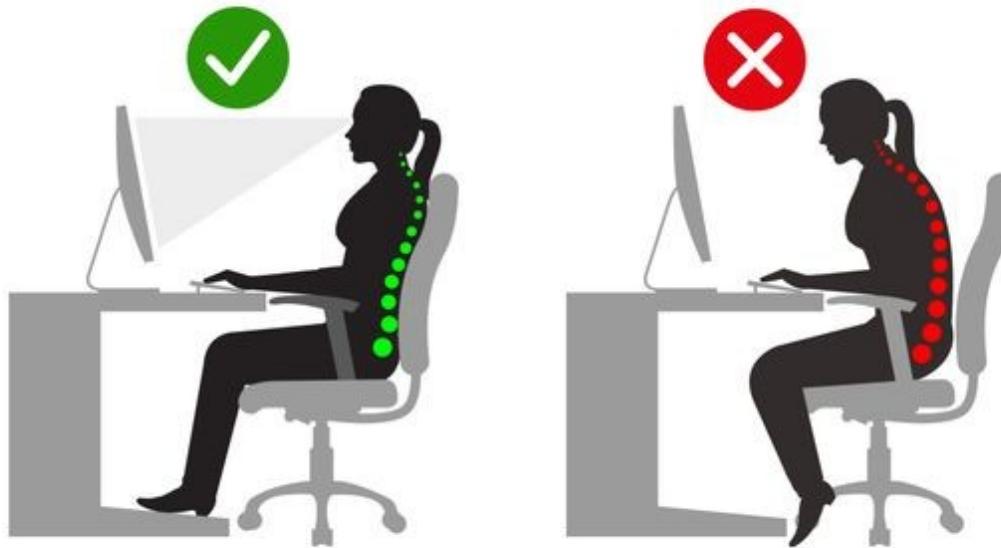


Détecteur de postures en position assise



Contexte



**9 FRANÇAIS SUR 10
DÉCLARENT AVOIR DÉJÀ
EU **MAL AU DOS****

Source: Doctissimo

Les chiffres du mal de dos lié au travail

20 %
des accidents
de travail

Près de
15 %
des accidents
de trajet

1/5
entraîne un arrêt
de travail

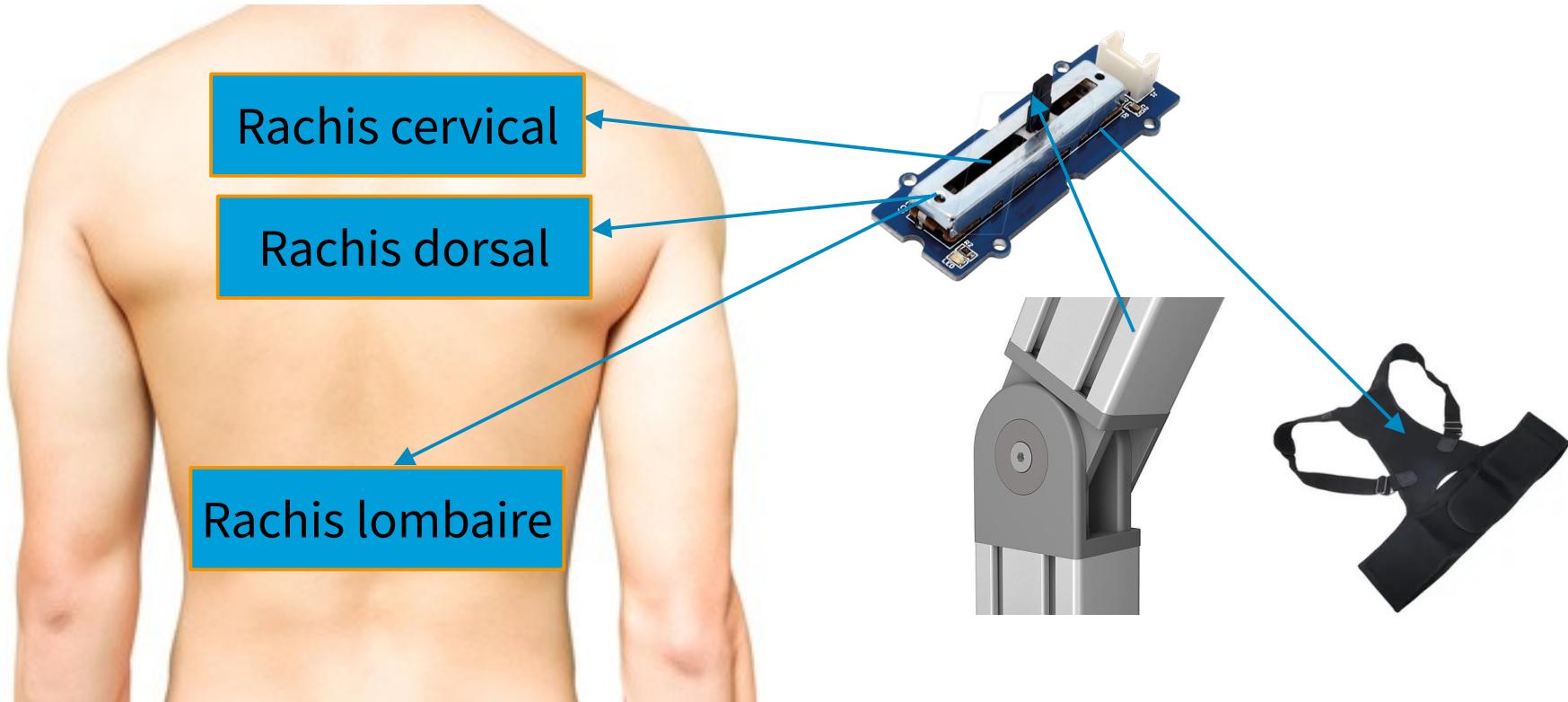
2 mois
d'arrêt en moyenne
pour un accident
du travail

Source: Ameli

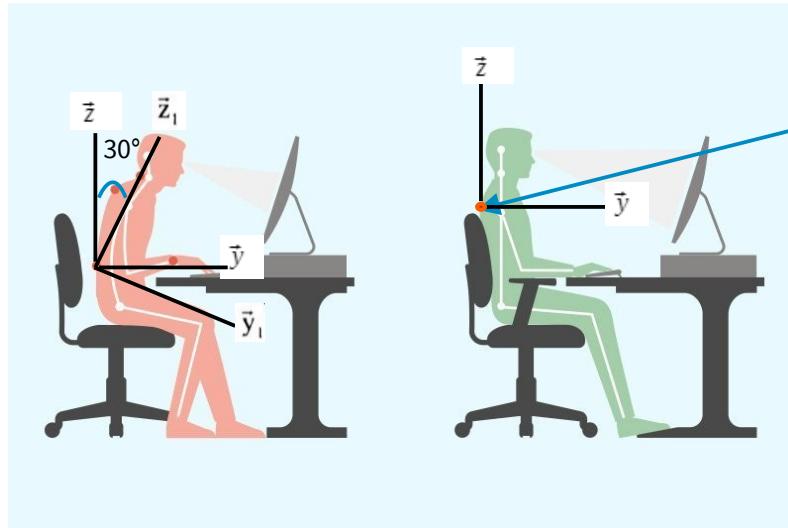
Comment peut-on améliorer la posture d'une personne assise ?



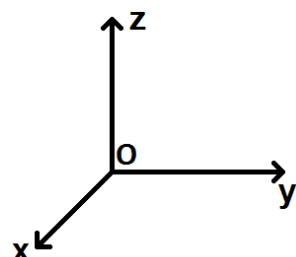
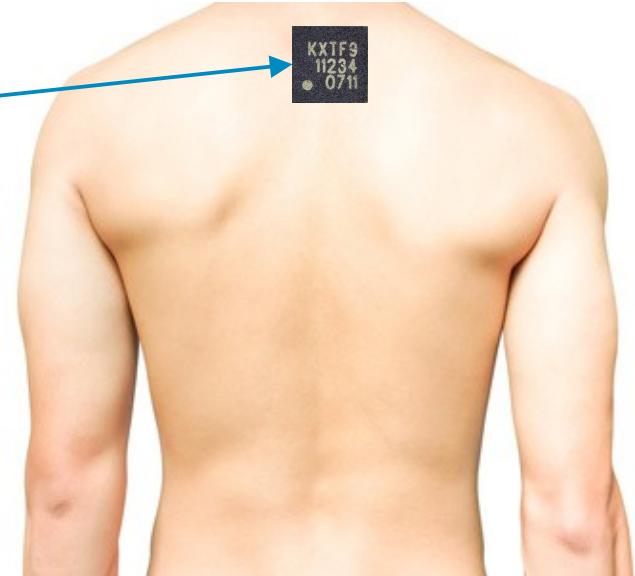
Solution envisagée pour la maquette



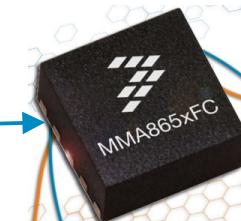
Solution retenue pour la maquette



Rachis cervical

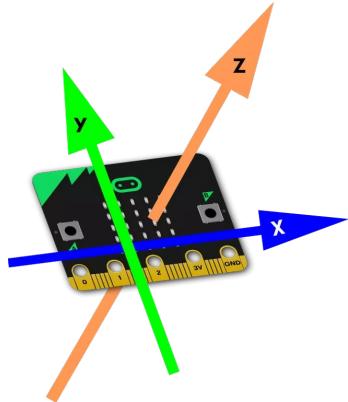


Accéléromètre



Matériels utilisés

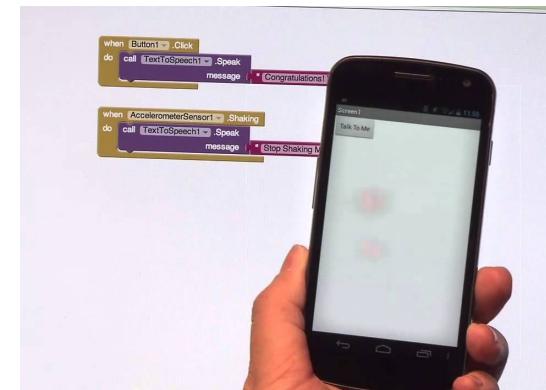
Carte Microbit v1



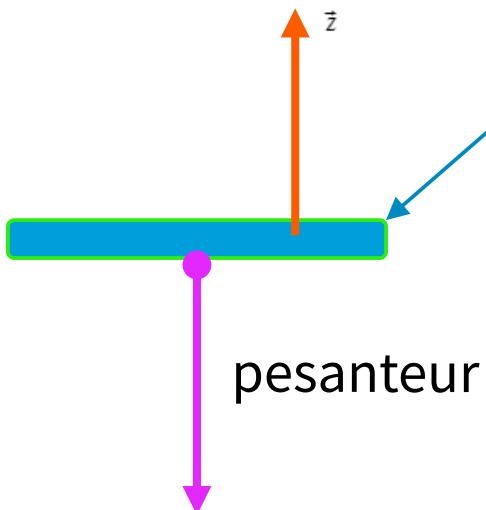
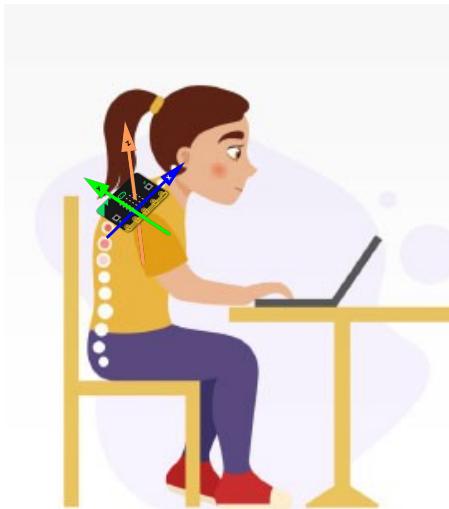
Boîtier d'alimentation



