

**FIRE
DETECTION**



Forest Fire Fighter F³

2nd sprint review

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01

PLANNED AND REALIZED STORIES

Caption:

Peanuts

Simple

Medium

Hard

Very Hard



Direction and
movement

Movement
between 2
GPS locations

Manage
direction of
front wheels

→ Ruiqi and Amélie



Computer vision

Fire detection
with machine
learning

→ Corentin and Axel



Website and
communication

Extract Gps
data

→ Youssef and Liao

01

PLANNED AND REALIZED STORIES

Caption:

TODO

IN
PROGRESS

TESTING

DONE

Peanuts

Simple

Medium

Hard

Very Hard

Movement
between 2
GPS locations





Fire detection
with machine
learning

Manage
direction of
front wheels

Extract Gps
data

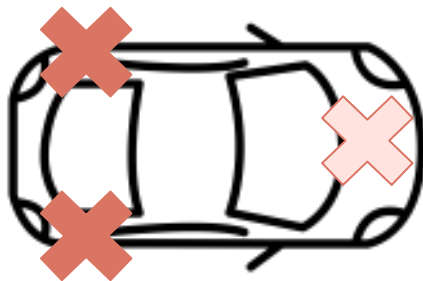
02 DIRECTION AND MOVEMENT

Stories

-  **User Story 1:** Management of the direction of front wheels
-  **Test:** Make a turn of 90 degrees on each sides
-  **User Story 2:** Management of the movement of the car between two GPS location in straight lines
-  **Test:** Going straight between two given GPS location and stop at it (50 cm accuracy)

02 DIRECTION AND MOVEMENT

Two motors at the back
-> Give power



One servomotor at the front
-> Give direction

Command between 25 and 75

- If command < 50, go backward
- If command > 50, go forward

Command between 10 and 90

- If command < 50, turn left
- If command > 50, turn right

02

DIRECTION AND MOVEMENT

Tests

1st test : Turn left



Front command in $[10, 40]$

2nd test : Turn right



Front command in $[60, 90]$

02

DIRECTION AND MOVEMENT

Movement between two GPS location :
How does it work ?



Without the GPS connected

- **input** = two GPS location coordinates (latitude and longitude)
- **calculation of the distance** in meters between the two locations
- **management of the speed** of the car so that it joins the right position with 50 cm accuracy



With the GPS connected

→ not tested because of problems with the communication

02

DIRECTION AND MOVEMENT

Test description

First step

- Give the GPS coordinates of the position of the car
- Give the GPS coordinates of the location to join
- Calculations



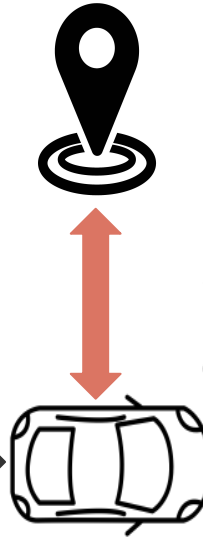
Second step

- Movement in straight line



Third step

- Verification of the position with the GPS



Acceptation threshold → the car stop at less than 50 cm of the location given

02 COMPUTER VISION

Stories



User Story 1: The user should be able to check the presence of a fire

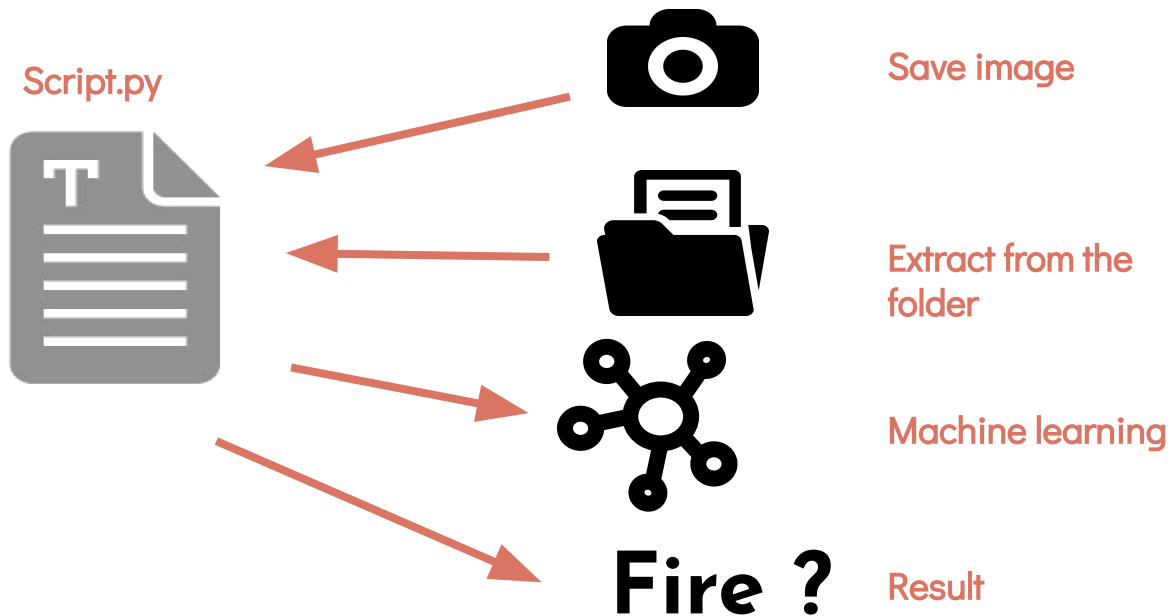


Test: Capture image from the camera, save it and check for a fire outbreak. Repeat 10 times.
Done when the program is right for 9 out of 10 images

