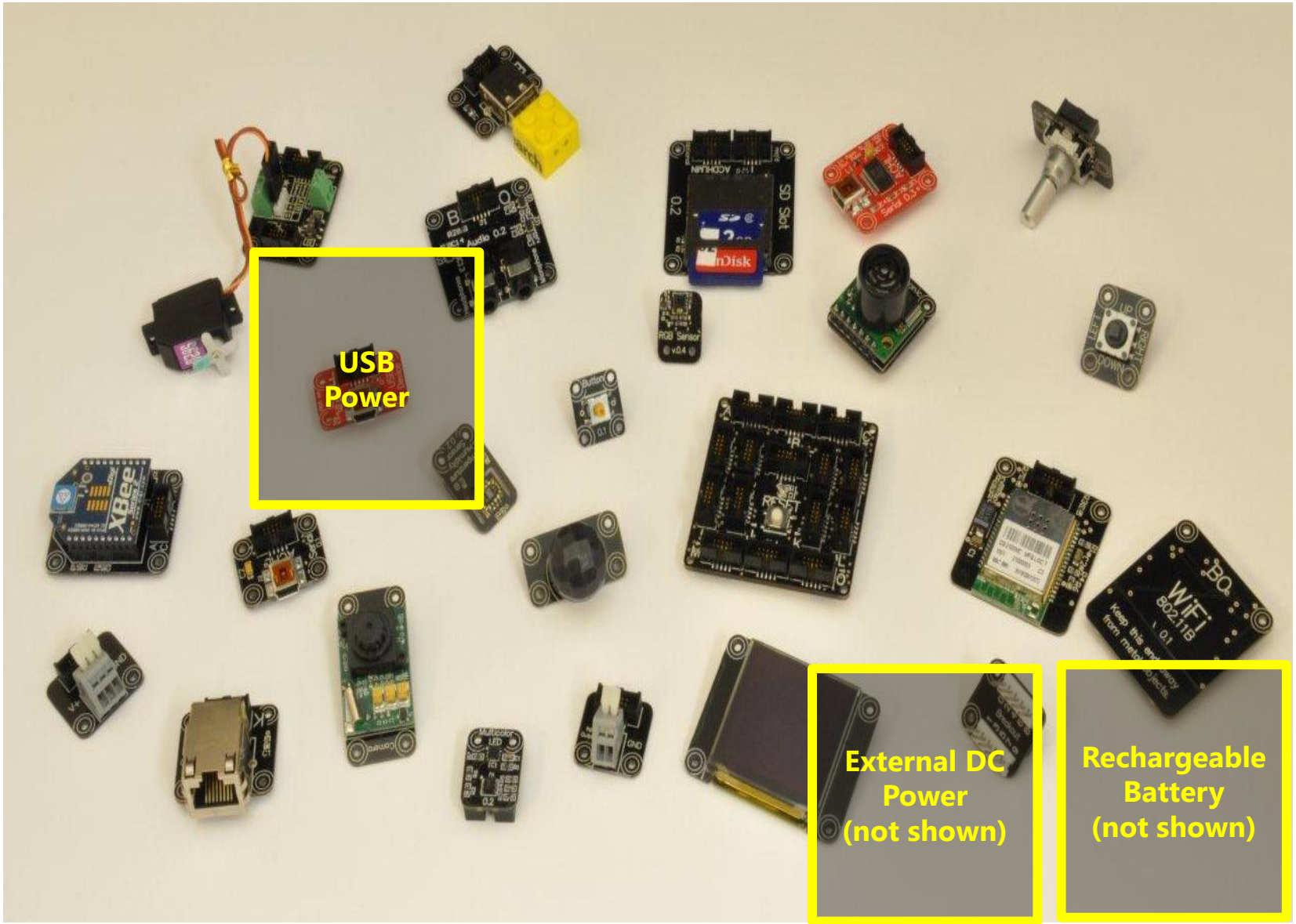
Storage modules



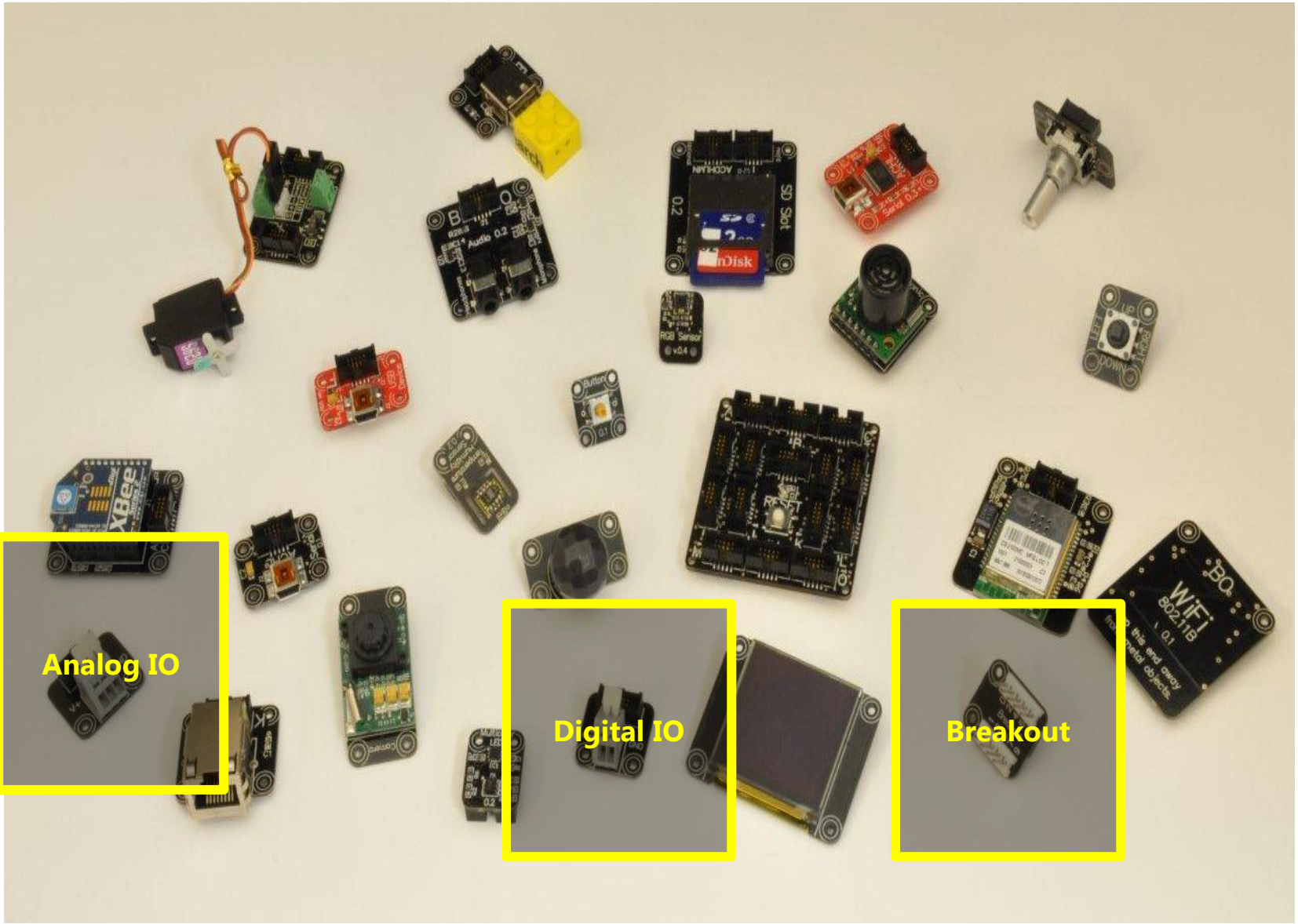
Actuator modules



Power supply modules



Extensibility modules



Second key component of .NET Gadgeteer

Object-Oriented Programming

```
void ProgramStarted()
{
    // Initialize GTM.Modules and ev
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    myButton.

    // Do one
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}
```
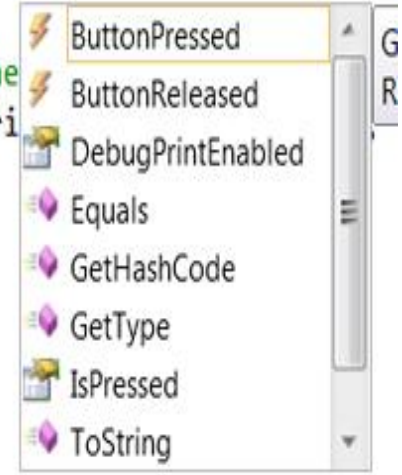