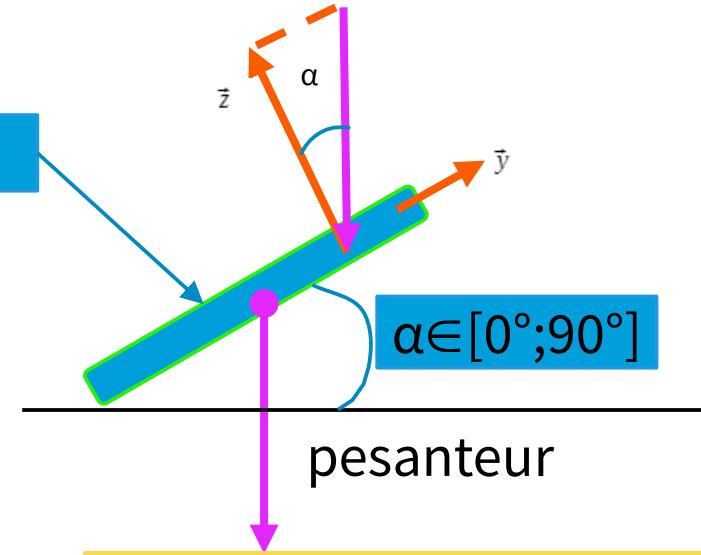
Smartphone Android



Utilisation d'un accéléromètre



Microbit



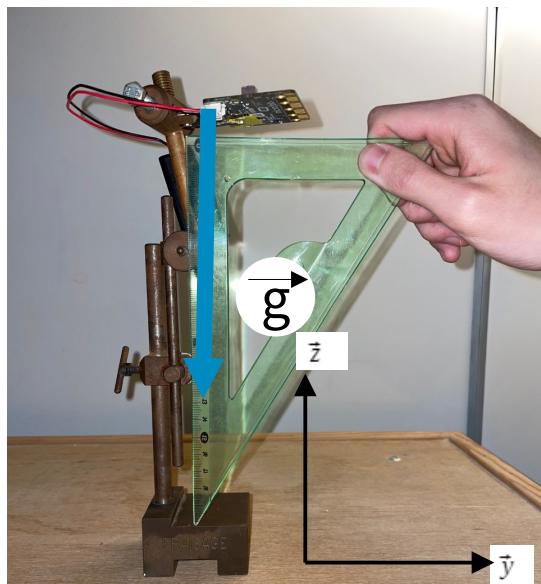
Formule:

$$||z|| = 9.81 * \cos(\alpha)$$
$$||y|| = 9.81 * \sin(\alpha)$$

Pesanteur=-9.81m/s²

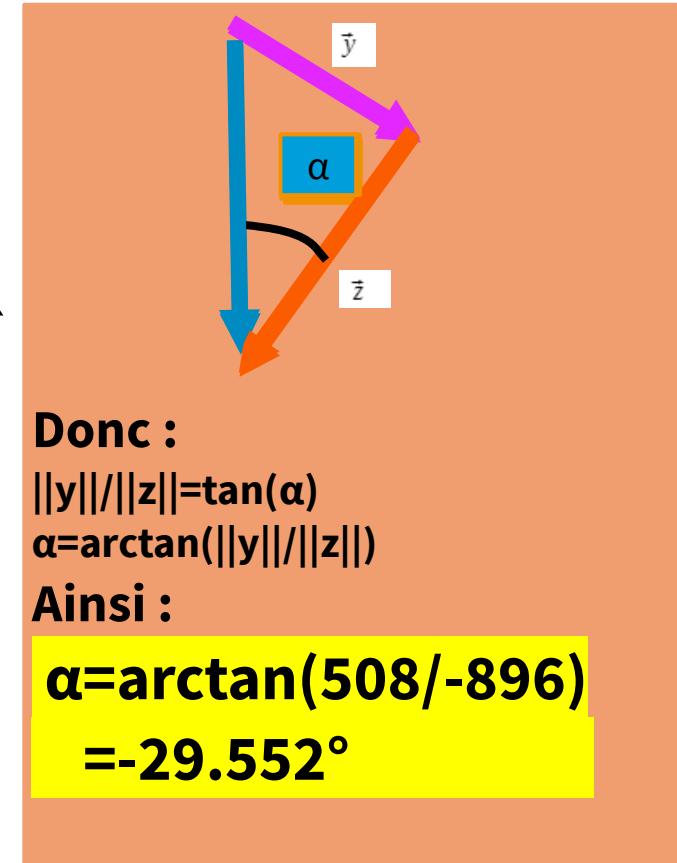
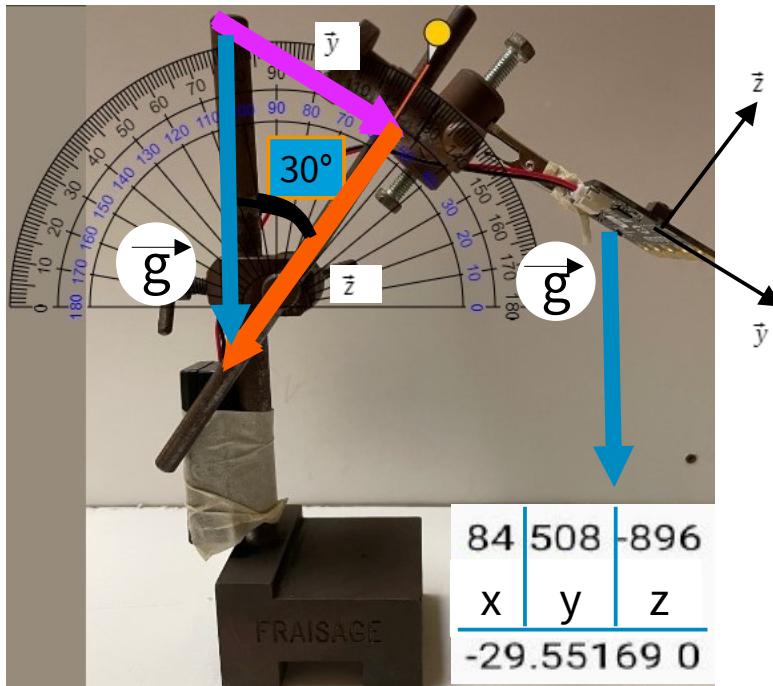
$$||z|| = 9.81$$

