Bird Feeder

1. Introduction

Bird Feeder is a project that aims to build a self-contained system which integrates a Pet Feeder manufactured by Nooie which will dispense food for birds via donations through a livestream. The Bird Feeder is projected to be placed in the bird house of Kalisto Tierpark located in Kamp-Lintfort.

The Nooie Pet Feeder features a microcontroller board manufactured by Tuya. Tuya is an IoT and cloud development service provider with a varied range of products. The pet feeder can be controlled through Tuya's cloud development platform. While cloud development is useful, we would like to control the pet feeder locally for security and latency reasons.

To control the pet feeder locally, we will be using Home Assistant. Home Assistant is a Linux based open-source software generally used for smart home automation. We will be using a Raspberry Pi to install Home Assistant, which will be our main control hub.

Additionally, an e-paper display will be used to display last donation information to show people physically present that this service actually exists.

2. Materials

- Raspberry Pi 4.
- Nooie Pet Feeder.
- Micro SD card.
- SD card reader.
- Ethernet Cable.
- A smartphone which is compatible with Tuya Smart application.
- XIAO Esp32S3.
- XIAO elnk Expansion Board.
- 7.5in E-ink Display.
- Camera (Any).
- PC (Any).

2.1 Raspberry Pi 4

- The Raspberry Pi 4 is a powerful single-board computer that can power through many affordable electronics.
- Home Assistant OS is installed on the RaPi4 to act as a hub for the different components and as an MQTT Broker.



2.2 Xiao Esp32S3

• XIAO ESP32S3 is a tiny and cool device that combines the ESP32-S3R8 processor and support for both 2.4 GHz Wi-Fi and Bluetooth 5.0. The other ones have 8 MB PSRAM, 8 MB Flash, and an external SD card slot.



Fig. 2: XIAO Esp32s3 Pinout

• It is mainly used to control the e-paper display using the XIAO elnk Expansion Board



Fig. 3: XIAO elnk Expansion Board

2.3 7.5in E-ink Display

- An E-Ink display, also referred to as e-paper, is a display technology that is synonymous with its low power consumption and visual appearance—mimicking ink on paper.
- Used to display last donation information.



Fig. 4: 7.5" E-Ink Display

3. Home Assistant on RaPi

- System-Architecture
- Home Assistant Installation

Home Assistant Installation

This guide was written using Home Assistant version 2024.5.x.

• Credits go to Taycan.

Raspberry Pi Setup

1. Install Raspberry Pi imager https://www.raspberrypi.com/software/.

Install Raspberry Pi OS using Raspberry Pi Imager		Raspberry Pi Imag	er v1.8.1
Raspberry Pi Imager is the quick and easy way to install Raspberry Pi OS and other operating systems to a microSD card, ready to use with your Baspberry Pi	Rastery Pi Devi	o Operating System	Shirage
Download and install Raspberry Pi Imager to a computer with an SD card reader. Put the SD card you'll use with your Raspberry Pi into the reader and run Raspberry Pi Imager.		2 CHOUSE US	NOT
Download for Windows			
Download for macOS			
<u>Download for Ubuntu for x86</u>			
To install on Raspberry Pi OS , type sudo apt install rpi-imager			

Fig. 5: Pick the operating system you are using

- 2. Insert the Micro SD card to the SD card reader.
- 3. Run the application.
- 4. Choose Device (Raspberry Pi 4 in this case).
- 5. Choose Operating System ("Other specific-purpose OS" \rightarrow "Home assistants and home automation" \rightarrow "Home Assistant" \rightarrow "Home Assistant OS 12.x").
- 6. Choose Storage.

Raspberry Pi Imager v1.8.5

👸 Ras	pberry Pi	
Raspberry Pi Device	Operating System	Storage
RASPBERRY PI 4	HOME ASSISTANT OS 12.3 (RPI 4/400)	SDHC CARD
		NEXT

Fig. 6: Home Assistant Installation, In this case, Raspberry Pi 4

- 7. Click "Next" \rightarrow "Yes". (Ignore Microsoft Error messages).
- 8. Remove the Micro SD card.
- 9. Insert the Micro SD card into the Raspberry Pi's Micro SD card slot.
- 10. Connect Raspberry Pi to power via the USB-C (or Micro-USB depending on the model) port.
- 11. Connect the Raspberry Pi to your network via the ethernet port on the Pi, make sure your computer is connected to the same network as well.
- 12. Home Assistant Installation happens automatically if the Micro SD card is inserted and the Raspberry Pi is powered on. This might take a few minutes. If you want to monitor the installation, connect the Raspberry Pi through its mini-HDMI port to a display.
- 13. Open a web explorer, navigate to http://homeassistant.local:8123/ and hit enter.
- 14. Wait for the setup to finish and click on "Create My Smart Home".
- 15. Create a user using your preferred credentials.

4. Implementation

- 1. System Architecture.
- 2. Connecting ESP32 to e-ink display using the extension board. (Display Component).
- 3. Installing ESP-Home on HA.
- 4. Connect **Display Component** to ESP-Home.
- 5. Setting up MQTT Broker on HA.
- 6. Rewriting the **Display Component** code from C++ to ESP-Home yaml syntax.
- 7. Setting up Frontend website.
- 8. Configuring website to use MQTT QoS-2.
- 9. Configuring Nooie-pet feeder on HA using LocalTuya.
- 10. Creating Automation function for pet feeder to trigger on MQTT Message.

4.1 System Architecture

- Raspberry Pi:
 - $\,\circ\,$ Home Assistant is flashed on a Raspberry Pi.
 - $\circ\,$ Local Tuya and MQTT Broker are installed and configured on HA.
 - $\circ\,$ Pet Feeder is connected to Local Tuya using LAN/WAN.
 - Both Pet Feeder and **Display Component** trigger on MQTT Messages.
- A PC Acting as a server to hold services:
 - OBS/Streaming connected to a camera in the exhibit.
 - A full-stack web application that hosts the stream and acts as an interactive environment for people to watch and potentially donate.
 - The front-end side sends a MQTT message on donation to trigger pet feeder and **Display Component**.



