Smart Weight Measuring Demo using the ESP32 and HX711

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1 Overview of the Demo

This demo shows a smart application to measure the current weight using ESP and HX711. The current weight can be displayed on the LED and the Blynk cloud. Users can also interact with the demo using the web interface, such as taring (zeroing) the scale or displaying the current weight. This Demo provides a basic framework for building a weight scale using an ESP32.

2 Objectives of the Demo

Design and implement firmware for an IoT enabled digital scale using ESP32, a load cell with HX711 amplifier, and a 4 digit 7 segment display. The device should show the current weight in real time and serve it via a local web interface. Demo is integrated with a Blynk cloud platform to shown the current weight.

3 Hardware Requirements

To run this demo, the following hardware must be provided:

3.1 ESP32 MCU

A feature rich MCU with integrated WiFi and Bluetooth connectivity for a wide range of applications. This MCU provides a range of smart application using IOT.

3.2 4 Digits 7 LED Segment Display

The 4 Digit 7 segment display consists of four 7 segment displays working together. It uses the principle of human visual persistence to quickly display

the characters of each 7 segment in a loop to form continuous strings. It can display a number from 0 to 9999.

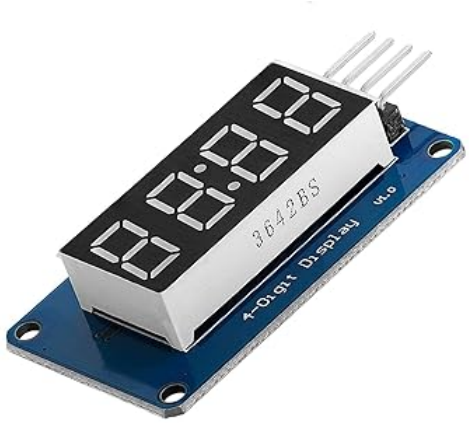

Figure 1: 4-digits -7 Segment Display

3.3 HX711 Amplifier

The HX711 is a 24 bit analogue to-digital converter (ADC) that is specifically designed for weighing scales and industrial control applications, particularly for interfacing with load cells and strain gauges. It amplifies the small signals from these sensors and converts them into a digital signal that can be read by a MCU, such as ESP32. The HX711 is designed to measure the output from load cells, which are transducers that convert force into electrical signals.

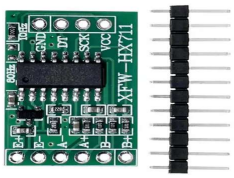

Figure 2: HX711 Amplifier

3.4 Load Cell Weight Scale

A load cell converts a force into an electrical signal that can be measured. The electrical signal changes proportionally to the force applied. Load cell is designed to interact with the HX711 to record the weight and send it to the display, such as LED, using ESP32 MCU.

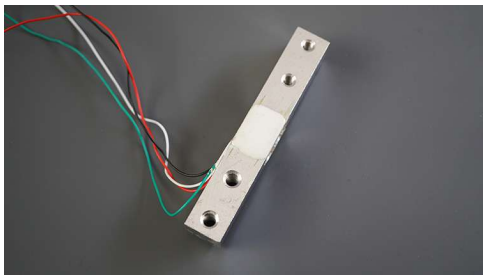

Figure 3: Arduino Manage Library

4 Software

This demo needs the following software.

4.1 Arduino IDE or PlatformIO

The ESP32 Development Environment frameworks such Arduino or PlatformIO. This is where you will write your code to interact with the Load cell to get the weight and then display in ton the LED provided.

4.2 C++ Compiler

C++ compiler must be installed before running this demo.

4.3 Required Libraries

You need to add all the required libraries for this demo to be successfully.Depending on the framework you using, do the following steps.

4.3.1 Arduino Libraries

You can simply use Manage libraries in the Arduino IDE to add the required libraries. This can be accessed from Tool in the Arduino IDE. To add any library, follow information given in this figure.

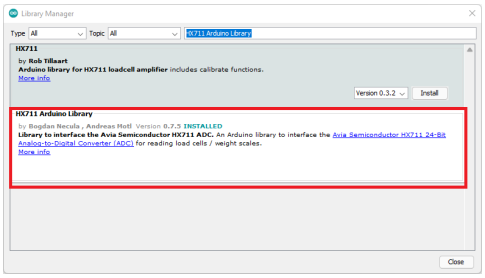

Figure 4: Arduino Manage Library

4.3.2 PlatformIO Libraries

If you using PlatformIO, open libraries and type the library you want to add, as shown below.

