Teletubbies Home

Report

IOT Essentials

Pierina Lopez

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Campus Geel, Kleinhoefstraat 4, BE-2440 Geel

LID VAN ASSOCIATIE KU LEUVEN

THOMAS MORE

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Teletubbies Home

1. Description

With the Teletubbies home project, it will be posibble to feed the fishes, turn on and off a lamp, fill the aquarium if is needed, mesure the depth, display infotmation in a LCD, displaying information in the UBEAC platform and live Stream the aquarium from anypart of the world.

1.1. Hardware Materials

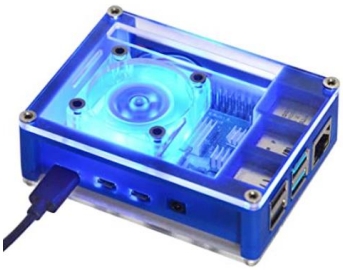
- Rasberry pi 4

- Raspberry pi power supply

- Rpi Camera v2 8 megapixels

- Case for camera

- Case for raspberry



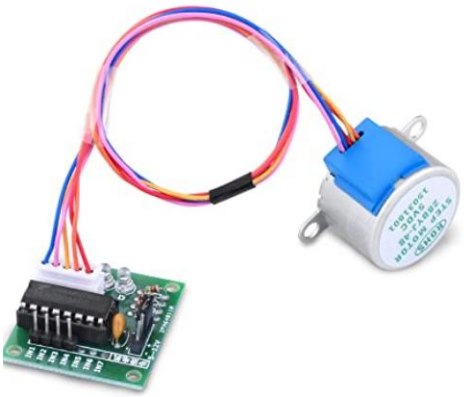
- USB Cable, Tyoe A to type C

- 6 1k ohm resistors

- 3 220 ohm resistors

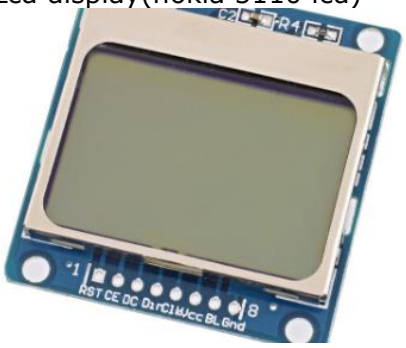
- 1 4 or 2 channel 5v relay board

- 1 stepper motor + driver



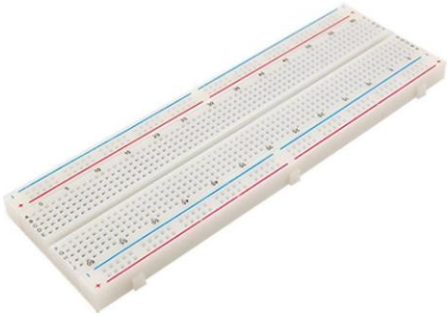
- 1 ultrasonic module

- Lcd display(nokia 5110 lcd)



- Picobbler

- 2 breadboards



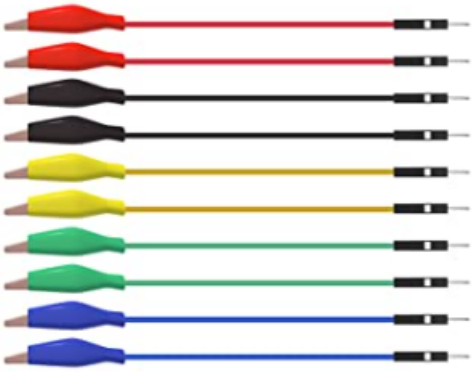
- 16 Gb micro SD

- 4 push buttons

- Wires

- 1 pump 12v/24v

- Alligator clip to breadboard



- 1 power supply module

- 1 red led

- 1 yellow led

- 1 green led

- 1 lamp

- Electrical Insulation Tape

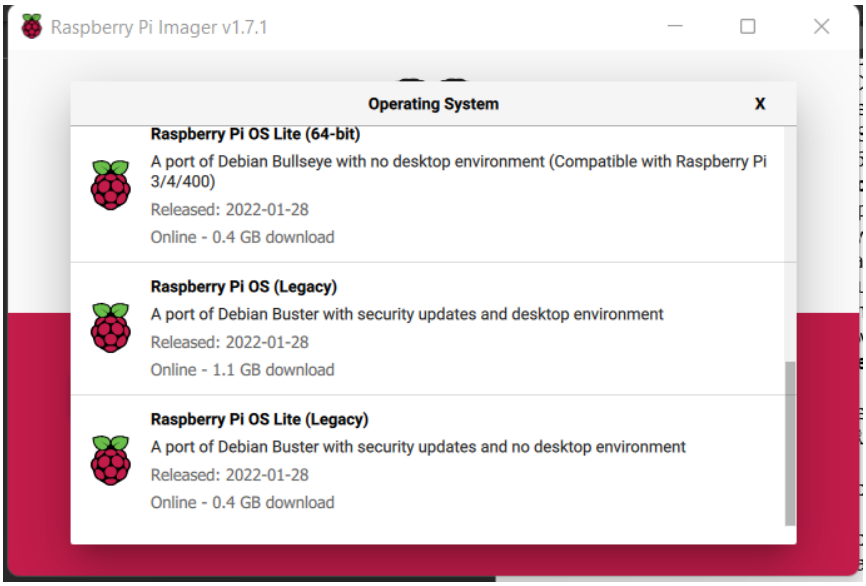
- Screwdriver

1.2. Software and Platforms

- Open CV
- Python 3.7+ & Flask
- Numpy
- Adafruit
- Remote.it

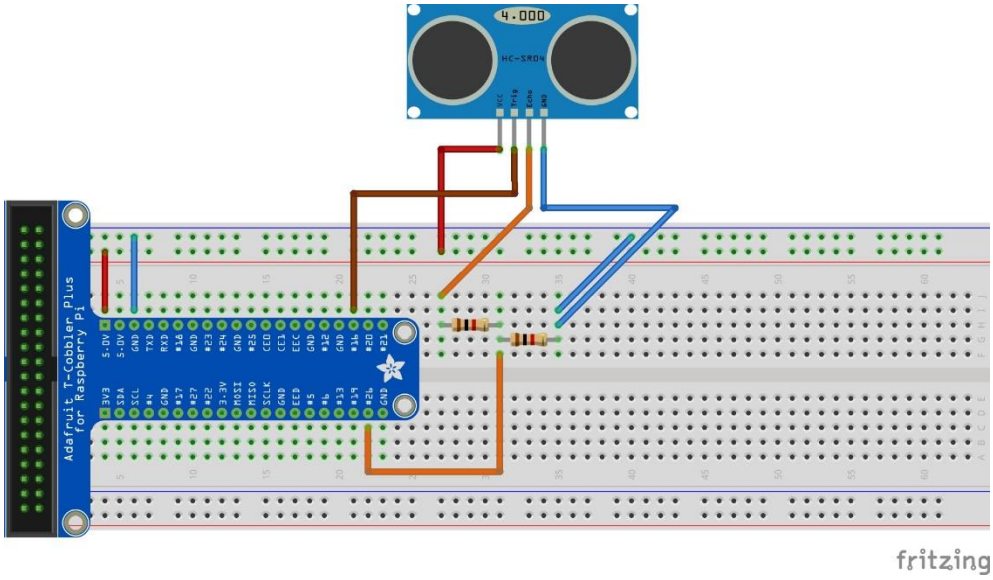
1.3. Setup Procedure:

- Setup Raspberry pi with "Pi Imager" select the Operating System "Raspberry Pi OS (Legacy)"

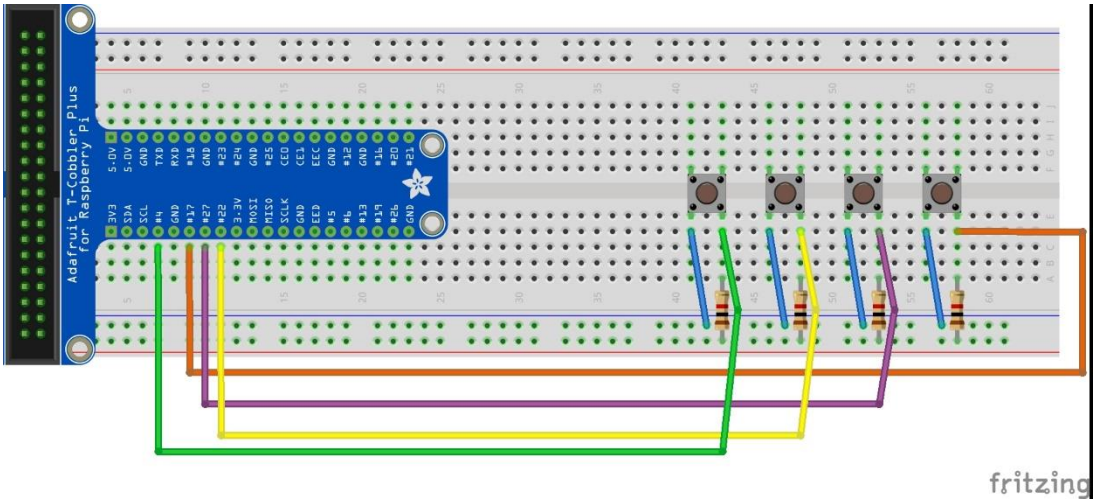


- Connect Rpi Camera to Raspberry pi

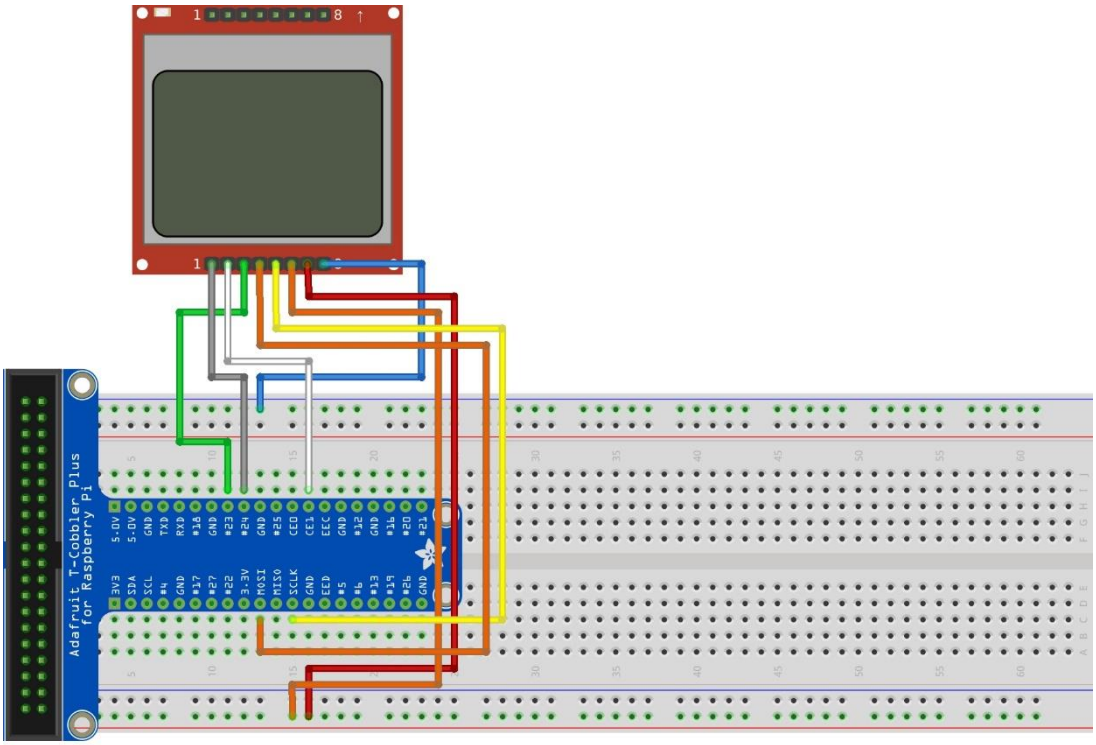
- Connect picobbler to breadboard, connect 2 1k OHM resistor as shown in the graphic:
    - VCC to 5 v
    - Trig to GPIO 16 (BCM)
    - Echo to resitor and to GPIO 26(BCM) as shown in the graphic
    - Gnd to resistor and to Gnd



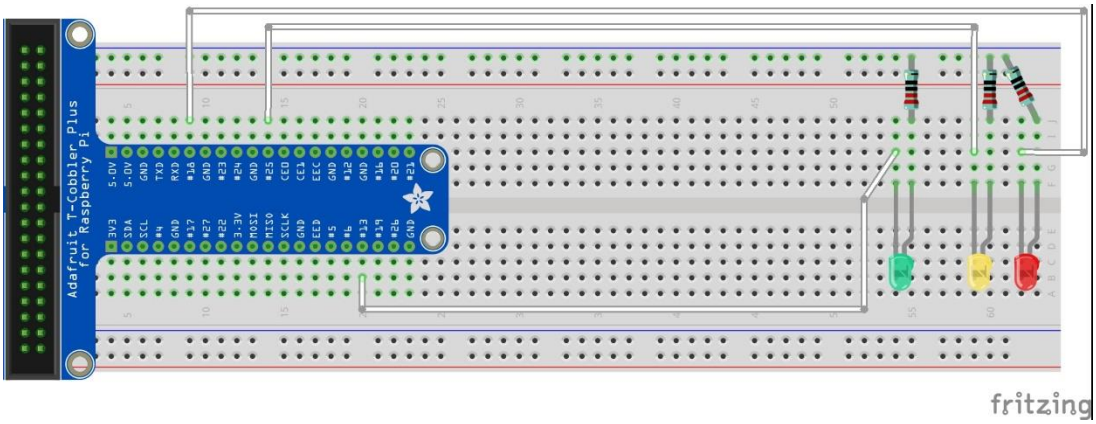
- Connect for buttons and for 1k ohm resistors as shown in the graphic:
    - First button: GPIO 17 / for the pump
    - Second button: GPIO 27/ for the lamp
    - Third button: GPIO 22/ for the feeding to the right
    - Fourth button: GPIO 4/for the feeding to the left