02

COMPUTER VISION

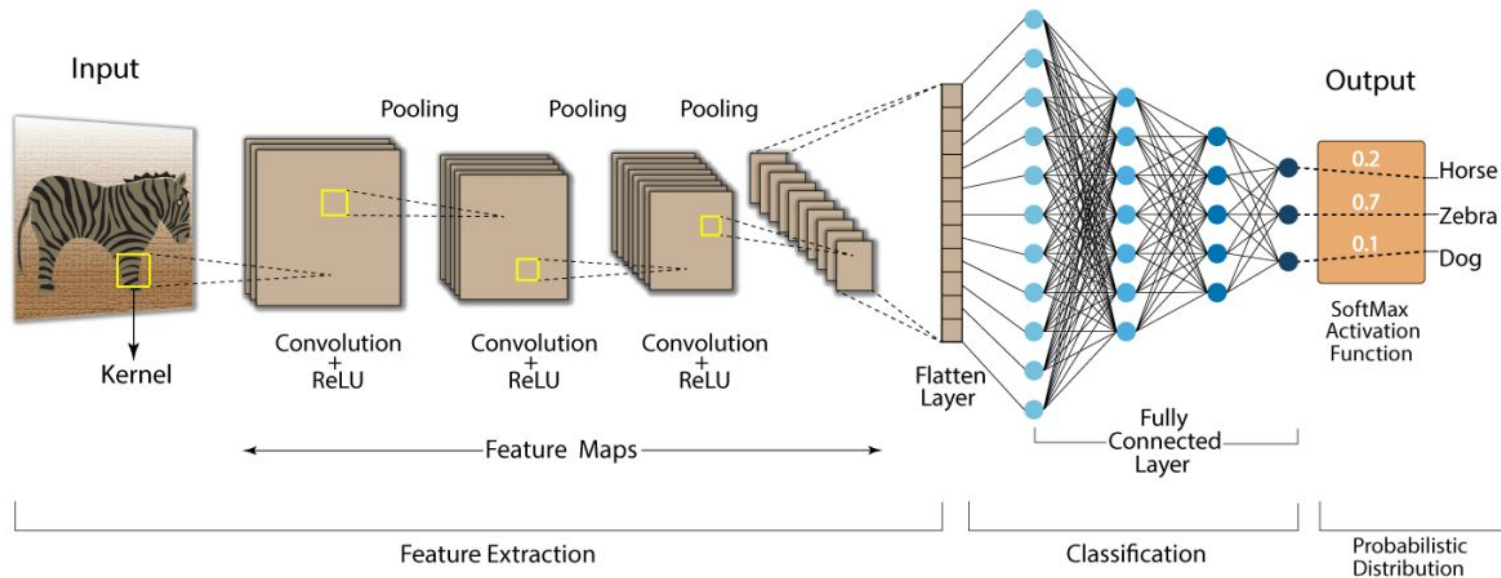
Camera test



02

COMPUTER VISION

Convolution Neural Network (CNN)



02

COMPUTER VISION

```
36 frame = cv2.resize(frame, None, fx=0.5, fy=0.5, interpolation=cv2.INTER_AREA)
37 cv2.imshow('Input', frame)
38
39 c = cv2.waitKey(1)
40 if c == 27:
41     break
42
43 _, frame = cap.read()
44 frame = cv2.resize(frame, dim, interpolation=cv2.INTER_AREA)
45 cv2.imwrite(file_name, frame)
46
47 transform = transforms.Compose( # composing several transforms together
48     [transforms.ToTensor(), # to tensor object
49     transforms.Normalize((0.5, 0.5, 0.5), (0.5, 0.5, 0.5))] # mean = 0.5, std = 0.5
50 )
```

PROBLEMS OUTPUT **TERMINAL** DEBUG CONSOLE

Segmentation fault (core dumped)

corentin@corentin-GE70-2PE:~/Desktop/TSFlow\$ bin/python3 /home/corentin/Desktop/TSFlow/Test_jetson.py

bash: bin/python3: No such file or directory

corentin@corentin-GE70-2PE:~/Desktop/TSFlow\$ /bin/python3 /home/corentin/Desktop/TSFlow/Test_jetson.py

Frame 0.jpg

^[[^[[^[[CTraceback (most recent call last):

File "/home/corentin/Desktop/TSFlow/Test_jetson.py", line 60, in <module>

Get_data()

File "/home/corentin/Desktop/TSFlow/Test_jetson.py", line 35, in Get_data

ret, frame = cap.read()