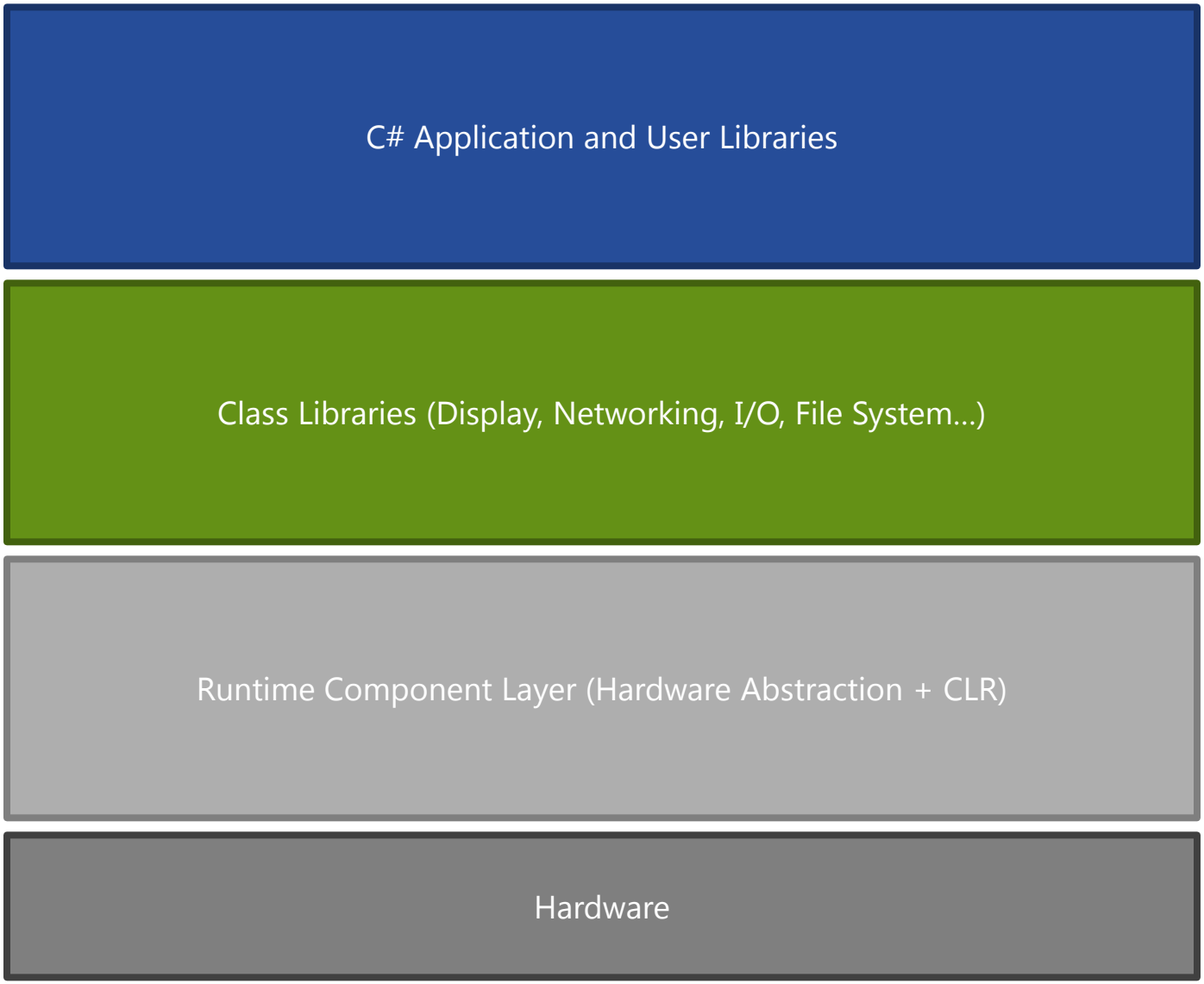



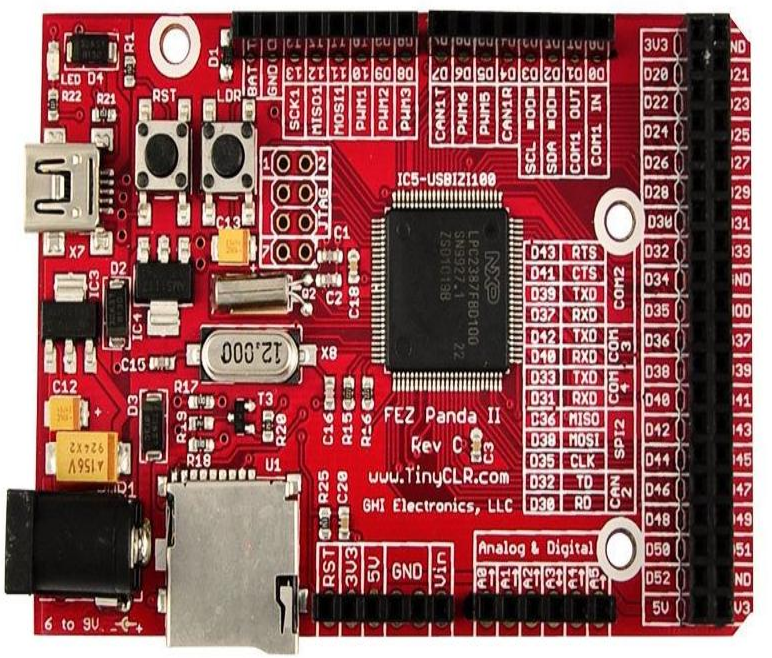
Software Development Libraries

- Gadgeteer uses the **Microsoft .NET Micro Framework** (NETMF), which provides a simple and powerful way to write software for small devices
- Software is developed and debugged in **Visual Studio**, and code is in managed, object-oriented **C#**
- The **Gadgeteer SDK** provides classes encapsulating functionality for individual hardware modules as well as other utility functions