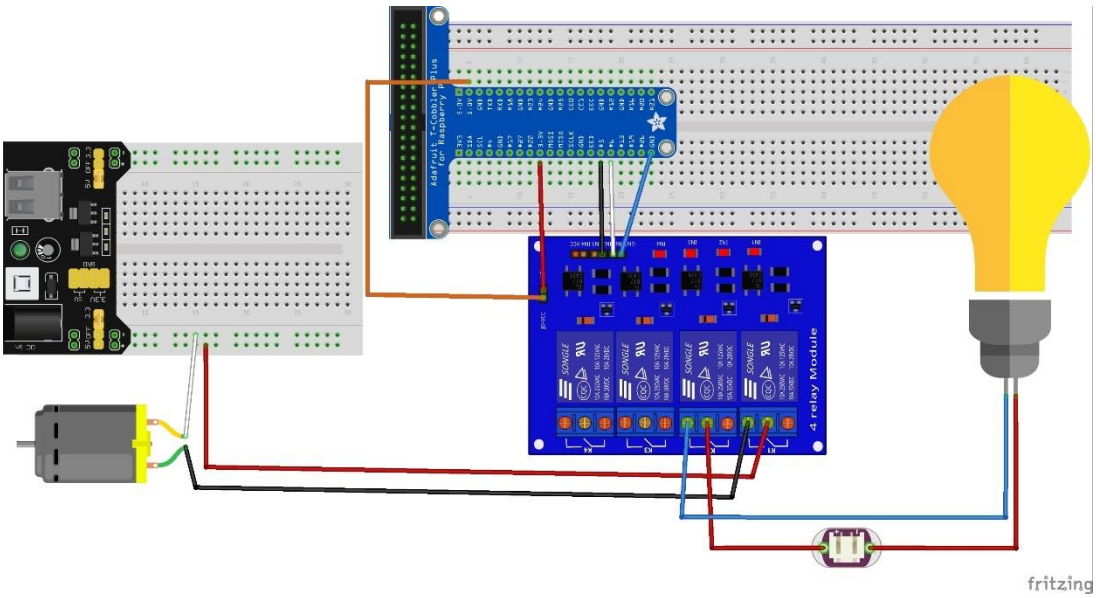
- Connect LCD as shown in graphic:
  - VCC to VCC
  - GROUND TO GROUND
  - DC to Gpio 23
  - Reset to gpio 24
  - Din to Mosi
  - CLK to SCLK
  - CE to CE1



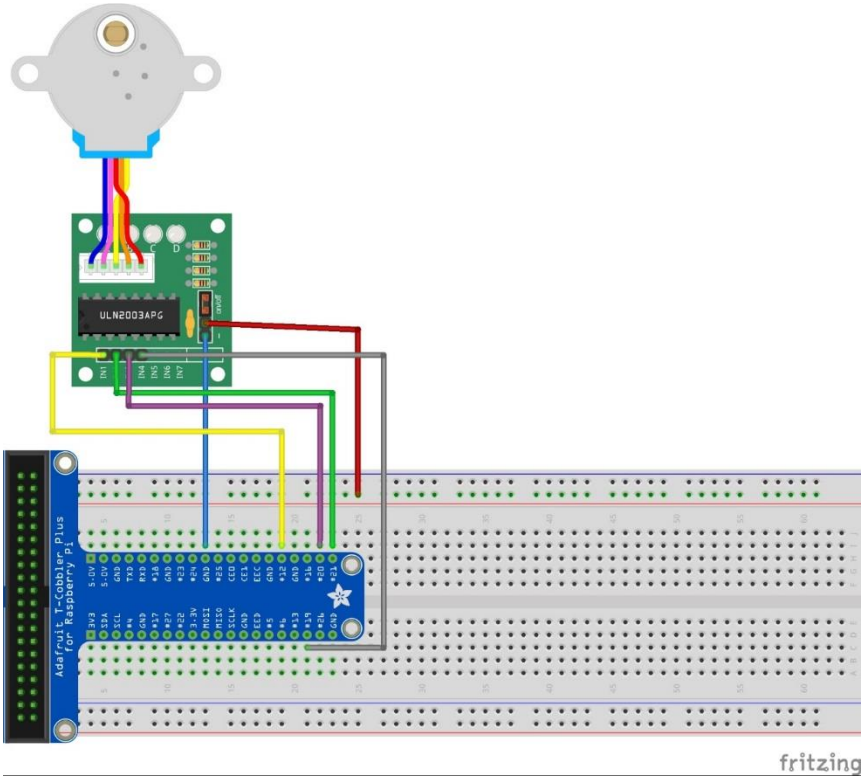
- Connect the led lights as shown in the graphic:
  - Connect 220 resistor to breadboard as shown
  - Green led to GPIO 13
  - Yellow led to GPIO 25
  - Red led to GPIO 18