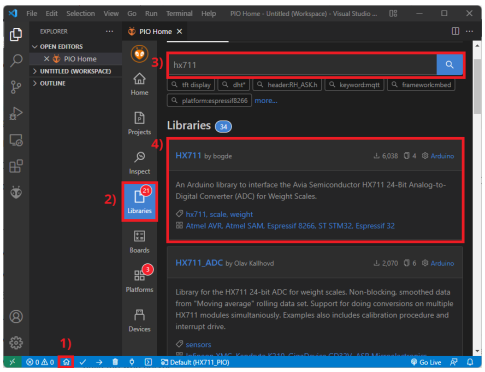

Figure 5: PlatformIO Manage Library

4.3.3 HX711 Library:

This library simplifies reading the data from the HX711 amplifier.

4.3.4 Display Library

The library named **TM1637** needs to be installed to display the current weight from the lead cell amplifier (HX711). the weight of the scale. Each project will have a different factor.

4.3.5 freeRTOS Library

An RTOS provides a framework for managing hardware resources and executing multiple tasks in a deterministic way, ensuring that tasks complete within specified deadlines. FreeRTOS provides APIs for creating tasks, synchronizing them using mechanisms like semaphores and mutex, and for communication between them. ESP32 has a built in freeRTOS framework.

5 Blynk Cloud Interaction

In this DEMO, esp32 MCU is integrated to the Blynk cloud to display the current weight. This demonstrate the solution where ESP32 can interacted using the Blynk mobile app. To do this, we need to create Blynk cloud account and add the required libraries.

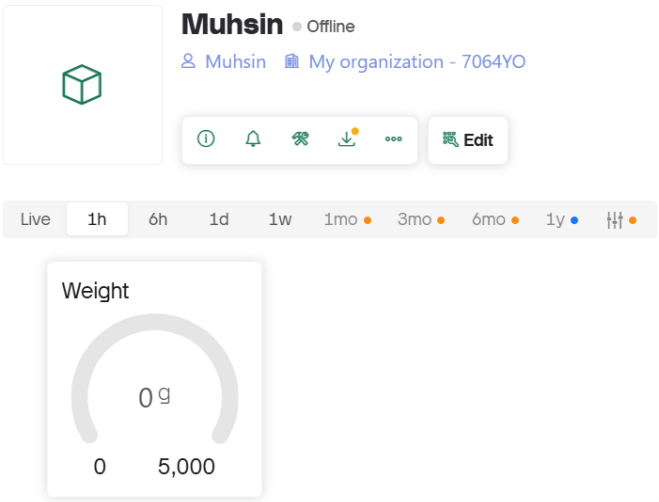

Figure 6: Blynk Cloud Interface

6 Web Server and Web Interface

Once Demo is started, web server is ready to receive any requests from the clients. Web interface allows used to interact with web server and update the display with the current weight and also tare (zeroing) the scale, when needed. To view the web interface to change and update the weight, you need to have the IP address of the web server. This IP server can be obtained from the Serial monitor in the Arduino after demo is started.

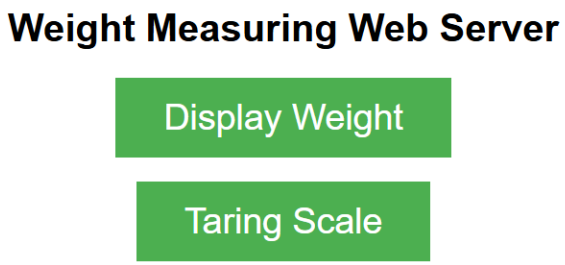

Figure 7: Web Interface

7 Demo Structure Set-up

To create this demo, the devices given above must be structured s shown below.