.NET *Micro* Framework



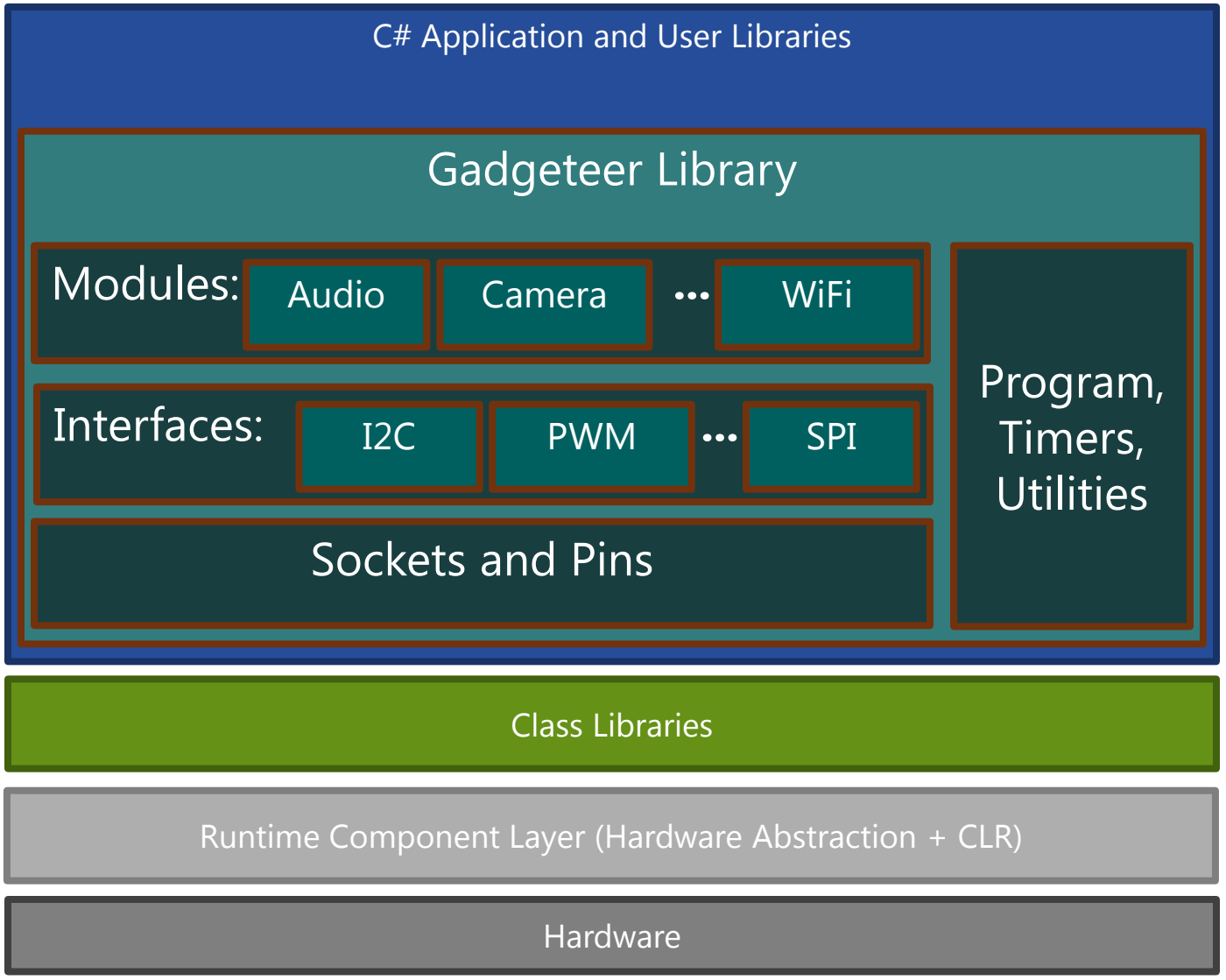
Other .NET Micro Framework Devices



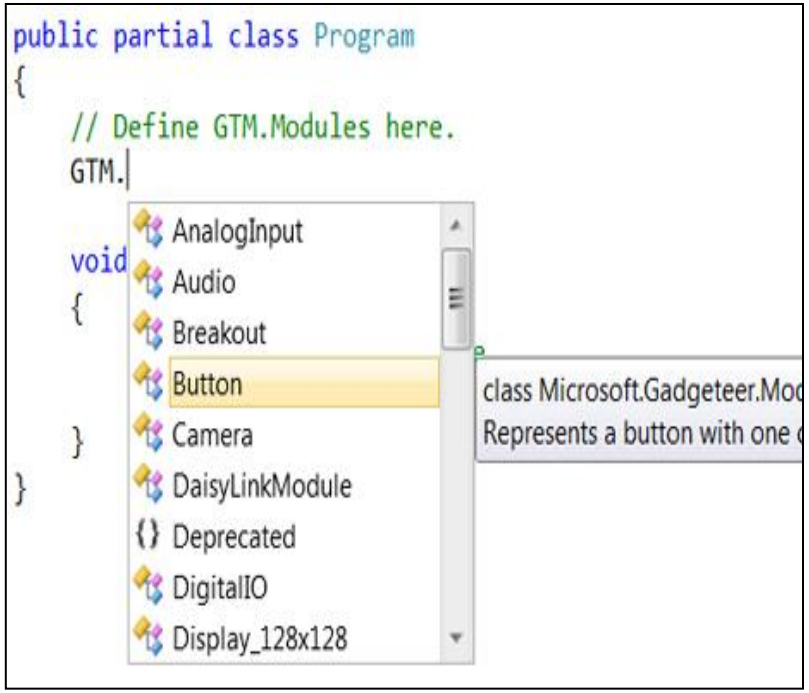
FEZ (GHI Electronics)

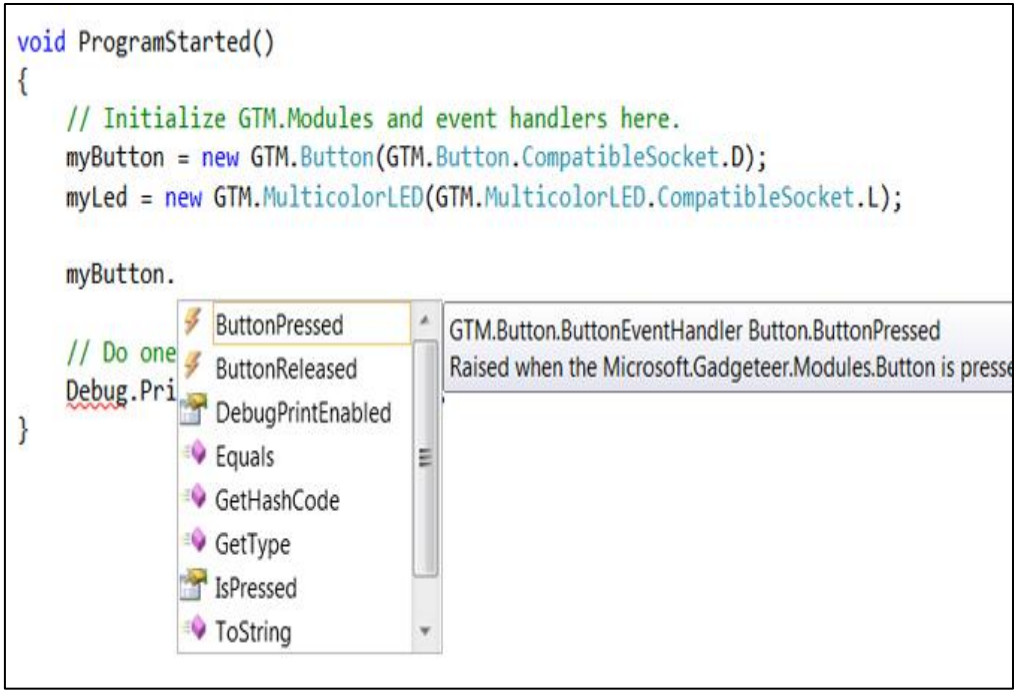
Netduino (Secret Labs)

Gadgeteer SDK



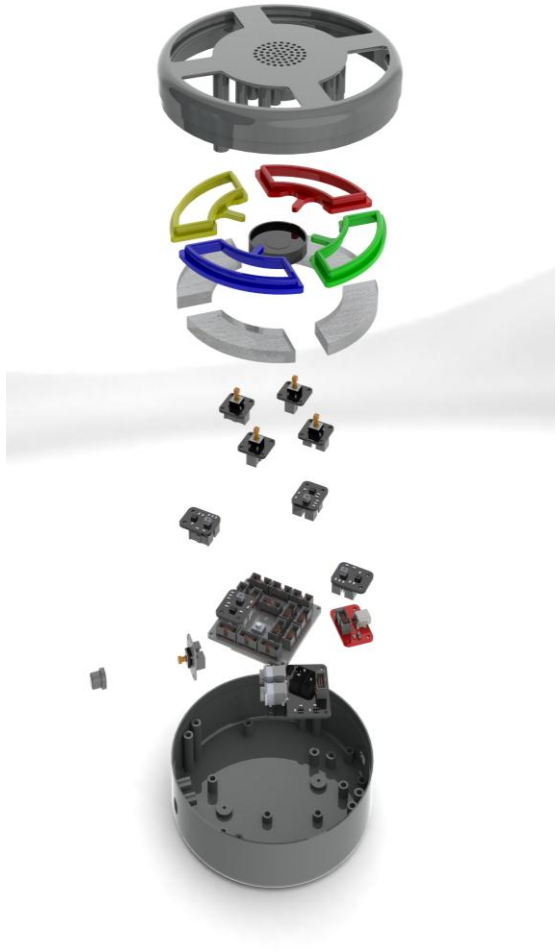
Development support from Visual Studio tools