KeyboardInterrupt

corentin@corentin-GE70-2PE:~/Desktop/TSFlow\$ /bin/python3 /home/corentin/Desktop/TSFlow/Test_jetson.py

Frame 0.jpg

['ImageSet/Fire', 'ImageSet/No_Fire']

No_Fire

corentin@corentin-GE70-2PE:~/Desktop/TSFlow\$ /bin/python3 /home/corentin/Desktop/TSFlow/Test_jetson.py

Frame 0.jpg

['ImageSet/Fire', 'ImageSet/No_Fire']

Fire

corentin@corentin-GE70-2PE:~/Desktop/TSFlow\$ /bin/python3 /home/corentin/Desktop/TSFlow/Test_jetson.py

02

COMPUTER VISION

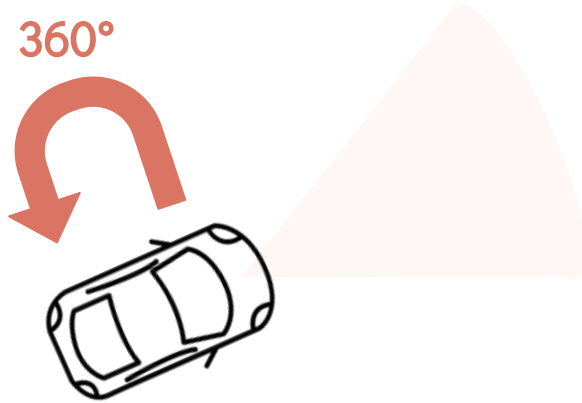
Test Results :

Variable	Expected value	Result
Global Accuracy	90%	92%
Rate of false Negatives	5%	4.2%
Rate of false Positives	0%	3.8%

02

COMPUTER VISION

Next improvements



OBJECTIVES

- 360° checking
- 1 image processed per seconde
- Send an image to the website when a fire is detected
- ~0% of false positives
- -5% of false negative

02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Stories



User Story 1: Exportation and acquisition of vehicle location information



Test: Observation of the data received through the GNSS module and processed data (vehicle coordinates) in real-time in the Raspberry Pi.

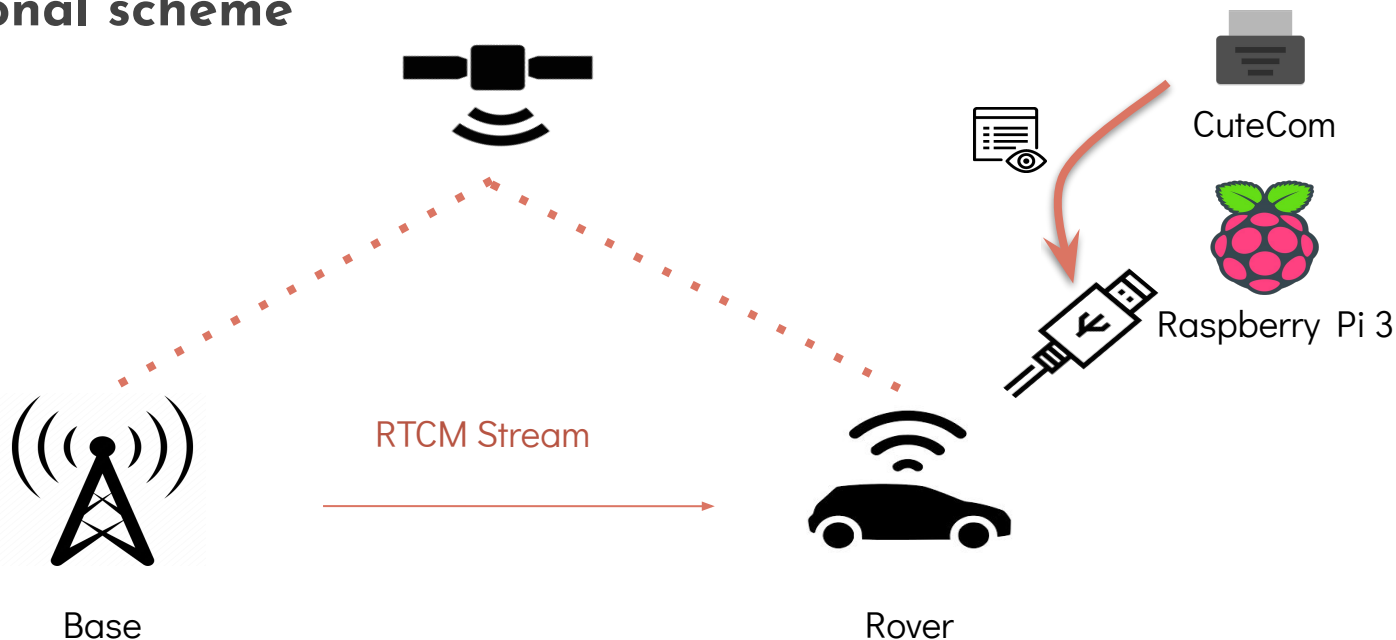
Done, when the precise coordinates (within 5 m) are achieved and comparison between displayed coordinates and actual location pretty match.

