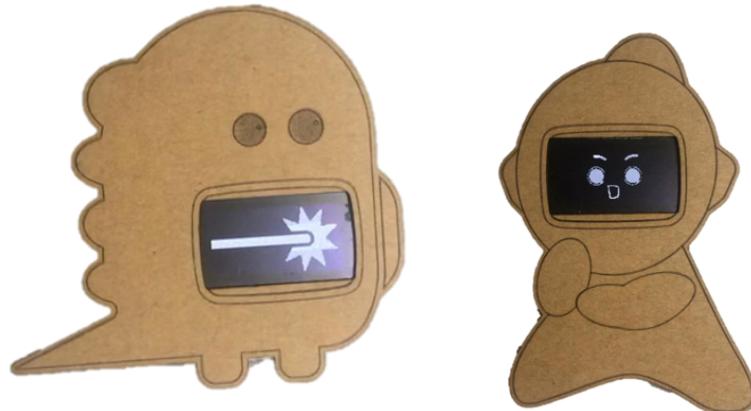


# **ezDisplay**

## **ezDisplay Kit**



## **User Guide**

By

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*Revision 1.1  
© August 2021*

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## 1.0 Getting Started



**Congratulations for purchasing the ezDisplay kit for yourself!**

Parts available in ezDisplay Kit:

**ezDisplay + USBasp Programmer**



**Cardboard characters/patterns**



**Follow the below steps to get started**

### **Step 1 Arduino IDE Download**

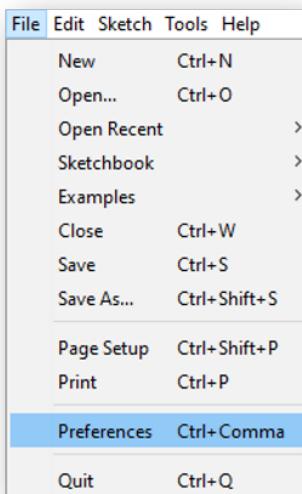
Download Arduino IDE on your PC: <https://www.arduino.cc/en/software>

## Downloads

The screenshot shows the Arduino IDE download page. On the left, there's a teal square icon with a white infinity symbol and a plus sign. Next to it, the text "Arduino IDE 1.8.15" is displayed. Below this, a paragraph explains what the IDE does: "The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board." A link to the "Getting Started" page is provided for installation instructions. Another section discusses source code development, mentioning GitHub and PGP-signed archives. On the right, a teal sidebar titled "DOWNLOAD OPTIONS" lists download links for various platforms: Windows (Win 7 and newer, ZIP file, app), Linux (32 bits, 64 bits, ARM 32 bits, ARM 64 bits), and Mac OS X (10.10 or newer). Release notes and checksums are also available.

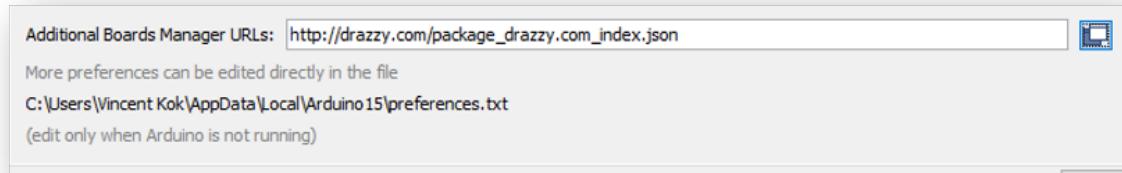
### **Step 2 Install Attiny 85 Board Support Package**

Go to *File > Preferences*



Attiny85 Board Manager URL: [http://drazzy.com/package\\_drazzy.com\\_index.json](http://drazzy.com/package_drazzy.com_index.json)

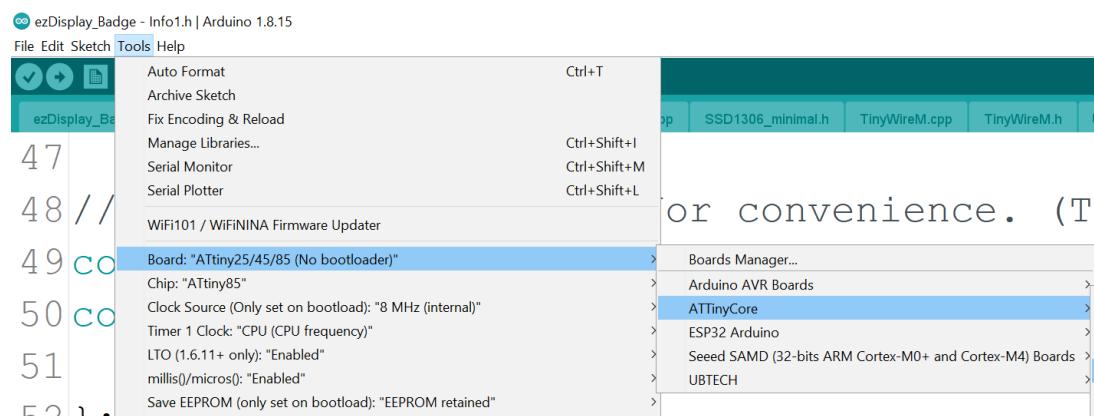
Enter the above URL in "Additional Boards Manager URLs"



Go to Tools > Board > Board Manager and select "ATTinyCore by Spence Konde" and click "Install". Current version is 1.5.2 (14th August 2021)



Upon successful installation, you will see the AttinyCore under **Tools > Board**