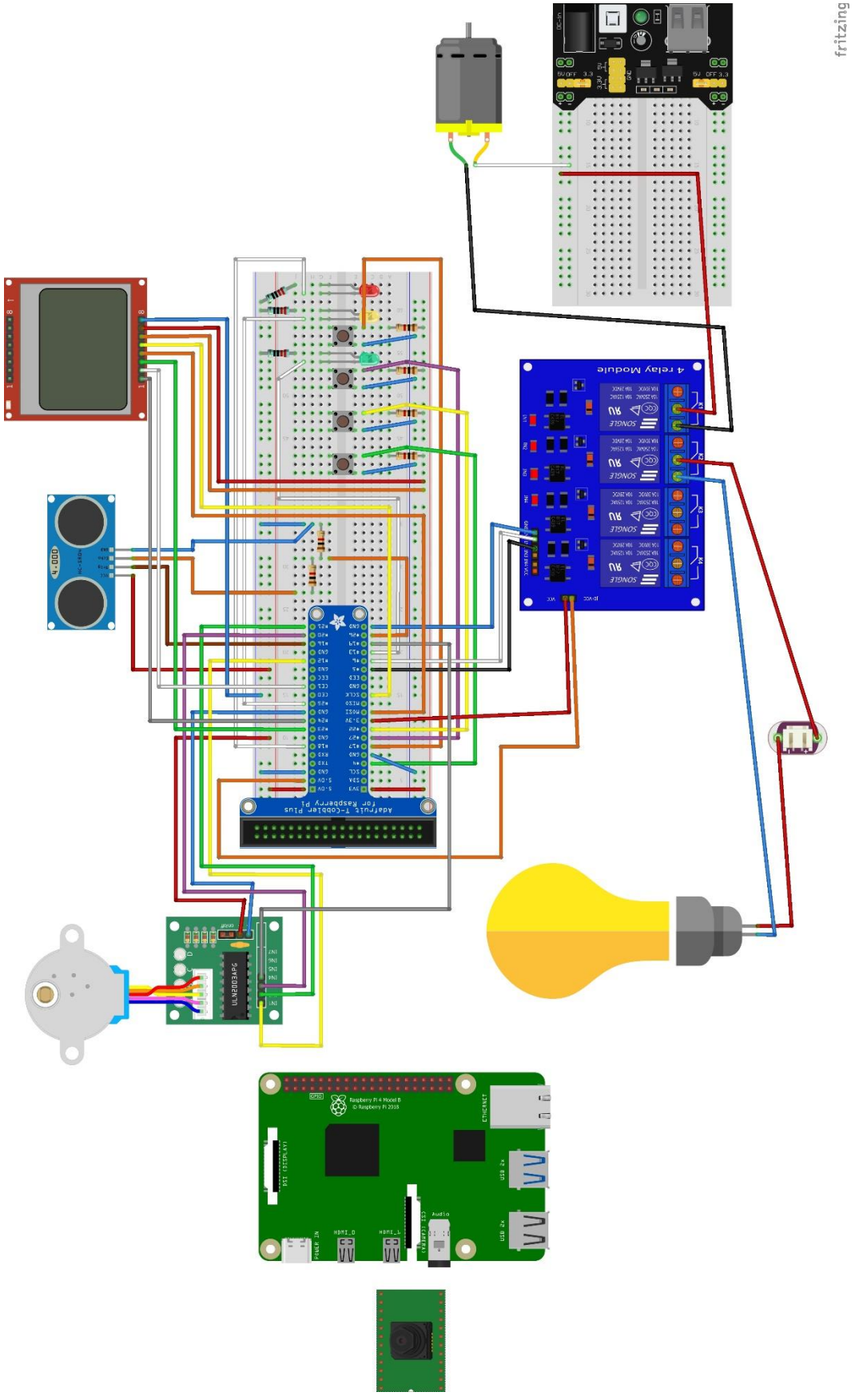
- Connect pump and lamp as shown in the graphic:
  - Relay board first channel to GPIO 6 for the pump
  - Relay board second channel to GPIO 5 for the lamp



- Connect Stepper Motor as shown in the graphic:
  - In1: GPIO 12
  - In2: GPIO 21
  - In3: GPIO 20
  - In4: GPIO 19



- Complete graphic



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- Install and use Putty for the following part

  - ✓ Upgrade python to 3.8
  - ✓ See what version of python you have with : python -V

    Upgrade with : https://itheo.tech/install-python-38-on-a-raspberry-pi

  Install one at a time:

  - ✓ sudo apt-get update
  - ✓ sudo apt-get upgrade
  - ✓ sudo apt-get install build-essential
  - ✓ sudo apt-get install cmake
  - ✓ sudo apt-get install gfortran
  - ✓ sudo apt-get install git
  - ✓ sudo apt-get install wget
  - ✓ sudo apt-get install curl
  - ✓ sudo apt-get install graphicsmagick
  - ✓ sudo apt-get install libgraphicsmagick1-dev
  - ✓ sudo apt-get install libatlas-base-dev
  - ✓ sudo apt-get install libavcodec-dev
  - ✓ sudo apt-get install libavformat-dev
  - ✓ sudo apt-get install libboost-all-dev
  - ✓ sudo apt-get install libgtk2.0-dev
  - ✓ sudo apt-get install libjpeg-dev
  - ✓ sudo apt-get install liblapack-dev
  - ✓ sudo apt-get install libswscale-dev
  - ✓ sudo apt-get install pkg-config
  - ✓ sudo apt-get install python3-dev
  - ✓ sudo apt-get install python3-numpy
  - ✓ sudo apt-get install python3-pip
  - ✓ sudo apt-get install zip
  - ✓ sudo apt-get clean
- Install the following:
  - ✓ sudo apt-get install python3-picamera
  - ✓ sudo pip3 install --upgrade picamera[array]
- Install supporting dlib libraries:
  - ✓ pip3 install numpy
  - ✓ pip3 install scikit-image
  - ✓ sudo apt-get install python3-scipy
  - ✓ sudo apt-get install libatlas-base-dev
  - ✓ sudo apt-get install libjasper-dev
  - ✓ sudo apt-get install libqtgui4
  - ✓ sudo apt-get install python3-pyqt5
  - ✓ sudo apt install libqt4-test
  - ✓ pip3 install opencv-python==3.4.6.27

2. Remote.it

To be able to see the live stream of the rpi camera, wi will need to set up an account to remote.it

- Install remote.it in to the raspberry pi
  - Sudo apt install remoteit
- Open remote.it in the browser
  - Create an account

        - Register your raspberry
        - Add a new service
            - Service name: camera
            - Service port:5000
            - save

3. **How to use:**
    - To be able to use the program it need to be in the same directory like this:
        - Main directory: TeletubiesWeb
            - Second directory: templates
                - In tamplates: camera.html
            - In TeletubbiesWeb:
                - Allforone.py
                - Lcd.py
                - Main.py
                - Web.py
    - Only need to run Main.py
4. **References:**

- https://www.youtube.com/watch?v=zfBHD4v8hD0
- https://www.youtube.com/watch?v=mQNJpWkdmbc
- https://www.youtube.com/watch?v=DOaDnYj3vfI
- https://www.youtube.com/watch?v=i9mJzdLYsVo