4.2 Connecting ESP32 to e-ink display using the extension board.

- Connecting the different parts was very simple. The microcontroller was connected to the extension board seamlessly as they are already compatible.
- Display was connected to the extension board using its 24-pin cable. Warning, the cable is very





Fig. 7: Display Component

- The following code file was implemented using **Seeed Studio**'s wiki/documentation page.
- The e-ink display needs to be refreshed fully or partially between data changes, otherwise the text/image will not show properly.
- The trickiest part was figuring out which pins to use for these pins: BUSY, RES, DC, CS.
- The display using bitmaps for... displaying text/images.
- A bitmap uses a grid of pixels to display text/images. Each pixel in the bitmap corresponds to a pixel on the e-ink display.

• A Converter can used to convert normal images to cpp bitmap files.

display_code.ino

```
//Most Important Import
#include <SPI.h>
#include "Display_EPD_W21_spi.h"
#include "Display_EPD_W21.h"
#include "frame.h"
#include "GUI_Paint.h"
#include "font.h"
```

```
#if 1
unsigned char BlackImage[EPD ARRAY]; //Define canvas space
#endif
//Most Important Part
void setup() {
  pinMode(D5, INPUT); //BUSY
  pinMode(D0, OUTPUT); //RES
  pinMode(D3, OUTPUT); //DC
  pinMode(D1, OUTPUT); //CS
 //SPI
 SPI.beginTransaction(SPISettings(10000000, MSBFIRST, SPI MODE0));
 SPI.begin();
 Serial.begin(9600);
 Serial.print(111);
}
//Tips//
/*
1. Flickering is normal when EPD is performing a full screen update to
clear ghosting from the previous image so to ensure better clarity and
legibility for the new image.
2. There will be no flicker when EPD performs a partial refresh.
3. Please make sue that EPD enters sleep mode when refresh is completed
and always leave the sleep mode command. Otherwise, this may result in
a reduced lifespan of EPD.
4. Please refrain from inserting EPD to the FPC socket or unplugging it
when the MCU is being powered to prevent potential damage.)
5.Re-initialization is required for every full screen update.
6.When porting the program, set the BUSY pin to input mode and other
pins to output mode.
*/
void loop() {
  Serial.print(111);
 #if 1 //Partial refresh demostration.
  EPD Init Fast(); //Full screen refresh initialization.
  EPD WhiteScreen White(); //Clear screen function.
  EPD DeepSleep(); //Enter the sleep mode and please do not delete it,
otherwise it will reduce the lifespan of the screen.
  delay(2000); //Delay for 2s.
  //Partial refresh demo support displaying a clock at 5 locations with
00:00. If you need to perform partial refresh more than 5 locations,
please use the feature of using partial refresh at the full screen
demo.
 //After 5 partial refreshes, implement a full screen refresh to clear
```

```
the ghosting caused by partial refreshes.
  ///////////////Partial refresh
Paint_NewImage(BlackImage, EPD_WIDTH, EPD_HEIGHT, 0, WHITE); //Set
canvas parameters, GUI image rotation, please change 0 to 0/90/180/270.
  Paint_SelectImage(BlackImage); //Select current settings.
  EPD Init(); //Full screen refresh initialization.
  Paint_Clear(WHITE); //Clear canvas.
  const char * Message = "Welcome to Kalisto";
  Paint_DrawString_EN(400 - (((strlen(Message) * 32) / 2)), 240 - (64 /
2), Message, & Font64, WHITE, BLACK);
  EPD Display(BlackImage); //Display GUI image.
  EPD DeepSleep(); //EPD DeepSleep,Sleep instruction is necessary,
please do not delete!!!
 delay(20000); //Delay for 2s.
 // Full screen update clear the screen.
  EPD Init(); //Full screen refresh initialization.
  EPD WhiteScreen White(); //Clear screen function.
  EPD DeepSleep(); //Enter the sleep mode and please do not delete it,
otherwise it will reduce the lifespan of the screen.
 delay(2000); //Delay for 2s.
 #endif
 delay(300000); // The program stops here
```

4.3 Installing ESP-Home on HA.

- **ESP-Home** enables advanced functionality on ESP devices without deep programming knowledge. Despite that fact, it has a specific syntax to follow and requires some learning. It acts a hub for all connected ESP devices.
- Following the **ESP-Home** Documentation website is essential for installation and general knowledge.
- To install **ESP-Home** on *HA*, this page is far better than any steps I can write.

4.4 Setting up MQTT Broker on HA.

- MQTT originally stood for MQ Telemetry Transport. It is an extremely lightweight publish/subscribe messaging transport protocol on top of TCP/IP designed for machine-tomachine or Internet of Things connectivity. It's a very powerful protocol for transmission in smart home devices.
- MQTT will be used for communication between the different components.
- A MQTT Broker called Mosquitto can be installed to **HA** as an add-on. This page contains detailed instructions for installation and configuration.

4.5 Connect Display Component to ESP-Home.

- Adding an ESP component is very simple and requires simple steps to be achieved.
- 1. Click on "New Device"

-	Horse Assistanti	+ 1379410					
:15	-	ESPHome					
	-						
+	1000			Welcome to ESPHome			
-	August .			C Tools He part don't part from pay dontant			
	i non :						
	-						
	the state						
=	-						
2	bertur bit						
	Million d	3					
6						(******	
			And and a second s				
Η	g. 8						

• 2. Click "Continue"



• 3. Enter a name for the device and give the Wifi SSID and password for the device to establish connection wirelessly. The click "Next"



• 4. Make sure "Use recommended settings" choose the device type, in our case it is "ESP32-S3".

 Home Assistant 	+ ED/Twise		
11	ESPHome		
A treat			
-		Chapter Bell provident' per laner	
-		CHI MANINE MAN	
and shares			
-		Tentent your choice town	
a na barazo		Mover two logics of devices that two will be considered on.	and and the second s
		1000100	
		Aurona .	
		Support of the Party	

- Fig. 11
- 5. Copy the encryption key safely for future use then click "Install".



• 6. This depends on how the device is connected. For the first time installation it is better to "Plug into the computer running ESPHome Dashboard".