Utilisation de l'accéléromètre

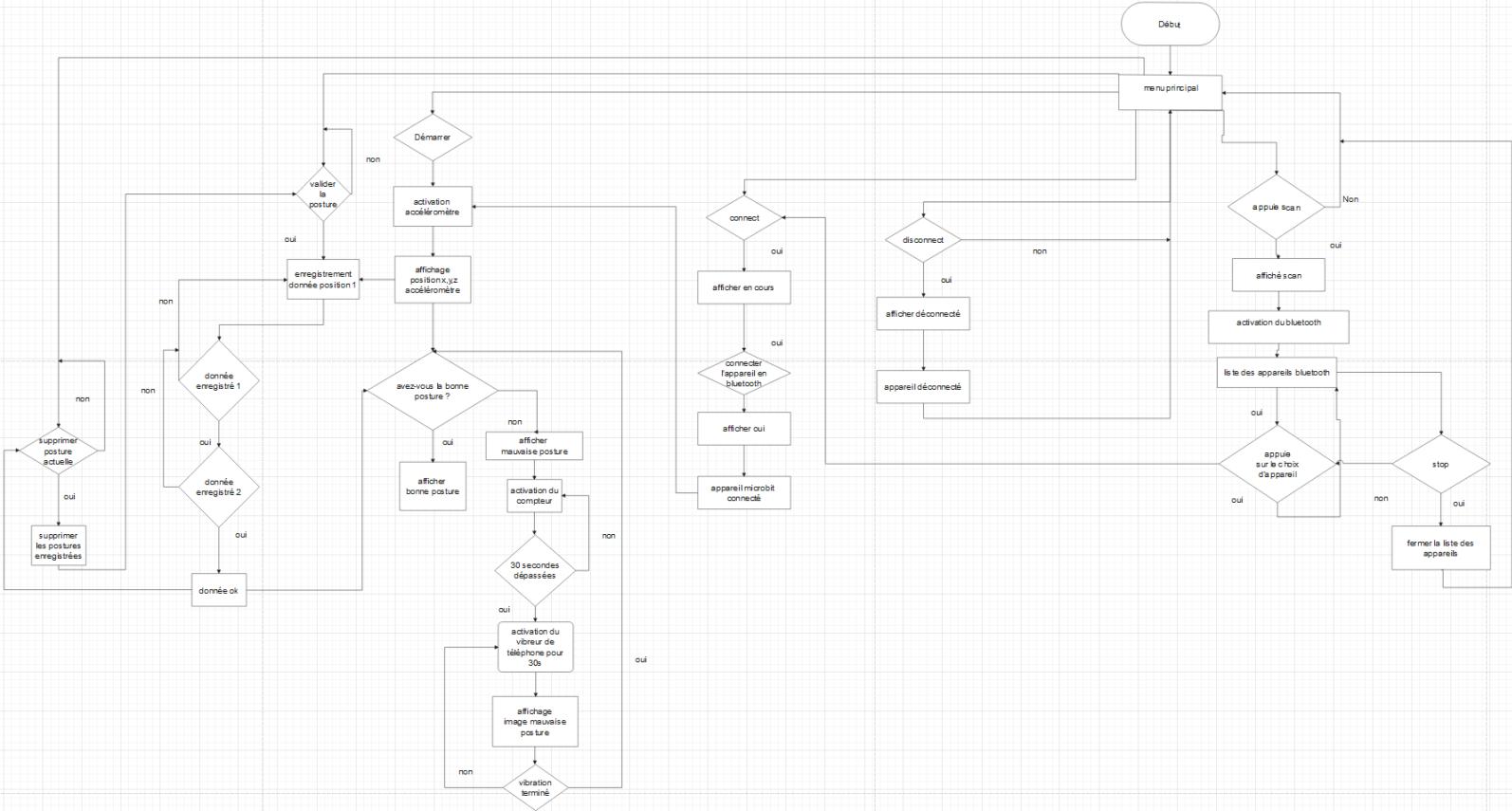


-68 -24 -1012

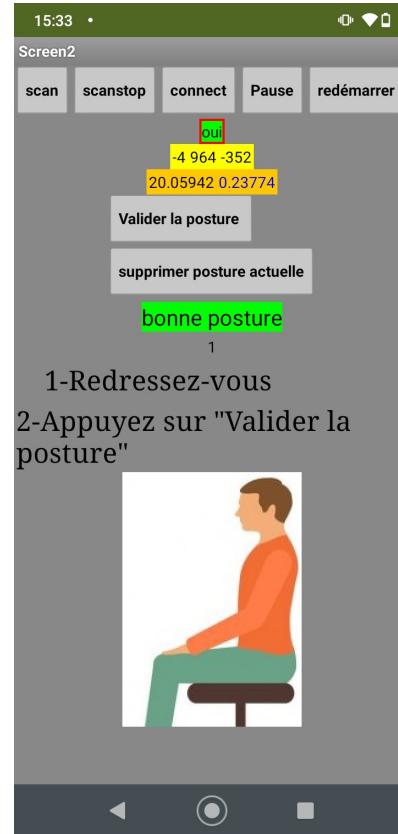
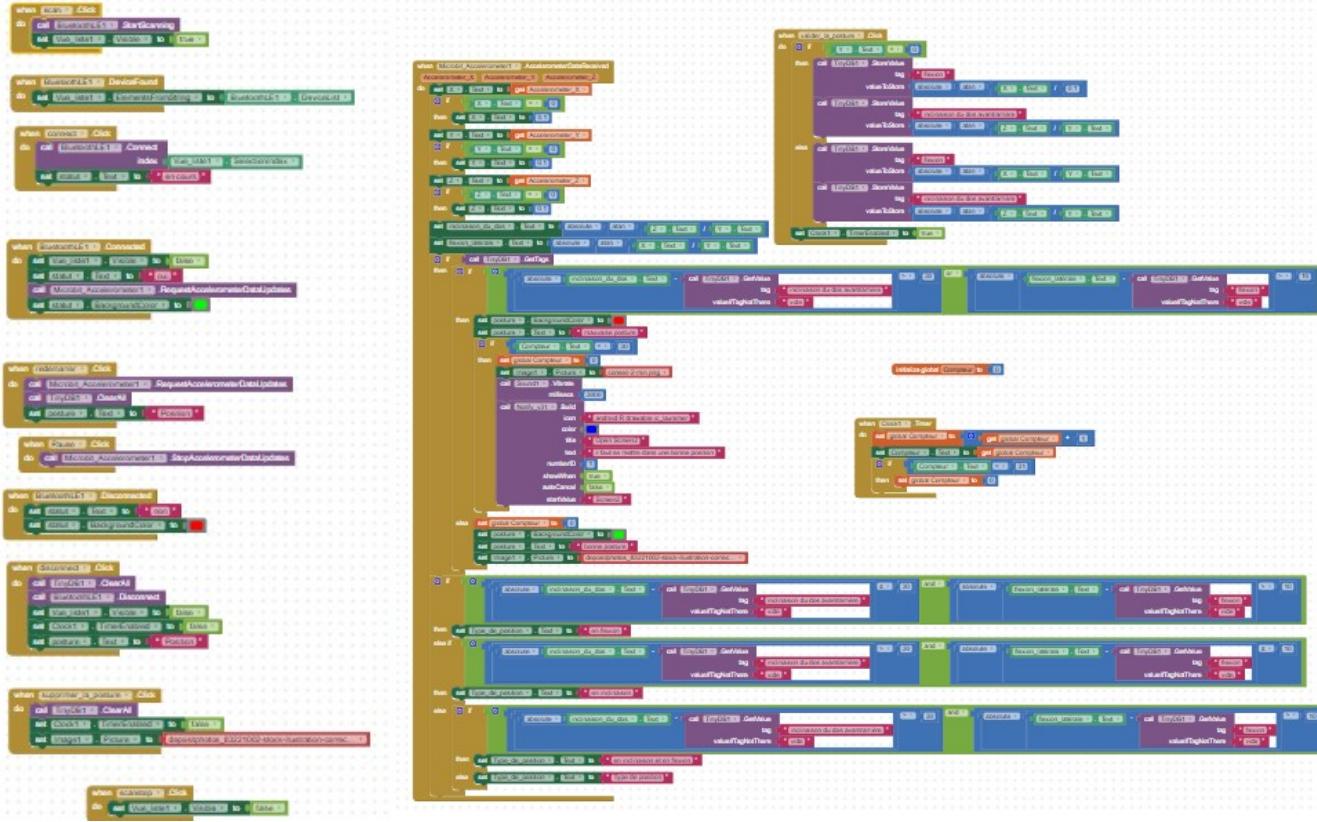
Donnée constructeur :
Pesanteur Microbit=-1023



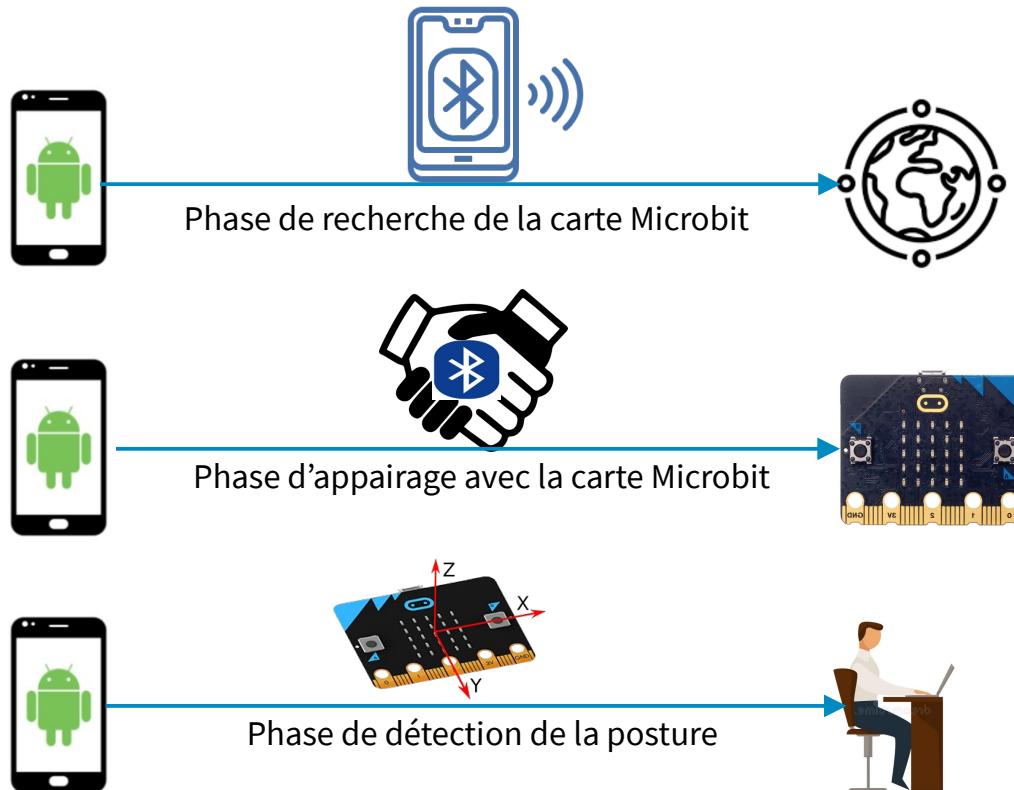
Algorigramme



Programmation de l'application



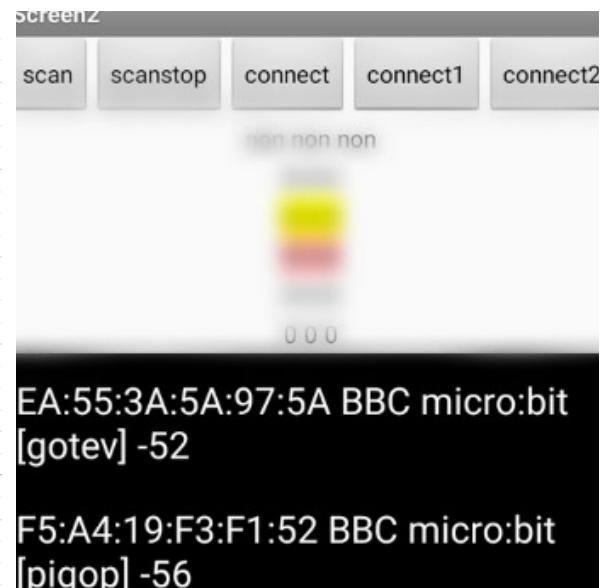
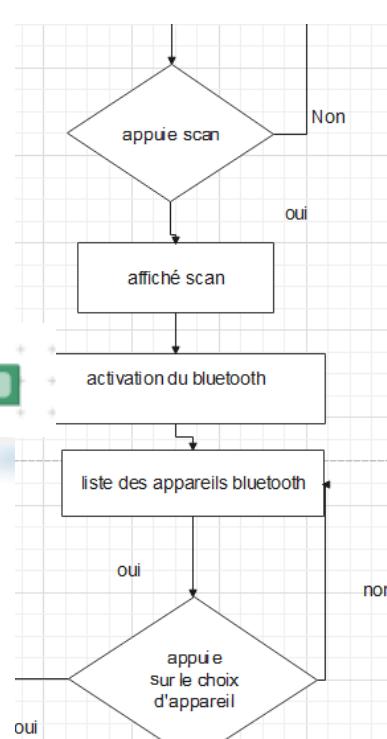
Connexion entre le téléphone et la carte Microbit



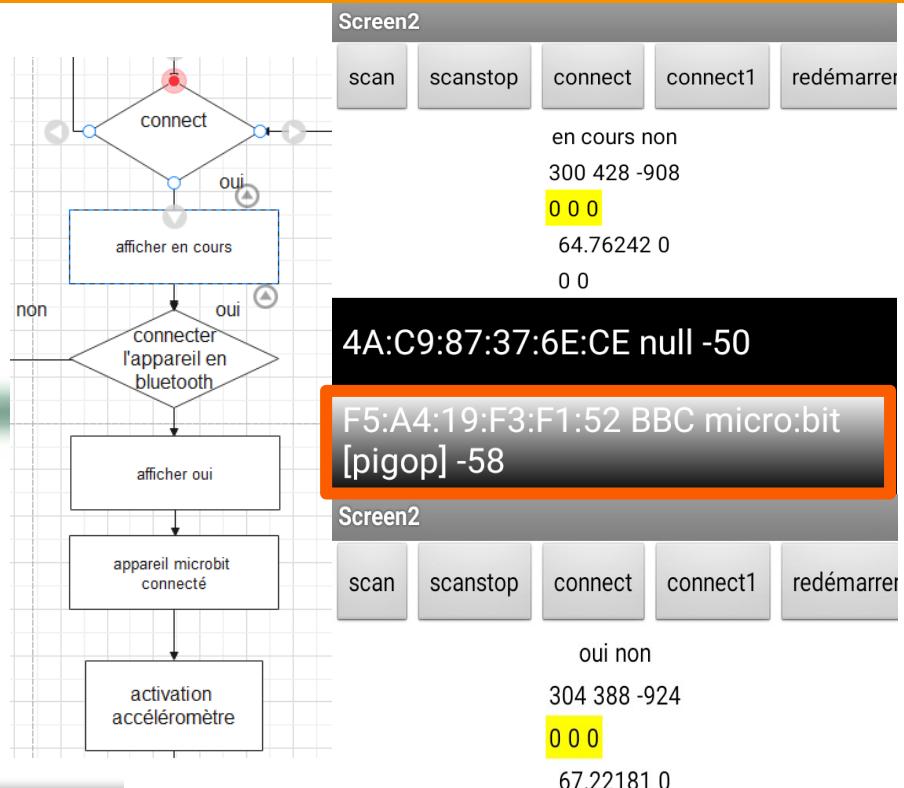
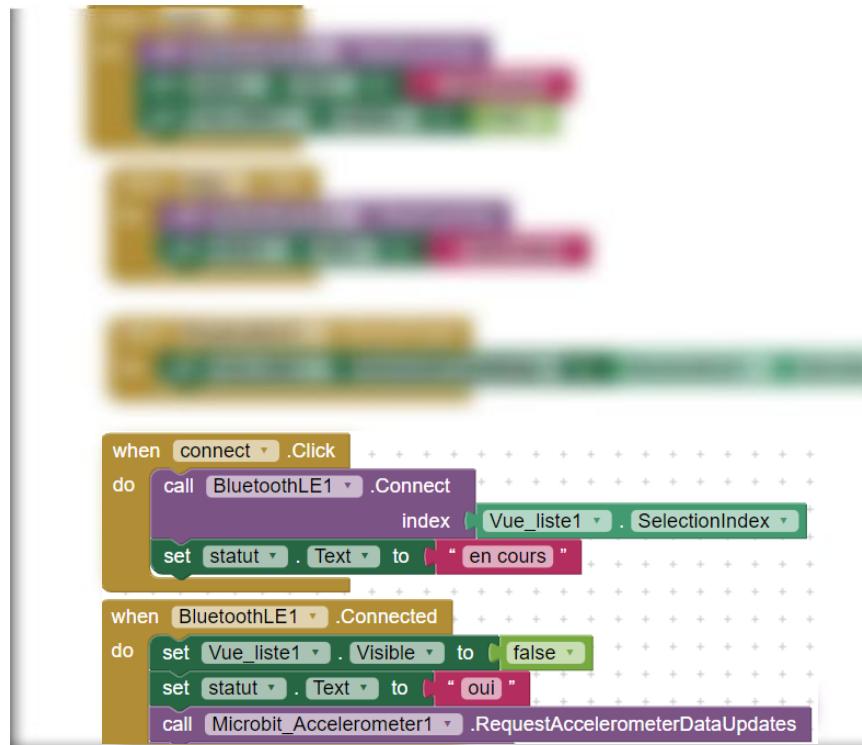
Phase de recherche de l'appareil

```
when scan .Click
do call BluetoothLE1 .StartScanning
set Vue_liste1 .Visible to true
```

