Voice Control Light Tutorial

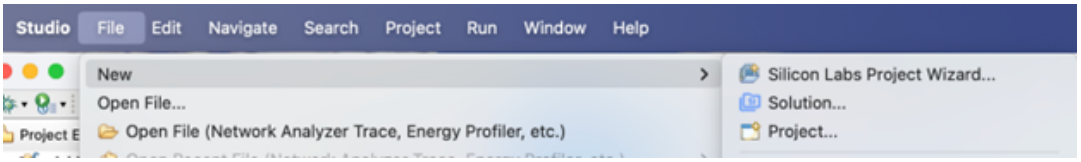
This guide details the process of creating a voice-controlled light application using TensorFlow Lite Micro (TFLM) on an EFR32xG24 Development Kit. This example uses the `keyword_spotting_on_off_v3.tflite` model (recommended) for "on" and "off" keyword detection. For more information on model creation, see the MLTK tutorial.

Hardware: EFR32xG24 Dev Kit Board (BRD2601B Rev A01)

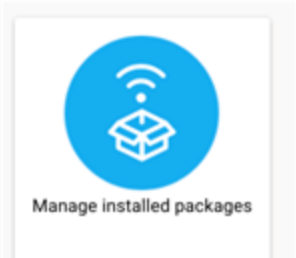
Software: Simplicity Studio (SiSDK 2024.12 or later)

1. Install AI/ML Extension

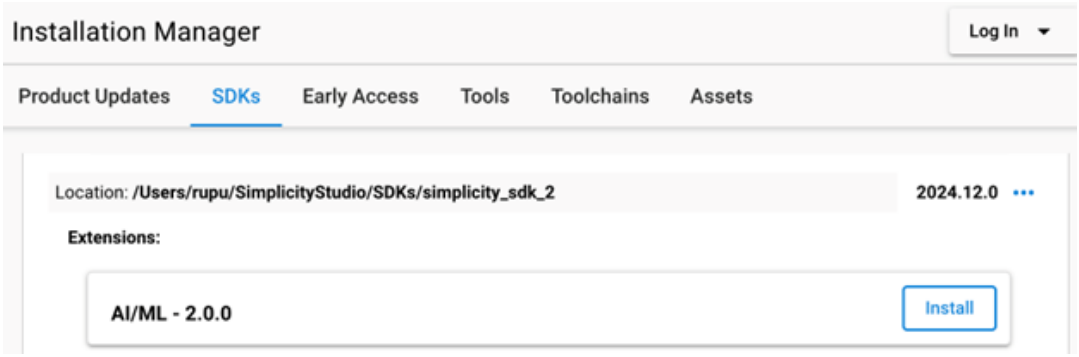
1. Click "Install" on the top bar.