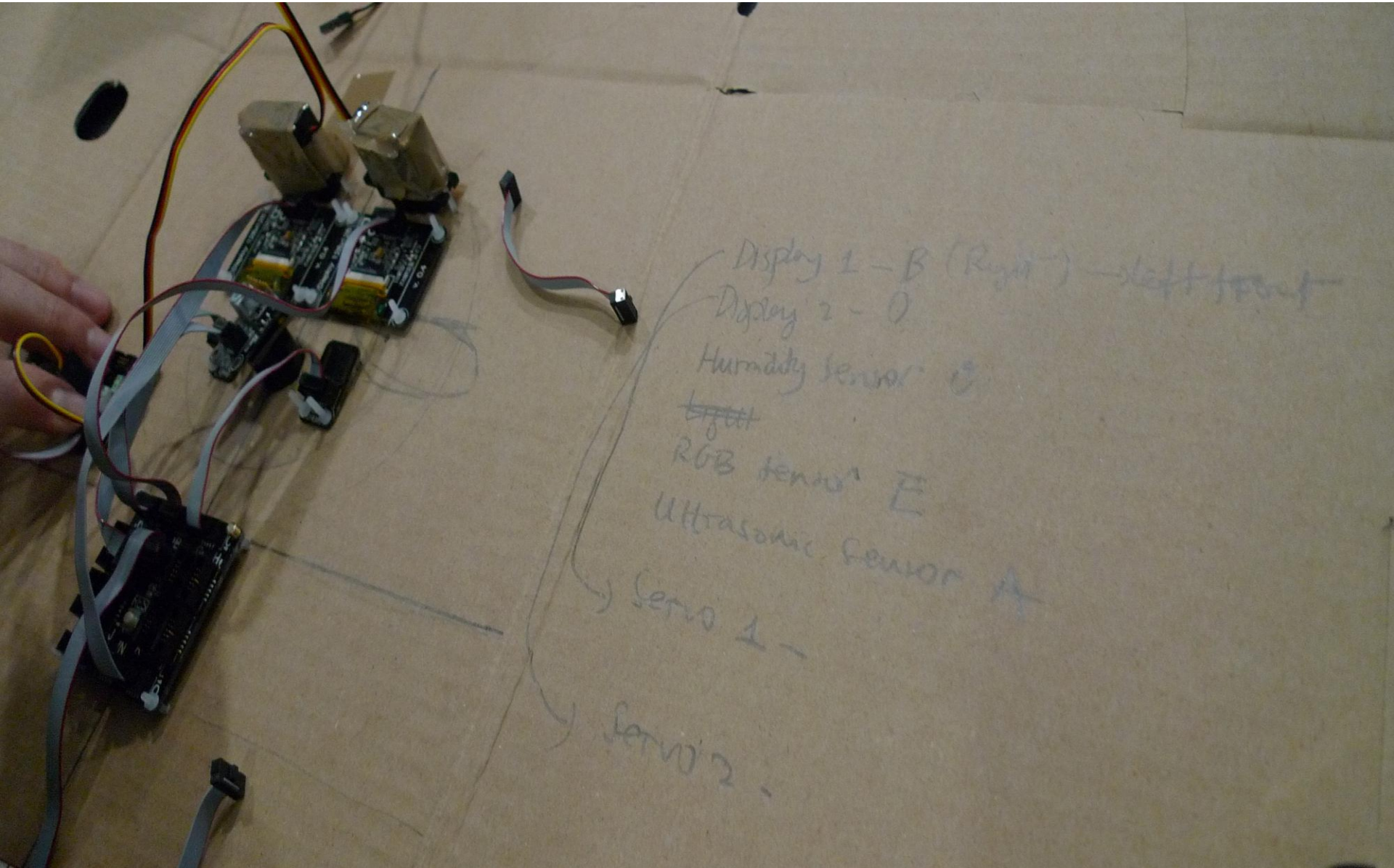


Third key component of .NET Gadgeteer

Digital Design and Rapid Manufacture



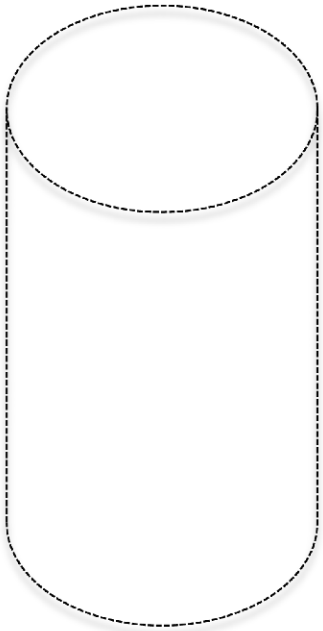
Cardboard prototyping



Cardboard prototyping

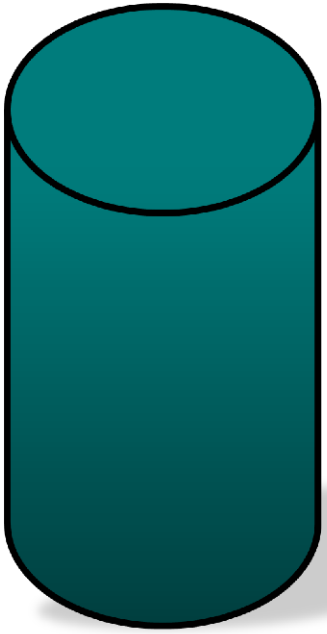
Digital design and rapid manufacture

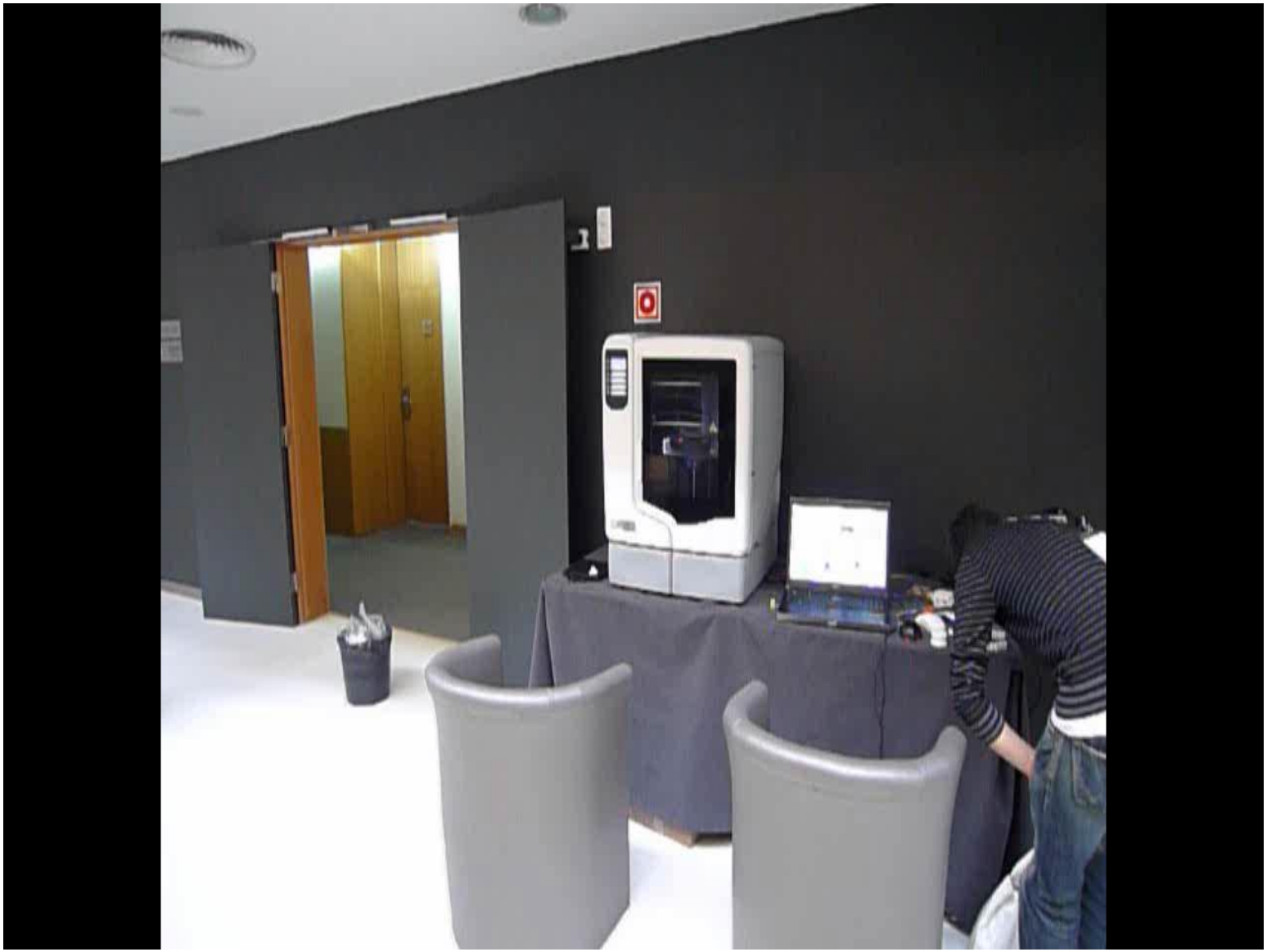
Digital Design