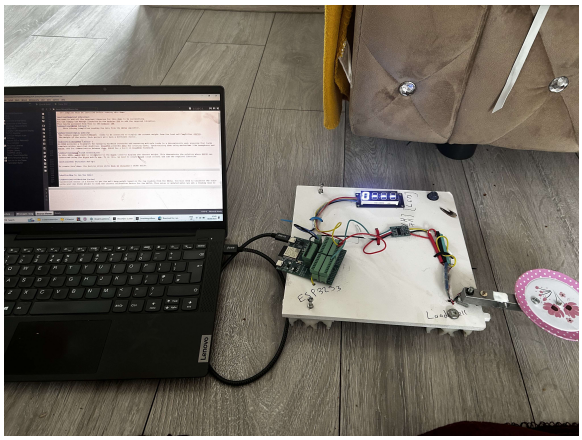

Figure 8: Demo Set-up Structure

8 How to run the Demo

8.1 Calibration Factor

Calibration factor is a factor to get the well-know weight based on the raw reading from the HX711. You will need to calibrate the scale using your own known weight to find the correct calibration factor for the HX711. This

value is updated until you get a reading near to to your known weight (50 grams).

8.2 How to start the Demo

After the required hardware are connected and all the required software and libraries are conducted, you can start to run the the demo as follows:

- Get the code from the Git
  (repository: $https://github.com/kp003919/Demo_FinalVersion.git$).
- Start the Arduino IDE or PlatformIO.
- select your MCU (ESP32S3 Dev Module)
- Select your port number.
- download your code into your MCU.
- Put your weight over the Load cell.
- You should be able to see your weight displaying on the LED.
- You can open your Blynk account and see the current weight, as shown in the Figure 6.
- Open your browser and use the IP address of the web server and type enter. You should see the web page, as shown in the Figure 7.
- Try different weights and repeat these steps.

9 Results of the Demo

Some well-known weight have been measured using the scale and then been tested to check if this demo will show the same results. These results are shown below.

