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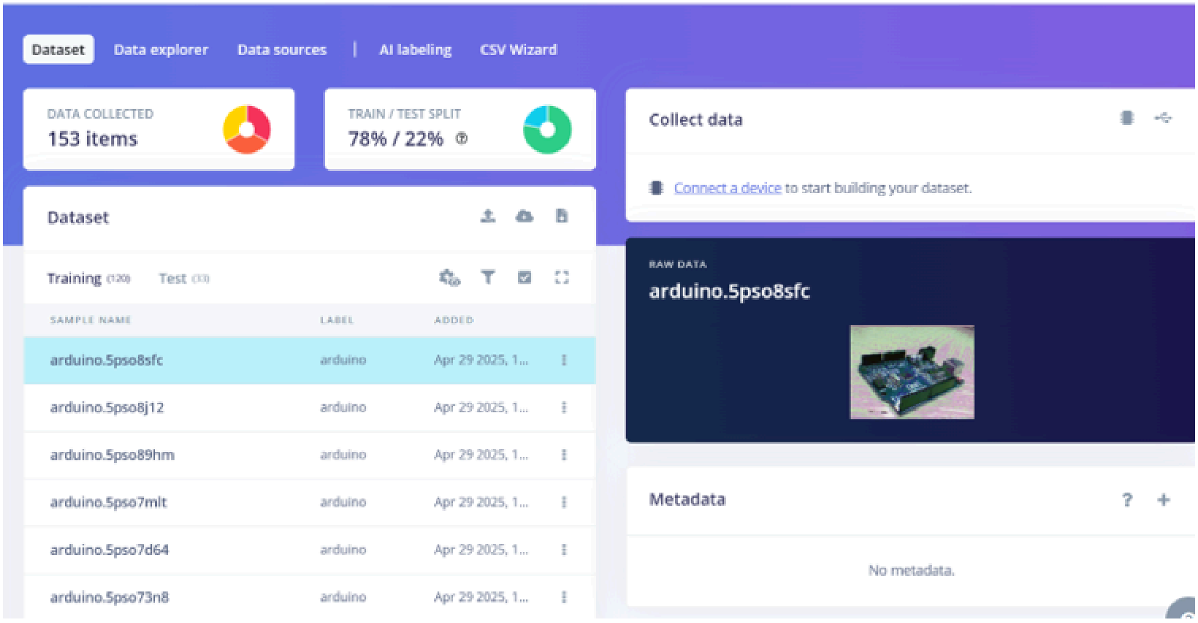
Class-TY-AIEC Batch-B

Experiment No-9

1 .DATASET-



DATA COLLECTED
153 items

TRAIN / TEST SPLIT
78% / 22%

Collect data

Connect a device to start building your dataset.

Dataset

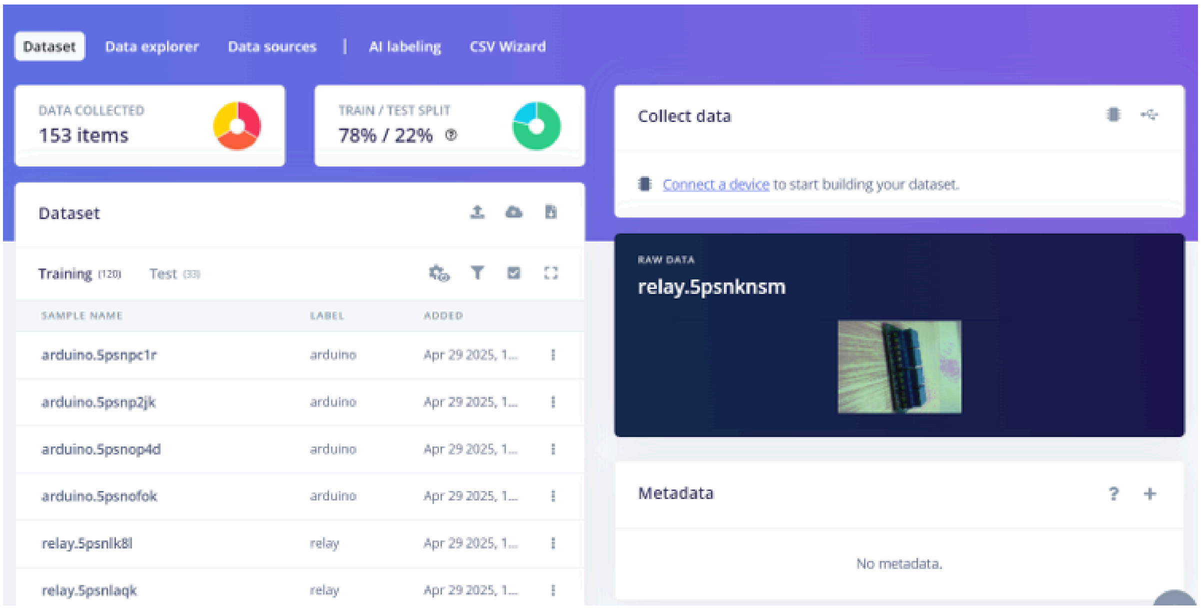
Training (120)   Test (33)

SAMPLE NAME	LABEL	ADDED
arduino.5pso8sfc	arduino	Apr 29 2025, 1...
arduino.5pso8j12	arduino	Apr 29 2025, 1...
arduino.5pso89hm	arduino	Apr 29 2025, 1...
arduino.5pso7mlt	arduino	Apr 29 2025, 1...
arduino.5pso7d64	arduino	Apr 29 2025, 1...
arduino.5pso73n8	arduino	Apr 29 2025, 1...

RAW DATA
arduino.5pso8sfc

Metadata

No metadata.



DATA COLLECTED
153 items

TRAIN / TEST SPLIT
78% / 22%

Collect data

Connect a device to start building your dataset.

Dataset

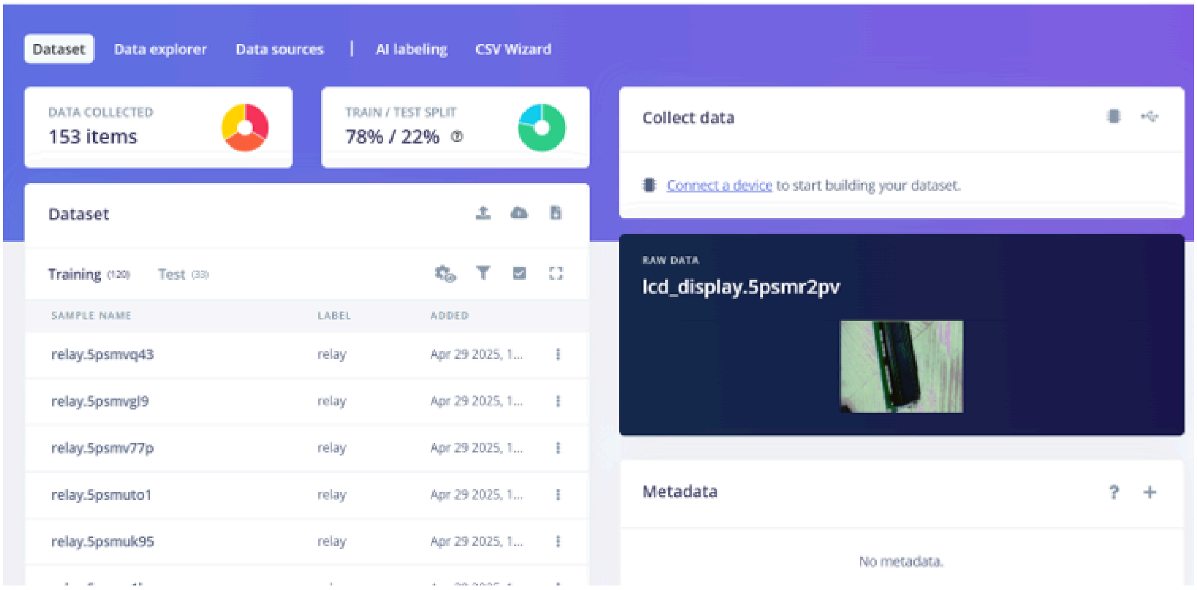
Training (120)   Test (33)

SAMPLE NAME	LABEL	ADDED
arduino.5psnpc1r	arduino	Apr 29 2025, 1...
arduino.5psnp2jk	arduino	Apr 29 2025, 1...
arduino.5psnop4d	arduino	Apr 29 2025, 1...
arduino.5psnofok	arduino	Apr 29 2025, 1...
relay.5psnlk8l	relay	Apr 29 2025, 1...
relay.5psnlaqk	relay	Apr 29 2025, 1...