3D Printer

Physical Object



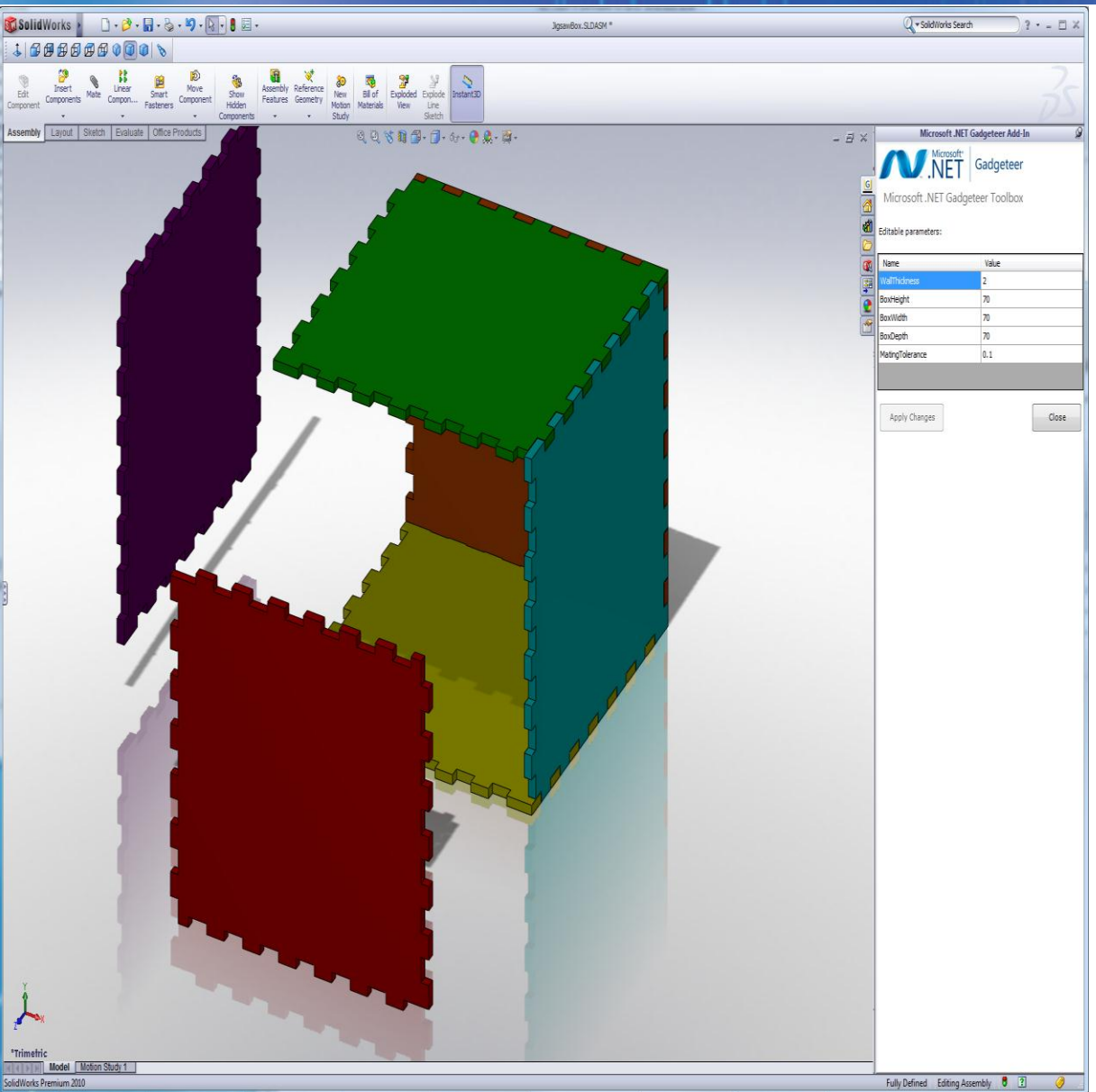


Falling cost and increasing availability of 3D printers

$100,000

$1000

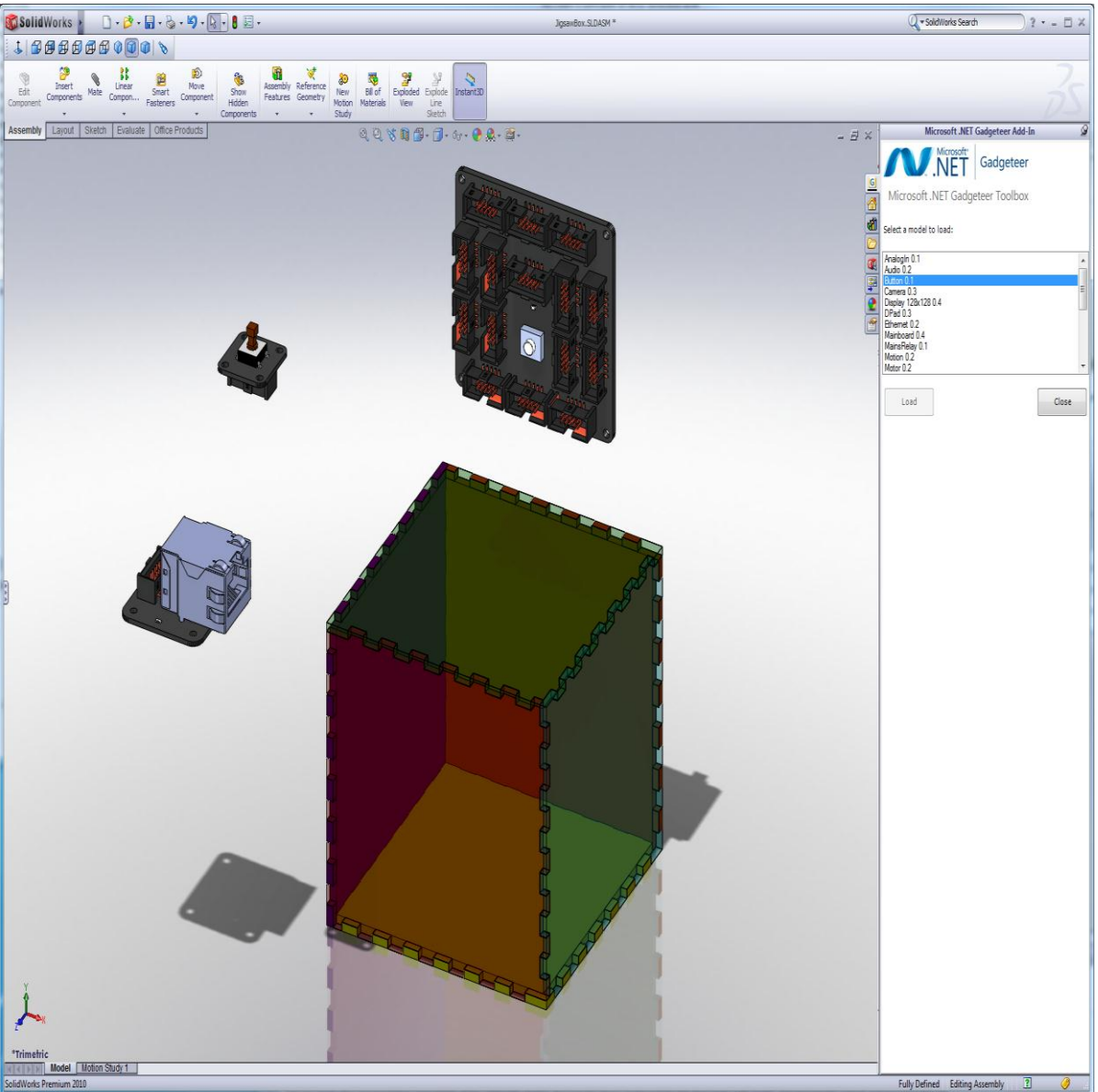
Integration of .NET Gadgeteer with 3D Modeling Tools



Reference
Case Templates

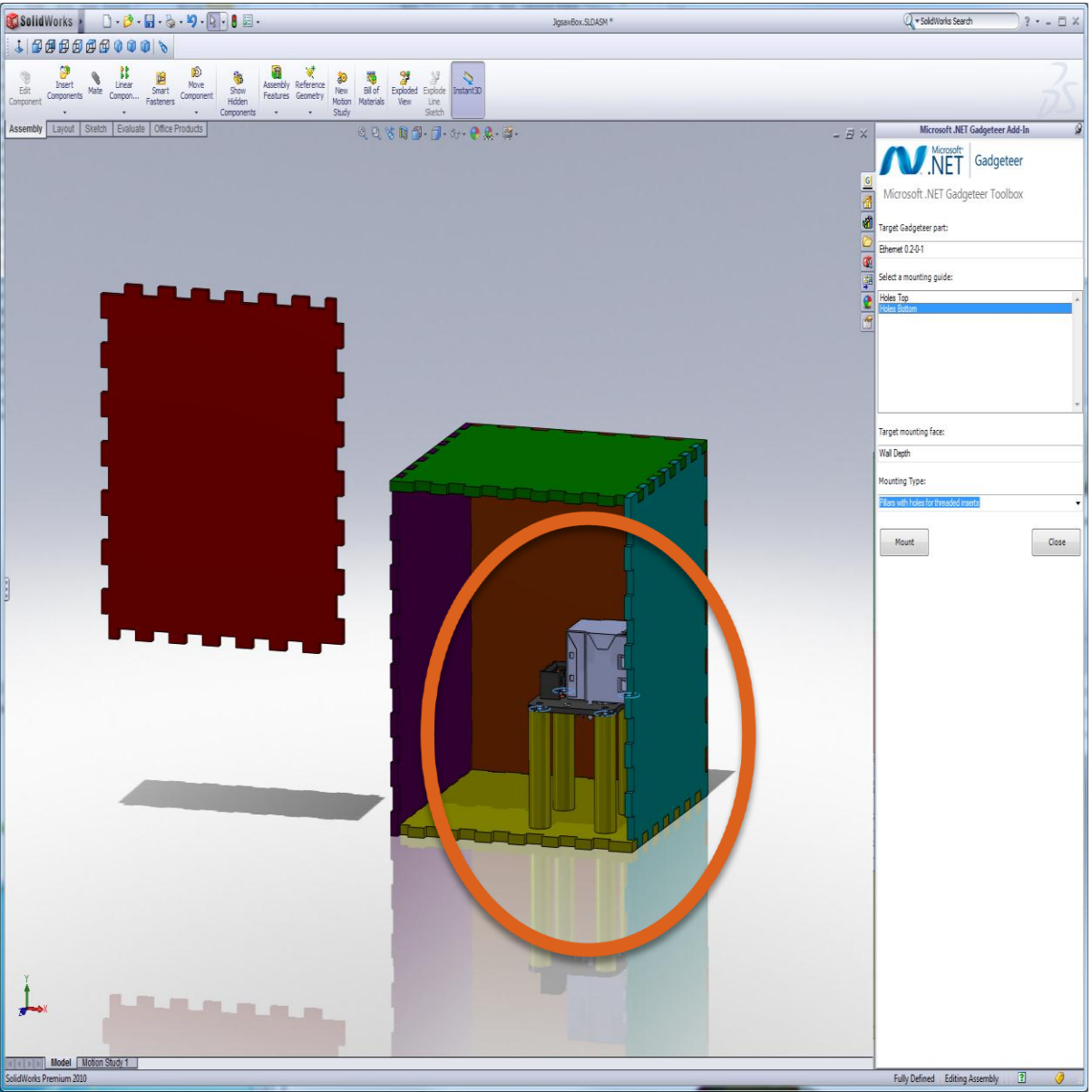
("Jigsaw Box" Template)