### **Step 3: Hardware Setup and USBasp driver installation**

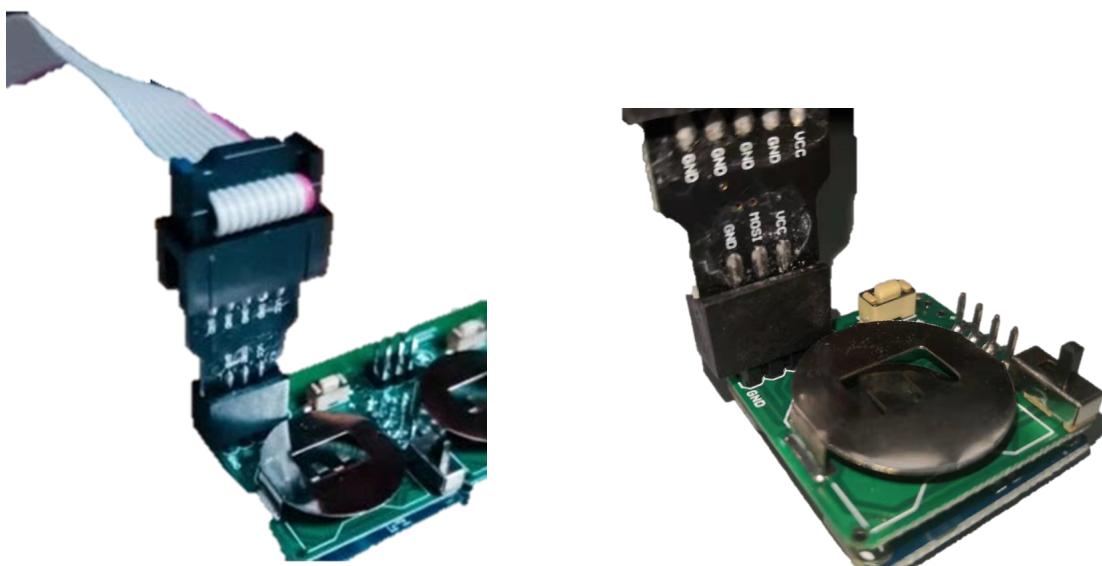
#### **Hardware Setup**

Connect the ezDisplay to the laptop via USBasp programmer.



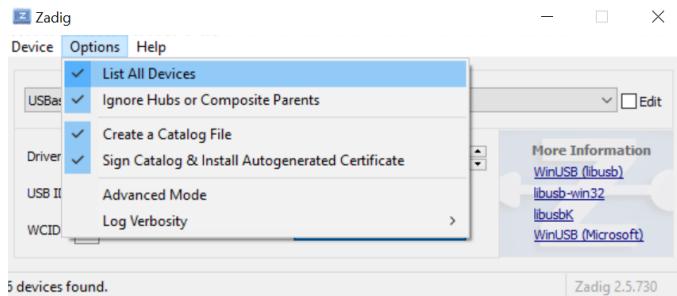
Connect the USBasp to the converter and plug it into the Programming Port.

Take note that the GND should match the GND label.