RAW DATA
relay.5psnknsm

Metadata

No metadata.



DATA COLLECTED
153 items

TRAIN / TEST SPLIT
78% / 22%

Collect data

Connect a device to start building your dataset.

Dataset

Training (120) Test (33)

SAMPLE NAME	LABEL	ADDED
relay.5psmvq43	relay	Apr 29 2025, 1...
relay.5psmvgl9	relay	Apr 29 2025, 1...
relay.5psmv77p	relay	Apr 29 2025, 1...
relay.5psmuto1	relay	Apr 29 2025, 1...
relay.5psmuk95	relay	Apr 29 2025, 1...

RAW DATA
lcd_display.5psmr2pv

Metadata

No metadata.

2. Feature Extraction Image

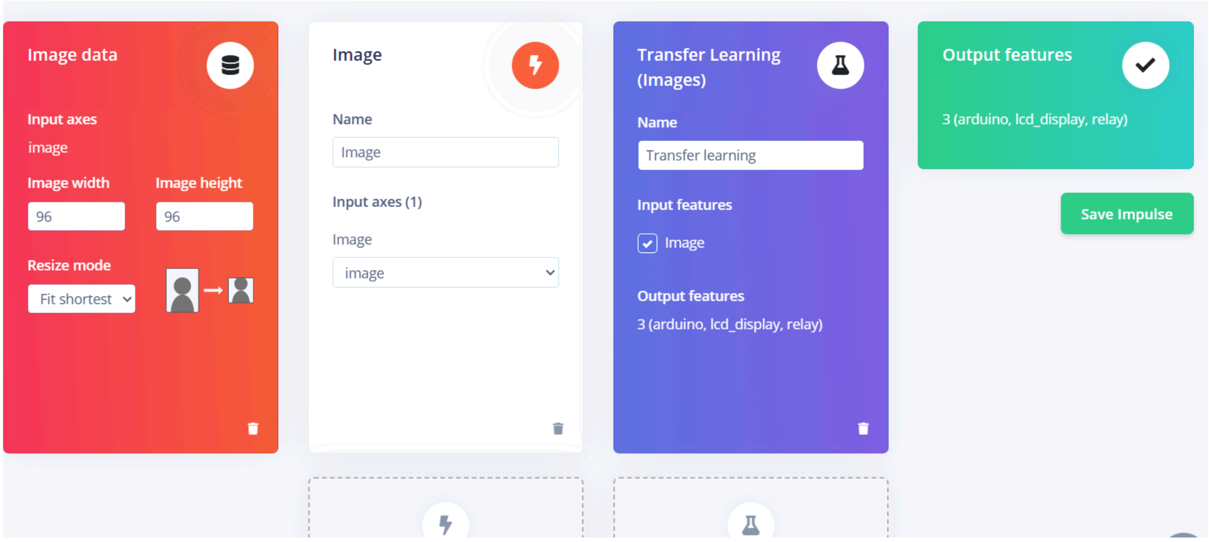


Image data

Input axes
image

Image width: 96
Image height: 96

Resize mode: Fit shortest

Image

Name: Image

Input axes (1)

Image: image

Transfer Learning (Images)

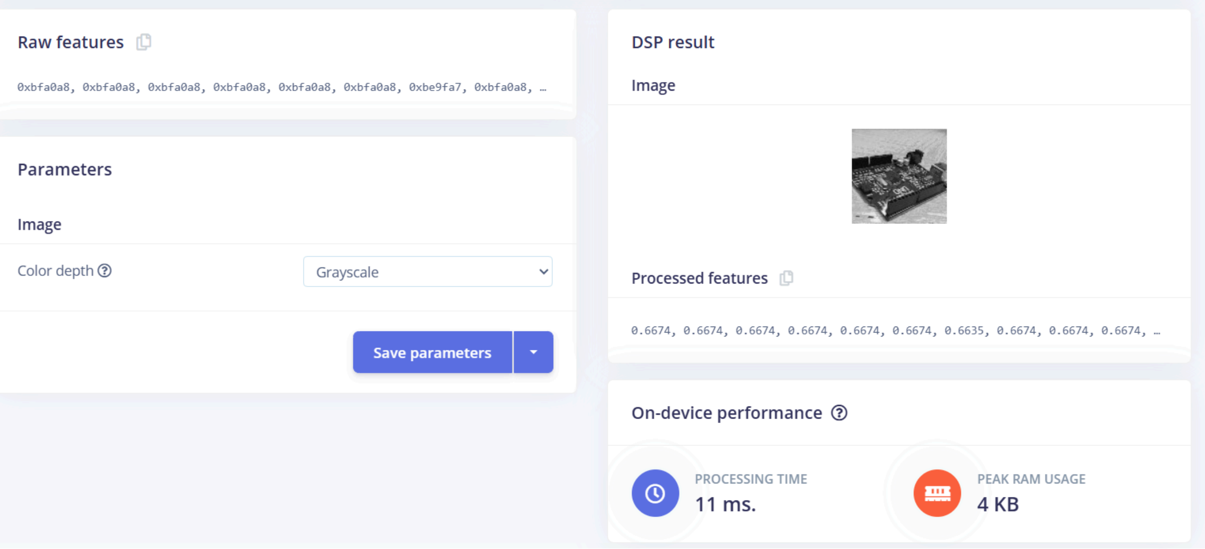
Name: Transfer learning

Input features
☑ Image

Output features
3 (arduino, lcd_display, relay)

Output features

3 (arduino, lcd_display, relay)



Raw features

```
0xbfa0a8, 0xbfa0a8, 0xbfa0a8, 0xbfa0a8, 0xbfa0a8, 0xbfa0a8, 0xbe9fa7, 0xbfa0a8, …
```