Integration of .NET Gadgeteer with 3D Modeling Tools



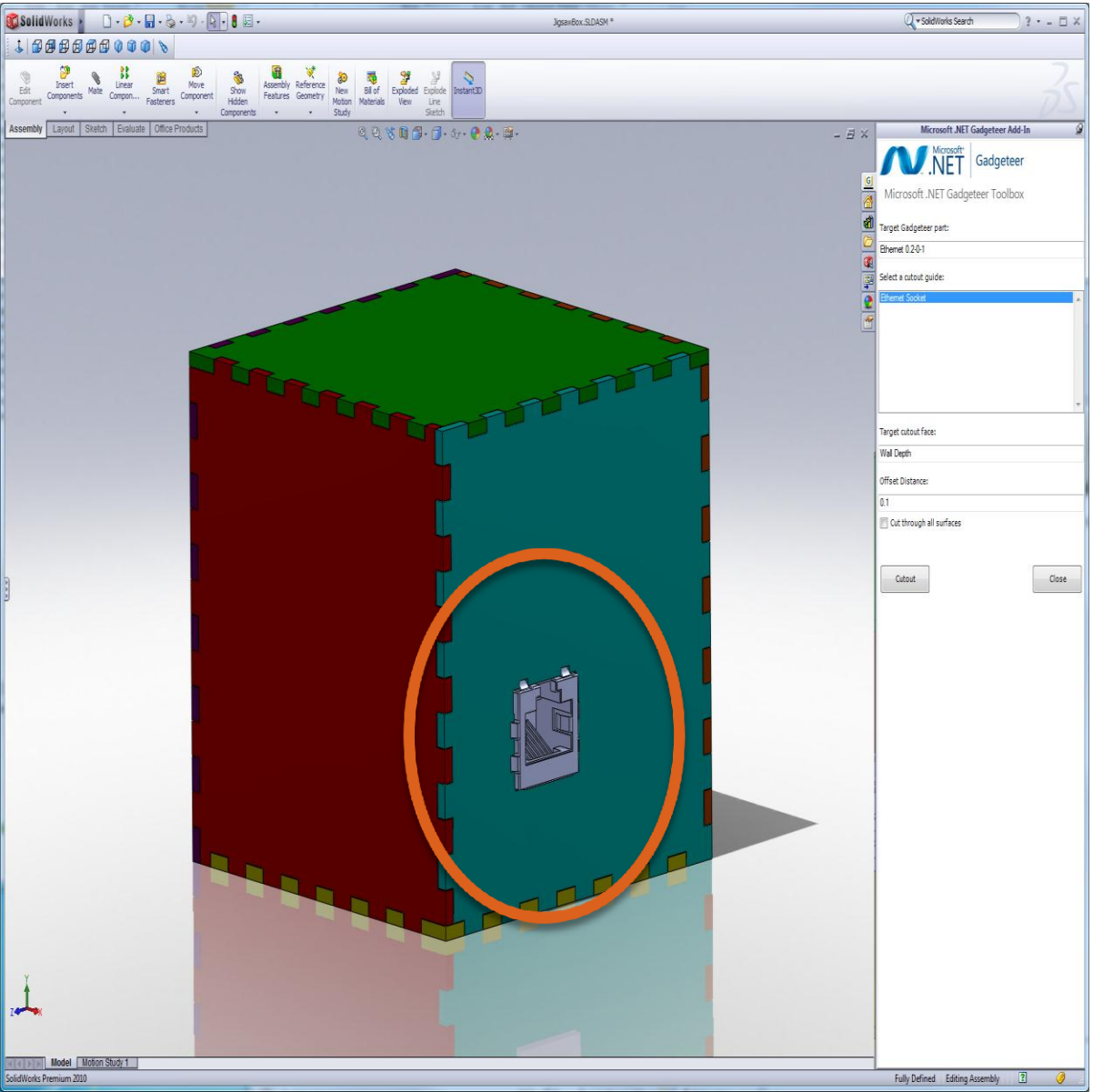
Adding digital models of Gadgeteer modules