02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Operational scheme



02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Positioning Data (U-Centre)

NMEA - PUBX - 00 (Position Data) 2857

Parameter	Value	Unit	Description
UTC	161538.00	hhmmss.sss	Universal time coordinated
Lat	4334.24554	ddmm.mmmm	Latitude
Northing Indicator	N		N=North, S=South
Lon	00127.98015	dddmm.mmmm	Longitude
Easting Indicator	E		E=East, W=West
Alt (HAE)	254.851	m	Altitude (above ellipsoid)
Status	D3		NF=No Fix, ...
Horizontal Accuracy	6.6	m	Horizontal accuracy
Vertical Accuracy	11	m	Vertical accuracy
SOG	0.234	km/h	Speed Over Ground
COG (true)	25.91	deg	Course Over Ground (true)
VD	-0.188	m/s	Velocity Down
Age of DGPS Corr	0.0	s	Age of Differential Corrections
HDOP	0.82		Horizontal Dillution of Precision
VDOP	1.38		Vertical Dillution of Precision
TDOP	0.92		Time Dillution of Precision
SVs Used	8		Number of SVs used for Navigation
DR Status	0		Dead Reckon Status Flags

Longitude	1.46633583 ?
Latitude	43.57075900 ?
Altitude	254.851 m
Altitude (msl)	
TTFF	
Fix Mode	3D/DGNSS
3D Acc. [m]	
2D Acc. [m]	6.60 10
PDOP	
HDOP	0.8 2
Satellites	

02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Data observed (CuteCom)

- Position data (00)
- Satellite data (03)
- Time/date data (04)

```
[18:02:15.239] $PUBX,00,170848.00,4334.24344,N,00127.97827,E,204.374,D3,4.9,6.5,0.115,0.00,0.032,0.0,0.72,1.28,0.75,11.0,0*70
[18:02:15.278] $PUBX,03,18,10,U,290,23,31.064,12,U,228,54,39.064,13,U,144,22,30.064,15,U,171,43,33.064,19,U,073,36,38.052,23,U,
253,23,23.000,24,U,353,78,36.064,25,U,233,20,28.064,32,e,318,07,27.009,69,-,182,18,28.005,70,-,247,57,000,71,e,320,33,24.009,73,e,
268,29,17.000,79,U,053,29,32.064,80,U,330,65,31.064,81,U,066,24,27.009,82,e,116,14,34.064,88,-,017,08,24,000*61
[18:02:15.278] $PUBX,04,170848.00,201121.580128,00,2184,18.988329,20.082,21*20
[18:02:15.254] $PUBX,00,170849.00,4334.24348,N,00127.97824,E,204.243,D3,4.9,6.5,0.124,0.00,0.023,0.0,0.72,1.28,0.75,11.0,0*74
[18:02:15.293] $PUBX,03,18,10,U,290,23,30.064,12,U,228,54,39.064,13,U,144,22,30.064,15,U,171,43,33.064,19,U,073,36,38.053,23,U,
253,23,22.000,24,U,353,78,36.064,25,U,233,20,28.064,32,e,318,07,27.010,69,-,182,18,28.006,70,-,247,57,000,71,e,320,33,24.000,73,e,
268,29,17.000,79,U,053,29,32.064,80,U,330,65,31.064,81,U,066,24,27.010,82,e,116,14,34.064,88,-,017,08,23,000*6F
[18:02:15.293] $PUBX,04,170849.00,201121.580129,00,2184,18.988348,20.079,21*23
[18:02:15.234] $PUBX,00,170850.00,4334.24355,N,00127.97825,E,204.039,D3,4.8,6.5,0.113,0.00,0.019,0.0,0.72,1.28,0.75,12.0,0*71
[18:02:15.273] $PUBX,03,18,10,U,290,23,30.064,12,U,228,54,39.064,13,U,144,22,30.064,15,U,171,43,33.064,19,U,073,36,38.054,23,U,
253,23,22.000,24,U,353,78,36.064,25,U,233,20,28.064,32,e,318,07,27.011,69,-,182,18,28.007,70,-,247,57,000,71,e,320,33,24.000,73,e,
268,29,17.000,79,U,053,29,32.064,80,U,330,65,31.064,81,U,066,24,27.011,82,U,116,14,34.064,88,-,017,08,22,000*58
[18:02:15.273] $PUBX,04,170850.00,201121.580130,00,2184,18.988371,20.079,21*29
[18:02:15.275] $PUBX,00,170851.00,4334.24353,N,00127.97814,E,204.111,D3,4.9,6.5,0.116,0.00,0.060,0.0,0.72,1.28,0.75,11.0,0*58
[18:02:15.313] $PUBX,03,18,10,U,290,23,30.064,12,U,228,54,39.064,13,U,144,22,30.064,15,U,171,43,33.064,19,U,073,36,38.055,23,U,
253,23,23.000,24,U,353,78,36.064,25,U,233,20,28.064,32,e,318,07,27.012,69,-,182,18,28.008,70,-,247,57,000,71,e,320,33,24.000,73,e,
268,29,17.000,79,U,053,29,32.064,80,U,331,65,31.064,81,U,066,24,26.012,82,U,116,14,34.064,88,-,017,08,22,000*66
[18:02:15.313] $PUBX,04,170851.00,201121.580131,00,2184,18.988384,19.985,21*23
```