Parameters

Image

Color depth: Grayscale

DSP result

Image

Processed features

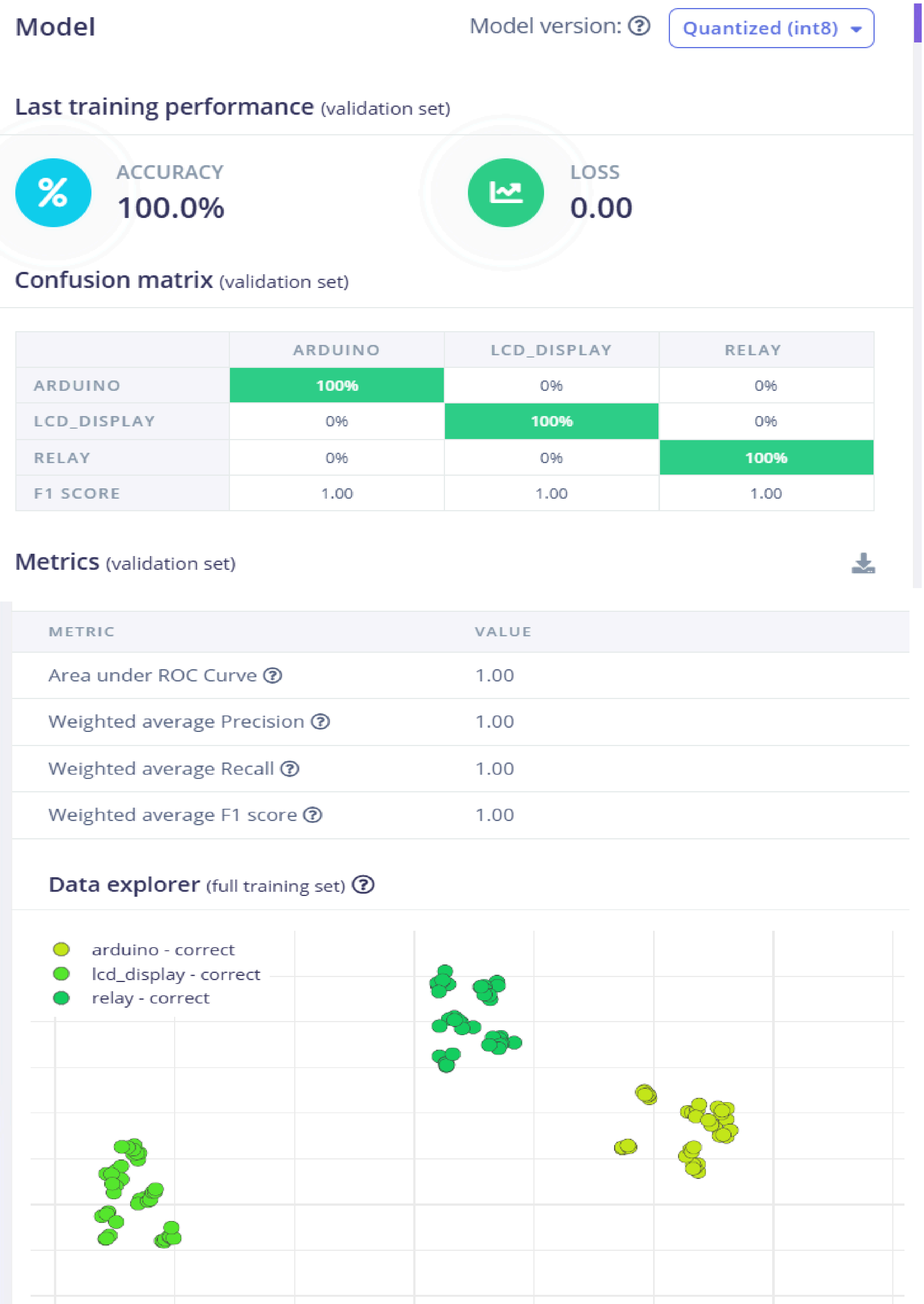
```
0.6674, 0.6674, 0.6674, 0.6674, 0.6674, 0.6674, 0.6635, 0.6674, 0.6674, 0.6674, …
```

On-device performance

PROCESSING TIME: 11 ms.

PEAK RAM USAGE: 4 KB

3. Accuracy / Loss Confusion Matrix Image



Model

Model version: ⓘ Quantized (int8) ▾

Last training performance (validation set)

ACCURACY

100.0%

LOSS

0.00

Confusion matrix (validation set)

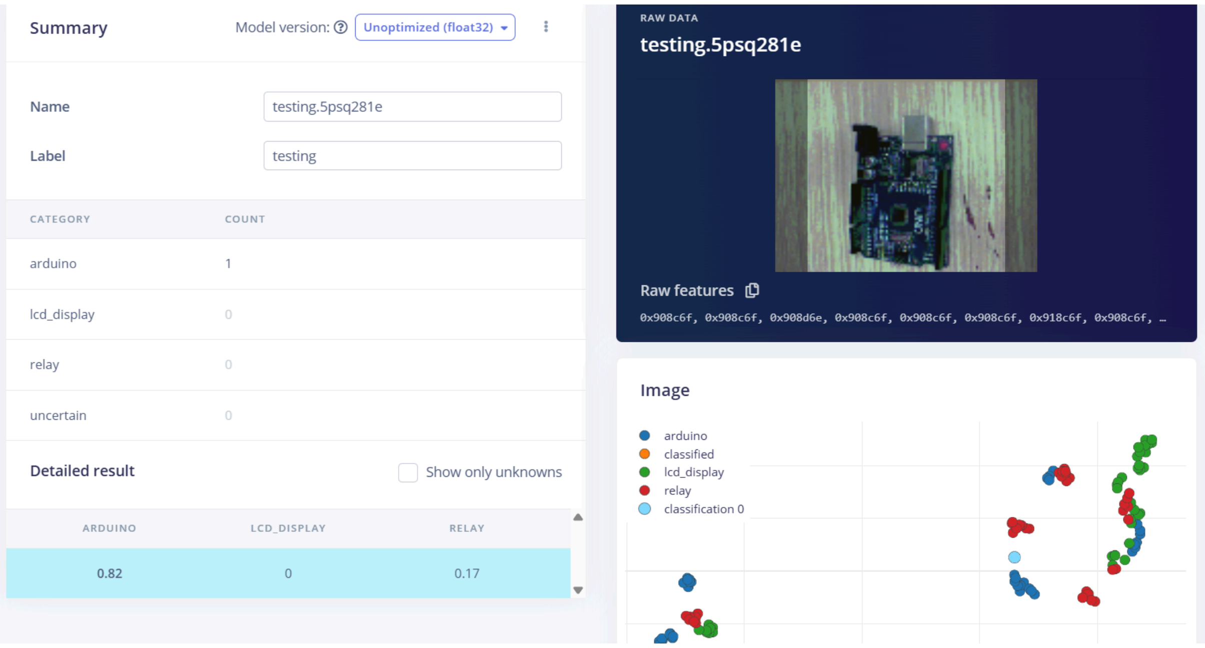
	ARDUINO	LCD_DISPLAY	RELAY
ARDUINO	100%	0%	0%
LCD_DISPLAY	0%	100%	0%
RELAY	0%	0%	100%
F1 SCORE	1.00	1.00	1.00

Metrics (validation set)

METRIC	VALUE
Area under ROC Curve ⓘ	1.00
Weighted average Precision ⓘ	1.00
Weighted average Recall ⓘ	1.00
Weighted average F1 score ⓘ	1.00