2. Click "Manage Installed Packages".

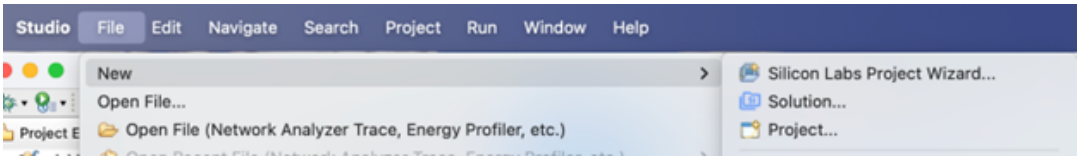


3. Under "SDKs", install the latest version of the AI/ML extension (available from SiSDK 2024.12 onwards).

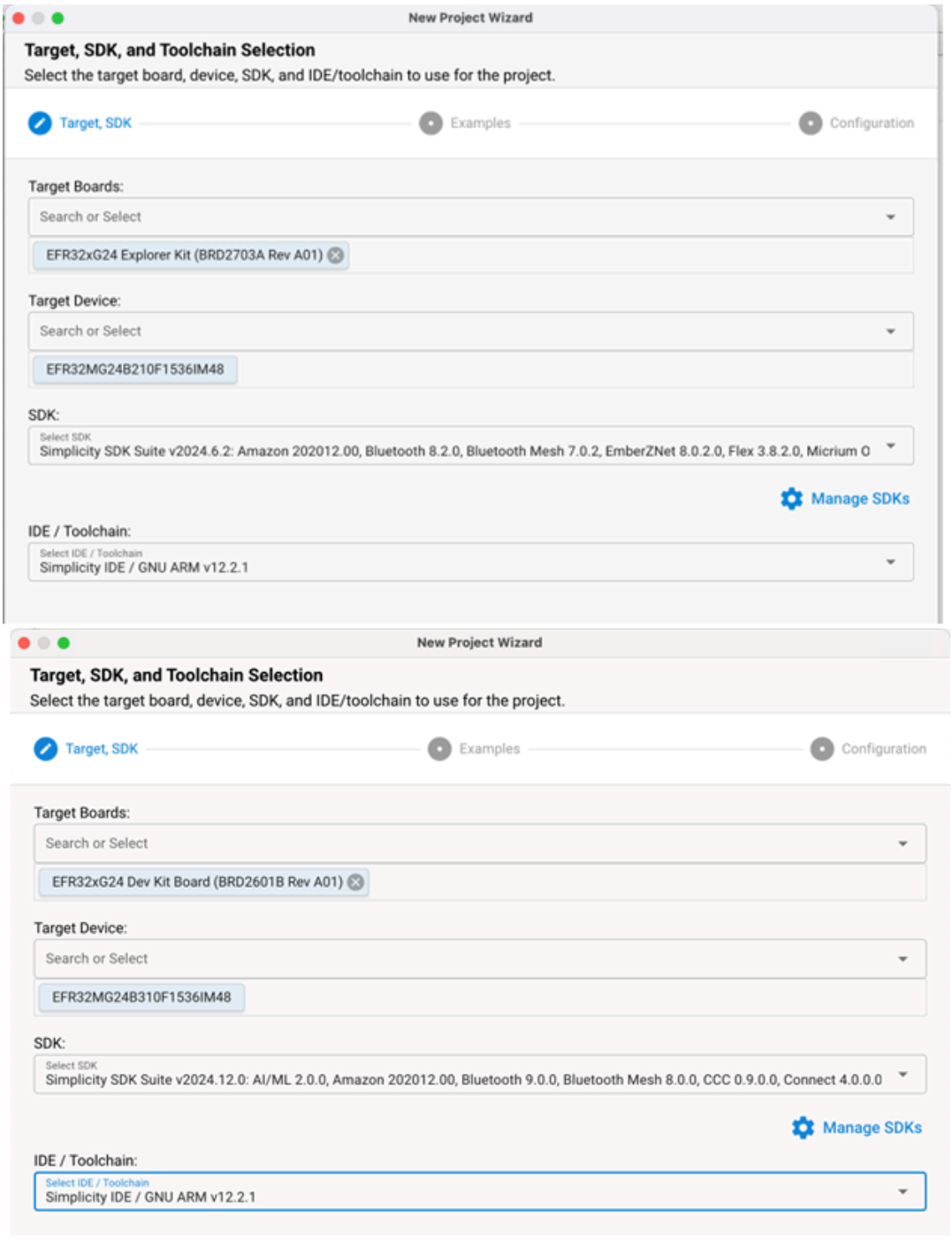


2. Start a New Simplicity Project

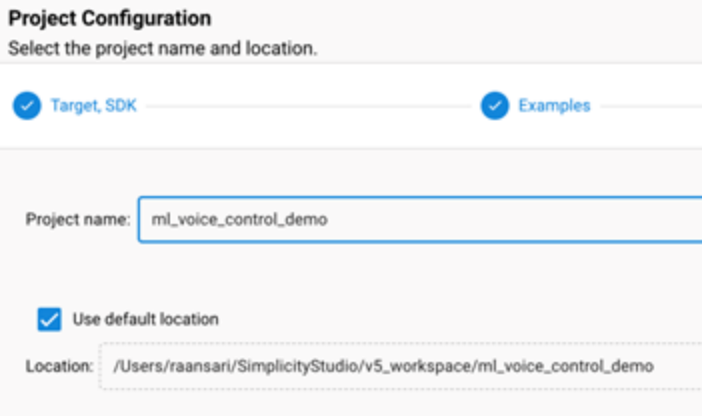
1. From the "File" menu, select "New" >> "Silicon Labs Project Wizard".



2. Select the target board (EFR32xG24 Development Kit), SDK (Simplicity SDK v2024.12.0 or later), and IDE/Toolchain (e.g., GNU ARM v12.2.1). Click "Next".