• 7. Choose the correct port. In this case it is only one.



• 8. Wait for the first installation to pass. You can see if it was successful or not but seeing whether the device connected to the wifi connection or not.

4.6 Rewriting the Display Component code from C++ to ESP-Home yaml syntax.

- The ESPHome documentation proven to be the best way to fulfil this step.
 - ESPHome Core Configuration , SPI, MQTT, text_sensor and Display were the most used pages in the documentation to reach this code.
- ESPHome Configuration: specifies the name of ESPHome project and on-boot actions.
- Configuration of ESP32 Board and Framework: In this, the ESP32 board and framework used are specified.
- Logging and API: Switches on logging and the Home Assistant API—all encrypted.
- WiFi Configuration: Provide WiFi credentials and setup fallback hotspot.
- MQTT Integration: Provide details of the MQTT broker to connect for communication.
- Display Setup: Specify your e-ink display model, pins, and update intervals.
- Text Sensor: Subscribes to MQTT topics to show messages on the e-ink display.

display_code.yaml

```
board: esp32-s3-devkitc-1
  framework:
    type: arduino
# Enable logging
logger:
# Enable Home Assistant API
api:
  encryption:
    key: "7QLJzR30itSBn30kootHbIE6FI8jmUtAl7/fcytRxis="
ota:
  platform: esphome
  password: "81ceca8aa7f29a76601df5539733d32f"
wifi:
  ssid: !secret wifi ssid
  password: !secret wifi password
 # Enable fallback hotspot (captive portal) in case wifi connection
fails
 ap:
    ssid: "Display Fallback Hotspot"
    password: "WgV5TWXpXcpT"
captive portal:
script:
  - id: update_screen
    then:
      - component.update: eink_display
font:
  - file: "gfonts://Roboto"
    id: roboto 64
    size: 64
spi:
  clk pin: GPI07
  mosi pin: GPI09
mgtt:
  broker: hafeeder.local
  port: 1883
  username: "mqtt"
  password: "1234"
text sensor:
  - platform: mqtt_subscribe
    name: "Data from topic"
```

```
id: mytext
    topic: birdfeeder
    qos: 2
    on value:
      then:
        - script.execute: update_screen
display:
  - platform: waveshare epaper
    model: 7.50in-bV3
    id: eink display
    cs_pin: GPI02
    dc pin: GPI04
    busy_pin: GPI06
    reset pin: GPI01
    update_interval: never
    lambda: |-
      it.printf(400, 240, id(roboto_64), TextAlign::TOP_CENTER,
id(mytext).state.c str());
```

4.7 Setting up Frontend website.

- I built a simple react frontend application for sake of testing and showing the viability of the whole concept.
- The application can be found on a Github Repo



Fig. 15

4.8 Configuring Nooie-pet feeder on HA using LocalTuya.

• Credits go to Taycan.

HACS Installation

Home Assistant Community Store (HACS) is a third-party download manager for Home Assistant which contains various custom integrations. We need to install LocalTuya integration through HACS to locally control the pet feeder. This guide was written using HACS version 1.34.0.

1. Go to your user profile and enable "Advanced mode".

≡<	Home Assistant		General Security	i i i i i i i i i i i i i i i i i i i
55	Overview		User settings	
₽	Мар		The following settings are tied to your account and will per- devices.	rsist across all sessions and
4	Energy			
≣	Logbook		Language Help translating	English *
11.	History		Mumber format	
۵	Media		Choose how numbers are formatted.	Auto (use language se *
Ē	To-do lists		Time format Choose how times are formatted.	Time format Auto (use language se
			Date format Choose how dates are formatted.	Date format Auto (use language se
			Time zone Choose the time zone to use for displaying times.	Time zone Use your local time zo
			First day of the week Choose the starting day for calendars.	First day of the week Auto (use language se
~	Developer tools		Advanced mode Unlocks advanced features. Learn more	²
۵	Settings			
•	Notifications 1	1	Browser settings The following settings are local to this client only, and may when local data is cleared.	reset to defaults on logout or

Fig. 16: User profile is found on the bottom right.

- 1. Go "Settings" \rightarrow "Add-ons" \rightarrow "Add-on store" \rightarrow search "SSH" \rightarrow Install "Terminal & SSH".
- 2. After the installation is complete, enable "Show in sidebar"

=<	Home Assistant	← Info Documentation Configuration Log
	Overview	Terminal & SSH
₽	Мар	Current version: 9.14.0 (Changelog)
4	Energy	? Rating 🛆 Manager 👸 Ingress 😋 Signed
i=	Logbook	Visit the Terminal & SSH page for more details
11.	History	Onar SSI
	Media	
>_	Terminal	Start URI DUDU Make the add-on start during a system boot
Ê	To-do lists	Watchdog This will start the add-on if it crashes
		Auto update Auto update the add on when there is a new version available
		Show in sidebar Add this add-on to your sidebar
		START
		Home Assistant Add-on: SSH server
7	Developer tools	Allow logging in remotely to Home Assistant using SSH or just the web terminal with ingress.
\$	Settings	About
	Notifications	Setting up an SSH server allows access to your Home Assistant folders with any SSH client. It also includes a command-line tool to access the Home Assistant API.
t		

Fig. 17: SSH Add-on options after installation

- 1. Navigate to "Terminal" on the sidebar, if it appears not to be running or if you are receiving error codes, refresh the instance.
- 2. Copy and paste (CTRL+SHIFT+V to paste) the following command to the terminal and hit Enter.

This will initiate the installation of HACS.

```
wget -0 - https://get.hacs.xyz | bash -
```



Fig. 18: HA SSH

- 1. After the installation is completed, restart the home assistant ("Settings" \rightarrow three dots on the top right \rightarrow "Restart Home Assistant" \rightarrow "Restart Home Assistant").
- 2. Home Assistant should automatically restart, if the browser crashes, refresh the browser page to access Home Assistant again.
- 3. Navigate to "Settings" → "Devices & Services" → Click "Add Integration" on the bottom right corner.
- 4. Type "HACS" on the search bar, click on the result.