Data explorer (full training set) ⓘ

4. Validation Result



Summary

Model version: ⓘ Unoptimized (float32) ▾

Name: testing.5psq281e

Label: testing

CATEGORY	COUNT
arduino	1
lcd_display	0
relay	0
uncertain	0

Detailed result

□ Show only unknowns

ARDUINO	LCD_DISPLAY	RELAY
0.82	0	0.17

RAW DATA

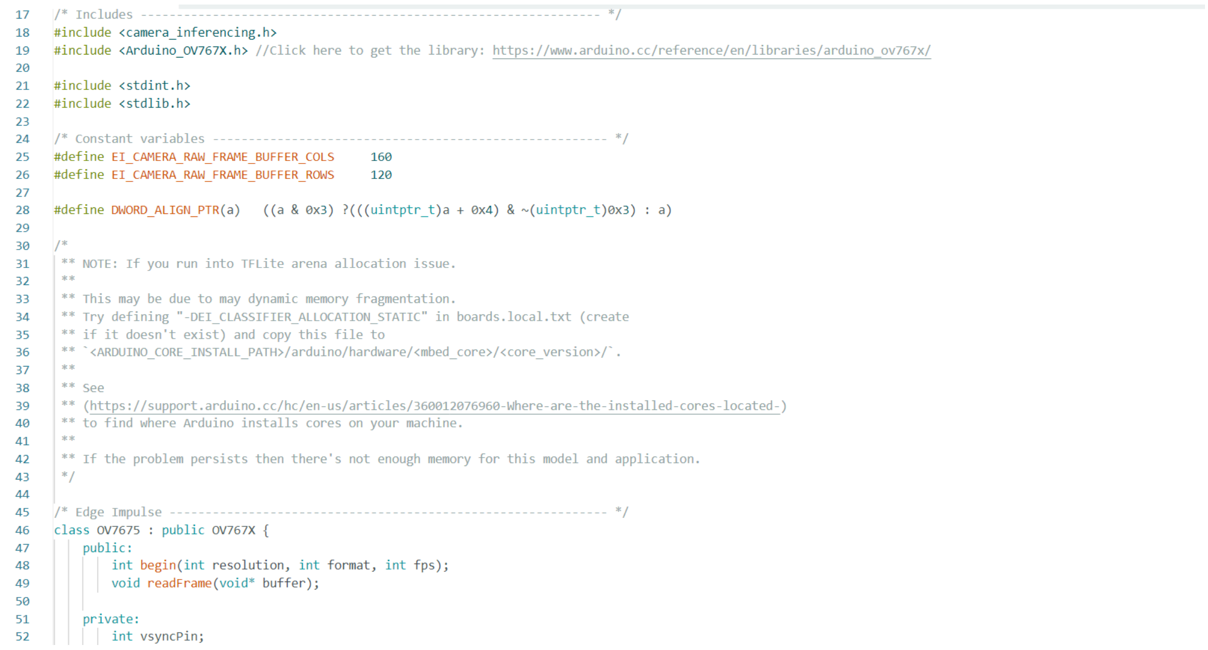
testing.5psq281e

Raw features

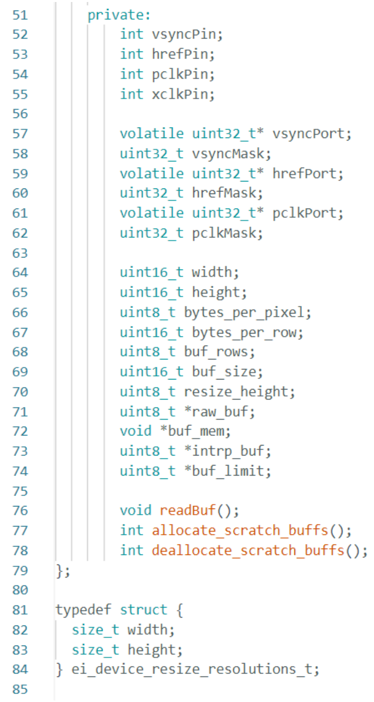
```
0x908c6f, 0x908c6f, 0x908d6e, 0x908c6f, 0x908c6f, 0x908c6f, 0x918c6f, 0x908c6f, …
```