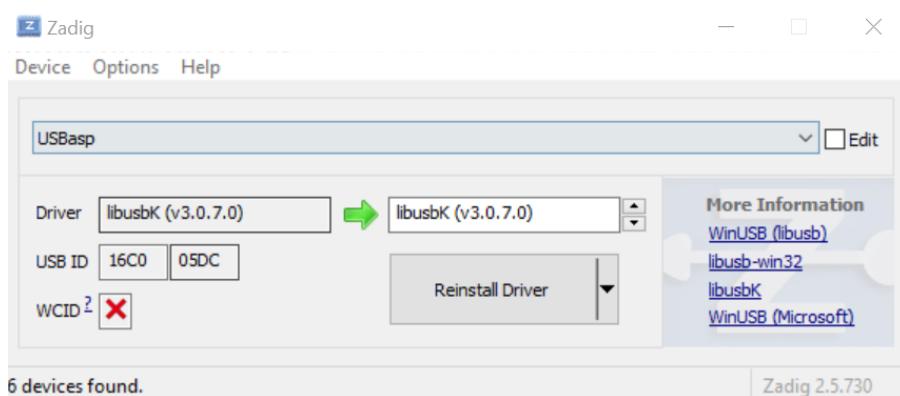


## USBasp driver installation

1. Download Zadig: <https://zadig.akeo.ie/>
2. Launch Zadig and List all devices

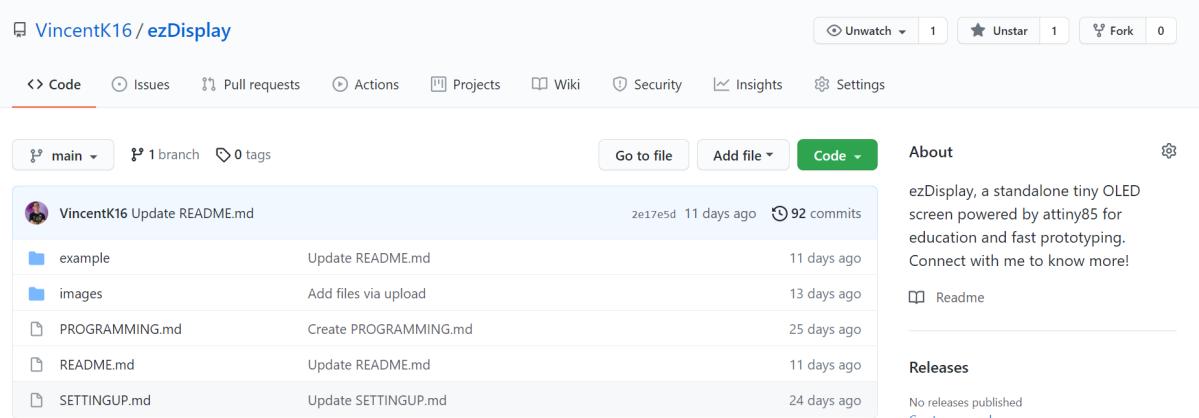


3. Find the USBasp device, libusbK driver and click on **Replace Driver/Reinstall Driver**

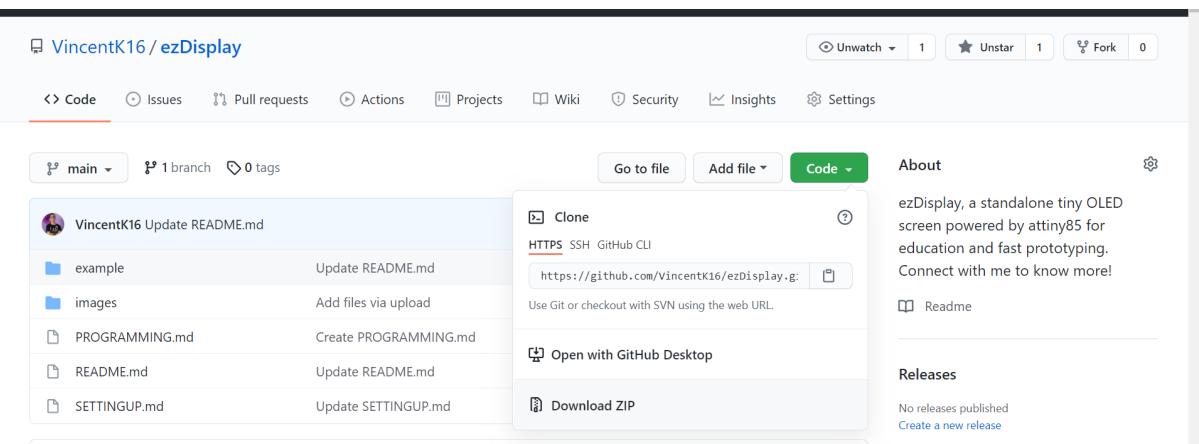


## Step 4: Clone the sample code

Browse <https://github.com/VincentK16/ezDisplay>



Click on the green “Code” button and select “Download ZIP”. This will download the whole project folder to your local disk.



Proceed to unzip the folder.



**ezDisplay-main.zip**

**p**

You will see the file structure below.

## ezDisplay-main

---

Name
example
images
PROGRAMMING.md
README.md
SETTINGUP.md

### Repo structure:

```
example
├── ezDisplay_Badge (Arduino sample code)
│   └── bitmap_samples (BMP format images used for sample)
PROGRAMMING.md (Guide on how to program ezDisplay)
SETTINGUP.md (Guide on how to set up the programming environment, Attiny 85 board installation etc...)
```

### Step 5: Open the example “ezDisplay\_Badge”

Go to *example > ezDisplay\_Badge*, and open the Arduino file “**ezDisplay\_Badge.ino**”

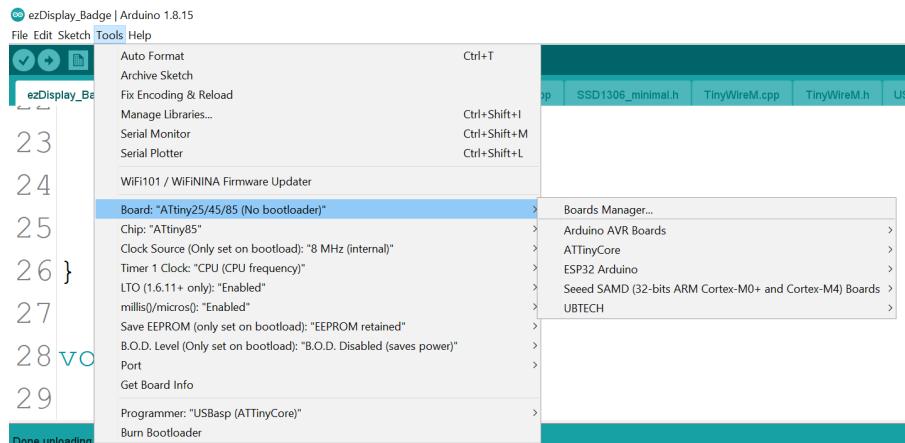
ezDisplay-main > example > ezDisplay\_Badge

---

Name
ezDisplay_Badge.ino
Info1.h
Info2.h
Info3.h
Info4.h
Info5.h
SSD1306_minimal.cpp
SSD1306_minimal.h
TinyWireM.cpp
TinyWireM.h
USI_TWI_Master.cpp
USI_TWI_Master.h

## Step 6: Arduino IDE Configuration

Before you upload, make sure your configuration of the board is correct in **Tools > Board**



**Board:** “Attiny25/45/85 (No bootloader)”

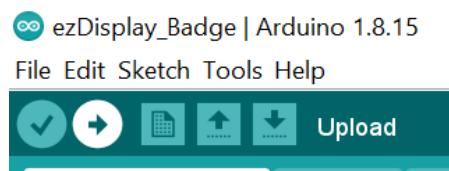
**Clock:** “8 MHz (Internal)

**Programmer:** USBasp (AttinyCore)

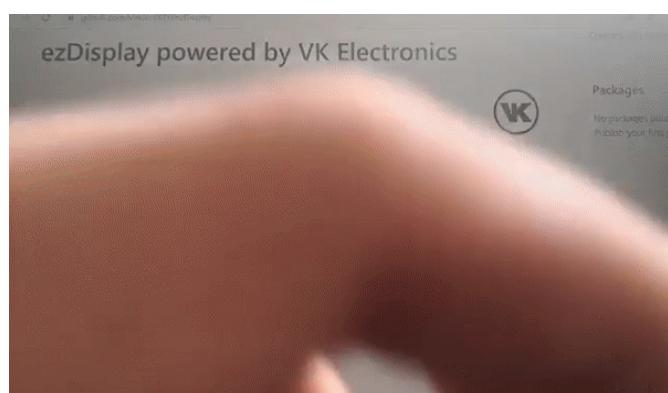
*For AttinyCore version 1.5.2*

## Step 7: Upload the code

Once configuration is done, proceed to upload the sample code by pressing on the “Upload” button. It will take about 15 - 30 seconds to upload.