1. Check all but the last checkbox and submit.

HACS O ×	
Before you can setup HACS you need to acknowledge the following	
✓ I know how to access Home Assistant logs	
✓ I know that there are no add-ons in HACS	
I know that everything inside HACS including HACS itself is custom and untested by Home Assistant	
I know that if I get issues with Home Assistant I should disable all my custom_components	
Enable experimental features, this is what eventually will become HACS 2.0.0, if you enable it now you do not need to do anything when 2.0.0 is released	
SUBMIT	
ia 20	_

Fig. 20

- 1. Create a github account if you don't have one.
- 2. HACS will ask you to activate device through your github account. Follow the instructions provided and link HACS with your github account.



Fig. 21: Copy highlighted code and click on the github link

	Device Activation
	Signed in as
	Enter the code displayed on your device
	8 4 D 8 - C 4 C
	Continue
	GitHub staff will never ask you to enter your code on this page.
0 2024 GitHub, Inc.	Terms Privacy Security Status Docs Contact Manage cookies Do not share my personal information

Fig. 22: Paste the code here.

- 1. Click on "Authorize" and exit github.
- 2. If everything is set correctly you should have installed HACS on your Home Assistant. Do not pick an area on the pop-up and click on "finish".
- 3. Now HACS should show up on the sidebar of Home Assistant UI.

LocalTuya integration Installation

LocalTuya integration is what we need to control the pet feeder locally. This guide was written for LocalTuya version 5.2.1.

1. On the HACS tab, click on "Integrations".

≕	Home Assistant	Home Assistant Community Store	
	Overview	2 Interrations	
₽	Мар	This is where you find custom integrations (custom_components)	
4	Energy	Frontend This is where you find themes, custom cards and other elements for lovelace	
Ξ	Logbook	Add-ons	
ıl.	History	There are no addons in HACS, but you can click here to get to the supervisor	
	HACS	About Show information about HACS	
	Media		
>_	Terminal		
i.	To-do lists		

Fig. 23

1. Click on "Explore & Download Repositories" on the bottom right, on the pop-up search, type

"LocalTuya". Click on the result.

÷	Integrations Frontend	:
Q Search for downloaded repositories		
	HACS HACS gives you a powerful UI to handle downloads of all your custom needs.	
²	Add repository × a beach for separate becallarya × bot by becall Tuya becall handling for Tuya devices	
771		1 + EXPLORE & DOWNLOAD REPORTORIES



1. Click on "Download" on the bottom right. Click on "Download" again on the pop-up.

=<	Home Assistant	← Local Tuya	:
	Overview	(2 grossopripe) (2 goostluid) (2 2009) (1138)	
₽	Мар	RECAUE V5.2.1	
4	Energy	MASS DEFAULT	
≣	Logbook		
16	History	the local tuva	
	HACS		
۵	Media	A Home Assistant custom Integration for local handling of Tuya-based de Show beta versions	
>	Terminal	This custom integration updates device status via pushing updates instead	
Ê	To-do lists	Ine integration also supports the Tuya To I Cloud APIs, for the retrieval of a section was v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v52.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v53.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v53.1 data after re-uniting a davida, of forsil keyr. Cloud API calls are v53.1 data after re-uniting a data after re-uniting a data after re-uniting a data after v53.1 data after re-uniting a data after v53.1 data after	
		performed only at startup, and when a local, key update is needed. */conflg/custom_components/localtuya'	
		The following Tuya device types are currently supported: Remember that you need to restart Home Assistant before changes to integrations (custom_components) are applied.	
		• Switches 2	
		- COVERS BOWNLOAD	
		• Fans	
		Climates Varians	
ア	Developer tools	Transporter for the second matter at the second of the second time is a second se	
\$	Settings	Energy monitoring (vollage, unreni, waits, etc.) is supported on companion devices.	
		Currently, luya protocols from 3.1 to 3.4 are supported.	
	Notifications	This repository's development began as code from @NameLessPed, @mileperhour and @TradeFace. Their code was then deeply relactored to provide proper integration with Home Assistant environment, adding contig flow as other features. Refer to the "Thanks to" section below.	id
t		Installation:	AD
Fig	g. 25		

Adding Pet Feeder to Home Assistant

- 1. Download the "Tuya Smart" app to your smartphone (version 5.13.0 was used for this guide).
- 2. Press both buttons on the pet feeder at the same time.
- 3. Run the "Tuya Smart" app, press "Add Device", the Pet feeder should appear automatically, turn on your Bluetooth if it doesn't. Insert the wireless credentials and press login. **Make sure the pet feeder and the Home Assistant are in the same network**.
- 4. Navigate to Tuya IoT development platform and create an account.

Create Your Tuya Account

@gmail.com	
Verification Code	
837329	Resend After 14 s
Password	
	~
onfirm Password	
	5,4
Organization Name Company Name (Optional)	
Country/Region	
Germany	\sim
 Agree to Terms of Use, Legal State I declare that I have reached legal a the capacity to consent to the above 	ment, Privacy Policy age of majority and have ve documents.

Fig. 26

- 5. Once the account is created, navigate to the developer platform on the top right corner of the page you were redirected to.
- 6. Skip the tutorials, hover the cursor over "Cloud" on the sidebar and click on "Development".