Image

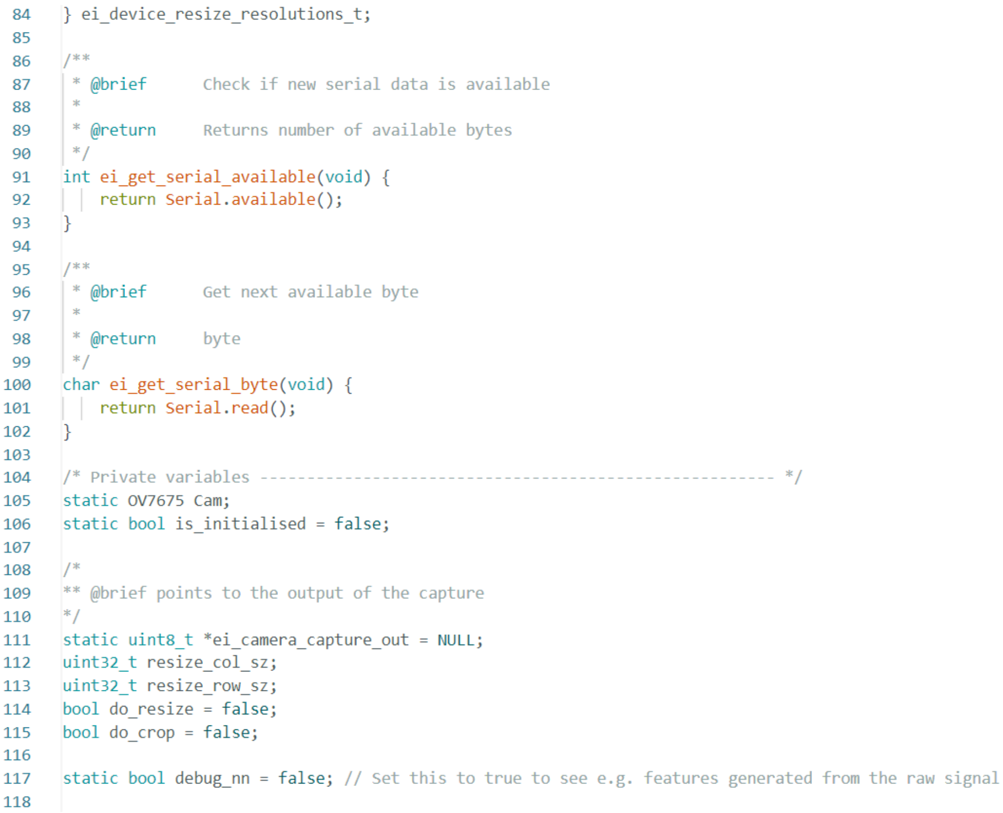
5. Copy of the Arduino Code-



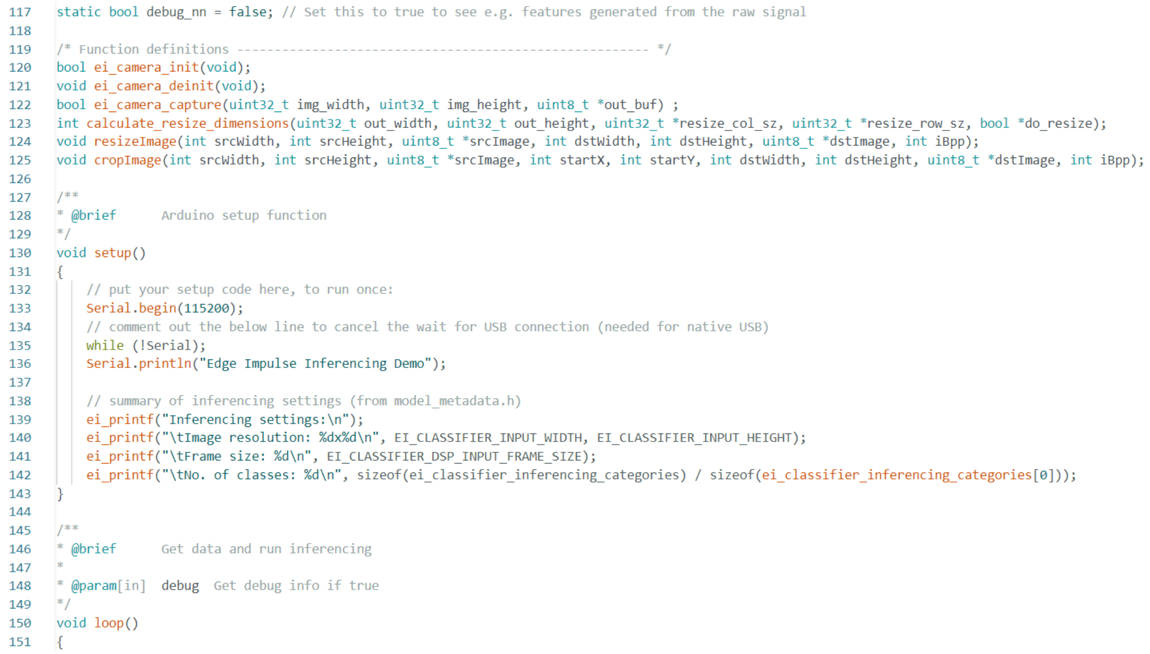
```
/* Includes ---------------------------------------------------------------- */
#include <camera_inferencing.h>
#include <Arduino_OV767X.h> //Click here to get the library: https://www.arduino.cc/reference/en/libraries/arduino_ov767x/

#include <stdint.h>
#include <stdlib.h>

/* Constant variables ------------------------------------------------------- */
#define EI_CAMERA_RAW_FRAME_BUFFER_COLS     160
#define EI_CAMERA_RAW_FRAME_BUFFER_ROWS     120

#define DWORD_ALIGN_PTR(a)   ((a & 0x3) ?(((uintptr_t)a + 0x4) & ~(uintptr_t)0x3) : a)

/*
 ** NOTE: If you run into TFLite arena allocation issue.
 **
 ** This may be due to may dynamic memory fragmentation.
 ** Try defining "-DEI_CLASSIFIER_ALLOCATION_STATIC" in boards.local.txt (create
 ** if it doesn't exist) and copy this file to
 ** `<ARDUINO_CORE_INSTALL_PATH>/arduino/hardware/<mbed_core>/<core_version>/`.
 **
 ** See
 ** (https://support.arduino.cc/hc/en-us/articles/360012076960-Where-are-the-installed-cores-located-)
 ** to find where Arduino installs cores on your machine.
 **
 ** If the problem persists then there's not enough memory for this model and application.
 */

/* Edge Impulse ------------------------------------------------------------- */
class OV7675 : public OV767X {
    public:
        int begin(int resolution, int format, int fps);
        void readFrame(void* buffer);

    private:
        int vsyncPin;
```



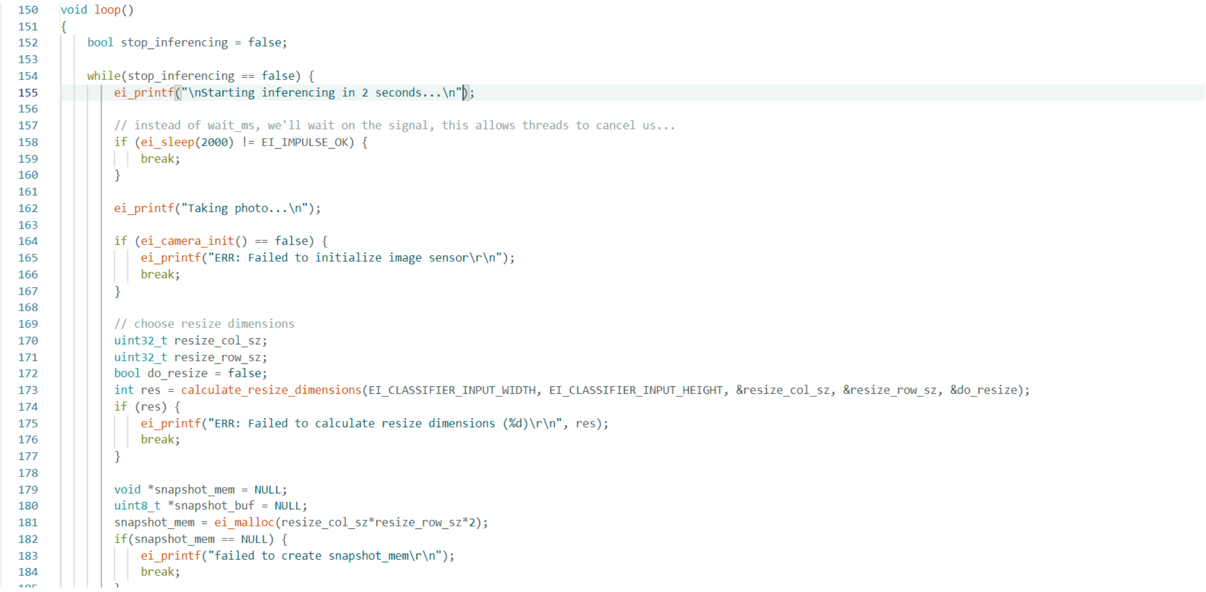
```
    private:
        int vsyncPin;
        int hrefPin;
        int pclkPin;
        int xclkPin;

        volatile uint32_t* vsyncPort;
        uint32_t vsyncMask;
        volatile uint32_t* hrefPort;
        uint32_t hrefMask;
        volatile uint32_t* pclkPort;
        uint32_t pclkMask;

        uint16_t width;
        uint16_t height;
        uint8_t bytes_per_pixel;
        uint16_t bytes_per_row;
        uint8_t buf_rows;
        uint16_t buf_size;
        uint8_t resize_height;
        uint8_t *raw_buf;
        void *buf_mem;
        uint8_t *intrp_buf;
        uint8_t *buf_limit;

        void readBuf();
        int allocate_scratch_buffs();
        int deallocate_scratch_buffs();
};

typedef struct {
  size_t width;
  size_t height;
} ei_device_resize_resolutions_t;

```



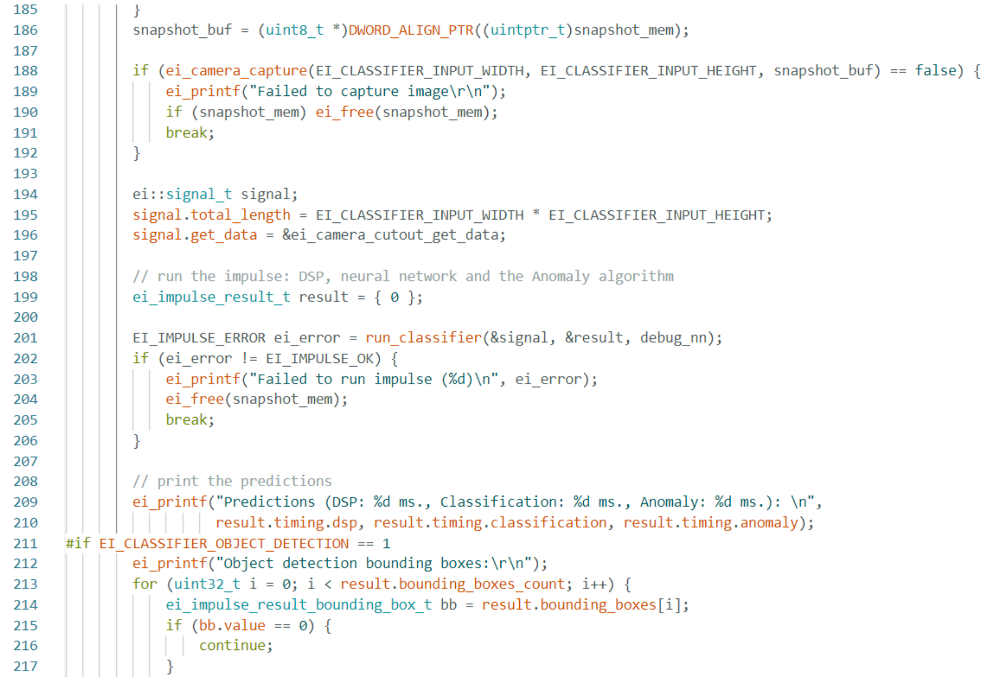
```
} ei_device_resize_resolutions_t;

/**
 * @brief      Check if new serial data is available
 *
 * @return     Returns number of available bytes
 */
int ei_get_serial_available(void) {
    return Serial.available();
}

/**
 * @brief      Get next available byte
 *
 * @return     byte
 */
char ei_get_serial_byte(void) {
    return Serial.read();
}

/* Private variables ------------------------------------------------------- */
static OV7675 Cam;
static bool is_initialised = false;

/*
** @brief points to the output of the capture
*/
static uint8_t *ei_camera_capture_out = NULL;
uint32_t resize_col_sz;
uint32_t resize_row_sz;
bool do_resize = false;
bool do_crop = false;

static bool debug_nn = false; // Set this to true to see e.g. features generated from the raw signal