Integration of .NET Gadgeteer with 3D Modeling Tools



Automatically generating mounting features

Integration of .NET Gadgeteer with 3D Modeling Tools

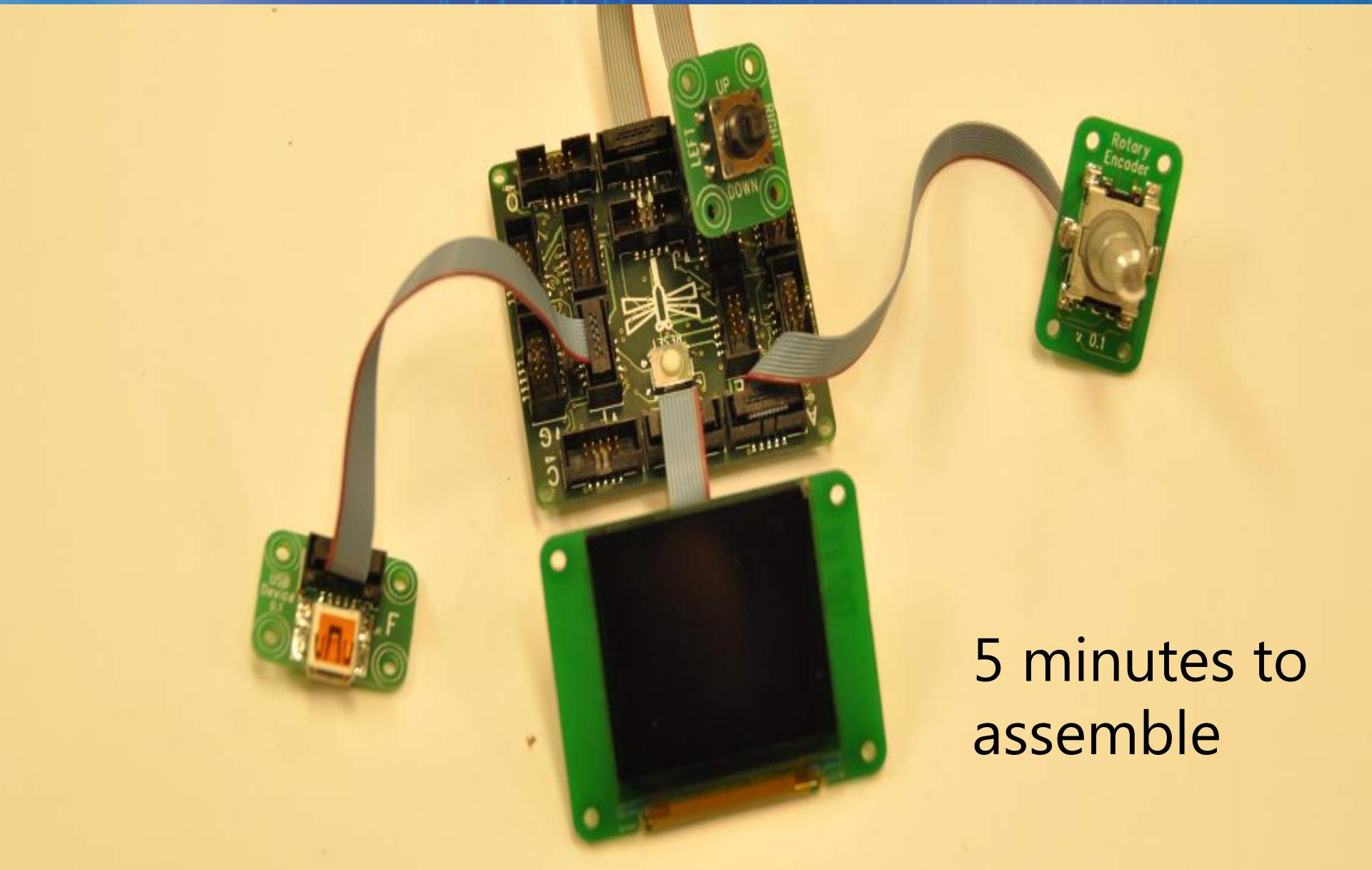


Automatically generating cutouts

Tying it all together

Making a handheld gaming device in less than 24 hours

Hardware configuration



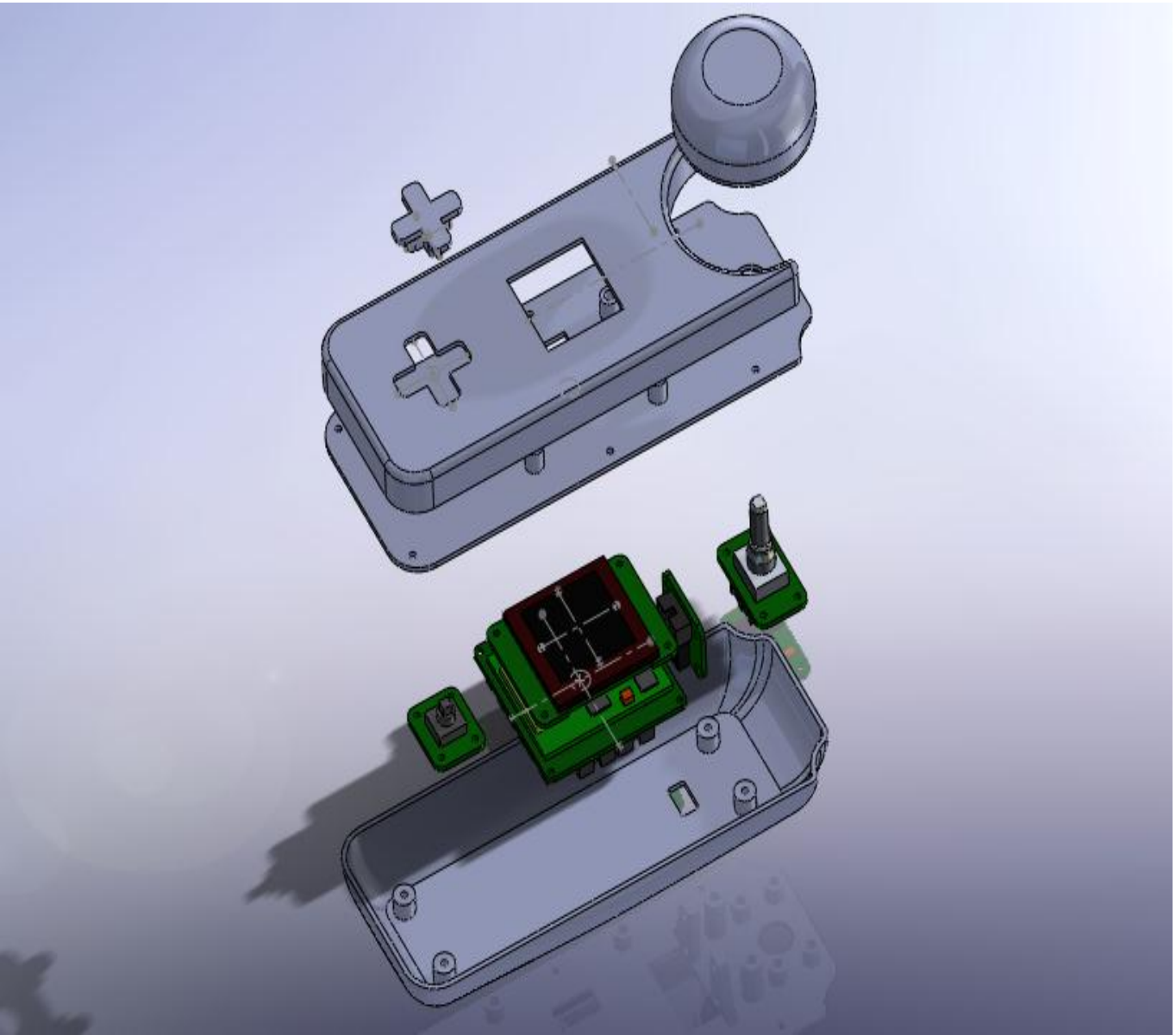
5 minutes to assemble

Software development in C#

```
public class Piece
{
    public Point[] positions;
    public Point displacement;
    public Color color;

    public Piece(Point[] positions, Point displacement, Color color)
    {
        this.positions = positions;
        this.displacement = displacement;
        this.color = color;
    }

    public void Rotate(bool clockwise)
    {
        for (int i = 0; i < positions.Length; i++)
        {
            Point oldpos = positions[i];
            positions[i].x = clockwise ? -oldpos.y : oldpos.y;
            positions[i].y = clockwise ? oldpos.x : -oldpos.x;
        }
    }

    public Piece Clone()
    {