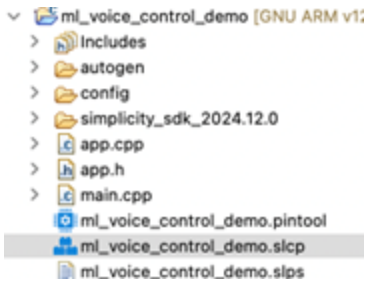


3. Choose "Empty C++ Project". Click "Next".
4. Give your project a name and click "Finish".



3. Add Machine Learning Software Component

1. Open your project file (the one with the `.slcp` extension).



2. Under "Software Components", search for "aiml".

3. Enable the AI/ML extension by clicking "Enable Extension".

4. Expand: AI/ML >> Machine Learning >> TensorFlow. Select "TensorFlow Lite Micro" and click "Install".

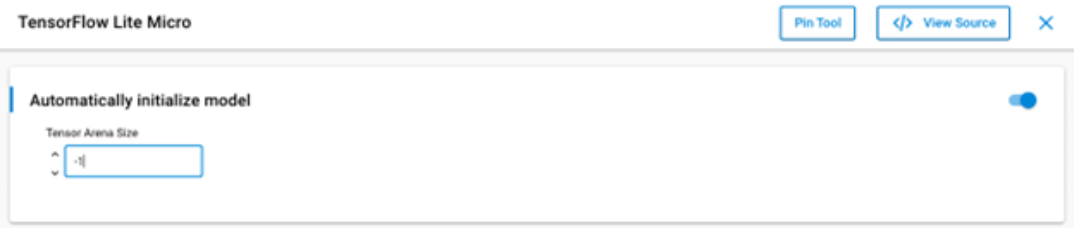
5. You'll be prompted to select additional components:
    - **Debug Logging:** Choose "Debug Logging using IO Stream" (if needed) or "Debug Logging Disabled". Click "Install".

    - **Kernels:** Select "MVPv1 Accelerated Kernels". Click "Install".

4. Configure the TFLM Component

1. Click "Configure" in the TensorFlow Lite Micro Software Component.

2. Set the "Arena Size". For this example, enter `1`. This tells the system to dynamically determine the optimal arena size at runtime.



5. Include and Convert the Model

1. Create a `tflite` directory inside your project's `config` directory (optional but recommended).
2. Drag and drop the `keyword_spotting_on_off_v2.tflite` file into the `config/tflite` directory (or directly into `config` if you skipped creating the subdirectory).
3. The framework will automatically convert the `.tflite` file into a C array (`sl_tflite_micro_model.c` in the `autogen` directory). The TFLM interpreter is also initialized automatically.

6. Profile the Model (Optional)

Model profiling can be helpful for optimization. For advanced users who wish to analyze model performance, the MLTK Model Profiler Utility can be used. This is not strictly required for this basic example.

7. Run the Model

1. **Include TensorFlow Init API:** Add the necessary code to initialize the TFLM interpreter.
2. **Provide Input Data:**

- Get a pointer to the input tensor: `TfLiteTensor* input = sl_tflite_micro_get_input_tensor();`
- Load your input data (microphone audio quantized to int8) into the input tensor: `input->data.int8f[0] = <input array from microphone quantized to int8>;` (See the example code for audio feature generation).

3. **Run Inference:**
   - Invoke the interpreter: `TfLiteStatus invoke_status = sl_tflite_micro_get_interpreter()->Invoke();`
   - Check for errors: `if (invoke_status != kTfLiteOk) { TF_LITE_REPORT_ERROR(sl_tflite_micro_get_error_reporter(), "bad input tensor parameters in model"); }`
4. **Read Output:**
   - Get a pointer to the output tensor: `TfLiteTensor* output = sl_tflite_micro_get_output_tensor();`
   - Access the output data: `int8_t value = output->data.int8_tf[0];`

8. Implement Post-Processing

1. **Develop an Algorithm:** Create an algorithm to interpret the model's output (e.g., the `int8_t value`) and determine whether "on" or "off" was spoken.
2. **Trigger Events:** Based on the post-processed output, trigger actions like controlling the LED. Refer to the `voice_control_light.cc`, `recognize_commands.cc`, and `recognize_commands.h` files in the aiml-extension examples for guidance on implementing this logic, including LED control and command recognition. You will need to add components for the microphone, audio processing, and LED control to your project.