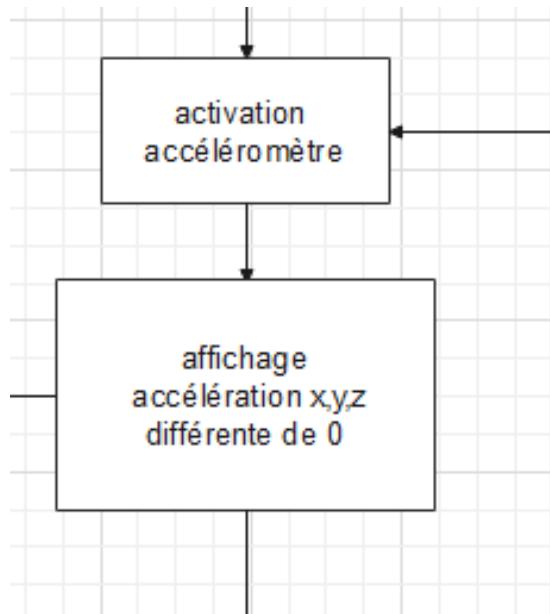
```
when BluetoothLE1 .DeviceFound
do set Vue_liste1 .ElementsFromString to BluetoothLE1 .DeviceList
```



Phase de connexion de l'appareil(1)



Phase de connexion de l'appareil(2)



```
when Microbit_Accelerometer1 .AccelerometerDataReceived
    Accelerometer_X Accelerometer_Y Accelerometer_Z
do
    set [X] .Text to get Accelerometer_X
    if X .Text = 0
        then set [X] .Text to 0.1
    set [Y] .Text to get Accelerometer_Y
    if Y .Text = 0
        then set [Y] .Text to 0.1
    set [Z] .Text to get Accelerometer_Z
    if Z .Text = 0
        then set [Z] .Text to 0.1
```

oui non
72 -752 -724
0 0 0
43.91322 0
0 0

Phase de détection de la bonne posture en inclinaison(1)

Formule:

Angle de posture=arctan(||z||/||y||)

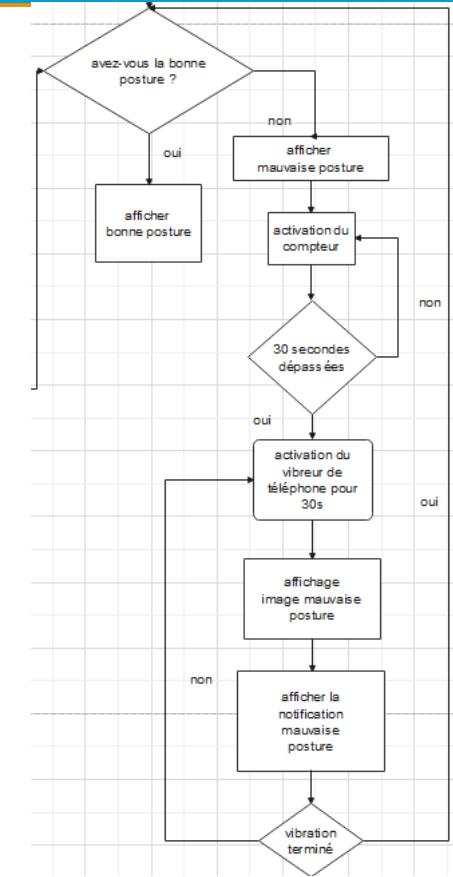
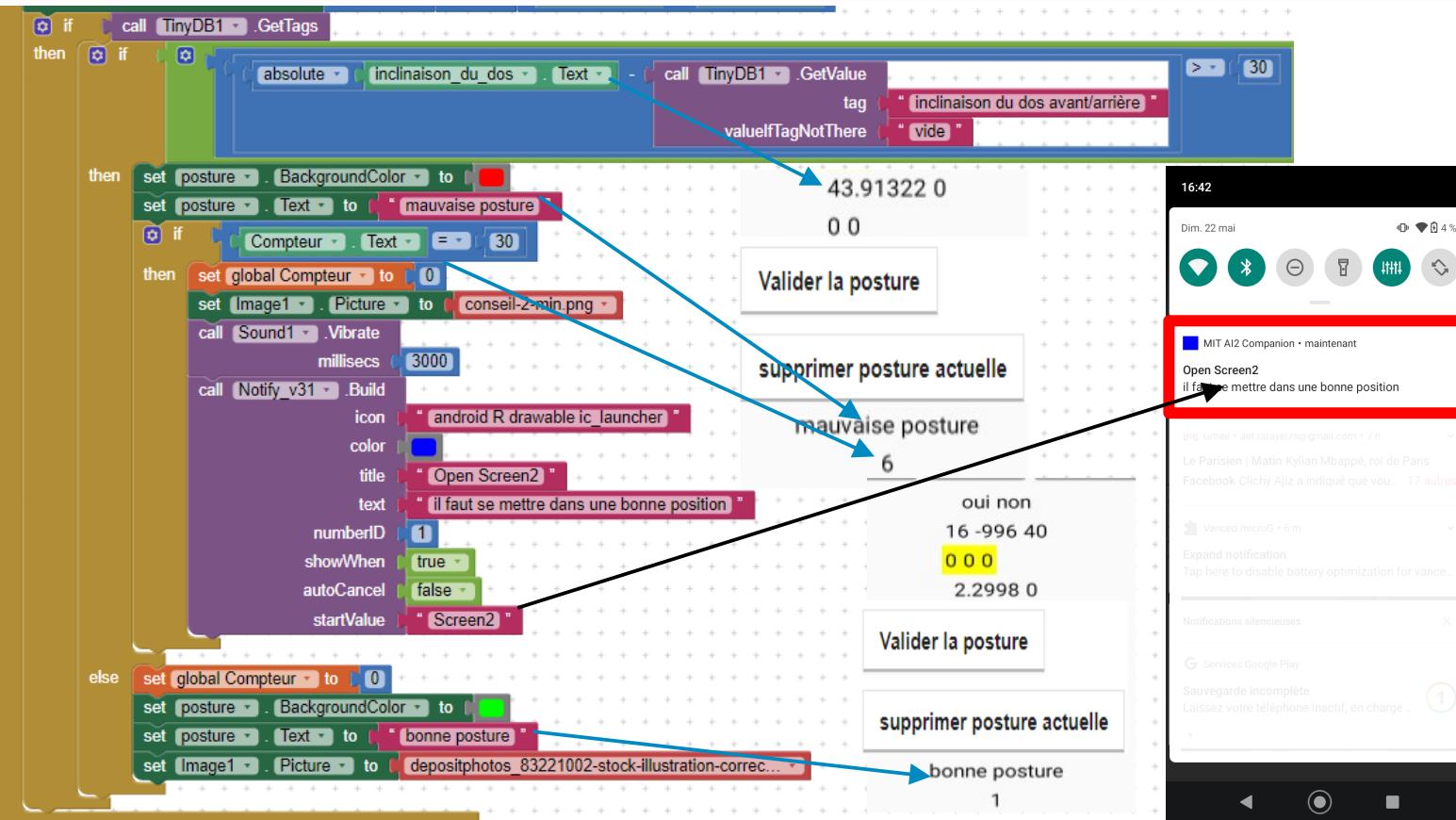
```

when valider_la_posture .Click
do call TinyDB1 .StoreValue
    tag " inclinaison du dos avant/arrière "
    valueToStore absolute atan Z .Text / Y .Text
  
```

Diagram illustrating the Microbit setup for posture detection:

- Scratch Script:** Triggers when the button is clicked, calling `TinyDB1 .StoreValue` with tag "inclinaison du dos avant/arrière" and valueToStore calculated as $\text{atan}(\text{absolute}(Z .Text) / Y .Text)$.
- Microbit Components:**
 - Coordinate System:** Shows a 3D coordinate system with axes \bar{x} , \bar{y} , and \bar{z} .
 - Back Posture Line:** A green line representing the back posture.
 - Microbit Board:** Labeled "Microbit".
 - Position Box:** Displays "Position 0" and contains two buttons: "Valider la posture" and "supprimer posture actuelle".

Phase de détection de la bonne posture en inclinaison(2)



Fonctionnement du compteur



The image shows a Scratch script consisting of two main parts:

- Initialisation du Compteur à 0**: A yellow-bordered box pointing to the first block: `initialize global [Compteur] to [0]`.
- Début de décomptage**: A yellow-bordered box pointing to the second block: `when [Clock1 Timer] do [set [global Compteur] to [get [global Compteur v] + [1]] & set [Compteur Text] to [get [global Compteur v]]]`.

The script runs when the `Clock1 Timer` event occurs. It initializes the global variable `Compteur` to 0. Then, it enters a loop where it increments the global variable by 1 and updates the `Compteur` text variable to reflect the current value.

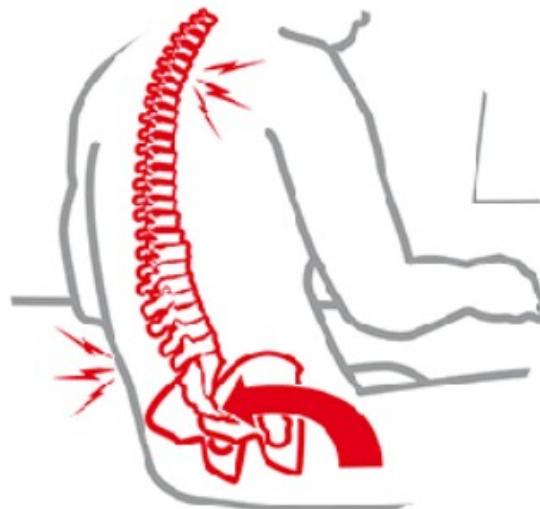
Scratch Interface Elements (Right Side):

- Posture List:** A table showing posture data:

oui non	16 - 996 40
0 0 0	2.2998 0
0 0	
- Buttons:**
 - Valider la posture**
 - supprimer posture actuelle**
- Countdown:** `bonne posture 1`

Autre cas de mauvaise posture

Flexion latérale



Flexion du haut du dos



Flexion du haut/latérale

```

if absolute flexion_latérale . Text - call TinyDB1 . GetValue > 10
then set posture . Text to "mauvaise posture"
else set posture . Text to "bonne posture"

7.00938 14.4774
1.82554 0

```

Valider la posture

supprimer posture actuelle

mauvaise posture

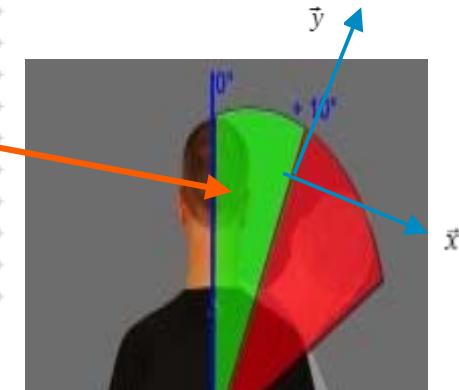
bonne posture

4

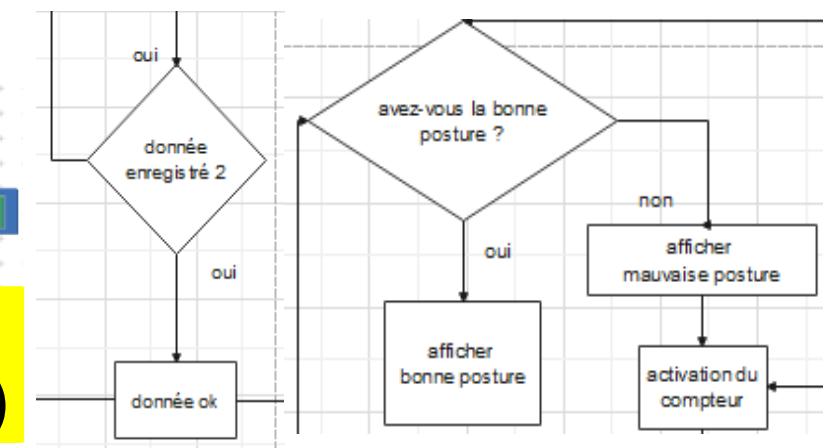
```

when valider_la_posture . Click do
call TinyDB1 . StoreValue tag "flexion"
valueToStore absolute atan X . Text / Y . Text
set Clock1 . TimerEnabled to true