Once uploaded, you will be able to see the expected output as shown below:



### **Step 8: Install to cardboards patterns**

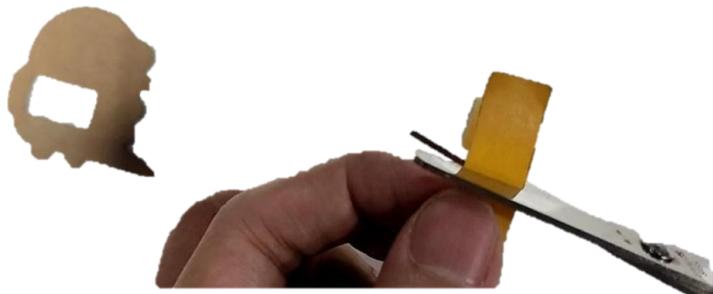
1. Get your cardboard pattern ready.



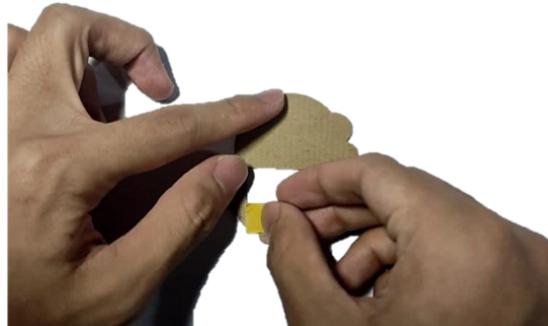
2. Turn to the other side of the cardboard pattern.



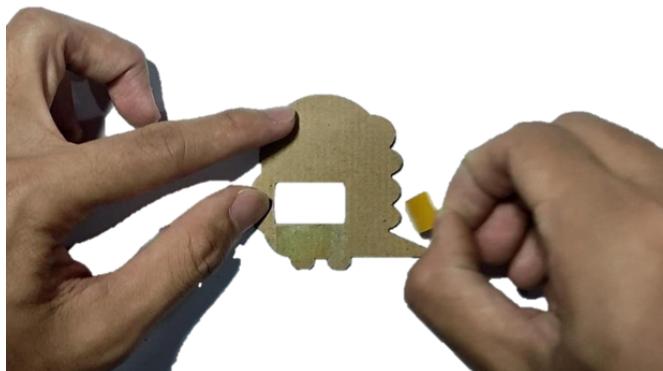
3. Cut out a small piece of double sided tape



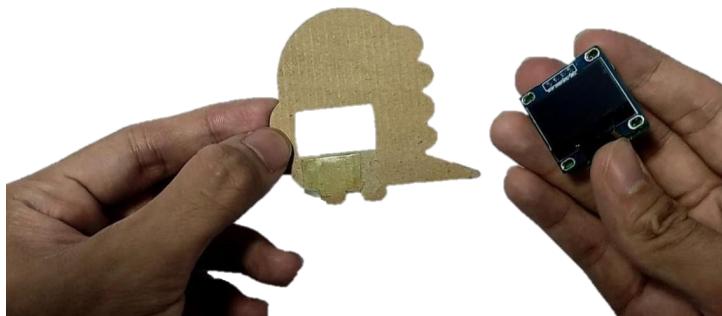
4. Stick it on the cardboard pattern



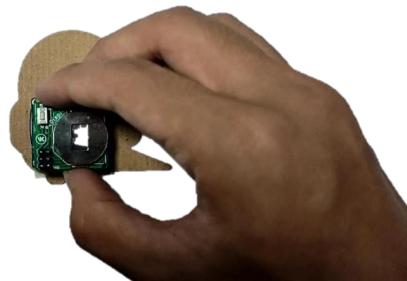
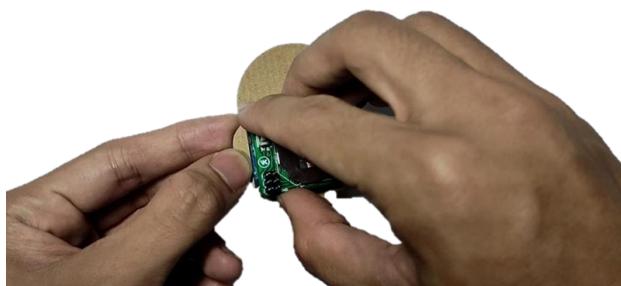
5. Peel off the double sided tape



6. Prepare your ezDisplay



7. Stick the ezDisplay onto the cardboard pattern



8. Taddaaaa! You have successfully installed the ezDisplay to the cardboard pattern.



## 2.0 Additional - How to Change your own favorite characters & expression

1. Look out for the expression you want to make for the cardboard patterns and download it. For example:



2. Go to the [image2cpp](#) tool website to generate the Arduino bytes for the expression.

### image2cpp

image2cpp is a simple tool to change images into byte arrays (or your array back into an image) for use with Arduino and (monochrome) displays such as OLEDs. It was originally made to work with the Adafruit OLED library. An example sketch for Arduino and this library can be found [here](#).

More info (and credits) can be found in the [Github repository](#). This is also where you can report any [issues](#) you might come across.

This tool also works offline. Simply save this page to your computer and open the file in your browser.