Device: u-blox AG - www.u-blox.com u-blox GNSS receiver @ttyACM0 Connection: 9600 @ 8-N-1

02

WEBSITE AND COMMUNICATION

Data flow

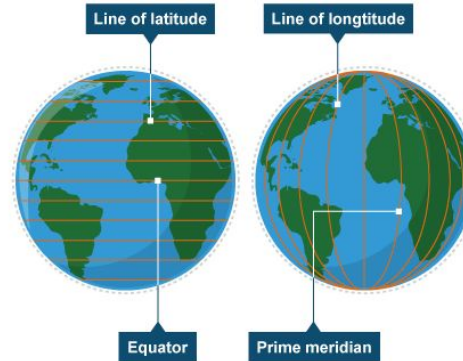
Gps module/Data processing

[20:03:08:230] \$PUBX,00,190327.00,4334.25783,N,00127.97922,E,213.608,D3,11,13,0.341,235.28,-0.166,0.0,0.98,1.57,1.04,10,0,0*55

Time UTC
hhmmss.ss

Latitude
ddmm.mm

Longitude
dddmm.mm



Caption:
h: Hour
m: Minute
s: Second
d: Degree

02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Data processed

- Parser in real time
- Sorted data
- [time, latitude, longitude]



Python (Thonny)



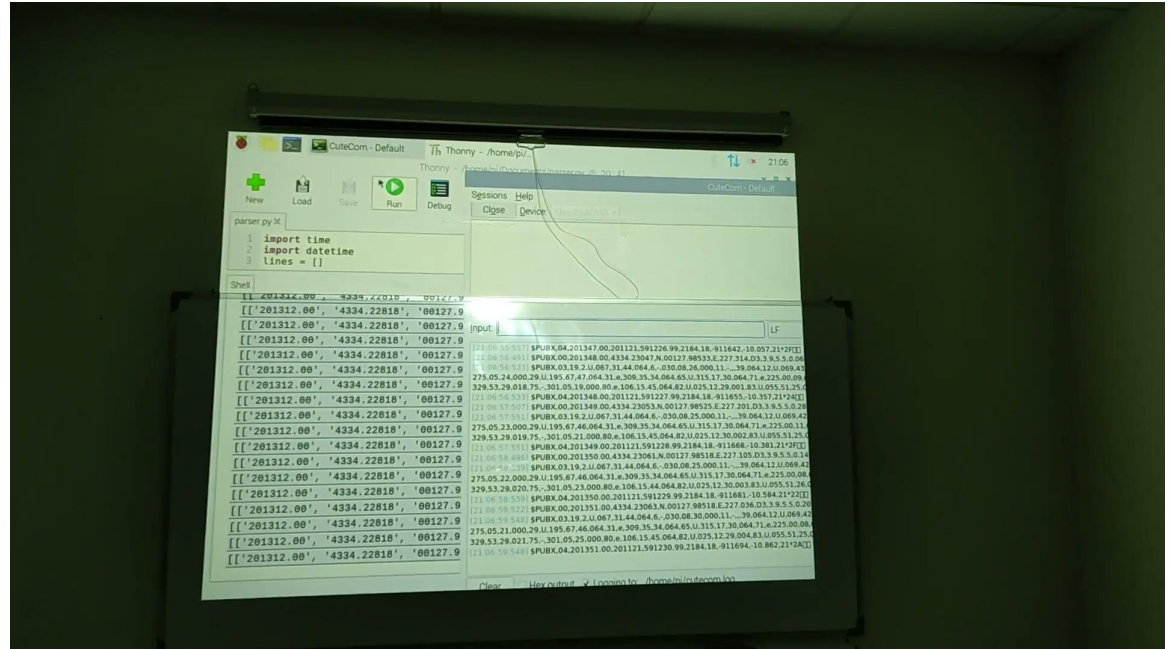
02

WEBSITE AND COMMUNICATION

Gps module/Data processing

Data processed

- CuteCom on the right
- CuteCom writes slowly -> Empty lists at beginning
- Python parser (Real time)
 - Sleeping for 1 s
- Keeping useful data