```



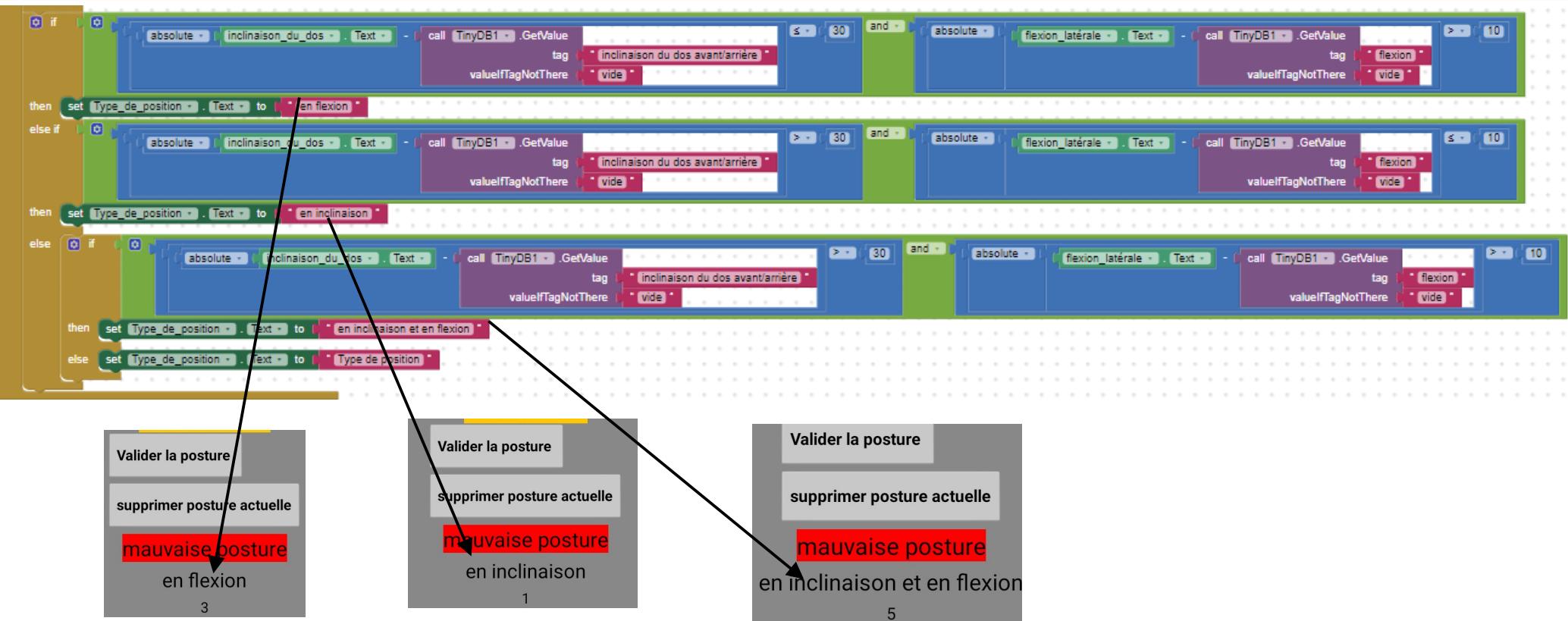
Formule:
Angle de posture=arctan(||x||/||y||)



Flexion et inclinaison du dos



Flexion et inclinaison du dos



Résultat final de l'interface de l'application

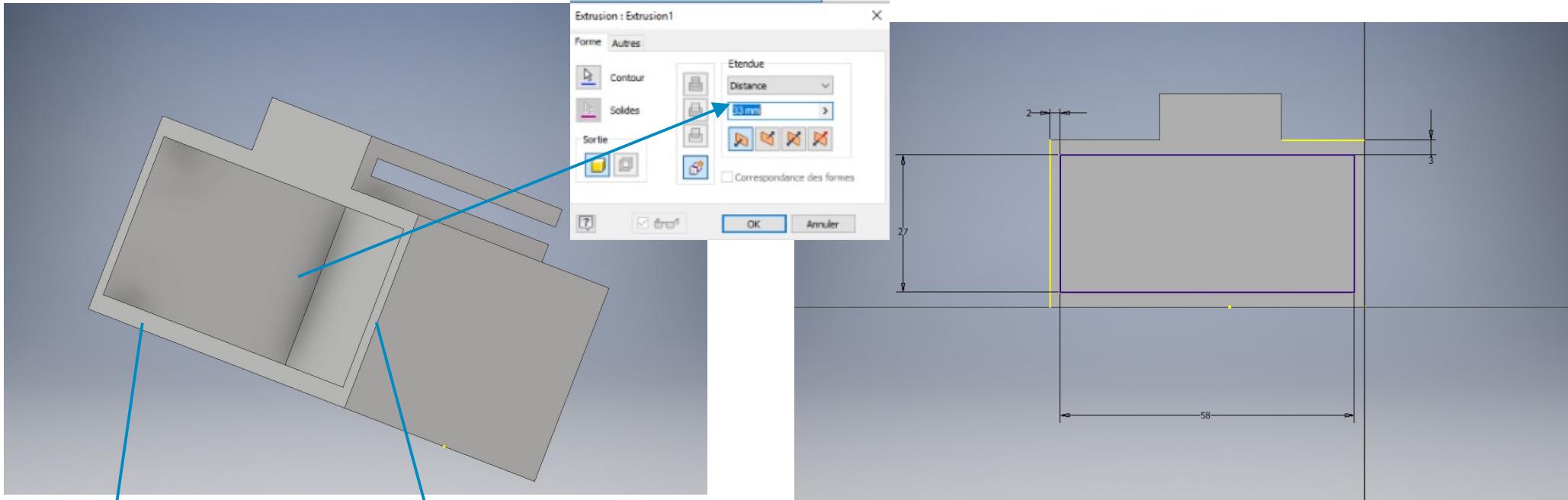
The image shows a Scratch script for a mobile application. The script consists of three main parts:

- when BluetoothLE1 Disconnected:** Sets the status text to "non" and changes the background color to red.
- when BluetoothLE1 Connected:** Sets the status text to "oui", calls a microbit accelerometer update function, and changes the background color to green.
- then (if Compteur = 30):** Sets the posture background color to red, sets the posture text to "mauvaise posture", and displays a notification with a message about posture correction.
- else:** Sets the global compteur to 0, sets the posture background color to green, sets the posture text to "bonne posture", and displays a notification with a message about good posture.

Smartphone Screenshots:

- Screen 1:** Shows a red arrow pointing to a red square icon on the screen. The screen has buttons for scan, scanstop, connect, pause, and redémarrer.
- Screen 2:** Shows a red arrow pointing to a red square icon on the screen. The screen has buttons for scan, scanstop, connect, pause, and redémarrer. It also displays posture data (e.g., 4.236944, 75.96376, 0.97102) and instructions: "1-Redressez-vous" and "2-Appuyez sur "Valider la posture"" with an illustration of a person sitting.
- Screen 3:** Shows a green arrow pointing to a green square icon on the screen. The screen has buttons for scan, scanstop, connect, pause, and redémarrer. It displays posture data (e.g., -24.964, -244, 14.20394, 1, 42616) and instructions: "bonne posture" and "Type de position 1". It also shows an illustration of a person sitting in a good posture.

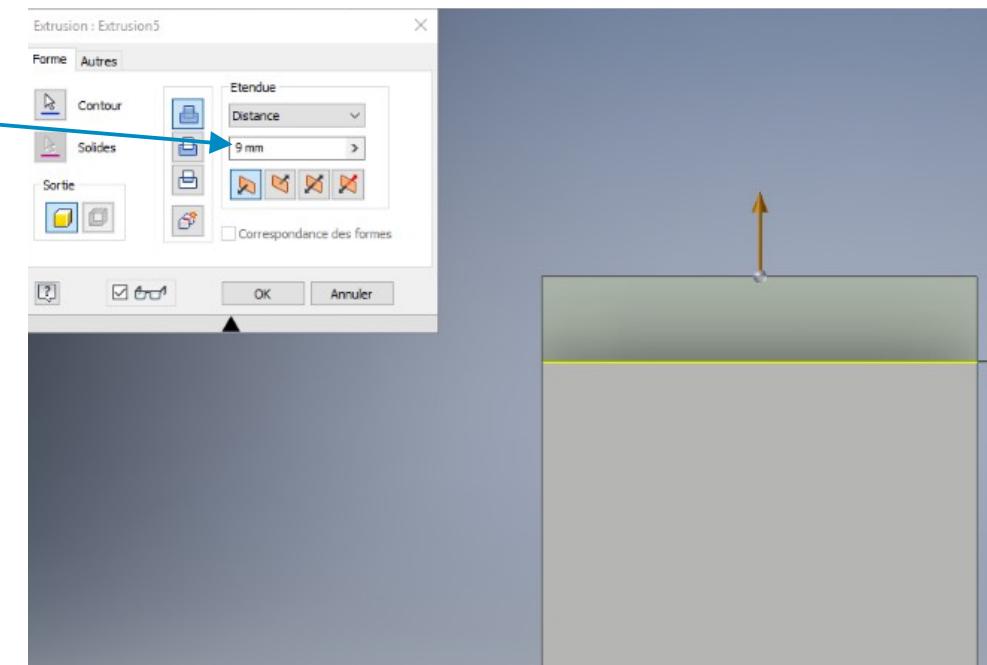
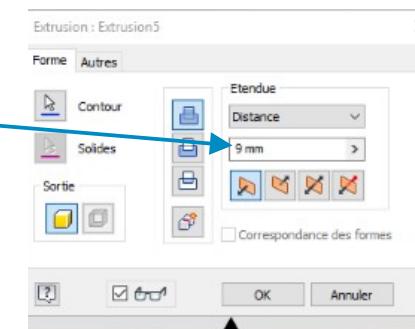
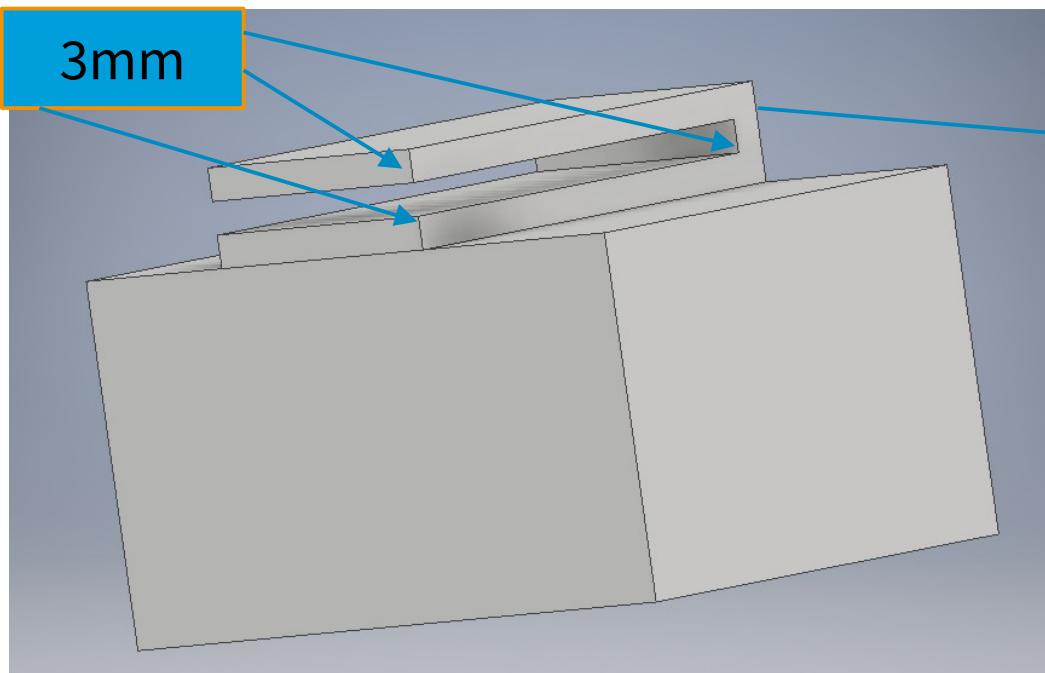
Support de la carte Microbit et batterie(1)