#### 1. Select image

or

#### 1. Paste byte array

Choose Files Picture1.png

x  px

---

#### 2. Image Settings

Canvas size(s):

Picture1.png (file resolution: 940 x 629)  
128 x 64 glyph

3. Load the image of the expression that was downloaded.

#### 1. Select image

or

#### 1. Paste byte array

Choose Files monster-teeth-png.png

x  px

4. You can change the Image settings:

- Note that the resolution of `ezDisplay` is 128 x 64. This means that the image canvas size needs to be scaled to **128 x 64**.
  - You can also **Invert Image colors** (check on the 3. Preview)
  - For Scaling, you may choose “**stretch to fill canvas**”

*Once you are satisfied with the Image settings, proceed to the next step #5.*

## 2. Image Settings

<b>Canvas size(s):</b>	<input style="width: 200px; border: 1px solid black; border-radius: 5px; padding: 2px 5px; margin-right: 10px;" type="text" value="monster-teeth-png.png"/> (file resolution: 2655 x 1313) <input style="width: 50px; border: 1px solid black; border-radius: 5px; padding: 2px 5px; margin-right: 10px;" type="text" value="128"/> x <input style="width: 50px; border: 1px solid black; border-radius: 5px; padding: 2px 5px; margin-right: 10px;" type="text" value="64"/> glyph <input style="width: 50px; border: 1px solid black; border-radius: 5px; padding: 2px 5px; margin-right: 10px;" type="text"/> <b>remove</b>		
<b>Background color:</b>	<input checked="" type="radio"/> White <input type="radio"/> Black <input type="radio"/> Transparent <input checked="" type="checkbox"/>		
<b>Invert image colors</b>			
<b>Brightness / alpha threshold:</b>	<input type="text" value="128"/> <p>0 - 255; if the brightness of a pixel is above the given level the pixel becomes white, otherwise they become black. When using alpha, opaque and transparent are used instead.</p>		
<b>Scaling</b>	<input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="stretch to fill canvas"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="scale image"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="fit image"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="original size"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="fit to canvas"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center in canvas"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in canvas"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in view"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in window"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in screen"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in monitor"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in display"/> <input style="border: 1px solid #ccc; border-radius: 5px; padding: 2px 10px; margin-right: 10px;" type="button" value="center image in window"/> <input style="border: 1px solid #ccc; 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### 3. Preview



## 5. Generate Arduino Bytes

Right now, you need to change the **4. Output** as accordingly:

**Identifier/Prefix:** Info1

**Draw mode:** Vertical - 1 bit per pixel

Finally, click on the “**Generate Code**”. Copy the generated byte code.

## 4. Output

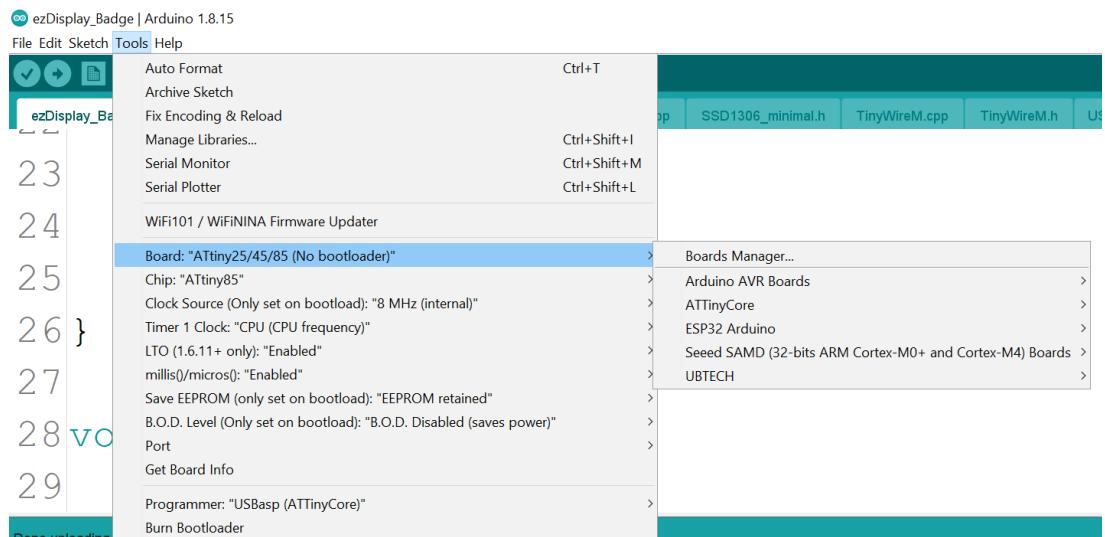
6. Paste the generated byte codes on the Arduino IDE. Replace the ***Info1.h*** with the copied items from ***image2cpp***.  
**Note:** If you are generating more than one image, you can replace ***Info2.h***, ***Info3.h*** and so on accordingly.



The screenshot shows the ezDisplay\_Badge software interface with the file Info1.h open. The code displays a PROGMEM constant array named Info1monster\_teeth\_png containing binary data representing a 128x64 pixel image of monster teeth.

```
1 // 'monster-teeth-png', 128x64px
2 const unsigned char Info1monster_teeth_png [] PROGMEM = {
3     0x00, 0x00, 0x00, 0x00, 0x00, 0xf8, 0xf8, 0xf8, 0xf8, 0xf
4     0xf8, 0xf8, 0x78, 0x38, 0x38, 0x78, 0xf8, 0xf8, 0xf8, 0xf
5     0x38, 0x78, 0xf8, 0xf8, 0xf8, 0xf8, 0xf8, 0xf8, 0xf8, 0x3
6     0xf8, 0xf8, 0xf8, 0x78, 0x18, 0x18, 0x18, 0x18, 0x38, 0x7
7     0x18, 0x18, 0x18, 0x18, 0x38, 0x78, 0xf8, 0xf8, 0x78, 0x3
```