02

WEBSITE AND COMMUNICATION

Gps module/Data processing

The screenshot displays a terminal window with two panes. The left pane shows raw NMEA sentences from a GPS module, including sentences like \$PUBX,00,201350.00,4334.23061,N,00127.98518,E,227.105,D,3.9,5.5,0.140,44.98,0.113,0.0,0.86,1.20,0.81,9.0,0*74. The right pane shows the same data wrapped for readability, with a message: "Squeezed text (1848 characters). For performance reasons, Shell avoids showing very long lines in full (see Tools => Options => Shell). Here you can interact with the original text fragment." The wrapped text shows the same NMEA sentences with line wrapping. At the bottom, there are buttons for "Copy to clipboard", "Expand in Shell", and "Close".

```
Input: LF Char delay: 0 ms Send file Plain

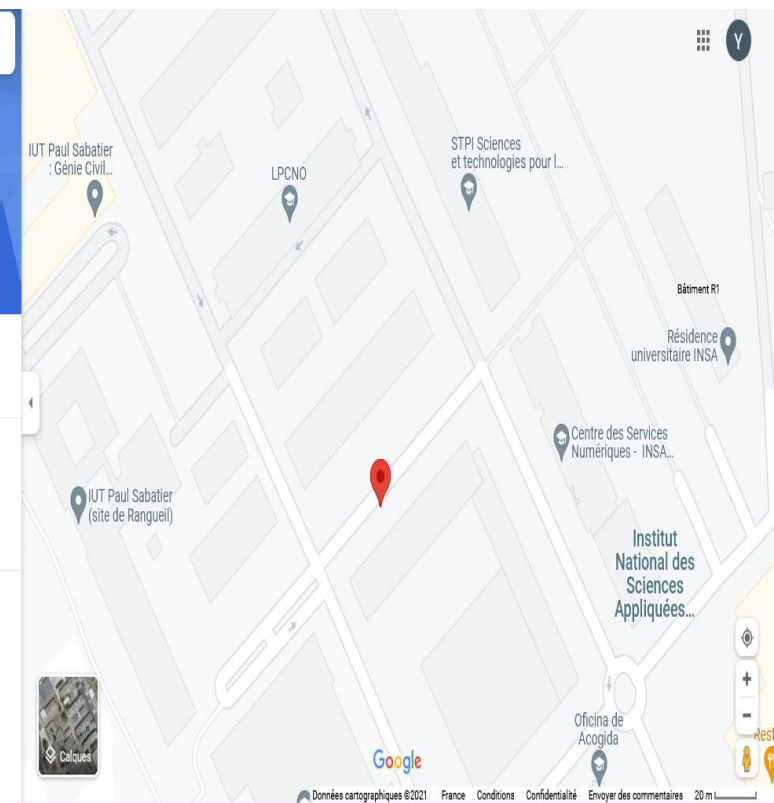
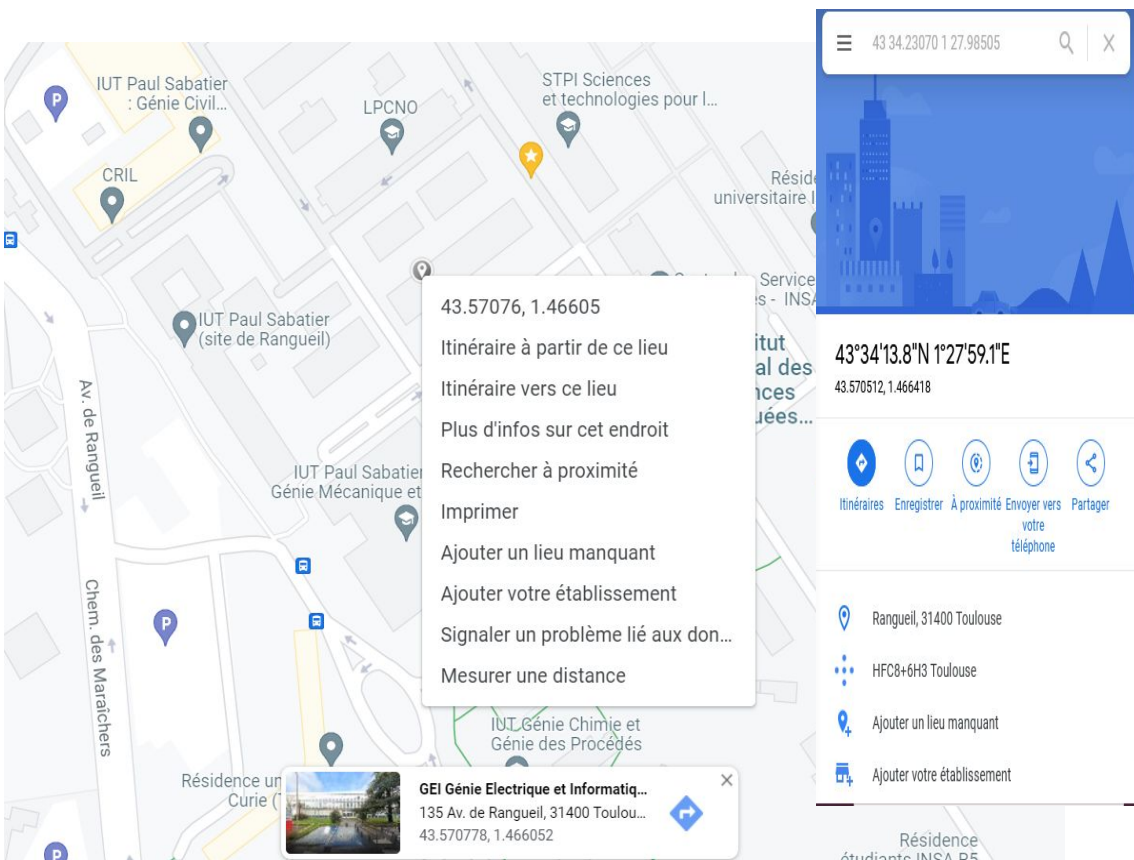
[21:06:58.496] $PUBX,00,201350.00,4334.23061,N,00127.98518,E,227.105,D,3.9,5.5,0.140,44.98,0.113,0.0,0.86,1.20,0.81,9.0,0*74
[21:06:58.539] $PUBX,03,19.2,U,0.67,31.44,064.6,-.030,08.25,000,11,-,39,064,12,U,0.69,42.45,064,24,e,141,16,37,064,25,e,028,73,14,000,26,e,
275,05,22,000,29,U,195,67,46,064,31,e,309,35,34,064,65,U,315,17,30,064,71,e,225,00,08,000,72,e,268,17,26,000,73,U,074,59,47,064,74,e,
329,53,29,020,75,-,301,05,23,000,80,e,106,15,44,064,82,U,025,12,30,003,0,055,51,26,004,84,U,161,44,41,064*0E
[21:06:58.539] $PUBX,04,201350.00,201121,591229.99,2184,18,-911681,-10.584,21*22
[21:06:59.522] $PUBX,00,201351.00,4334.23063,N,00127.98518,E,227.036,D,3.9,5.5,0.209,44.98,-0.027,0.0,0.92,1.20,0.84,10,0,0*68
[21:06:59.548] $PUBX,03,19.2,U,0.67,31.44,064.6,-.030,08,30,000,11,-,39,064,12,U,0.69,42.45,064,24,e,141,16,37,064,25,e,028,73,10,000,26,e,