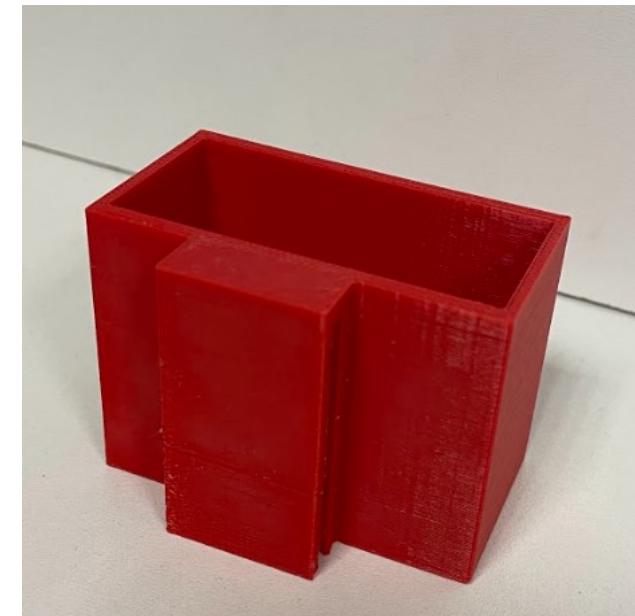
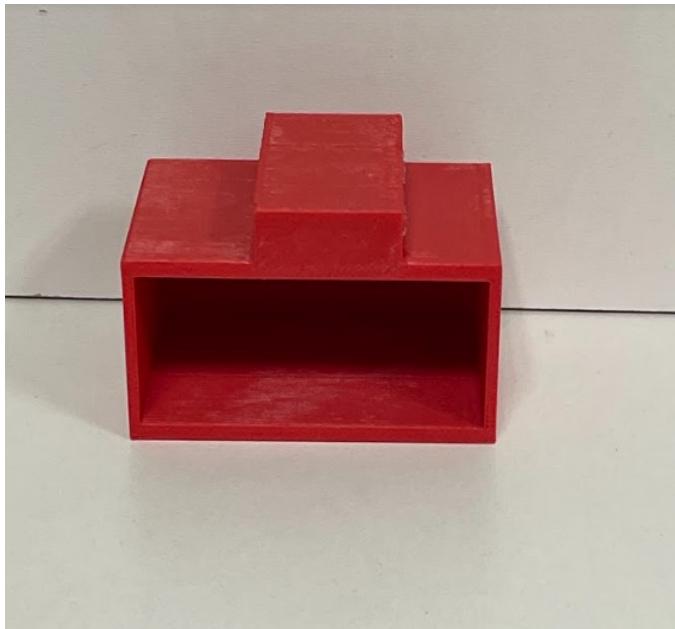
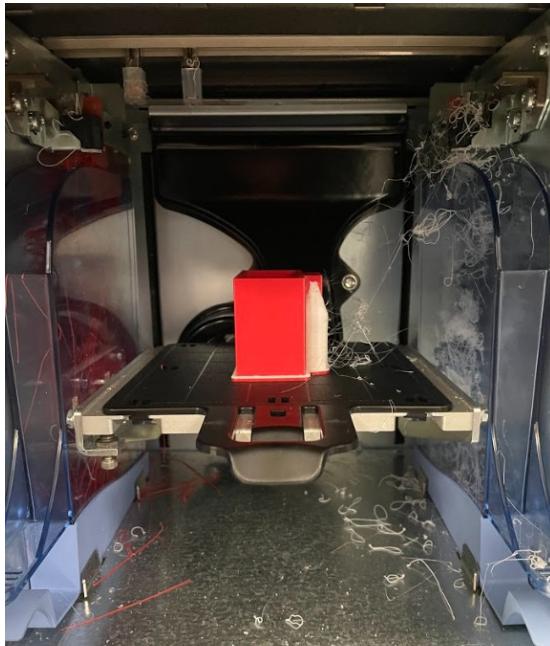
Longueur:
62 mm

Largeur:
46 mm

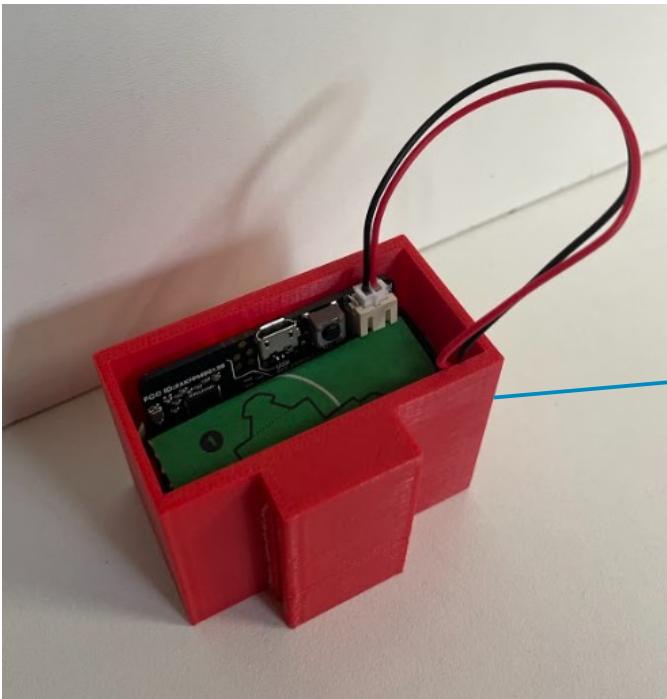
Support de la carte Microbit et batterie(2)



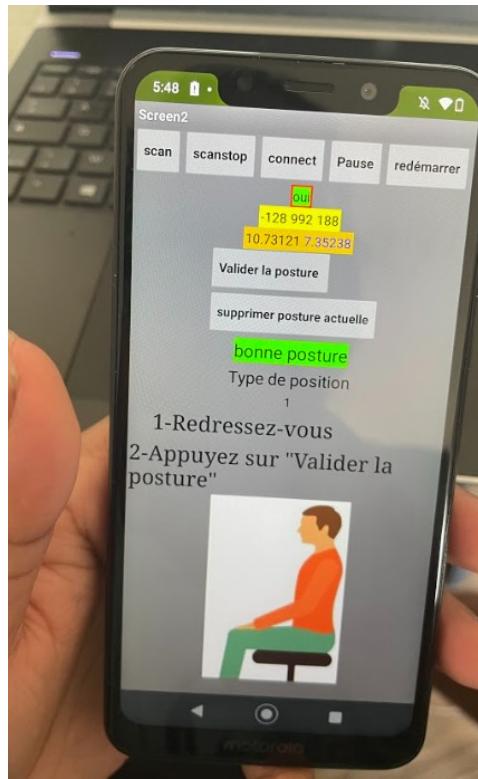
Support de la carte Microbit et batterie



Essai réel(1)



Essai réel(2)



Coût

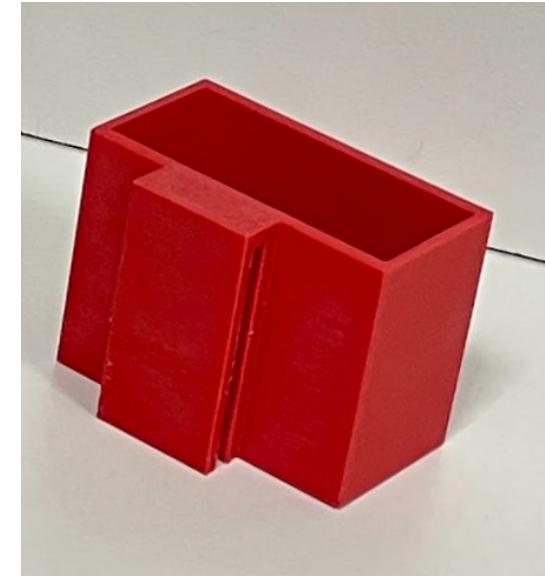
20 euros



80 à 2000 euros



4.18 euros



Conclusion

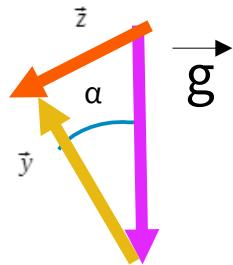
Merci pour votre attention...

Inconvénient de l'accéléromètre

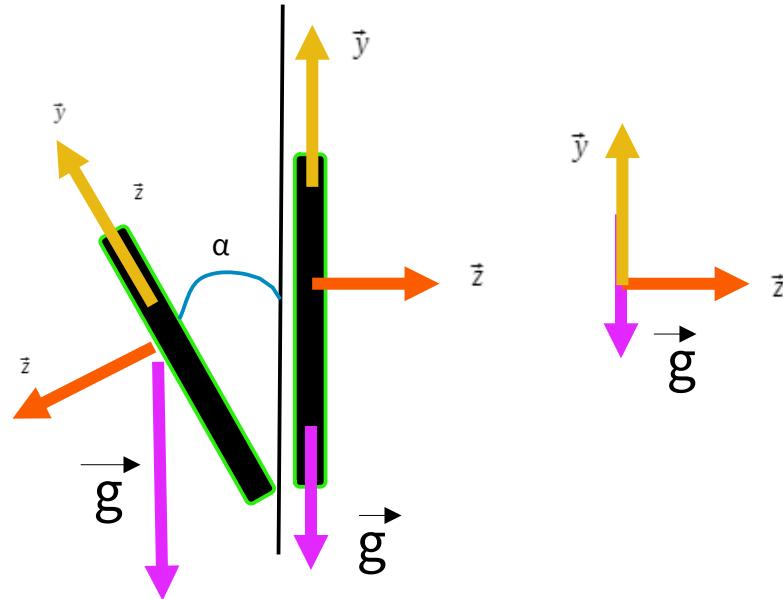
Torsion du dos



Inclinaison du dos



Torsion du dos



Annexe

Programmation de l'affichage de l'accéléromètre

```

when scan .Click
do call BluetoothLE1 .StartScanning
set Vue_liste1 .Visible to true

when BluetoothLE1 .DeviceFound
do set Vue_liste1 .ElementsFromString to BluetoothLE1 .DeviceList

when connect .Click
do call BluetoothLE1 .Connect
index Vue_liste1 .SelectionIndex
set statut .Text to "en cours"

when BluetoothLE1 .Connected
do set Vue_liste1 .Visible to false
set statut .Text to "oui"
call Microbit_Accelerometer1 .RequestAccelerometerDataUpdates
set statut .BackgroundColor to green

when redémarrer .Click
do call Microbit_Accelerometer1 .RequestAccelerometerDataUpdates
call TinyDB1 .ClearAll

when Pause .Click
do call Microbit_Accelerometer1 .StopAccelerometerDataUpdates

when BluetoothLE1 .Disconnected
do set statut .Text to "non"
set statut .BackgroundColor to red

```

```

when Microbit_Accelerometer1 .AccelerometerDataReceived
Accelerometer_X Accelerometer_Y Accelerometer_Z
do set X .Text to get Accelerometer_X
if X .Text = 0
then set X .Text to 0.1
set Y .Text to get Accelerometer_Y
if Y .Text = 0
then set Y .Text to 0.1
set Z .Text to get Accelerometer_Z
if Z .Text = 0
then set Z .Text to 0.1

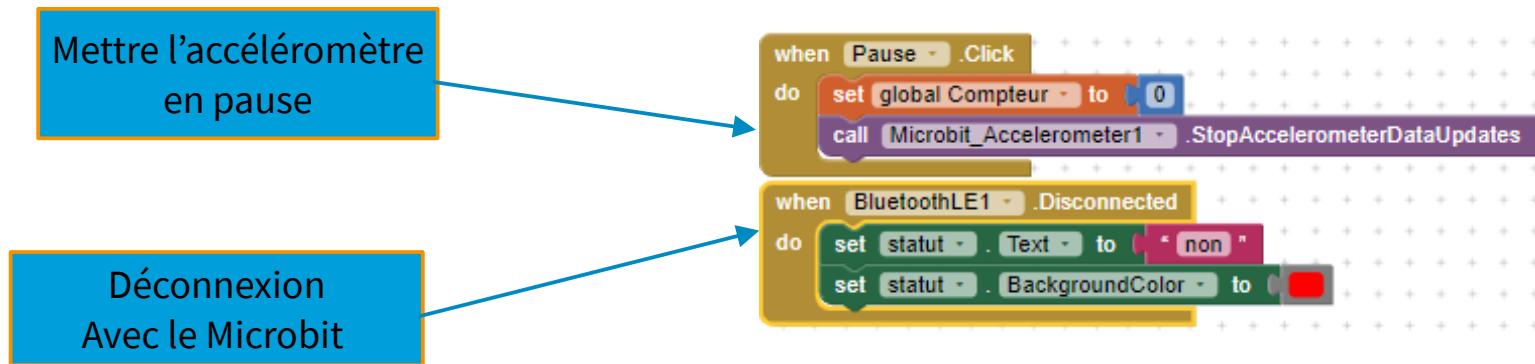
```