Figure 9: 112 Grams

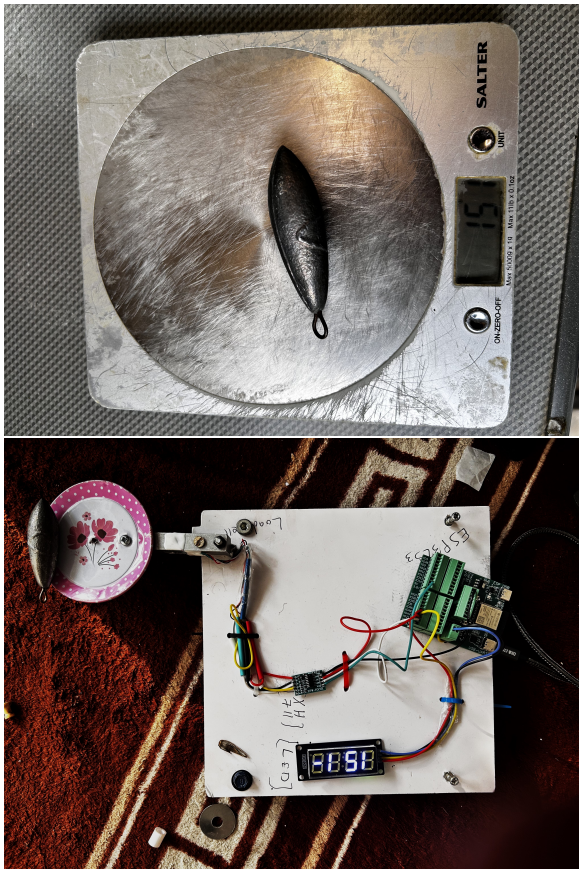

Figure 10: 151 Grams

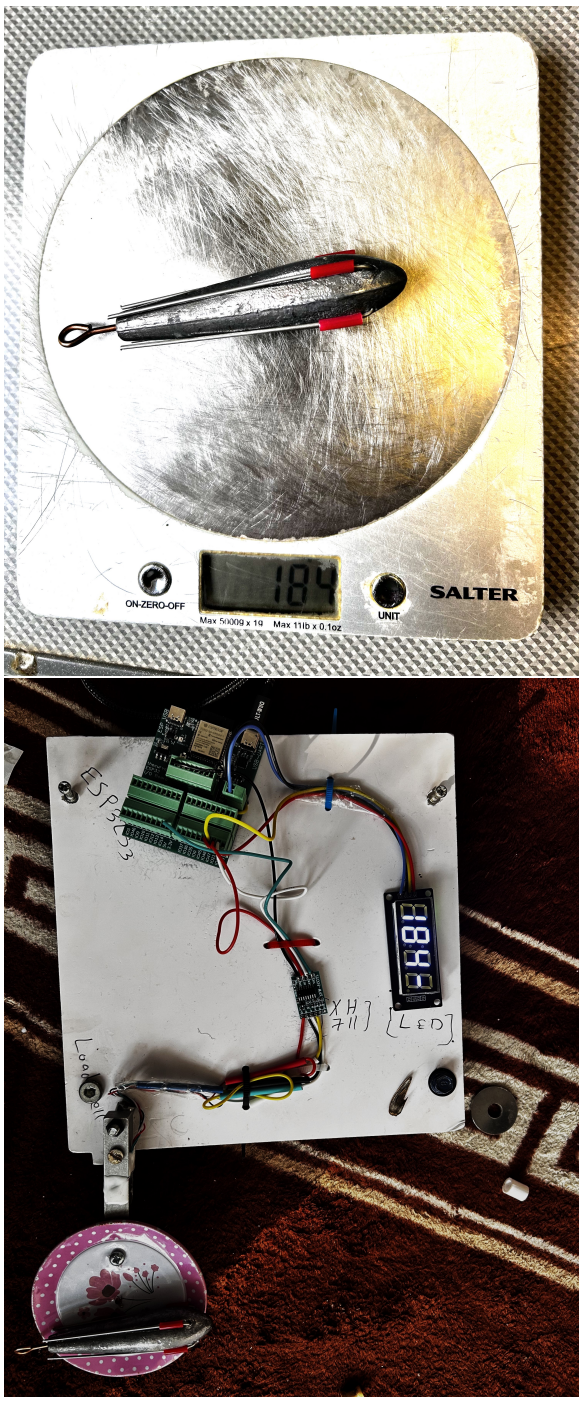

Figure 11: 184 Grams

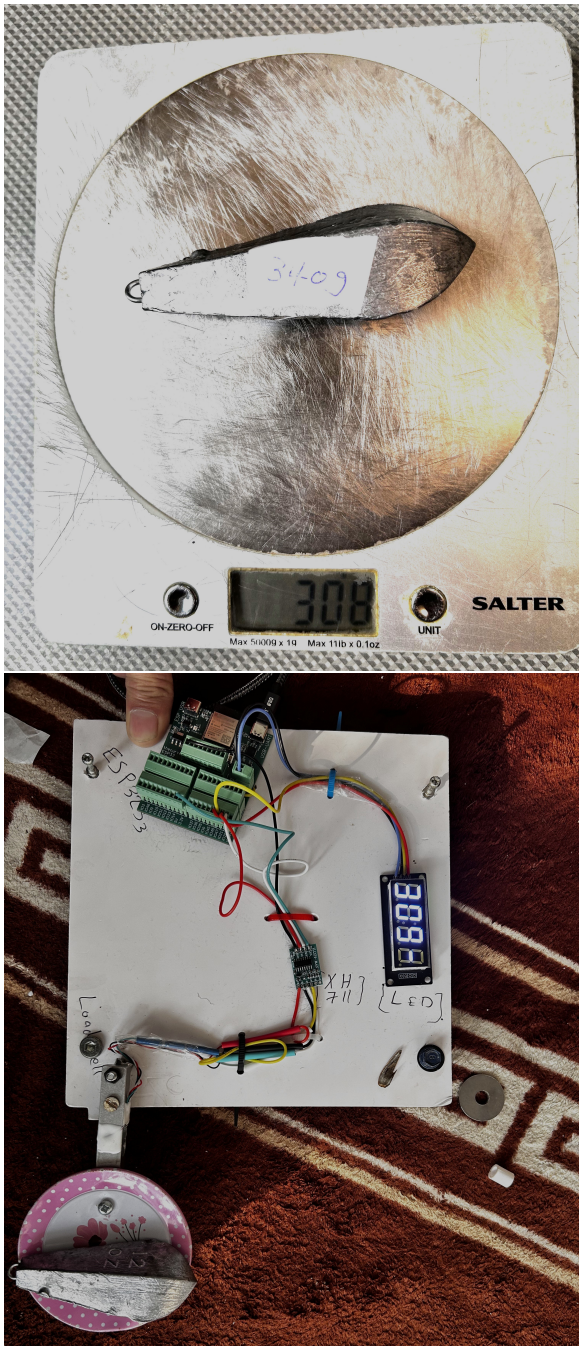

Figure 12: 309 Grams