275,05,21,000,29,U,195,67,46,064,31,e,309,35,34,064,65,U,315,17,30,064,71,e,225,00,08,000,72,e,268,17,26,000,73,U,074,59,47,064,74,e,
329,53,29,021,75,-,301,05,25,000,80,e,106,15,45,064,82,U,025,12,29,004,83,U,055,51,25,005,84,U,161,44,42,064*04
[21:06:59.548] $PUBX,04,201351.00,201121,591230.99,2184,18,-911694,-10.862,21*2A
[21:07:00.499] $PUBX,00,201352.00,4334.23065,N,00127.98509,E,226.629,D,3.9,5.4,0.307,44.98,0.084,0.0,0.75,1.12,0.69,10,0,0*46
[21:07:00.524] $PUBX,03,19.2,U,0.67,31.44,064.6,-.030,08,29,000,11,-,39,064,12,U,0.69,42.45,064,24,e,141,16,37,064,25,e,028,73,08,000,26,e,
275,05,21,000,29,U,195,67,46,064,31,e,309,35,34,064,65,U,315,17,30,064,71,e,225,00,10,000,72,U,268,17,28,001,73,U,074,59,48,064,74,U,
329,53,28,022,75,-,301,05,26,000,80,e,106,15,46,064,82,U,025,12,30,005,83,U,055,51,26,006,84,U,161,44,43,064*06
[21:07:00.524] $PUBX,04,201352.00,201121,591231.99,2184,18,-911710,-11.026,21*2C
[21:07:01.504] $PUBX,00,201353.00,4334.23070,N,00127.98505,E,226.503,D,3.9,5.4,0.531,148.88,0.182,0.0,0.75,1.12,0.69,10,0,0*7C
[21:07:01.529] $PUBX,03,19.2,U,0.67,31.44,064.6,-.030,08,23,000,11,-,39,064,12,U,0.69,42.45,064,24,e,141,16,37,064,25,e,028,73,08,000,26,e,
275,05,20,000,29,U,195,67,46,064,31,e,309,35,34,064,65,U,315,17,30,064,71,e,225,00,11,000,72,U,268,17,28,000,73,U,074,59,47,064,74,U,
329,53,28,023,75,-,301,05,26,001,80,e,106,15,44,064,82,U,025,12,30,006,83,U,055,51,25,000,84,U,161,44,41,064*04
[21:07:01.529] $PUBX,04,201353.00,201121,591232.99,2184,18,-911723,-10.664,21*2F

Clear Hex output Logging to: /home/pi/cuteacom.log

Device: u-blox AG - www.u-blox.com u-blox GNSS receiver @ttyACM0 Connection: 9600 @ 8-N-1
```