```



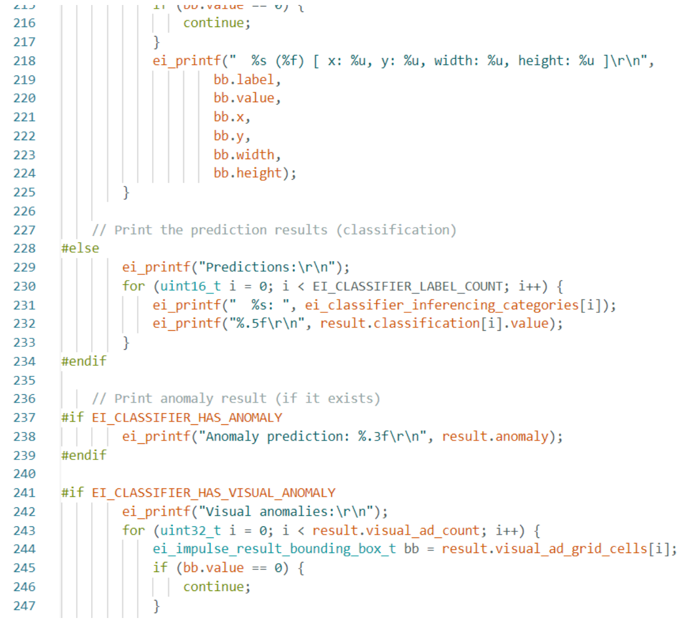
```
static bool debug_nn = false; // Set this to true to see e.g. features generated from the raw signal

/* Function definitions ------------------------------------------------------- */
bool ei_camera_init(void);
void ei_camera_deinit(void);
bool ei_camera_capture(uint32_t img_width, uint32_t img_height, uint8_t *out_buf) ;
int calculate_resize_dimensions(uint32_t out_width, uint32_t out_height, uint32_t *resize_col_sz, uint32_t *resize_row_sz, bool *do_resize);
void resizeImage(int srcWidth, int srcHeight, uint8_t *srcImage, int dstWidth, int dstHeight, uint8_t *dstImage, int iBpp);
void cropImage(int srcWidth, int srcHeight, uint8_t *srcImage, int startX, int startY, int dstWidth, int dstHeight, uint8_t *dstImage, int iBpp);

/**
* @brief      Arduino setup function
*/
void setup()
{
    // put your setup code here, to run once:
    Serial.begin(115200);
    // comment out the below line to cancel the wait for USB connection (needed for native USB)
    while (!Serial);
    Serial.println("Edge Impulse Inferencing Demo");

    // summary of inferencing settings (from model_metadata.h)
    ei_printf("Inferencing settings:\n");
    ei_printf("\tImage resolution: %dx%d\n", EI_CLASSIFIER_INPUT_WIDTH, EI_CLASSIFIER_INPUT_HEIGHT);
    ei_printf("\tFrame size: %d\n", EI_CLASSIFIER_DSP_INPUT_FRAME_SIZE);
    ei_printf("\tNo. of classes: %d\n", sizeof(ei_classifier_inferencing_categories) / sizeof(ei_classifier_inferencing_categories[0]));
}

/**
* @brief      Get data and run inferencing
*
* @param[in]  debug  Get debug info if true
*/
void loop()
{
```



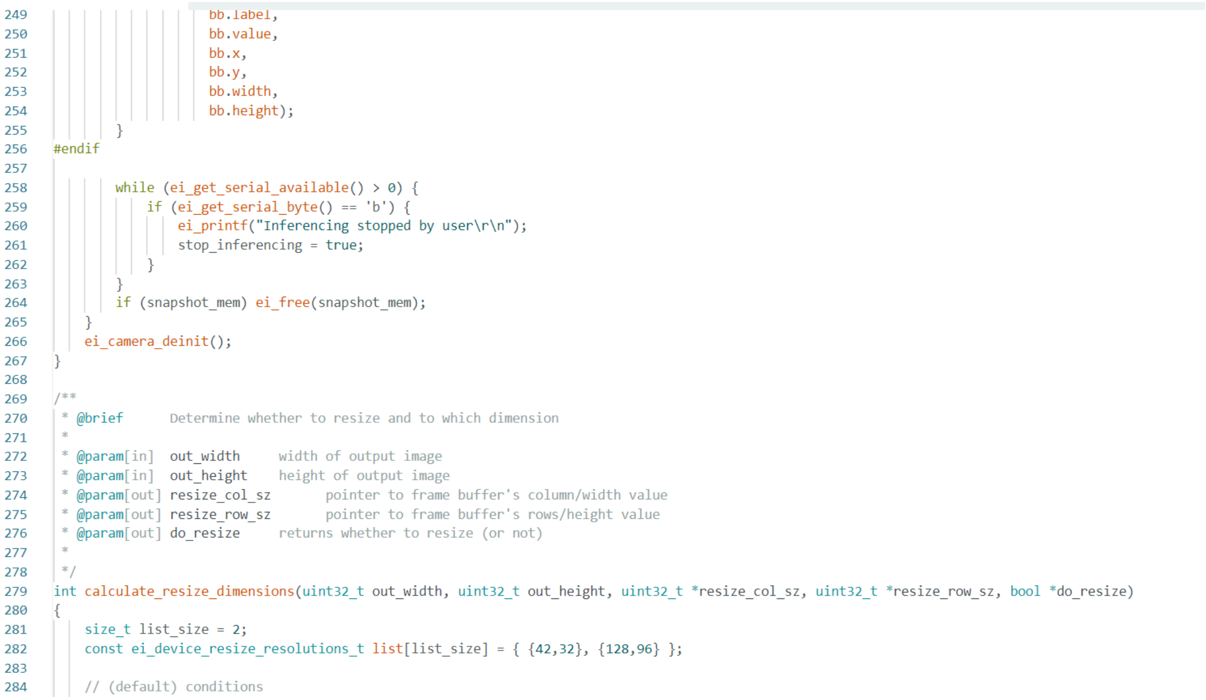
```
void loop()
{
    bool stop_inferencing = false;

    while(stop_inferencing == false) {
        ei_printf("\nStarting inferencing in 2 seconds...\n");

        // instead of wait_ms, we'll wait on the signal, this allows threads to cancel us...
        if (ei_sleep(2000) != EI_IMPULSE_OK) {
            break;
        }

        ei_printf("Taking photo...\n");

        if (ei_camera_init() == false) {
            ei_printf("ERR: Failed to initialize image sensor\r\n");
            break;
        }

        // choose resize dimensions
        uint32_t resize_col_sz;
        uint32_t resize_row_sz;
        bool do_resize = false;
        int res = calculate_resize_dimensions(EI_CLASSIFIER_INPUT_WIDTH, EI_CLASSIFIER_INPUT_HEIGHT, &resize_col_sz, &resize_row_sz, &do_resize);
        if (res) {
            ei_printf("ERR: Failed to calculate resize dimensions (%d)\r\n", res);
            break;
        }

        void *snapshot_mem = NULL;
        uint8_t *snapshot_buf = NULL;
        snapshot_mem = ei_malloc(resize_col_sz*resize_row_sz*2);
        if(snapshot_mem == NULL) {
            ei_printf("failed to create snapshot_mem\r\n");
            break;
```