 Click on "Create Cloud Project" on the Development page. Fill in the project details. Pick "Custom" Development method and "Central European Data Center", pick the rest as you see fit.

tuya	Developer Platform			Help	Documents	Tech Support	English(EN) 🔻	My Space 🔻	1		.
Overview	Development Based on the API products and supporting technical services provided by the Cloud Developme	Create Cloud Project		×							
Product	Operation Guide Cloud Development Website 7	* Project Name:	pet feeder								
App	My Cloud Projects Upgrade IoT Core Plan >	Description:	Please briefly describe the functions and scenarios of your project, with no more than 255 words.					\Rightarrow	Create	Cloud Pro	oject
Cloud											
Data		* Industry:	Others v								
Operation		* Development Method:	Custom								
Purchase		Data Center ():	Central Europe Data Center ×								
VAS 71	•		Cancel								
Fig	. 28										

8. In the next step, add "Smart Home Basic Service" and "[Deprecate]Device Log Query" to the selected API services. Click on "Authorize".

ithorize API Services			
e platform recommends some API services, and you can remove and this project will be granted access the API products.	ve and selec	t them as needed. The selected unsubscribed API se	ervices will be subscribe
Select API Services	All	Selected API Service(s) (5)	Delete All
Fire Protection Service	>	IoT Core (Free Basic Resource Pack)	X
Vehicle Detection	>	Authorization Token Management	X
General Scene Template	>	Industry Basic Service	
[Deprecate]Industrial General Device Group Management	>		^
Elevator Control Service	>	Smart Home Basic Service	×
Pet Detection	>	[Deprecate]Device Log Query	×
Country and City Info			

Fig. 29

9. Now that the project is created, let's add the pet feeder to the project. Navigate to "Devices" \rightarrow "Link Tuya App Account" \rightarrow "Add App Account".

tuya	Developer Platform			Help	Documents	Tech Support English(E	N) 🔻 My Spa	ce* 🗑 🌲 🎹 🚨
Overview	← pet feeder Switch Project \$					Show Wiza	erd 🗸 Cen	tral Europe Data Center \vee 🌒
Product	Overview Authorization Service API Devices Message Service	Project SaaS						
App	You can add devices to a project by using the IoT Device Management app, and can also Device Linking Methods	link device resources of other apps. 🗢 Operat	tion Guide 🛛 🚡 View					
Cloud	All Devices Link My App Link My WeChat Mini Program Link Tuya App	Account Link SaaS						
Data	You can link devices to this project by using accounts of Smart Life App. Already added 0 accounts and	inked 0 devices.						Add App Account
Operation	App Account UID	App Name	Devices	Linked Projects		Device Linking Method	Linked Devices	Operation
Purchase								
VAS 7								
	•		No data found					

Fig. 30

- 10. A QR code will appear, open the "Tuya Smart" app on your phone, press on "Me" on the bottom right and then press on the scan icon on the top right, scan the QR code.
- 11. After the QR code is scanned, pick "Automatic Device Linking Method" and click on OK.

	Link Tuya App Account	×
52	You are trying to link the "Tuya Smart" App Account and subordinate devices with this project. Please select the device linking method and device permission to continue.	
	Device Linking Method	
l	Automatic Link (Recommended) : After you confirm the linking operation, all devices under the App Account will be automatically linked with the project.	
le	Custom Link : After you confirm the linking operation, you need to manually select and link the specified device(s) with the project.	
l	Cancel	Ж

12. Once the linking is complete, you should be able to see your account details on the "Link Tuya App Account" tab. **Make note of the "UID"**, we will use this later. Click on "Manage Devices".

tuya	Deve	eloper Platform							He	elp Documents	Tech Support English	n(EN) 🔻 My Sj	pace 🔹 🛛 📜	. Ⅲ	<u>*</u>
Overview		← pftk Sw	vitch Project 🗘								Show W	izard 🗸 🗌 Ci	entral Europe Da	ata Center \vee	0
D		Overview A	uthorization	Service API Devi	ces Messa	age Service Project S	SaaS								
App		You can add devi Device Linking M	ces to a project by ethods	using the IoT Device I	Management ap	op, and can also link device	e resources of other apps. 📚	Operation Guide 🛛 🖪 View							
Cloud		All Devices	Link My App	Link My WeChat M	ini Program	Link Tuya App Account	Link SaaS								
Data		You can link devices	to this project by usin	ng accounts of Smart Life	App. Already adde	ed 1 accounts and linked 0 dev	ices.						_	Add App Accour	nt
Operation		App Account			UID		App Name	Devices	Linked Projects		Device Linking Method	Linked Devices	Operation	n	
Purchase		?	@gmail.com		eu1714	YBR1	Tuya Smart	1	pftk		Custom Link	0	Manage Unlink	Devices	
VAS 7	×										Total Ite	ms: 1 < 1) > 10) Items/Page 🗸	

Fig. 32

13. If the Pet Feeder is shown as unlinked, check the checkbox next to the pet feeder and hit "Link Device".

Manag	je Devices								×
Ye	ou can choose ei evice allowance o	ther method to lini of your IoT Core is	k devices. In the sufficient. In the	e automatic e custom m	mode, all device ode, you need to	es under the ap o manually sele	p账号 will be linke ct and add device(d with the cloud p s) to the cloud pro	roject if the oject.
Informa	ation								
Name:	@gm	ail.com	Type:	app账号					
Linking	Configuration								
Device 1	Management Me	thod:Custom settin	ngs Modify						
Device	List								
Devic	е Туре 🛛 🗸	Device Permiss	i V Enter	r device inf	ormation for f	Search			
🔽 1 D	evice(s) Selecte	Link Device	Unlink						
	Device Name	Device ID		Product	Device Status	Device Type	Activation Time	Device Permission	Operation
	Pet Feeder	bfd6	liad	Nooie NPF01	Online	Real Device	2024-05-24 12:37:36		Link
							Total Items: 1	< 1 >	10 / page ∨

14. Confirm the pet feeder exists on the "All Devices" tab, do not close this webpage.

tuyo"	Develo	oper Platfo	orm									Help	Documents	Tech Suppor	t English(EN) *	My Space 🔻	₩ ₹	
Overview Product	¢	← pftk ≫erview	Switch Project Authorization	¢ n Service	API Dev	vices Message	Service Project	SaaS							Show Wizard \sim	Central Euro	ope Data Ce	nter 🗸 🌒
App	Y	ou can add o Ievice Linkin	devices to a pro g Methods	oject by using th	e loT Device	Management app, a	nd can also link devi	e resources of other a	pps. 🗢 Operatio	on Guide 📑 View								
Cloud		All Devices	Link My	App Link !	vly WeChat N	fini Program Li	nk Tuya App Accoun	Link SaaS										
Data		View Device	s by Product.															~
Coperation		Noole NP Devices:1	F01 Standard Insti	ruction														
Purchase																		
VAS 7		Choose	× [[Device Type	V D	evice Permission ∨	Product	✓ Enter device	e name, or d	Search Reset							_/	Add Device
	•	Device Nam	e D	Device ID		Prod	uct	Source		Online Status	Device Type	Activation	Time		Device Permission			Operation
		Pet Feeder	b	ofd£	163iad	Noo	ie NPF01	@gmail.c	om	Online	Real Device	2024-05-	24 12:37:36		Read Change		Deb	ug Device

Fig. 34

- 15. Navigate back to the Home Assistant UI
- 16. Go to "Settings" \rightarrow "Devices & Services" \rightarrow "Add Integration" on the bottom right corner, Search for "LocalTuya". Click on "LocalTuya Integration".