Actual coordinates

GPS coordinates



02

WEBSITE AND COMMUNICATION

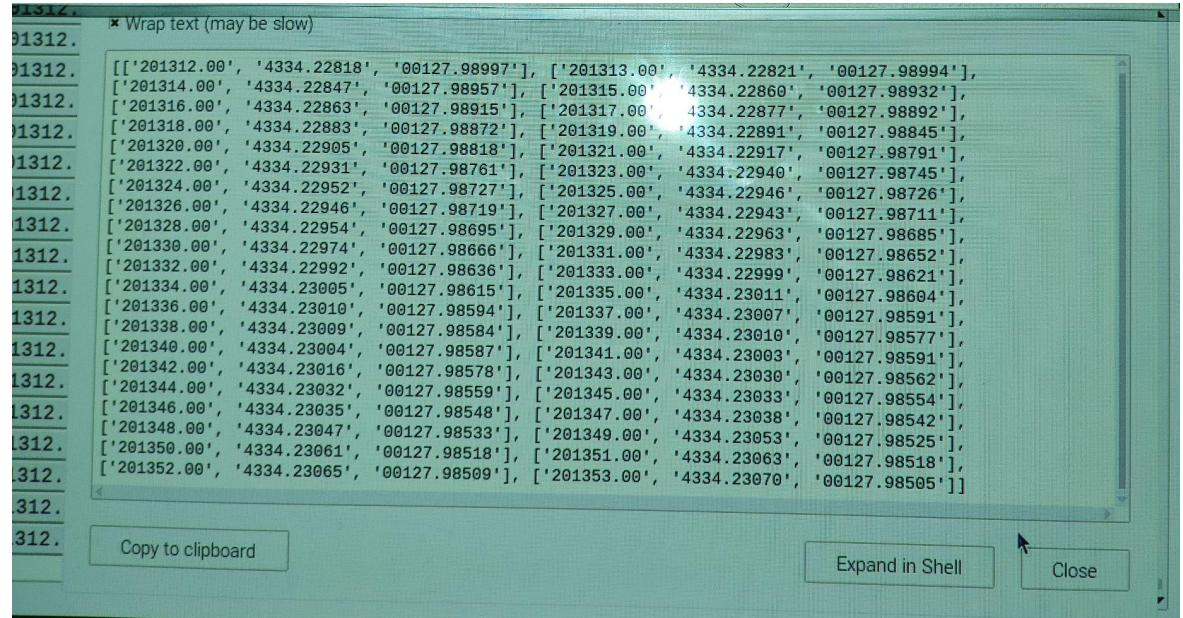
Gps module/Data processing

Data processed

- 41 seconds -> 41 lists of data
- Real coordinates of GEI at INSA Toulouse: -> **latitude = 43°57076"**
-> **longitude = 1°46605"**

Average % of error for latitude = **0.524 %**

Average % of error for longitude = **12.7 %**



```
[[ '201312.00', '4334.22818', '00127.98997', ['201313.00', '4334.22821', '00127.98994'],  
[ '201314.00', '4334.22847', '00127.98957', ['201315.00', '4334.22860', '00127.98932'],  
[ '201316.00', '4334.22863', '00127.98915', ['201317.00', '4334.22877', '00127.98892'],  
[ '201318.00', '4334.22883', '00127.98872', ['201319.00', '4334.22891', '00127.98845'],  
[ '201320.00', '4334.22905', '00127.98818', ['201321.00', '4334.22917', '00127.98791'],  
[ '201322.00', '4334.22931', '00127.98761', ['201323.00', '4334.22940', '00127.98745'],  
[ '201324.00', '4334.22952', '00127.98727', ['201325.00', '4334.22946', '00127.98726'],  
[ '201326.00', '4334.22946', '00127.98719', ['201327.00', '4334.22943', '00127.98711'],  
[ '201328.00', '4334.22954', '00127.98695', ['201329.00', '4334.22963', '00127.98685'],  
[ '201330.00', '4334.22974', '00127.98666', ['201331.00', '4334.22983', '00127.98652'],  
[ '201332.00', '4334.22992', '00127.98636', ['201333.00', '4334.22999', '00127.98621'],  
[ '201334.00', '4334.23005', '00127.98615', ['201335.00', '4334.23011', '00127.98604'],  
[ '201336.00', '4334.23010', '00127.98594', ['201337.00', '4334.23007', '00127.98591'],  
[ '201338.00', '4334.23009', '00127.98584', ['201339.00', '4334.23010', '00127.98577'],  
[ '201340.00', '4334.23004', '00127.98587', ['201341.00', '4334.23003', '00127.98591'],  
[ '201342.00', '4334.23016', '00127.98578', ['201343.00', '4334.23030', '00127.98562'],  
[ '201344.00', '4334.23032', '00127.98559', ['201345.00', '4334.23033', '00127.98554'],  
[ '201346.00', '4334.23035', '00127.98548', ['201347.00', '4334.23038', '00127.98542'],  
[ '201348.00', '4334.23047', '00127.98533', ['201349.00', '4334.23053', '00127.98525'],  
[ '201350.00', '4334.23061', '00127.98518', ['201351.00', '4334.23063', '00127.98518'],  
[ '201352.00', '4334.23065', '00127.98509', ['201353.00', '4334.23070', '00127.98505'] ] ] ]
```

03 NEXT SPRINT ?

DIRECTION AND MOVEMENT

- ▶ **User Story 1:** Direction and movement between three GPS location with real time management
- ✓ **Test:** Given three GPS location, the car is able to join each location (50 cm accuracy)

WEBSITE AND COMMUNICATION

- ▶ **User Story 2:** Coordinates and images sent and displayed on website and can be used by motors
- ✓ **Test:** Coordinates can be viewed on website in real time and can be used thanks to MQTT

COMPUTER VISION

- ▶ **User Story 3:** Fire detection process
- ✓ **Test:** ~0% rate of false positives, -5% rate of false negatives

04

CONCLUSION

*Thank you for your
attention*

Any questions ?