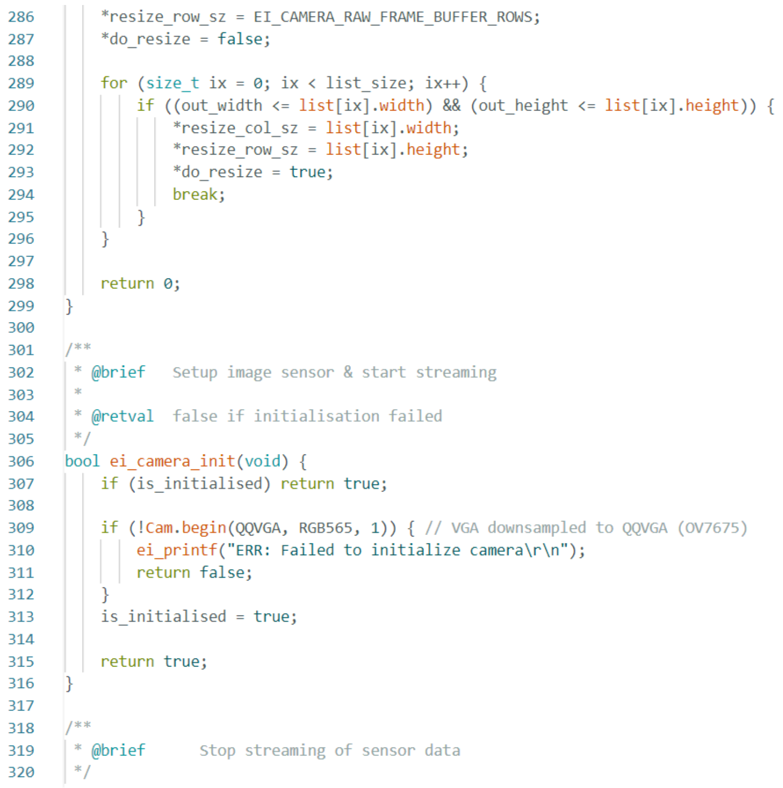
```
        }
        snapshot_buf = (uint8_t *)DWORD_ALIGN_PTR((uintptr_t)snapshot_mem);

        if (ei_camera_capture(EI_CLASSIFIER_INPUT_WIDTH, EI_CLASSIFIER_INPUT_HEIGHT, snapshot_buf) == false) {
            ei_printf("Failed to capture image\r\n");
            if (snapshot_mem) ei_free(snapshot_mem);
            break;
        }

        ei::signal_t signal;
        signal.total_length = EI_CLASSIFIER_INPUT_WIDTH * EI_CLASSIFIER_INPUT_HEIGHT;
        signal.get_data = &ei_camera_cutout_get_data;

        // run the impulse: DSP, neural network and the Anomaly algorithm
        ei_impulse_result_t result = { 0 };

        EI_IMPULSE_ERROR ei_error = run_classifier(&signal, &result, debug_nn);
        if (ei_error != EI_IMPULSE_OK) {
            ei_printf("Failed to run impulse (%d)\n", ei_error);
            ei_free(snapshot_mem);
            break;
        }

        // print the predictions
        ei_printf("Predictions (DSP: %d ms., Classification: %d ms., Anomaly: %d ms.): \n",
                  result.timing.dsp, result.timing.classification, result.timing.anomaly);
#if EI_CLASSIFIER_OBJECT_DETECTION == 1
        ei_printf("Object detection bounding boxes:\r\n");
        for (uint32_t i = 0; i < result.bounding_boxes_count; i++) {
            ei_impulse_result_bounding_box_t bb = result.bounding_boxes[i];
            if (bb.value == 0) {
                continue;
            }
```