2024/07/31	00:10
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Bird Feeder

=<	Home Assistant	÷		Integrations	Devices	Entities	Helpers	:
55	Overview	Q Search						
₽	Мар	Discovered						
4	Energy			Select brand		×		
≔	Logbook	Draam Machina Dro. JoTLah (102.169		Search for a brand name				
	History	UniFi Protect		Q localtuya		×	2	
	HACS	CONFIGURE		LocalTuya integration		� >	≤ 1	
	Media	Orafianad						
>_	Terminal	Configured				_		
Ê	To-do lists	Bluetooth >	Goog			>	HACS >	Home Assistant Supervisor >
		1 DEVICE	1 DEVICE			0	1 SERVICE	5 SERVICES
		Meteorologisk institutt >	🚳 Radio			>	Shopping List	IỘI Sun >
			1 ENTRY				1 ENTITY	1 SERVICE
7	Developer tools					_		
\$	Settings							
t	Notifications ()						1	+ add integration
Fig	. 35							

17. Once LocalTuya is installed, Cloud API configuration pop up will appear. Make sure API server region is EU. For the rest of the credentials, we need to navigate back to Tuya developer platform.

Cloud API account configuration 🕐	×
Input the credentials for Tuya Cloud API.	
API server region	
💿 eu	
O us	
O cn	
O in	
Client ID	
Secret	O
User ID	
localtuya	
Do not configure a Cloud API account	
	SUBMIT



18. On the left sidebar, hover on "Cloud" → "Development" → "Open Project". The "Client ID" and the "Secret" can be found under the "Overview" tab of the cloud project. (not the Overview on the sidebar, the one under our project name).

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້ຽດທີ່	Develo	per Platform	Help	Documents	Tech Support
Overview	÷	pftk Switch Project 🕈			
D roduct	0	verview Authorization Service API Devices Message Service Project SaaS			
App	Thea	ne cloud development project is a collection of resources on the Tuya IoT Development Platform, including devices. APIs, and data. Resources deployed for cch project are isolated from those for the other projects. 🕏 Operation Guide			
Cloud		pftk			🖉 Edit
📈 Data		Industry : Smart Home Creation Time : 2024-05-08 16:13:28 Data Center : Central Europe Data Center			
R		Authorization Key 💿		View Aut	horization >
Operation		Access ID/Client ID: qj8 yjtj			
Purchase		Access Secret/Client Secret: ************************************			
۲		Cloud Authorization IP Allowlist 🖉			
VAS /	•	To improve security, you can set up a list of IPs that can legally access Tuya's data centers through the IP whitelist function. Requests from source IPs that are not in this list will be rejected.			

Fig. 37

- 19. Insert the credentials back to Home Assistant. Use the previously mentioned "UID" from "Link Tuya App Account" tab and click on "Submit".
- 20. LocalTuya Integration is now linked with your Tuya Development Account. We still need to configure the pet feeder for local use.
- 21. You will be redirected to LocalTuya integration page, if not, Navigate to "Settings" \rightarrow "Devices & Integrations" \rightarrow "LocalTuya".
- 22. Click on "Configure" on the same page \rightarrow "Add a New Device" \rightarrow "Pet Feeder" (which should be recognized automatically) and submit.

🔬 local tu	iya	Integration entries	
5.2.1		localtuya No devices or entities	CONFIGURE
😚 Custom integration			
Documentation	Z	ADD DITINT	
Known issues			

Fig. 38





Pet	Feeder
Host 192	* .168.2 ¹
Devic b1	ie ID* 3iad
Loca _ZG	lkey* (' }_n
rotoc	ol Version
\bigcirc	3.1
\bigcirc	3.2
\bigcirc	3.3
0	3.4
	Enable debugging for this device (debug must be enabled also in configuration.yam
-	n interval (seconds, only when not updating automatically)

1. Skip to step 23 if the credentials of the Pet Feeder are configured automatically. If the Pet Feeder's configuration is **not set automatically**, navigate back to the Tuya Developer

Platform, hover on the "Cloud" icon on the sidebar \rightarrow "API Explorer".



Fig. 42: Optional step, refer to step 22.a.

- 2. On the API explorer, Navigate to "Query Devices in Project" on "Device Management".
- 3. Type "1" to "page_size" and click on "Submit Request".
- 4. The response query gives us credentials of the device. We can find the local key and device id (called "id").

ore V Central Europe Data Center V	Debugging Result View Docs Locate Errors
ch Q Q Query Devices in Project ⑦	1564476DED52D65266FF76C65E881DC5E8EFABF85E111803FC6A"header "access_token: 03e6 bdf052953e96b97da7b8c48b67"
pace Management Parameter(Request Method: GET)	
evice Management Params	Response
Get Status Reporting	
odate Progress	{ "result":[
nov Device Details i	{
produce_los () :	"activeTime": 1716800168,
lete Device string	"category": "cwwsg".
t Update Information	"createTime": 1715678729,
ery Device Details	"customName": "",
last_id ② :	"id": "bfd671 (iad",
string	
Device State	"isOnline": true, "lot": "54 5"
Operation Log	"localKey": "eVCgi "NZ",
dify Basic Properties	"lon": "6.55",
n // Inference Davies	model: , "name": "Pet Feeder",
sze/onireeze bevice	"productId":
ansfer Device	"productName": "Nooie NPF01", "sub": folso
Restore Factory Defau	"timeZone": "+02:00",
Query Devices in Space	"updateTime": 1716800172,
Nume Daviene in Prei	"uuid": }
duely bences in high	L.
Pair Device by Scanni	"success": true,
Query Pairing Result	· · 1/10015105151,
vice Control	}
vice Group	<
zene Linkage Rules	Request

Fig. 43: Optional step, refer to step 22.a.