        Piece clone = new Piece((Point[])positions.Clone(), new Point(displacement.
        return clone;
    }

}
```

5 hours to write and debug code

Case design

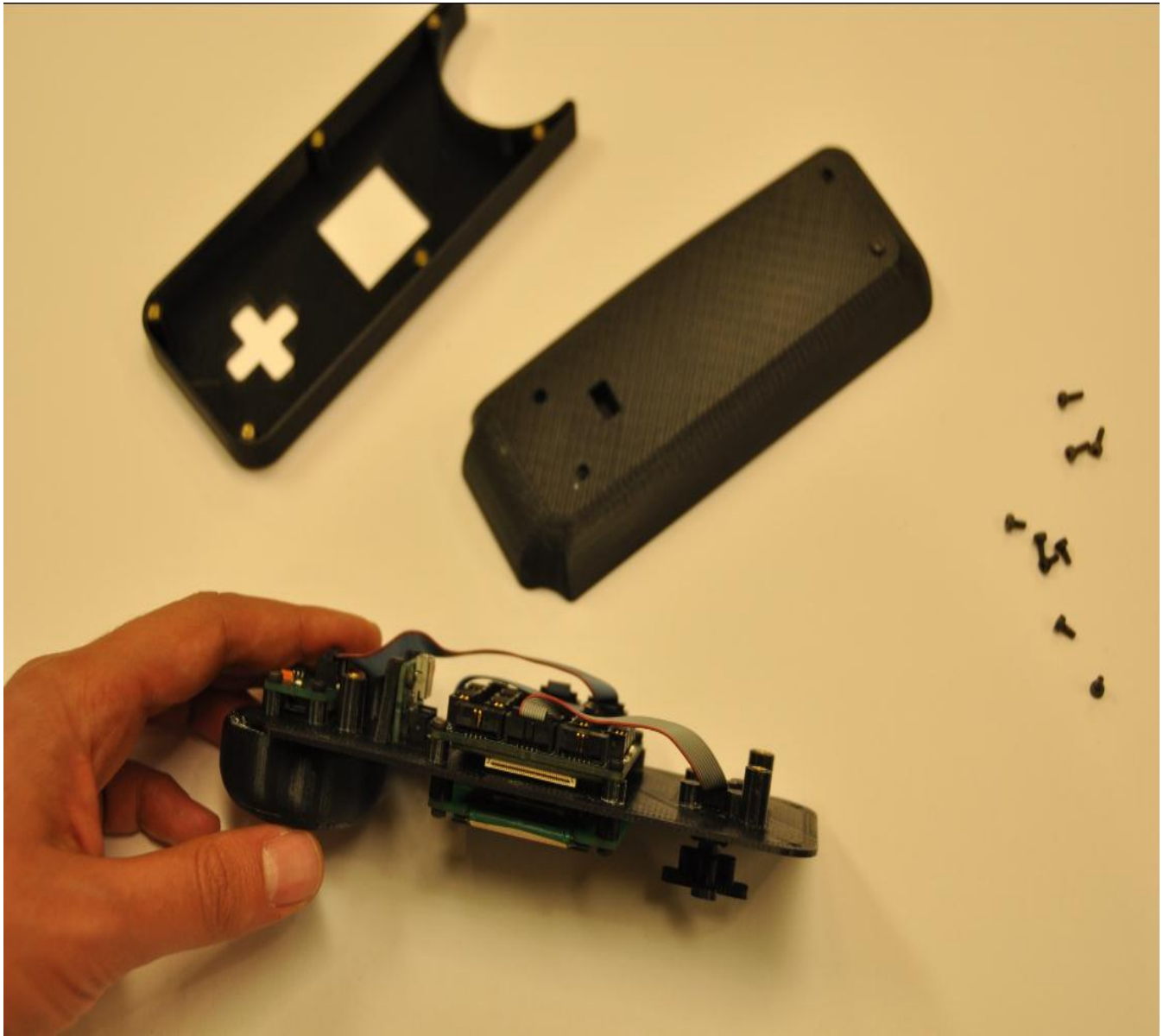


3 hours to design a custom case

3D printing

6 hours to 3D print case

Final assembly



30 minutes to assemble

A fully functional device in less than 24 hours

Next steps: Getting .NET Gadgeteer out of the lab

- .NET Gadgeteer software, hardware design and design guidelines released as open source project:
  http://gadgeteer.codeplex.com/

- Community site (in development):
  http://netmf.com/gadgeteer

Next steps: Getting .NET Gadgeteer out of the lab

- Working with a number of hardware manufacturers who will build, distribute and sell the hardware modules
- Initial availability expected end of July
- Started kit priced around $250
- More modules to become available from different manufacturers during the rest of the year

More information

Please get in touch if you are interested in using .NET Gadgeteer for research or teaching

gadgeteer@microsoft.com