7. Before you upload, make sure your configuration of the board is correct in **Tools > Board**



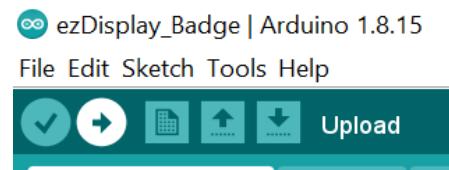
**Board:** “Attiny25/45/85 (No bootloader)”

**Clock:** “8 MHz (Internal)

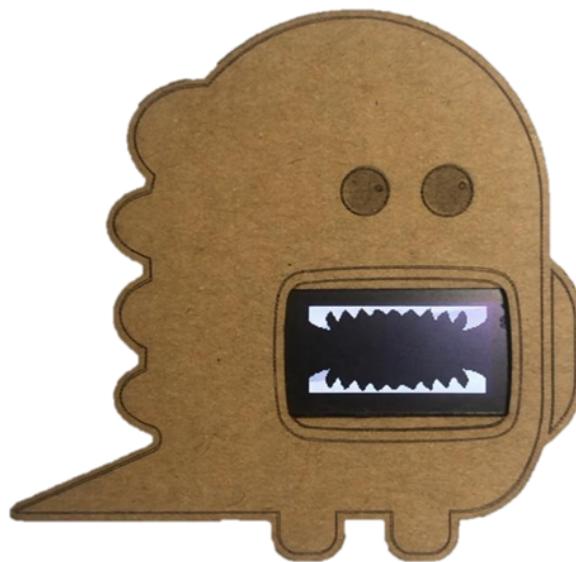
**Programmer:** USBasp (AttinyCore)

*For AttinyCore version 1.5.2*

- Once configuration is done, proceed to upload the sample code by pressing on the “Upload” button. It will take about 15 - 30 seconds to upload.



**CONGRATULATIONS!** You have a  
**Gozilla expression**  
right now!



### 3.0 Additional - How to Display Animation

1. Animation basically consists of frames of images. Hence, you could follow the previous steps on “**Additional - How to Change your own favorite characters & expression**”, but the only additional thing you need to take note is to prepare the images for the frames of animations.

For example we have two simple images as below:



2. Follow through the previous steps and the goal is to generate **two separate bytes of code** for Arduino.

*Remember that you can always change the Image Settings and have a look at the Preview.*

#### 1. Select image

Choose Files **2 files**

or

#### 1. Paste byte array

  
128 x 64 px

**Read as horizontal** **Read as vertical**

---

#### 2. Image Settings

##### Canvas size(s):

1-04.png (file resolution: 534 x 267)	128 x 64	glyph <input type="text"/>	<b>remove</b>
1-12.png (file resolution: 534 x 267)	128 x 64	glyph <input type="text"/>	<b>remove</b>

**all same size**

##### Background color:

White  Black  Transparent

##### Invert image colors

##### Brightness / alpha threshold:

128

*0 - 255; if the brightness of a pixel is above the given level the pixel becomes white, otherwise they become black. When using alpha, opaque and transparent are used instead.*

##### Scaling

##### Center:

horizontally  vertically

##### Rotate image:

rotate 180 degrees

##### Flip:

horizontally  vertically

*Note: centering the image only works when using a canvas larger than the original image.*

---

#### 3. Preview



3. Right now, you need to change the **4. Output** as accordingly:

**Identifier/Prefix:** Info1

**Draw mode:** Vertical - 1 bit per pixel

Finally, click on the “**Generate Code**”. Copy the generated byte code. But for this case, since you are loading both images at the same time, you need to be very careful when you copy as the byte codes are for the two images:

## 4. Output

Notice that when you scroll down, you will see another byte code for the second image.

For your reference, below are the two separate byte codes generated

// '1-12', 128x64px

```
const unsigned char Info11[12] PROGMEM = {
```

```
// Array of all bitmaps for convenience. (Total bytes used to store images in PROGMEM = 2080)
const int Info1allArray_LEN = 2;
const unsigned char* Info1allArray[2] = {
```

```
const unsigned char* Info11Array[2] = {
```

Info11\_04,  
Info11\_12

3,

4. Copy the byte codes to Arduino accordingly

a. Copy the first byte code into *Info1.h*.



The screenshot shows the Arduino IDE interface with the following details:

- Title Bar:** Displays "eDisplay\_Badge - Info1.h | Arduino 1.8.15".
- File Menu:** Contains "File", "Edit", "Sketch", "Tools", and "Help".
- Toolbar:** Includes icons for back, forward, upload, and other functions.
- Code Editor:** Shows the following C++ code for a 128x64px display badge:

```
1 // '1-04', 128x64px
2 const unsigned char Info11_04 [] PROGMEM = {
3     0x00, 0x00,
4     0x00, 0x00,
5     0x00, 0x00,
6     0x00, 0x00,
7     0x00, 0x00,
```
- Header Tab:** Shows the currently selected file "Info1.h" along with other header files: Info2.h, Info3.h, Info4.h, Info5.h, SSD1306\_minimal.cpp, SSD1306\_minimal.h, TinyWireM.cpp, TinyWireM.h, USI\_TWI\_Master.cpp, and USI\_TWI\_Master.h.

b. Copy the second byte code into *Info2.h*.