- 5. The Host address can be obtained via your router's web interface.
- 23. After you submit, you will be met with the "Entity Type Selection" pop-up. The pet feeder has different functions such as dispensing food or turning the LED on the pet feeder on and off. Each of these functions has their own "Data Point ID" to communicate with the cloud. We need to intercept these Data Points and create separate entities to control the device via the Home Assistant.

Entity type selection	?	×
Please pick the type of entity you war	nt to add.	
Platform* switch		Ŧ
	SL	јвміт

Fig. 44

24. Do not exit the Home Assistant instance and navigate back to Tuya Developer Platform. Open your project and navigate to "All Devices" tab under "Devices" and click on "Debug Device".

Last update: 2024/07/31 00:09 amc:ss2024:bird feeder:start https://student-wiki.eolab.de/doku.php?id=amc:ss2024:bird feeder:start

← pftk s	witch Project 🗘							Show Wizard ~	Central Europe Data Center $ \lor $
ou can add dev	ices to a project by fethods	using the IoT Device Manag	ement app, and can also link i	device resources of other apps.	Operation Guide https://www.icea.com View				
All Devices	Link My App	Link My WeChat Mini Pro	gram Link Tuya App Acc	ount Link SaaS					
View Devices by	Product.								~
Nooie NPF01 Devices:1	Standard Instruction								
Choose	✓ Device	Type V Device Pe	rmission V Product	V Enter device name	e, or d Search Reset				Add Device
Device Name	Device II)	Product	Source	Online Status	Device Type	Activation Time	Device Permission	Operation
Pet Feeder	b	iad	Nooie NPF01	@gmail.com	Online	Real Device	2024-05-27 10:56:08	Read Change	Debug Device

Fig. 45

- 25. On the device debugging page, under "Standard Instructions Set" are the functions of the device we can set new values for. Under "Standard Status Set" are the previously mentioned functions and the available sensors of the device.
- 26. To find out which Data Point is associated with which function of the device, navigate to "Device Logs" tab.

← pftk Sw Overview A	vitch Project 🕈	Service API Devices Me	ssage Service Project Sa	aS				Show Wizard V	Central Europe Data Center \vee
You can add devid Device Linking M	ces to a project by ethods	using the IoT Device Management	app, and can also link device r	esources of other apps. 🗢 Operation	n Guide 📑 View				
All Devices	Link My App	Link My WeChat Mini Program	Link Tuya App Account	Link SaaS					
View Devices by	Product.								V
Nooie NPF01 Devices:1 S	Standard Instruction								
Choose	V Device 1	fype ∨ Device Permissio	on V Product	✓ Enter device name, or d	Search Reset				Add Device
Device Name	Device ID	1	Product S	ource	Online Status	Device Type	Activation Time	Device Permission	Operation
Pet Feeder	b	iad	Nooie NPF01	@gmail.com	Online	Real Device	2024-05-27 10:56:08	Read Change	Debug Device

Fig. 46

- 27. Turn the developer console on of your browser (CTRL+SHIFT+I or F12 for Google Chrome). Navigate to "Network" tab on the developer console.
- 28. Notice the "Select DP ID" dropdown menu on the top left side of the page.
- 29. While the Developer console is on, click on the DP ID dropdown menu and select "Manual Feed", click on "Search".
- 30. After you click on "Search", you should see the network tab of your developer console update with several different logs. "list" is the one we are looking for.

tuge lot Platform Device Deb	ugaina pftk Switch Project		English(EN) 🔻	My Space 🔻 🚨	Elements		es Network >>		
Central Europe Data Center V	Basic Information Device Debugg	ing Device Logs			● ⊘ ▼ Q ±	Preserve log	Disable of the Noth	rrottling 🔻 🤿	± ⊕
Tuya App Account / taycankaya@ V	Select DP ID V	ent ∨ 2024-05-27 16:05:19 → 2024-0	5-27 16:05:19 🗎 Search		Filter All Fetch/XHR Do Blocked response c	c CSS JS Font	Hide ats URLs I Img Media Manifes equests 3rd-party	Hide extension l t WS Wasm (requests	JRLs Other
Enter device ID Q	Time Device Event	DP ID Event Details	Source Source Details		20 ms	40 ms	60 ms	80 ms	100 ms
Pet Feeder(bfd67fe2ceb62d3d963iad)		戦死日志							

Fig. 47

31. Click on "list", and navigate to the "Payload" tab, "Code" is the Data Point ID we are looking for. In this case it's 3.

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Elements Console Sources Net	twork Performance Memory Application Security >> 🛛 😣 11 🗛 3 🗖 1 🛛 🕄 🗄 🕹 🔀
Filter Hide	data URLs 🔲 Hide extension URLs
All Fetch/XHR Doc CSS JS Font Img Me	rdia Manifest WS Wasm Other 🔲 Blocked response cookies 📄 Blocked requests
3rd-party requests	
] 20000 ms 40000 ms 60000 ms ⊡	80000 ms 100000 ms 120000 ms 140000 ms 160000 ms 200000 ms 2200
Name	X Headers Payload Preview Response Initiator Timing Cookies
○ data:image/svg+xml,	▼Request Payload view source
(i) list	▼ {startRowId: "", pageNo: 1, pageSize: 10, code: "3", startTime: 1716818719016, endTime: 1
tpm.gif?ss=1920x1080&ws=898x963&sp=0x0∾	code: "3"
tpm.gif?ss=1920x1080&ws=898x963&sp=0x0∾	deviceId: "bfd67f ad"
😣 envelope/?sentry_key=92a749b330bd49b19d769	endTime: 1716818719017
tpm.gif?ss=1920x1080&ws=996x963&sp=0x0∾	pageno: 1 pageSize: 10
tpm.gif?ss=1920x1080&ws=996x963&sp=0x0∾	pageStartRow: ""
	projectCode: "p171 jp"
	region: "EU"
	sourceld: "eul/] IR1"
	startRowId: ""
	startTime: 1716818719016

Fig. 48

- 32. The ID is our Data Point, which is 3.
- 33. Navigate back to "Device Debugging" tab, make note of the manual_feed's type and values. It's an integer with a minimum value of 1, maximum value of 20 and with a step of 1.