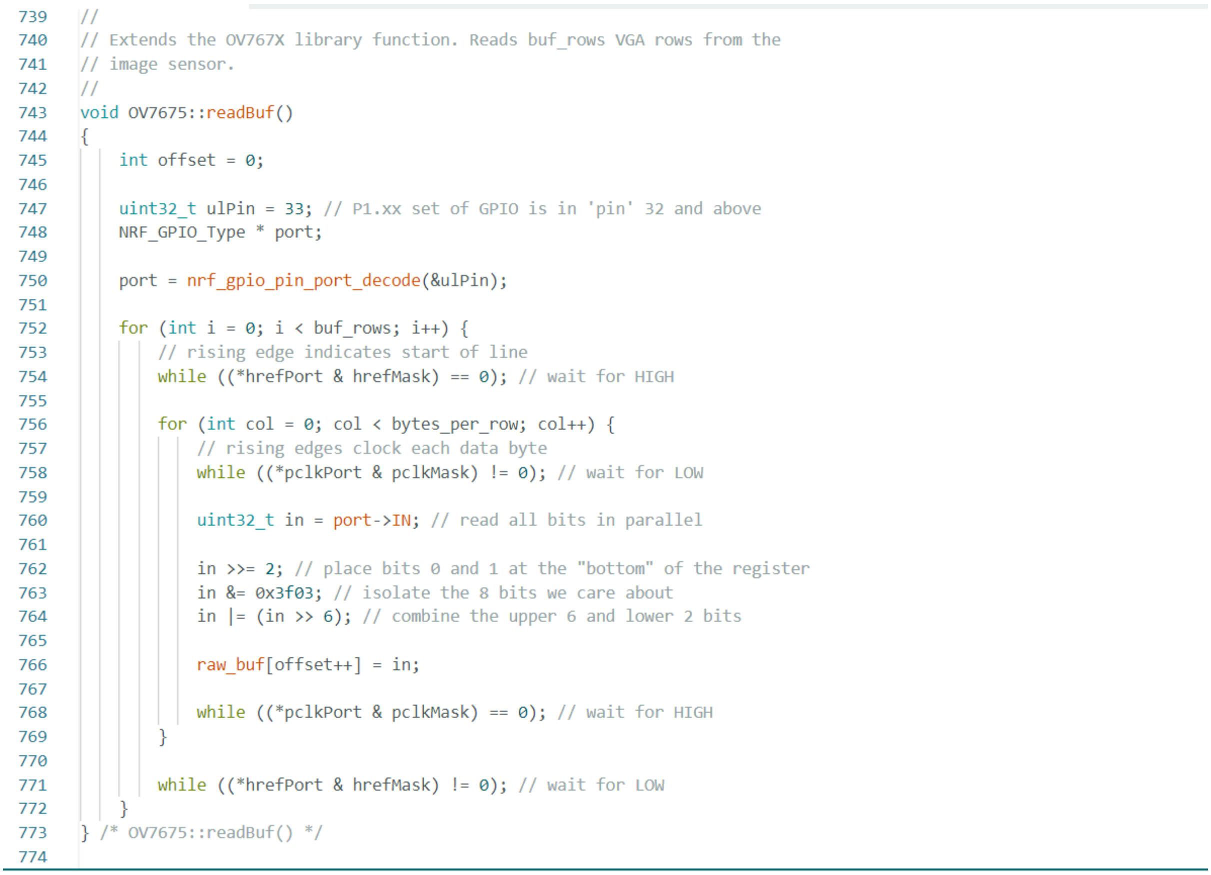
```
            if (bb.value == 0) {
                continue;
            }
            ei_printf("  %s (%f) [ x: %u, y: %u, width: %u, height: %u ]\r\n",
                    bb.label,
                    bb.value,
                    bb.x,
                    bb.y,
                    bb.width,
                    bb.height);
        }

    // Print the prediction results (classification)
#else
        ei_printf("Predictions:\r\n");
        for (uint16_t i = 0; i < EI_CLASSIFIER_LABEL_COUNT; i++) {
            ei_printf("  %s: ", ei_classifier_inferencing_categories[i]);
            ei_printf("%.5f\r\n", result.classification[i].value);
        }
#endif

    // Print anomaly result (if it exists)
#if EI_CLASSIFIER_HAS_ANOMALY
        ei_printf("Anomaly prediction: %.3f\r\n", result.anomaly);
#endif

#if EI_CLASSIFIER_HAS_VISUAL_ANOMALY
        ei_printf("Visual anomalies:\r\n");
        for (uint32_t i = 0; i < result.visual_ad_count; i++) {
            ei_impulse_result_bounding_box_t bb = result.visual_ad_grid_cells[i];
            if (bb.value == 0) {
                continue;
            }
```



```
                    bb.label,
                    bb.value,
                    bb.x,
                    bb.y,
                    bb.width,
                    bb.height);
        }
#endif

        while (ei_get_serial_available() > 0) {
            if (ei_get_serial_byte() == 'b') {
                ei_printf("Inferencing stopped by user\r\n");
                stop_inferencing = true;
            }
        }
        if (snapshot_mem) ei_free(snapshot_mem);
    }
    ei_camera_deinit();
}

/**
 * @brief      Determine whether to resize and to which dimension
 *
 * @param[in]  out_width     width of output image
 * @param[in]  out_height    height of output image
 * @param[out] resize_col_sz       pointer to frame buffer's column/width value
 * @param[out] resize_row_sz       pointer to frame buffer's rows/height value
 * @param[out] do_resize     returns whether to resize (or not)
 *
 */
int calculate_resize_dimensions(uint32_t out_width, uint32_t out_height, uint32_t *resize_col_sz, uint32_t *resize_row_sz, bool *do_resize)
{
    size_t list_size = 2;
    const ei_device_resize_resolutions_t list[list_size] = { {42,32}, {128,96} };

    // (default) conditions
```

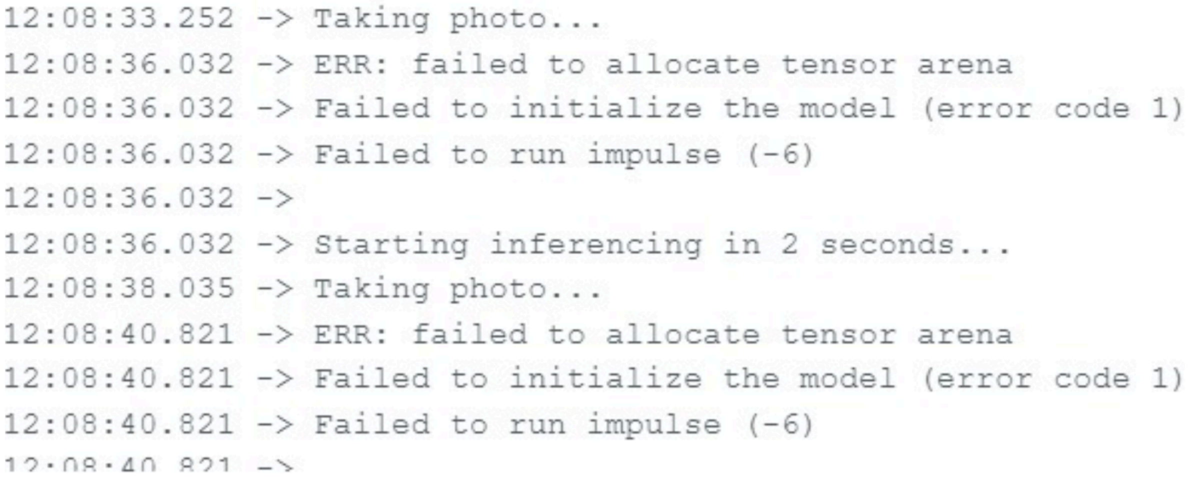


```
    *resize_row_sz = EI_CAMERA_RAW_FRAME_BUFFER_ROWS;
    *do_resize = false;

    for (size_t ix = 0; ix < list_size; ix++) {
        if ((out_width <= list[ix].width) && (out_height <= list[ix].height)) {
            *resize_col_sz = list[ix].width;
            *resize_row_sz = list[ix].height;
            *do_resize = true;
            break;
        }
    }

    return 0;
}

/**
 * @brief   Setup image sensor & start streaming
 *
 * @retval  false if initialisation failed
 */
bool ei_camera_init(void) {
    if (is_initialised) return true;

    if (!Cam.begin(QQVGA, RGB565, 1)) { // VGA downsampled to QQVGA (OV7675)
        ei_printf("ERR: Failed to initialize camera\r\n");
        return false;
    }
    is_initialised = true;

    return true;
}

/**
 * @brief      Stop streaming of sensor data
 */
```



```
//
// Extends the OV767X library function. Reads buf_rows VGA rows from the
// image sensor.
//
void OV7675::readBuf()
{
    int offset = 0;

    uint32_t ulPin = 33; // P1.xx set of GPIO is in 'pin' 32 and above
    NRF_GPIO_Type * port;

    port = nrf_gpio_pin_port_decode(&ulPin);

    for (int i = 0; i < buf_rows; i++) {
        // rising edge indicates start of line
        while ((*hrefPort & hrefMask) == 0); // wait for HIGH

        for (int col = 0; col < bytes_per_row; col++) {
            // rising edges clock each data byte
            while ((*pclkPort & pclkMask) != 0); // wait for LOW

            uint32_t in = port->IN; // read all bits in parallel

            in >>= 2; // place bits 0 and 1 at the "bottom" of the register
            in &= 0x3f03; // isolate the 8 bits we care about
            in |= (in >> 6); // combine the upper 6 and lower 2 bits

            raw_buf[offset++] = in;

            while ((*pclkPort & pclkMask) == 0); // wait for HIGH
        }

        while ((*hrefPort & hrefMask) != 0); // wait for LOW
    }
} /* OV7675::readBuf() */

```

6. Output



```
12:08:33.252 -> Taking photo...
12:08:36.032 -> ERR: failed to allocate tensor arena
12:08:36.032 -> Failed to initialize the model (error code 1)
12:08:36.032 -> Failed to run impulse (-6)
12:08:36.032 ->
12:08:36.032 -> Starting inferencing in 2 seconds...
12:08:38.035 -> Taking photo...
12:08:40.821 -> ERR: failed to allocate tensor arena
12:08:40.821 -> Failed to initialize the model (error code 1)
12:08:40.821 -> Failed to run impulse (-6)
12:08:40.821 ->
```