Programmation de l'application

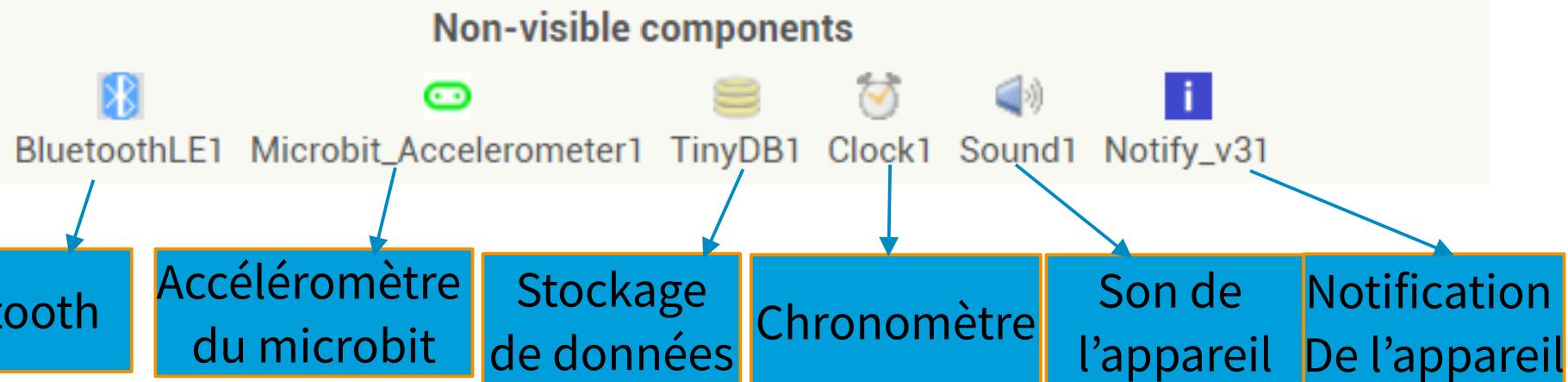
Arrêt du scan des appareils bluetooth

```
when scanstop .Click
do set Vue_liste1 .Visible to false
```