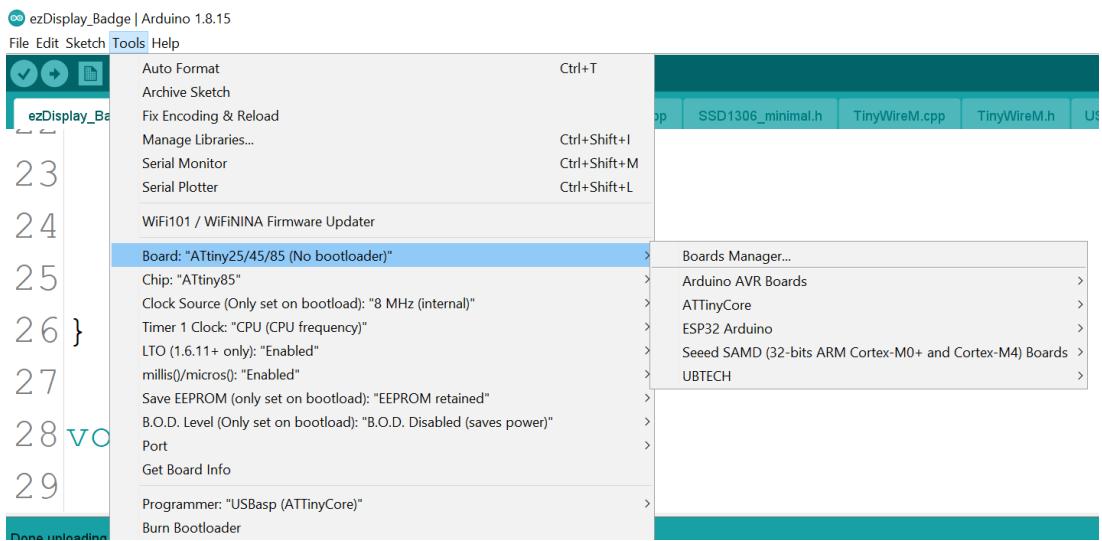
```
ezDisplay_Badge - Info2.h | Arduino 1.8.15
File Edit Sketch Tools Help

File Display Tools Help
ezDisplay_Badge Info1.h Info2.h Info3.h Info4.h Info5.h SSD1306_minimal.cpp SSD1306_minimal.h TinyWireM.cpp TinyWireM.h USI_TWI_Master.cpp USI_TWI_Master.h
1 // '1-12', 128x64px
2 const unsigned char Info11_12 [] PROGMEM = {
3     0x00, 0x00,
4     0x00, 0x00,
5     0x00, 0x00,
6     0x00, 0x00,
7     0x00, 0x00,
```

5. Change the flow for your frames to generate animation on your ezDisplay\_Nadge.ino (main Arduino file)

```
void loop() {  
    oled.setCursor(0, 0);  
    oled.drawImage(Info11_04, 0, 0, 128, 8);  
    delay(50);  
    oled.clear();  
    oled.drawImage(Info11_12, 0, 0, 128, 8);  
    delay(50);  
    oled.clear();
```

6. Before you upload, make sure your configuration of the board is correct in **Tools > Board**



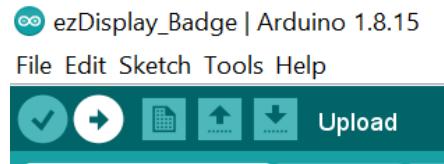
**Board:** “Attiny25/45/85 (No bootloader)”

**Clock:** “8 MHz (Internal)“

**Programmer:** USBasp (AttinyCore)

*For AttinyCore version 1.5.2*

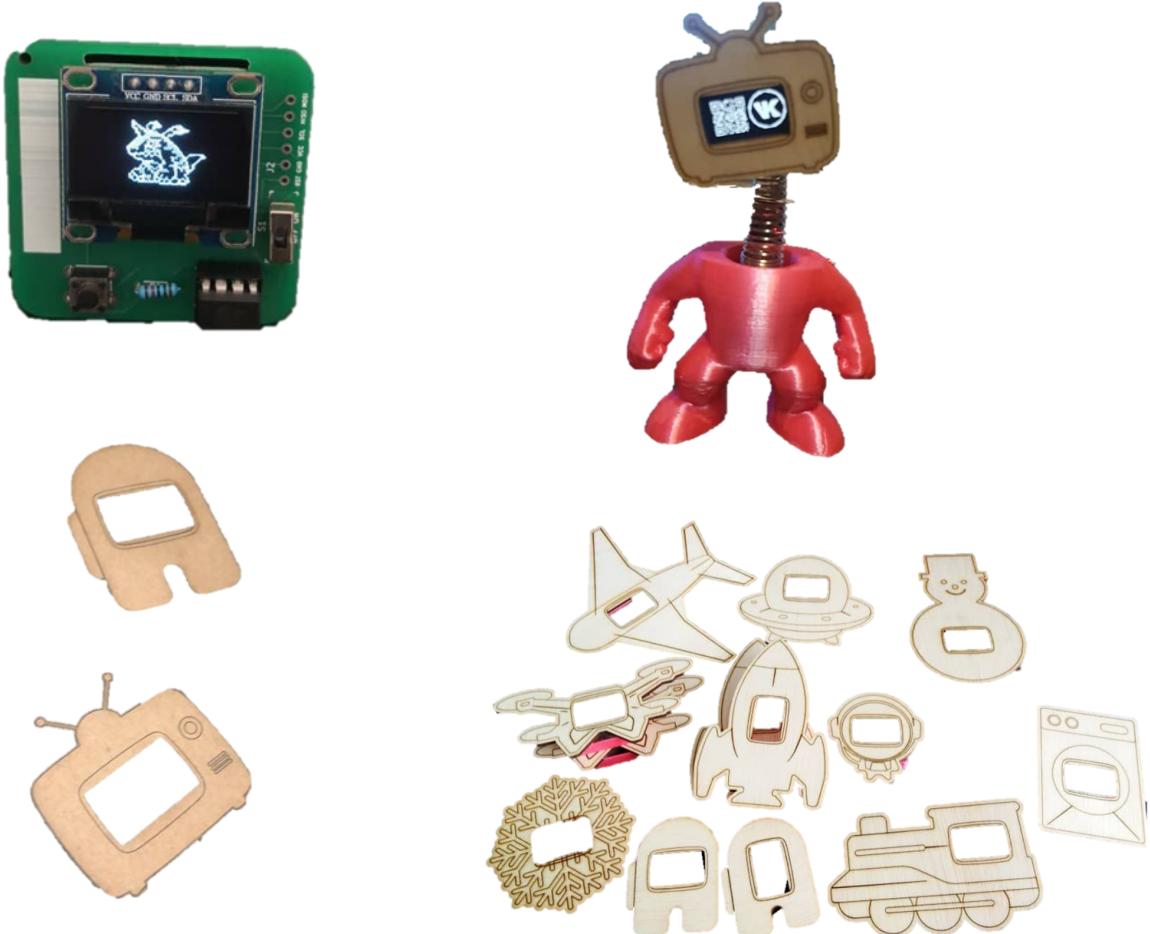
7. Once configuration is done, proceed to upload the sample code by pressing on the “Upload” button. It will take about 15 - 30 seconds to upload.