5. **Code**

5.1. Code for funtions: allforone.py

```
#import libraries
import requests
import RPi.GPIO as GPIO
import time
import datetime

#funtion for the pump
def pumpwater():

    #turn off warnings
    GPIO.setwarnings(False)
    #set location mode
    GPIO.setmode(GPIO.BCM)

    #Pump output
    GPIO.setup(6, GPIO.OUT)
    GPIO.output(6, True)

    #sensor output and input
    GPIO.setup(16, GPIO.OUT)
    GPIO.setup(26, GPIO.IN)

    #Pump Button
    GPIO.setup(17, GPIO.IN)
```

```
    #GREEN LED
    GPIO.setup(13, GPIO.OUT)
    #YELLOW LED
    GPIO.setup(25, GPIO.OUT)
    #RED LED
    GPIO.setup(18, GPIO.OUT)


    try:
        #infinite loop
        while True:
            #measure the distance
            #send a 10 µs pulse with the TRIG-pin
            GPIO.output(16, GPIO.HIGH)
            time.sleep(0.00001)
            GPIO.output(16, GPIO.LOW)

            #Loop to record the last timestamp before the signal
reaches the receiver
            while (GPIO.input(26)== GPIO.LOW):
                timestart = time.time()
            #register the last timestamp at which the receiver detects
the signal
            while (GPIO.input(26)== GPIO.HIGH):
                timeend = time.time()
            #calculate time difference between the timestamps
            totaltime = timeend - timestart

            #calculate the difference and multiply with 17000
            depth = totaltime * 17000
            depth = round(depth, 2)

            #create condition, if depth is less than 4 cm and
button  is not pressed
            if depth < 4 and GPIO.input(17)==1:
                #only green led on
                GPIO.output(13, 1)
                GPIO.output(25, 0)
                GPIO.output(18, 0)
                time.sleep(0.1)
                print("Depth is", depth)
                #pump is off
                GPIO.output(6, 1)
                time.sleep(1)

            #condition if depth is less then 4.5 cm and button is not
pressed
            elif depth < 4.5 and GPIO.input(17)==1:
                #only yellow led on
```

```
                GPIO.output(13, 0)
                GPIO.output(25, 1)
                GPIO.output(18, 0)
                time.sleep(0.1)
                print("Depth is", depth)
                #pump off
                GPIO.output(6, 1)
                time.sleep(1)
            #condition if depth is more than 5 cm or button is
pressed
            elif depth > 5 or GPIO.input(17)==0:
                #only red led on
                GPIO.output(13, 0)
                GPIO.output(25, 0)
                GPIO.output(18, 1)
                time.sleep(0.1)
                print("Depth is", depth)
                #pump is on
                GPIO.output(6, 0)
                time.sleep(1)

    finally:
        GPIO.cleanup()
#funtion for feeding
def feeding():
    #turn off warnings
    GPIO.setwarnings(False)

    #set location mode
    GPIO.setmode(GPIO.BCM)

    #button to the left
    bl = 22
    #button to the right
    br = 4
    #set buttons as input
    GPIO.setup(bl, GPIO.IN)
    GPIO.setup(br, GPIO.IN)

    #sequence for button to the right
    CPinR = [12,21,20,19]
    #8 steps sequence
    seq1 = [[1,0,0,1],
            [1,1,0,0],
            [0,1,1,0],
            [0,0,1,1],
            [1,0,0,1],
            [1,1,0,0],
            [0,1,1,0],
```

```
            [0,0,1,1]]

    #sequence for button to the left
    CPinL = [19,20,21,12]
    #8 steps sequence
    seq2 = [[1,0,0,1],
            [1,1,0,0],
            [0,1,1,0],
            [0,0,1,1],
            [1,0,0,1],
            [1,1,0,0],
            [0,1,1,0],
            [0,0,1,1]]

    try:
        while True:
            #if button "bl" is pressed
            if GPIO.input(bl)==0:
                #set pin to out and low
                for pin in CPinL :
                    GPIO.setup(pin, GPIO.OUT)
                    GPIO.output(pin, 0)
                #for loop for the rotation
                for i in range (1):
                    for singlestep in range(8):
                        for pin in range(4):
                                GPIO.output(CPinL[pin],
seq1[halfstep][pin])
                        time.sleep(0.01)
            #if button "br" is pressed
            elif GPIO.input(br)==0:
                #set pin to out and low
                for pin in CPinR:
                    GPIO.setup(pin, GPIO.OUT)
                    GPIO.output(pin, 0)

                #for loop for the rotation
                for i in range (1):
                    for singlestep in range(8):
                        for pin in range(4):
                                GPIO.output(CPinR[pin],
seq2[halfstep][pin])
                        time.sleep(0.01)
            else:
                for pin in CPinL:
                    GPIO.setup(pin, GPIO.OUT)
                    GPIO.output(pin, 0)
    finally:
        GPIO.cleanup()
```

```
#lamp funtion
def lamp():
    #set location mode
    GPIO.setmode(GPIO.BCM)
    #turn off warnings
    GPIO.setwarnings(False)
    #set button as input
    GPIO.setup(27, GPIO.IN)
    #set lamp to output
    GPIO.setup(5, GPIO.OUT)
    #set lamp output to false or low
    GPIO.output(5, False)

    #variable for button state as false
    BS1=False

    try:
        #funtion to recognize if lamp is on or off
        def switch(ev=None):
            nonlocal BS1
            BS1 = not BS1

            if BS1 == True:
                GPIO.output(5, GPIO.HIGH)
            else:
                GPIO.output(5, GPIO.LOW)
        #funtion to change the state of the lamp with button
        def button():
            GPIO.add_event_detect(27, GPIO.FALLING, callback = switch,
bouncetime=300)

        #funtion for the while True
        def wait():
            while True:
                time.sleep(1)
        #starting funtions
        button()
        wait()

    finally:
        GPIO.cleanup()



#funtion to share information to UBEAC
def status():

    #set location mode
    GPIO.setmode(GPIO.BCM)
```

```
    GPIO.setwarnings(False)

    #sensor output and input
    GPIO.setup(16, GPIO.OUT)
    GPIO.setup(26, GPIO.IN)

    #define actuators GPIOs
    lamp = 5
    pump = 6
    #initialize GPIO status variables
    lampSts = 1
    pumpSts = 1

    # Define pins as output
    GPIO.setup(lamp, GPIO.OUT)
    GPIO.setup(pump, GPIO.OUT)
    # turn pins OFF
    GPIO.output(lamp, GPIO.HIGH)
    GPIO.output(pump, GPIO.HIGH)

    #SET URL AND UID PROVIDE FROM UBEAC
    url = "http://itproject.hub.ubeac.io/iotpierina"
    uid = "iotPierina"

    def readdepth():
        #measure the distance
        #send a 10 µs pulse with the TRIG-pin
        GPIO.output(16, GPIO.HIGH)
        time.sleep(0.00001)
        GPIO.output(16, GPIO.LOW)

        #Loop to record the last timestamp before the signal reaches
the receiver
        while (GPIO.input(26)== GPIO.LOW):
            timestart = time.time()
        #register the last timestamp at which the receiver detects the
signal
        while (GPIO.input(26)== GPIO.HIGH):
            timeend = time.time()
        #calculate time difference between the timestamps
        totaltime = timeend - timestart
        #calculate the difference and multiply with 17000
        depth = totaltime * 17000
        depth = round(depth, 2)

        return depth

    def readlamp():
        while True:
```

```
            # Read Sensors Status
            lampSts = GPIO.input(lamp)
            return lampSts

    def readpump():
        while True:
            # Read Sensors Status
            pumpSts = GPIO.input(pump)
            return pumpSts
    #endless loop for the reading data
    while True:
        pumpdata=readpump()
        depthdata=readdepth()
        lampdata=readlamp()
        data={
            "id": uid,
            "sensors":[
                {
                'id': 'lamp Status',
                'data': lampdata
                },
                {
                'id': 'Depth',
                'data': depthdata
                },
                {
                'id': 'pump Status',
                'data': pumpdata
                }]
        }
        r = requests.post(url, verify=False, json = data)
        time.sleep(1)
```