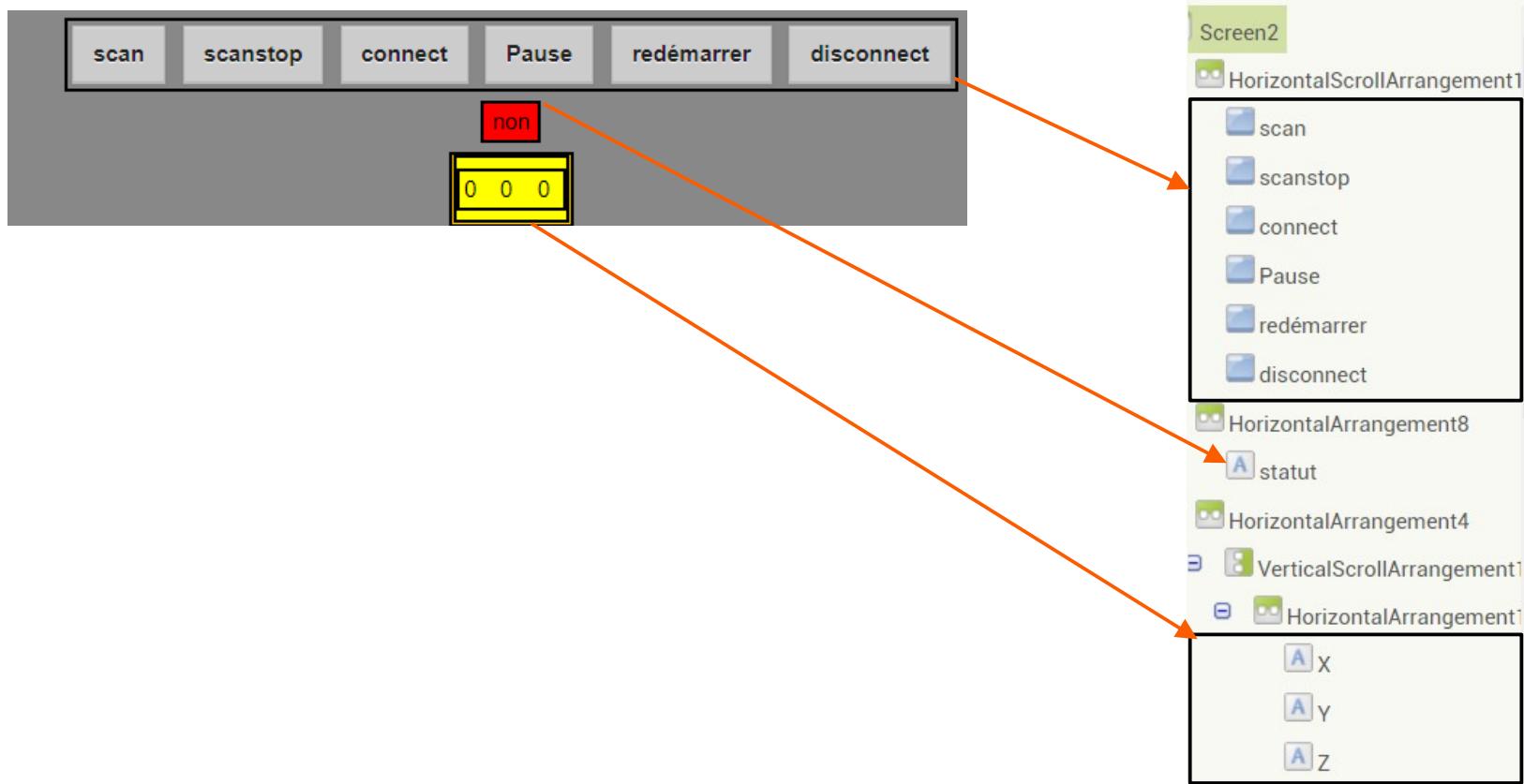
Programmation de l'application



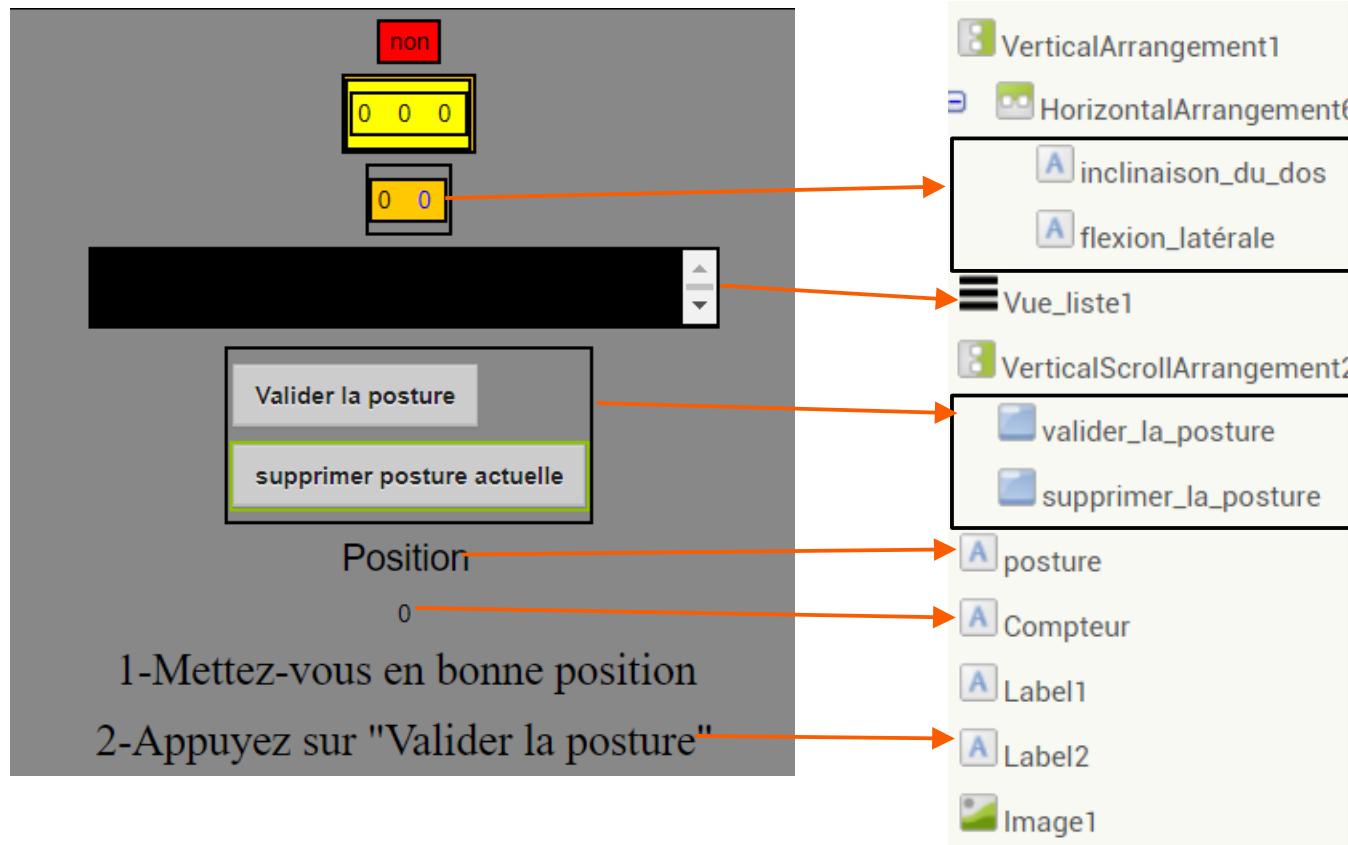
Module de l'application



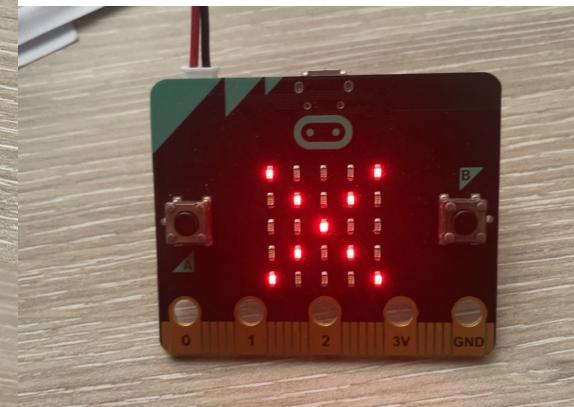
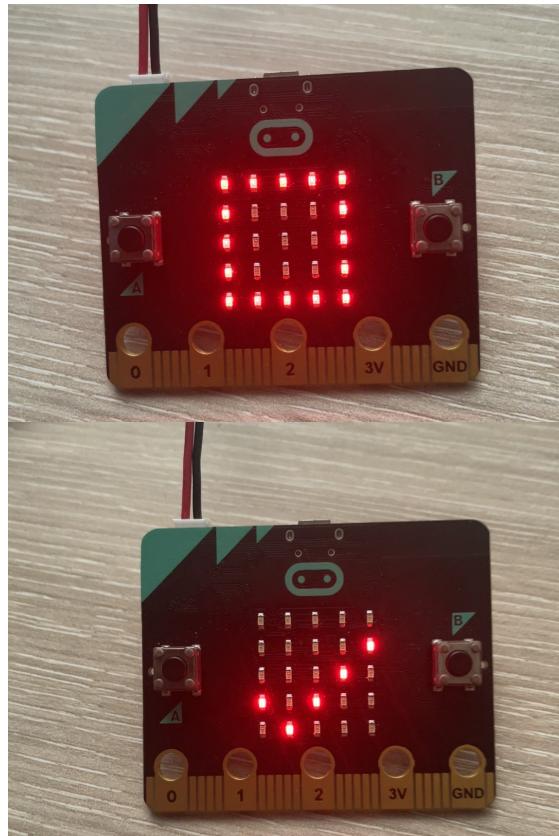
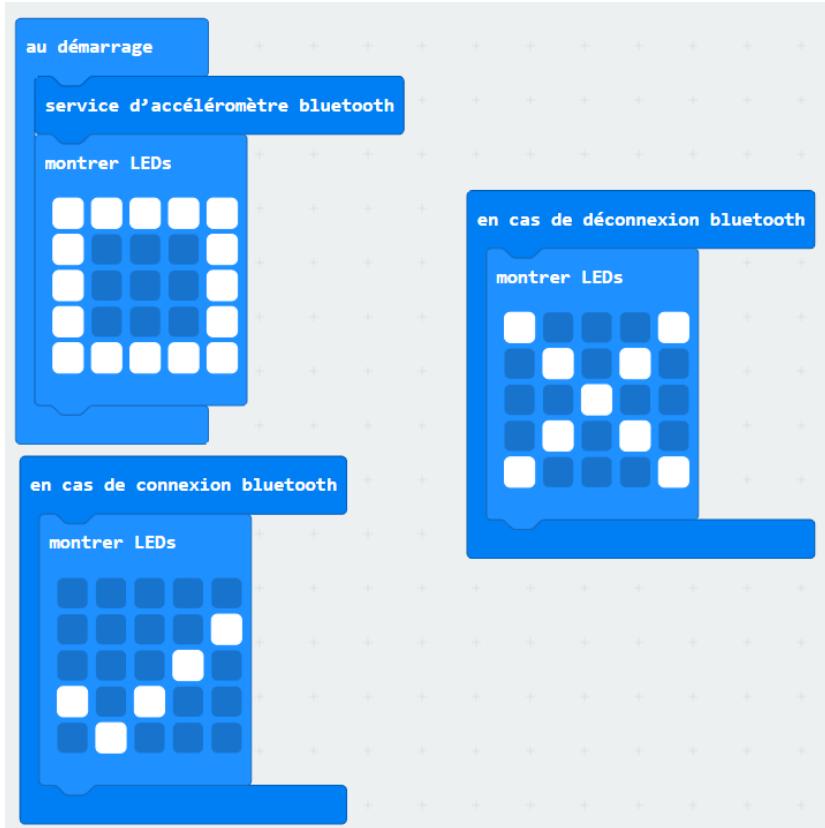
Interface de l'application



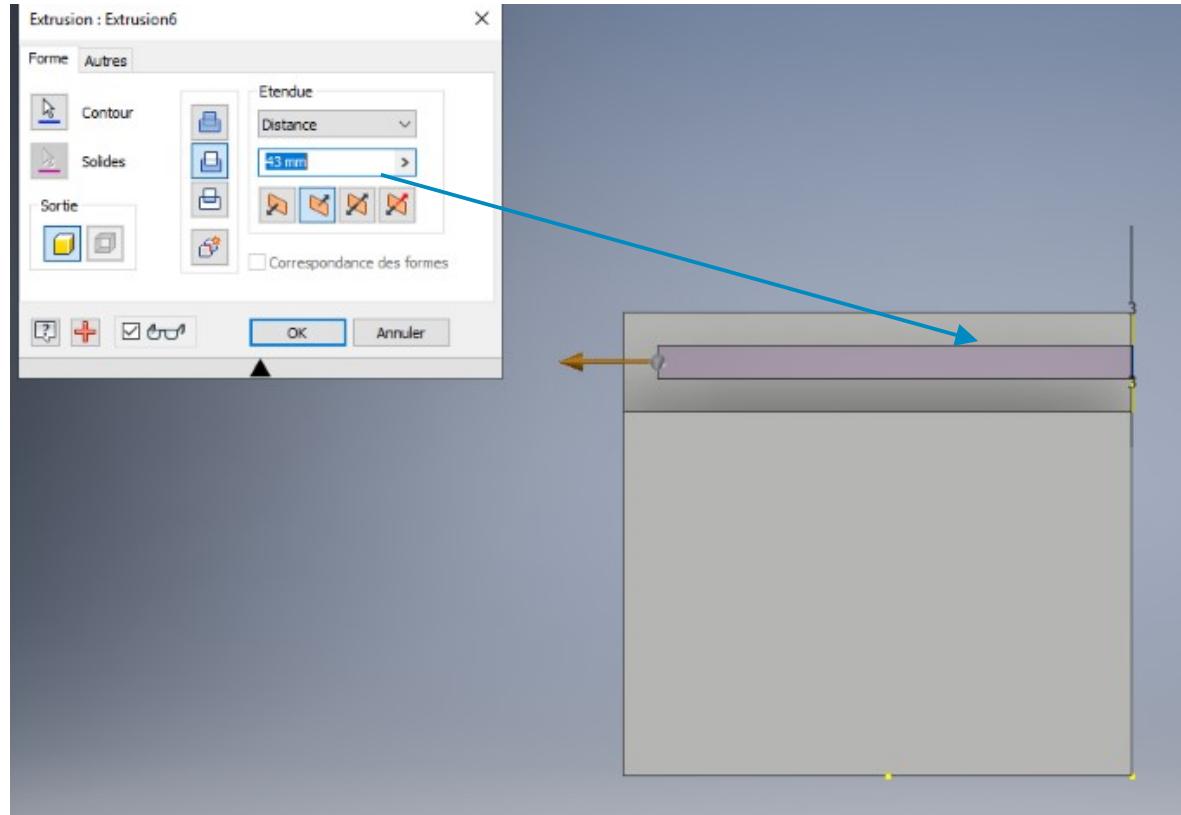
Interface de l'application



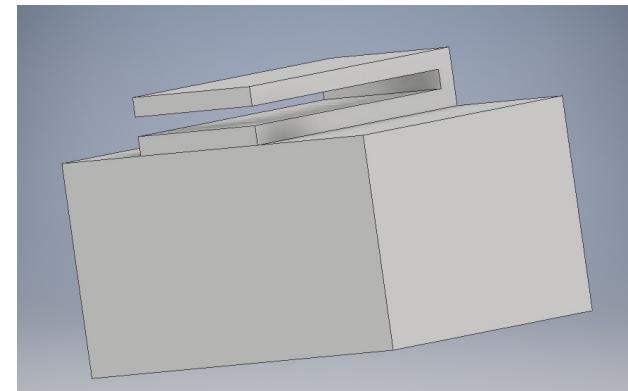
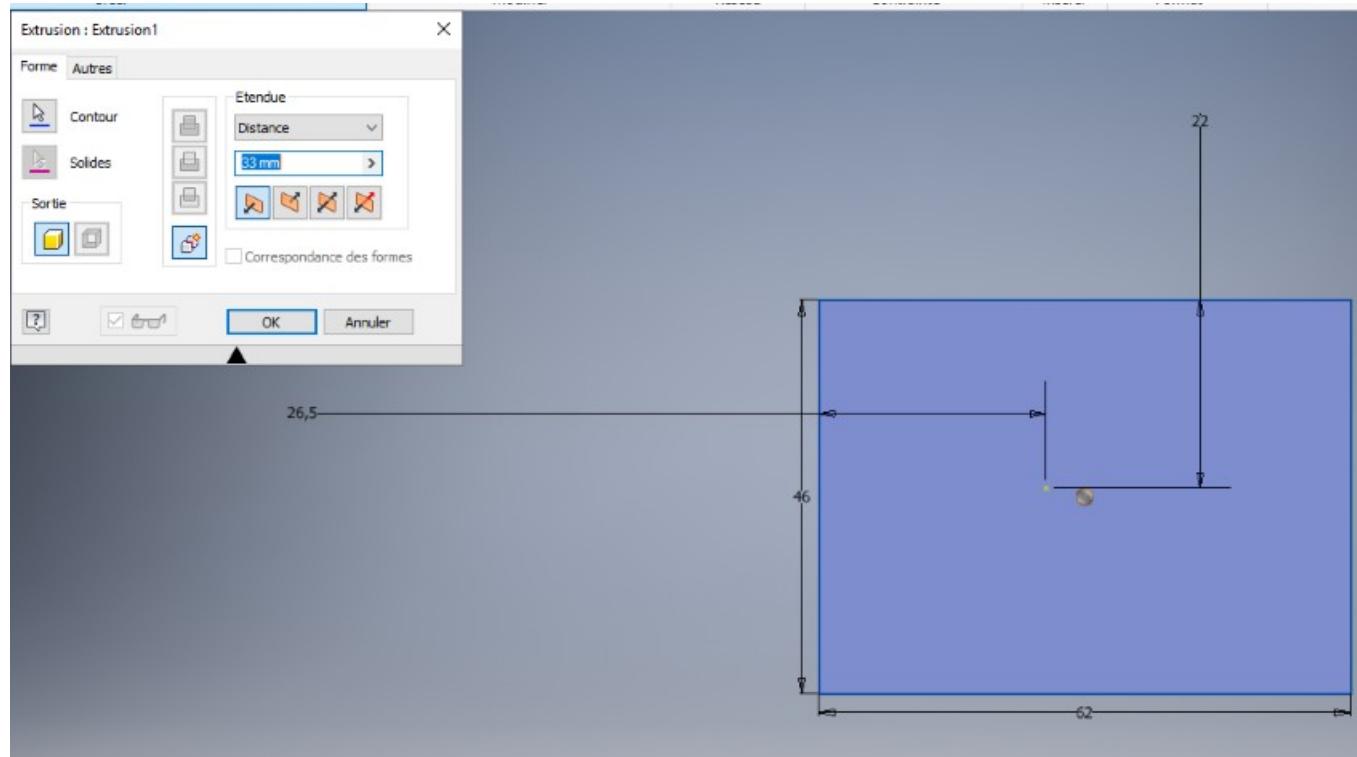
Programmation du Microbit



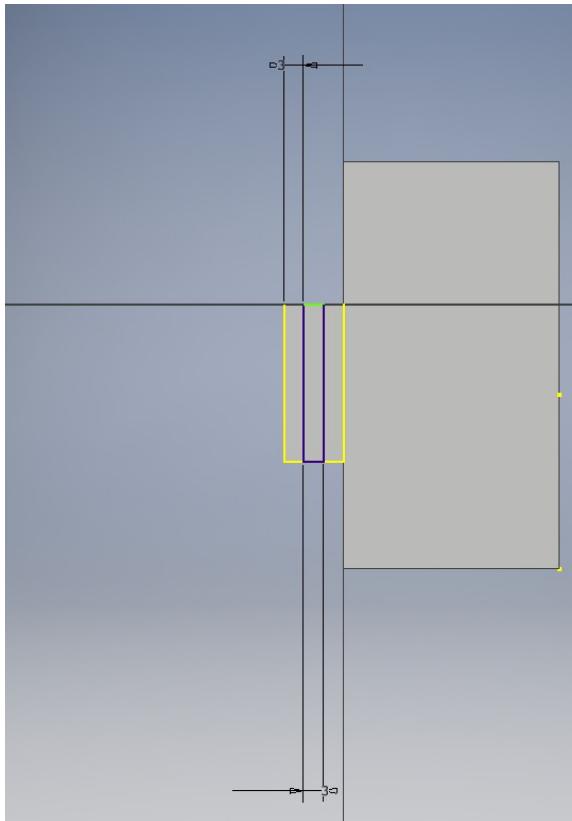
Support de la carte Microbit et batterie



Support de la carte Microbit et batterie



Support de la carte Microbit et batterie



Coût de fabrication du support

Coût de la matière première: $(100+20)*0.032=3.84$ euros

- 100 représente le coût d'utilisation de la machine après son amortissement après 5 ans par kg :
- 20 représente le coût du PLA(Acide Polylactique) par kg
- 0.032 représente le poids de la pièce

Coût de consommation: $0.5*0.15*4.5=0.34$ euros

- 0.5 représente la consommation d'électricité en kWh
- 4.5 représente le temps de fabrication en heure
- 0.15 représente le prix de consommation en France par kWh