Control Device with Standard Update Device Status	JSON Editing	Standard Instructio	on Set Sta	ndard Status Set
Instruction Set		Code	Туре	Values
feed_report (0 - 20)	0	meal_plan	Raw	0
charge_state battery_percentage (0 - 100%) manual_feed (1 - 20)	0	manual_feed	Integer	{ "unit": "", "min": 1, "max": 20, "scale": 0, "step": 1 }
0	1	factory_reset	Boolean	"{true,false}"
factory_reset		light	Boolean	"{true,false}"
light				

- Fig. 49
- 34. Navigate back to Home Assistant, last time, we were at the Entity Type Selection pop-up.
 "Settings" → "Devices & Services" → "LocalTuya" → "Configure" → "Add a new Device" → "Submit" → "Submit".
- 35. Let's add the manual feed function to LocalTuya. LocalTuya includes integers in "number", pick it from the dropdown menu and submit.



36. The "ID" dropdown menu includes DP IDs of the pet feeder, we know 3 is manual feed. From the dropdown menu, pick 3. Call it Manual Feed. The minimum value is 1, maximum value is 20 and the increment between values is 1. Click "Submit'.

С	onfigure entity	?	\times
Ple car	ease fill out the details for an entity with type number . All settings ex n be changed from the Options page later.	cept for	ID
10 3)* 3 (value: 3)		•
F	Friendly name* Manual Feed		
1	Minimum Value 1		
	Maximum Value* 20		
1	Minimum increment between numbers* 1		
[Restore the last set value in HomeAssistant after a lost connection		
[Passive entity - requires integration to send initialisation value		
[Default value when un-initialised (optional)		
		SUE	вміт

37. On the next step, the entity type selection will appear again, for now, check the "Do not add any more entities" and click "Submit" (we can always add more later).



38. Now let's see if the manual feed entity works. Click on "1 device" below the logo of localtuya.

🔬 local tuy	ya	Integration entries	
5.2.1		localtuya 1 device and 1 entity	CONFIGURE
😚 Custom integration		ADD ENTRY	
💶 1 device	>		
▲ 1 entity	>		
II Documentation	Z		
Known issues	Z		
👯 Enable debug logging			

Fig. 53

39. Slide the Manual Feed to any value and check the Pet Feeder is dispensing food.

Controls	3
- Manual Feed	<u> </u>
ADD TO DASHBOARD	

Fig. 54

40. Add more entities by repeating step 26 and beyond.

4.9 Creating Automation function for pet feeder to trigger on MQTT Message.

1. This step was by far the easiest in the whole process.

- 2. In the "When" section, choose MQTT and set the topic to the one we already established in the MQTT Broker.
- 3. In the "Then Do" section, choose the device, in our case "Pet Feeder". Choose the action already established in the previous step "Manual Feed" then set the value to be between 1-10.

Home Assist	ant + New automation			194230
Overstee		When	0	
Map		$\kappa_{\rm c} = \omega^{\rm s}$. When an IASTT message fractions interimed	8 1	
Dungy		here in		
L History				
Estrana		Paginal (adverse)		
1925		1220000000		
Mada				
Studio Code Betve	*)	Add If salesal	0	
Terminal		The deal products when the ender complete contributions	an and diversion for a second and a second solution of an one and	
To do here		• PHO DEPENDING • AND DECLEDES PLACE		
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		 (a) the rate for treat 	# 1	
		Second And President	×+	
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		T.		
		+ 495 AUTOR: + 400 BALDING BADD		
Seculator taols				
1 Settings	•			
Constant of				
samulation				-

Fig. 55: Pet feeder automation configuration

5. Results and Discussion

- The concept has proven to be very much viable with all the requirements fulfilled in a prototype and ready to be moved to the next steps.
- Using MQTT for communication between the different devices has proven simple yet efficient.
- The e-ink display was a great choice for this project due to its high visibility in daylight and power efficiency.
- To display payer information, the payload of an MQTT message can be used.

6. Future Steps

- Build a casing for the display component to keep it protected and portable without any fear of damaging connectors.
- Further develop the design of the text/images shown on the e-ink display.
- Figure out whether the Kalisto main website can be used to integrate this whole system or not.
 - $\,\circ\,$ If not, further development of the web-application must proceed.
- Payment can be handled using Stripe, a comprehensive suite of tools for handling online financial transactions.
- Payer information should be stored in a queue like structure to give a chance for the display to show all donations.

7. Obstacles

- It was also a difficult and challenging accomplishment of the particular system architecture to ensure high level expertise with precision.
 - This can be shown from the different system architecture diagrams here.
- Finds the correct pin configuration for between the XIAO ESP-32 and the e-ink display.
- The e-ink display cable broke at some point during the implementation and testing and another display was ordered to continue with the project.
- Just before the presentation, as there was another team using a RaPi and the same Nooie Pet Feeder connected on the same network, there was a conflict between both the 2 RaPis. This was solved by changing both the hostname and the port for one of them.

8. Key Learnings

- The different communication protocols such as SPI and I2C.
- E-ink displays and how they function.
- Home Assistant and most of its features.
- Automation and triggers
- ESPHome and how its yaml syntax works.
- MQTT, Brokers, Topics, QoS, etc.
- Networking Basics.

9. References

- https://wiki.seeedstudio.com/xiao_esp32s3_getting_started/
- https://wiki.seeedstudio.com/XIAO-eInk-Expansion-Board/
- https://www.home-assistant.io/docs/
- https://esphome.io/
- https://www.npmjs.com/package/precompiled-mqtt

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Permanent link: https://student-wiki.eolab.de/doku.php?id=amc:ss2024:bird_feeder:start



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