5.2. Display code: lcd.py

```
def lcd():
    #import libraries
    import time
    import cgitb
    from os import read #cgitb.enable()
    import spidev
    import busio
    import digitalio
    import board
    import adafruit_pcd8544
    from adafruit_bus_device.spi_device import SPIDevice
    from PIL import Image
```

```
    from PIL import ImageDraw
    from PIL import ImageFont
    import datetime
    import RPi.GPIO as GPIO

    #set location mode
    GPIO.setmode(GPIO.BCM)
    #turn off warnings
    GPIO.setwarnings(False)
    #variable for the lamp pin
    lamp = 5
    #set lamp pin to output and high
    GPIO.setup(lamp, GPIO.OUT)
    GPIO.output(lamp, GPIO.HIGH)

    #initialize GPIO status variables
    lampSts = 1

    # Initialize SPI bus
    spi = busio.SPI(board.SCK, MOSI=board.MOSI, MISO=board.MISO)

    cs0 = digitalio.DigitalInOut(board.CE0)

    #funtion for countdown to feeding time
    def countdown():

        def dateDiffInSeconds(date1, date2):
          timedelta = date2 - date1
          return timedelta.seconds

        def daysHoursMinutesSecondsFromSeconds(seconds):
            minutes, seconds = divmod(seconds, 60)
            hours, minutes = divmod(minutes, 60)
            days, hours = divmod(hours, 24)
            return (days, hours, minutes, seconds)

        req = datetime.datetime.strptime('2025-05-08 17:03:30', '%Y-
%m-%d %H:%M:%S')
        now = datetime.datetime.now()

        while req>now:
            countdown = "%dd %dh %dm %ds" %
daysHoursMinutesSecondsFromSeconds(dateDiffInSeconds(now, req))
            return (countdown)
            sleep(1)
            now = datetime.now()

            if countdown == "0d 0h 0m 0s":
                return("Fedding time")
```

```
                sleep(10)
    #funtion to read the depth
    def readdepth():
        #sensor output and input
        GPIO.setup(16, GPIO.OUT)
        GPIO.setup(26, GPIO.IN)
        #measure the distance
        GPIO.output(16, GPIO.HIGH)
        time.sleep(0.00001)
        GPIO.output(16, GPIO.LOW)

        while (GPIO.input(26)== GPIO.LOW):
            timestart = time.time()

        while (GPIO.input(26)== GPIO.HIGH):
            timeend = time.time()

        totaltime = timeend - timestart

        depth = totaltime * 17000
        depth = round(depth, 2)

        return depth
    #funtion to read the status of lamp
    def readlamp():
        lampSts = GPIO.input(lamp)
        return lampSts

    #funtion to display current time
    def daate():
        return datetime.datetime.now().strftime('%H:%M:%S')

    # Initialize display
    dc = digitalio.DigitalInOut(board.D23) # data/command
    cs1 = digitalio.DigitalInOut(board.CE1) # chip select CE1 for
display
    reset = digitalio.DigitalInOut(board.D24) # reset
    display = adafruit_pcd8544.PCD8544(spi, dc, cs1, reset, baudrate=
1000000)
    display.bias = 4
    display.contrast = 60
    display.invert = True

    # Clear the display. Always call show after changing pixels to
make the display update visible!
    display.fill(0)
    display.show()

    # Load default font.
```

```
    #font = ImageFont.load_default()
    font =
ImageFont.truetype("/usr/share/fonts/truetype/freefont/FreeSansBold.tt
f", 10)

    # Get drawing object to draw on image
    image = Image.new('1', (display.width, display.height))
    draw = ImageDraw.Draw(image)

    # Draw a white filled box to clear the image.
    draw.rectangle((0, 0, display.width, display.height), outline=255,
fill=255)

    #loop for displaying information
    while True:
        display.fill(0)
        display.show()
        draw.rectangle((0, 0, display.width, display.height),
outline=255, fill=255)

        draw.text((1,1), "Time: " + str(daate()), font=font)
        draw.text((1,9), "Lamp: " + str(readlamp()), font=font)
        draw.text((1,18), "Depth: " + str(readdepth()), font=font)
        draw.text((1,27), "Next fedding:", font=font)
        draw.text((1,36), str(countdown()), font=font)
        display.image(image)
        display.show()
        time.sleep(1)
```

5.3. Code for the web page: web.py

```
#import libraries
import cv2
import numpy
from flask import Flask, render_template, Response,
stream_with_context, request, redirect, url_for
import time
import RPi.GPIO as GPIO
import datetime
import psutil
import os

#set location mode
GPIO.setmode(GPIO.BCM)
#turn off warnings
GPIO.setwarnings(False)
#variable for the lamp pin
lamp = 5
```

```
#set lamp pin to output and high
GPIO.setup(lamp, GPIO.OUT)
GPIO.output(lamp, GPIO.LOW)
#initialize GPIO status variables
lampSts = 1

#starting the video
video = cv2.VideoCapture(0)
app = Flask('__name__')

#funtion for the video streaming
def video_stream():
    while True:
        ret, frame = video.read()
        if not ret:
            break;
        else:
            ret, buffer = cv2.imencode('.jpeg',frame)
            frame = buffer.tobytes()
            yield (b' --frame\r\n' b'Content-type:
imgae/jpeg\r\n\r\n' + frame +b'\r\n')

#set route for funtion to show the current time
@app.route("/camera")
def timeserver():
    now = datetime.datetime.now()
    timeString = now.strftime("%Y-%m-%d %H:%M")
    templateDate = {'time' : timeString}
    return render_template('camera.html',**templateDate)

#set route for funtion to read the light status
@app.route("/camera")
def lights():
    lampSts = GPIO.input(lamp)
    templateData = {
        'lamp' : lampSts
        }
    return render_template('camera.html', **templateData)

#set route for funtion of buttons in webpage to turn on and off the
lamp
@app.route("/<deviceName>/<action>")
def action(deviceName, action):
    if deviceName == 'lamp':
        actuator = lamp
    if action == "on":
        GPIO.output(actuator, GPIO.LOW)
        time.sleep(900)
        GPIO.output(actuator, GPIO.HIGH)
```

```
    if action == "off":
        GPIO.output(actuator, GPIO.HIGH)

    lampSts = GPIO.input(lamp)
    templateData = {
        'lamp'   : lampSts
        }
    return render_template('camera.html', **templateData)
#route for the template
@app.route('/camera')
def camera():
    return render_template('camera.html')
#route to show streaming video
@app.route('/video_feed')
def video_feed():
    return Response(video_stream(), mimetype='multipart/x-mixed-
replace; boundary=frame')

#set rule to connect to webpage
app.run(host='0.0.0.0', port='5000', debug=False)
```

