Edge IoT System

N1: Hardware Components: Edge Device

Components	Qty	Ref URL	Comments
Raspberry Pi 5	1	URL	Already Acquired
RPI power Adapter	1	URL	To be purchased
RPI Active cooler	1	URL	To be purchased
micro SD Card	1	URL	Already Acquired
Google Coral TPU	1	URL	To be purchased

N2: Hardware Components: COTS integrated controllers

There are integrated sensor and wall socket solutions available in the market but for the vast majority of them, the key challenge is their proprietary wireless interface discouraging integration with custom devices. The very common example is Phillips Hue Bulbs. Many of such devices use WiFi and allow a very limited control in reprogrammability. We can never be sure about what communications these devices might want to establish over the internet.

However, some devices in this domain that feature a programmable microcontroller and BLE connectivity are hack-able which means with some tweaks, they can be re-programmed for a customized job as needed but there is no certainty of success with these devices. An example is Xiaomi MIjia Temperature sensor. The same example applies to some switching and monitoring applications.

I have shortlisted a few of such devices in the table below. However, there is no guarantee of success with re-programmability and customizability for our needs. Please see comments for each option.

Device	Description	URL	Comments
Cloudfree Smart Plugs	Extension adapter for wall sockets. (SonOff S31)	URL	Integrated Controller. Runs Tasmota/ESPhome and is programmable with specialized builder and binaries.
Cloudfree Light Switch	Light Switch (1x SPDT) with ESP32 integrated controller	URL	Built around ESP32-C3 so very much configurable and controllable.
Athom Smart Plug	ESP32-C3 AU Plug V3	URL	Built around ESP32-C3 so very much configurable and controllable.
Sonoff MINI R4	An All purpose switch featuring ESP32	URL	Basically a multi-purpose controller for seamless integration inside wall sockets and switches
Shelly Plugs	A wide range of EU, US, AU, UK plugs with integrated ESP32 based controllers.	URL	Basically a multi-purpose controller for seamless integration inside wall sockets and switches

The ESP32 is a very common chipset in the commercial home automations sector especially because of its high performance, low cost and easy availability. Moreover, it's wireless frontend is FCC approved which makes it a suitable option in small batch commercial segment.
What's important for us is that the ESP32 chipset has integrated WiFi/BLE and it is easily programmable over the standard UART interface which is easy to identify in custom boards. If we use an off-the-shelf integrated solution, we can likely access it's programming interface with little effort. However it is not a guaranteed solution but has a good probability of success.

N3: Hardware Components: Pre-assembled basic solutions

Device	Description	Comments
KiCony ESP32 Automation Controller	Can be used without any Devkit. A pre assembled solution with 8-Channel Inputs and outputs	The main controller board integrat-able with different IO devices. Features integrated BLE/WiFi

N4: Hardware Components: Self assembly solutions

Device	URL	Comments
ESP32-Dev Kits	URL	The main controller board integrat-able with different IO devices. Features integrated BLE/WiFi
Relay Board **(Already Acquired)**	URL	Can be paired with ESP32-Devkit and placed inside wall-sockets to control outlets. Output Only.
Current Sensors (Zmct103c)	URL	Used to detect the condition of Switches (On/OFF). Moreover, it can measure the amount of current a particular appliance might be using. A cost effective solution for monitoring of power switches. To be used with ESP32-Devkit
Misc. Sensors	Please include more sensors of your choice	You can include other sensors of choice to increase the detectable variables e.g DHT11, MQ135 Gas sensor, Light sensors etc

Note: Each of the item (relays/sensors) in N4 Category require 1x ESP32 Devkit

Summary:

N1 Category is our Edge device. All the components listed are required. In N2, I have mentioned some of the Off-the-shelf solutions that are integrat-able into our system. There is no certainty but higher probability of their compatibility. They require some reversing effort to access the terminal and program the integrated MCU. These devices are shortlisted after exploring several manufacturers and products from the internet.

N3 Category Hardware lists a pre-assembled solution capable of monitoring and controlling components along with an integrated ESP32 MCU and Wireless transceiver. There is a choice between N2, N3 and N4.

I believe the quickest way for now is to purchase N4 components as I believe they are available from the local market. They can be quickly assembled on a proto board and we can start using them. Downside is that this may not be the best looking solution. N2 hardware is a better solution but it will take some time in purchase + shipping and then disassembly of hardware in an attempt to program the chip. It may take several days to figure out the programming pattern for those N2 market products. One point to be noted is that N2 category products may not be a sustainable solution for commercialization as they are already the product of another company and there are complications involved. The best approach to commercial scaling of our solution would be to take our already tested (by then) N4 setup to a custom hardware design.