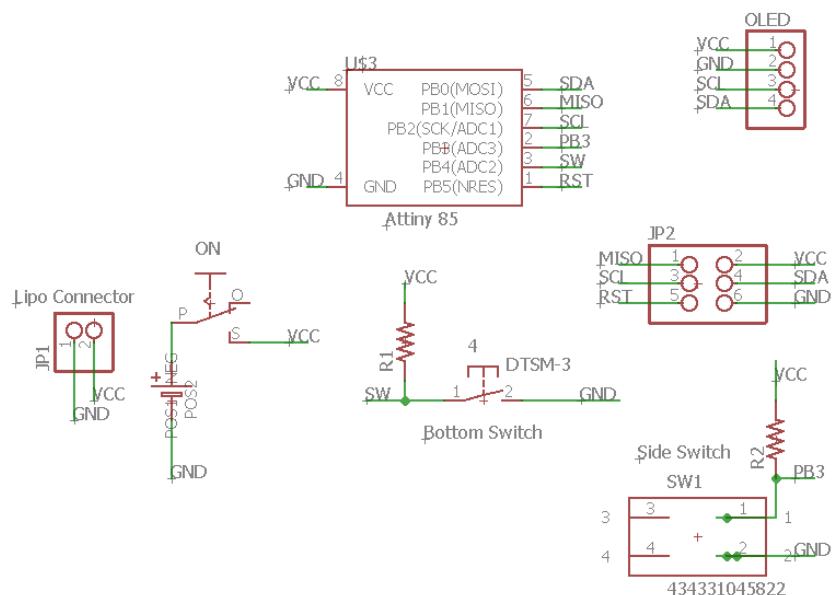
**CONGRATULATIONS!** You have a  
**Blinking Eyes Ultraman**  
right now!



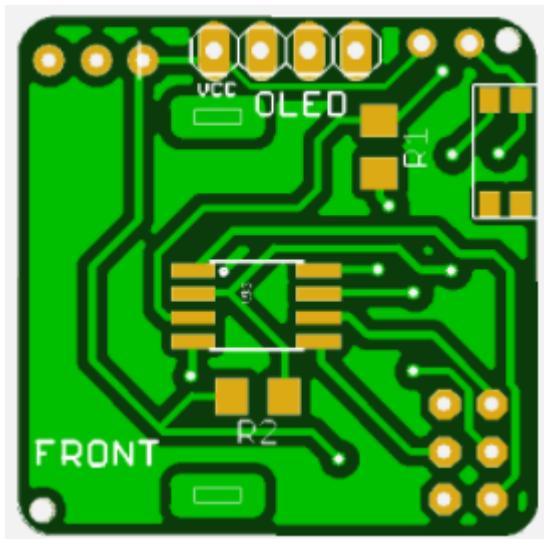
## Prototypes



## Circuit for ezDisplay



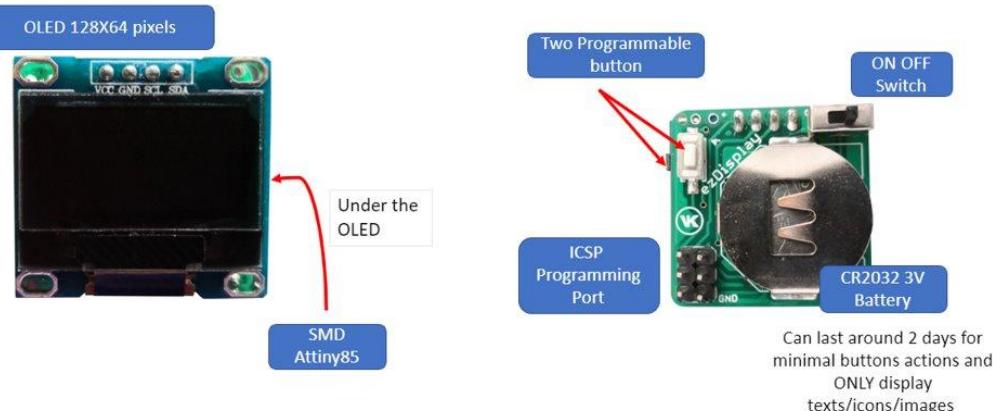
Layout (TOP)



Layout (Bottom)



## Hardware Overview



**Why do we choose this project?**

Everything around us is becoming smart such as smart phones, smart televisions, smart refrigerators, so why not smart display badges for fun STEM activities. The ezDisplay kit allows users to customize their digital badge and create fun characters among them to share their knowledge of coding, programming and design.

**Estimated Cost**

25 USD for ezDisplay Kit

**Estimated time to build the project**

60 minutes (1 hour)

## **Part List**

1. ezDisplay set



2. Cardboard patterns