5.4. Template for web page: camera.html

```
<html>
 <head>
   <meta name="viewport" content="width=device-width, initial-
scale=1">
   <style>
      body {background:black;color: white}
      img {display: block;margin-left: auto;margin-right: auto;}
      h1 {text-align: center;}
      h2 {text-align: center;}
      button {font: bold 15px Arial;text-decoration:
none;background: darkcyan;color: white;padding: 2px 6px 2px 6px;
              border-top: 1px solid #CCCCCC;border-right: 1px solid
#333333;border-bottom: 1px solid #333333;
              border-left: 1px solid #CCCCCC;
              }
      button {background: darkcyan;color:white}
    </style>
  </head>
  <body>
     <h1>Teletubbies Home</h1>
     <h2>Surveillance Camera</h2>
     <h2>Server Time: {{ time }}</h2>
     <h3>
         <a href="/lamp/on"><button>TURN ON LAMP</button></a>
         <a href="/lamp/off"><button>TURN OFF LAMP</button></a>
```

```
    </h3>
    <img id="bg" src="{{ url_for('video_feed') }}"
style="width:88%;">
  </body>
</html>
```

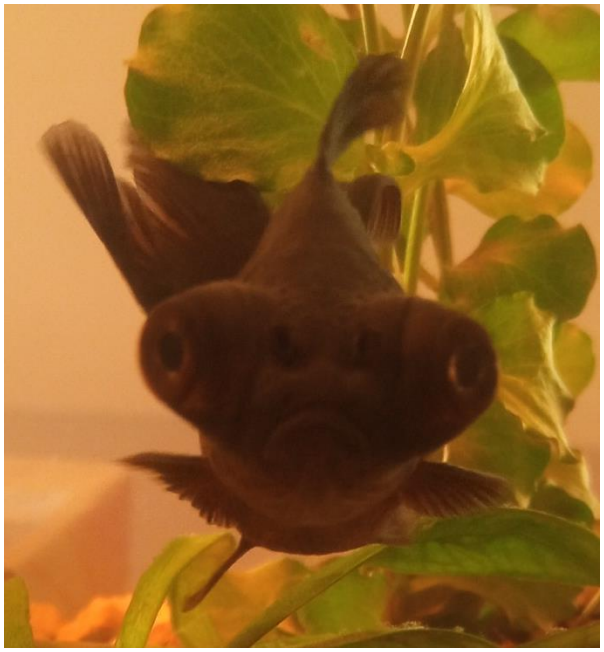
5.5. Code for main program: main.py

```
#import libraries
from allforone import pumpwater,feeding,lamp,status
from multiprocessing import Process
from lcd import lcd
from web import webtst


if __name__ == "__main__":

    #set variables for funtions
    w = Process(target=pumpwater)
    f = Process(target=feeding)
    l = Process(target=lamp)
    s = Process(target=status)
    d = Process(target=lcd)
    t = Process(target=webtst)

    #starting funtions
    t.start()
    w.start()
    f.start()
    l.start()
    s.start()
    d.start()

    #joining the funtions
    t.join()
    w.join()
    f.join()
    l.join()
    s.join()
    d.join()
```

6. Additional Set up

For this project I bought 4 golden fishes and named them as the Teletubbies characters:

- Po

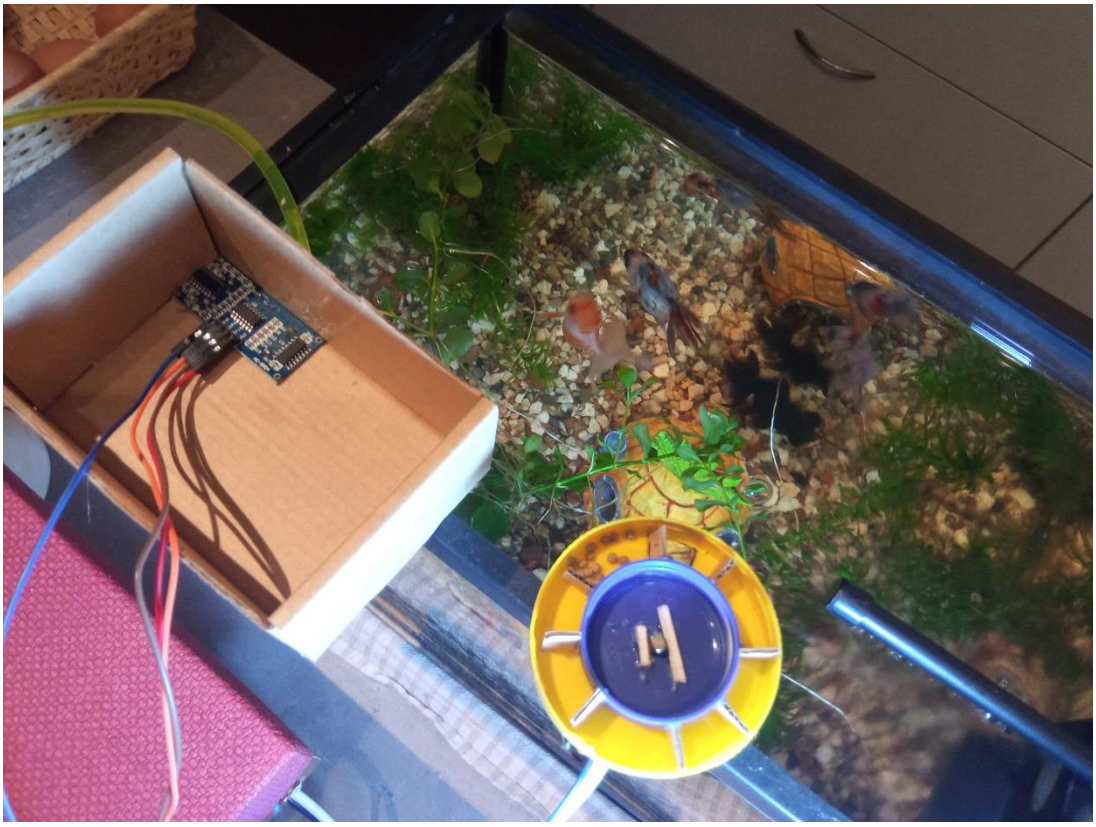


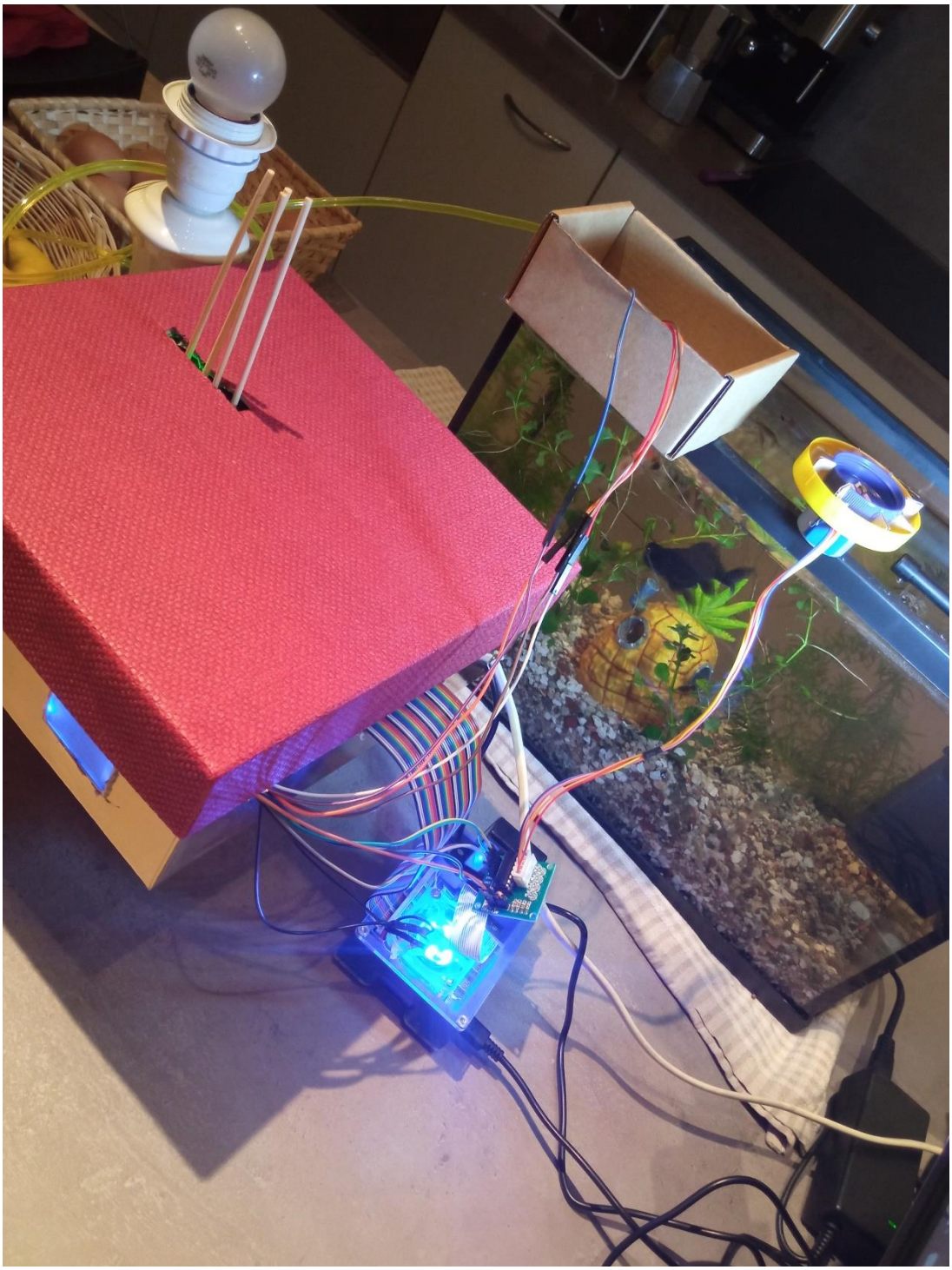
- Tinky-Winky

- Laa-laa

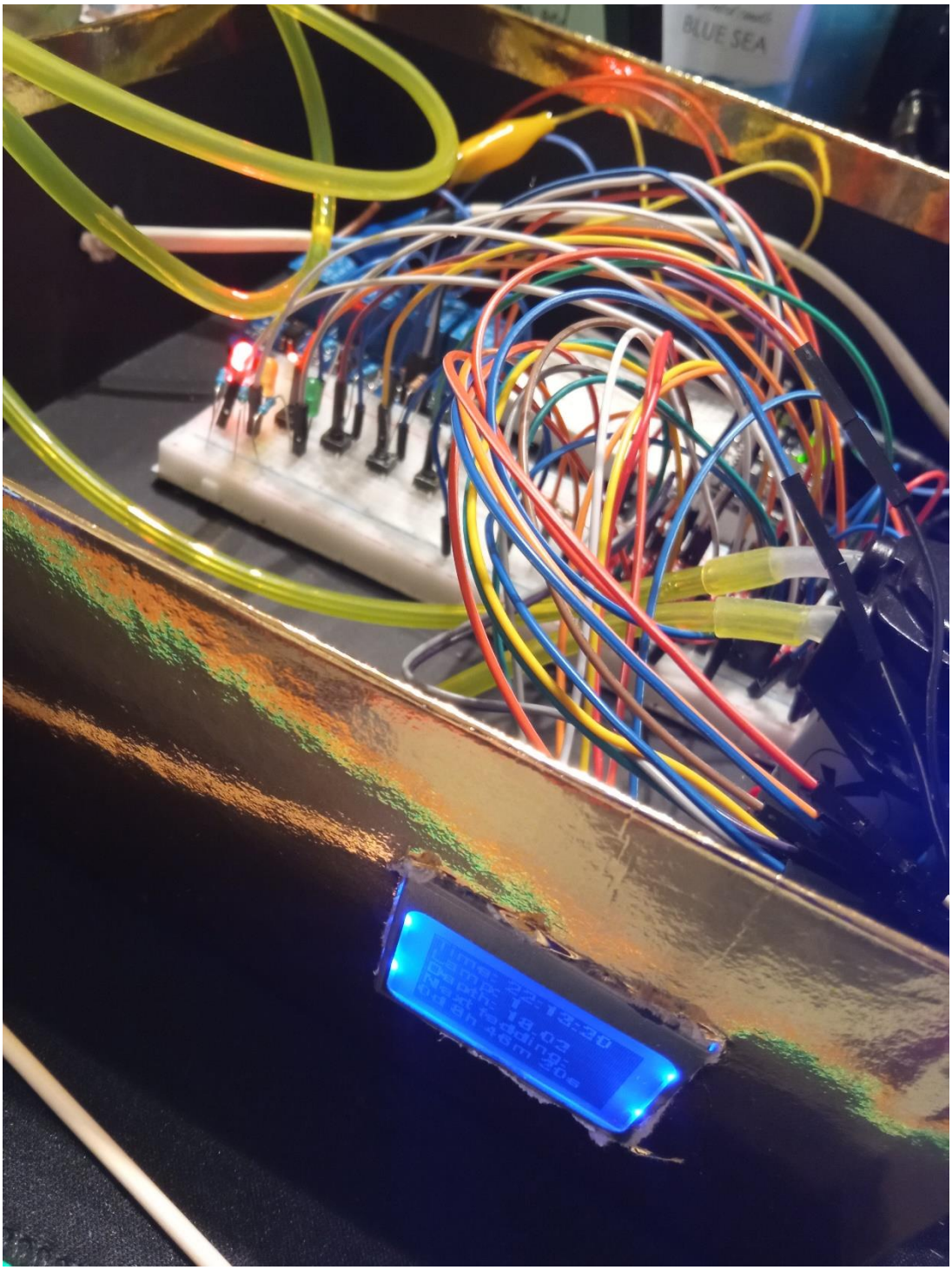
- Dipsy

7. Pictures of project






Time: 22:13:23
Lamp: 1
Depth: 18.02
Next feedding:
0d 8h 46m 36s


BLUE SEA