European Astro Pi Challenge
2016 - 2017

Phase 2 – Mission Report

In order for you and your team to have the chance to have your computer codes run on the International Space Station, you have to come up with a solution for the two missions that ESA astronaut Thomas Pesquet assigned to you. The scientific value of your mission will be of major importance. It's also very important that your mission meets all the requirements and constraints for phase 2. You can find more information here.

You must include a full description of your primary and secondary missions using this mission report template. The reports must be submitted in English.

Please note that you should not use this report to submit your codes.

Primary mission

Main objective(s): To detect crew presence in the Columbus module using the ISS Astro Pi and its sensors

Procedure

Describe the idea and methodology followed to achieve your mission objectives. Identify the sensors that you will use and the data that will be collected.
(*maximum words: 350)*

Since the camera or the joystick or any astronaut interaction with the AstroPi are not allowed for this project we decided to detect a nearby presence by monitoring a raise in the Humidity levels. The humidity level on ISS is usually maintained at around 60%. When there is astronaut activity nearby, then the Sense Hat's sensor will measure an increase due to the water that leaves astronaut's body as vapor (through the pores or breathing). In our code, first a humidity baseline is calculated as an average from 5 humidity readings that are relatively constant. This is compared with the current humidity readings and if a 4% humidity raise is measured an astronaut is said to be detected. Then a suitable yellow "HI" appears in the LED display as greeting to the astronaut. In addition the humidity levels are constantly visualized and shown in the LED display as pixel bars. When inside normal levels the bar is colored green otherwise it is colored orange and red for extreme values! Of course every now and then the humidity baseline is updated. Everything is logged in a file as well, so that we can later analyse all collected data in detail and possibly plot some graphs.

Expected results

Present your prediction of the ISS results and explain your prediction.
(*maximum words: 150)*

Since the ISS humidity is expected to be maintained aboard ISS at around 60%, our AstroPi is expected to show some pretty green colored bars for the humidity. Every now and then that an astronaut will pass near by and a small humidity raise will be picked up, then a big yellow colored "HI" text will greet the astronaut. In the ISS accurate system sensors continuously measure the humidity since the surplus water vapour in the air can cause damage to sensitive electronic equipment and of course put extra charge to astronaut's breathing and health condition. The ISS life-support system takes care of the surplus water. Our AstroPi code is programmed to run for about 40 minutes and collect the humidity readings and astronaut detections of presence to a csv file for later use. The contents of the log file will look like:

Date, Time, Humidity, Diff, Percentage
02/23/17, 02:38:07, 52.62, 0.0, 0.0
02/23/17, 02:38:08, 53.96, 1.0, 2.0
02/23/17, 02:38:09, 54.31, 2.0, 4.0
02/23/17, 02:38:10, 57.27, 5.0, 10.0
Astronaut present
02/23/17, 02:38:13, 57.27, 0.0, 0.0
02/23/17, 02:38:14, 57.27, 0.0, 0.0

Secondary mission

Main objective(s)

Identify the main objectives of your secondary mission. Can you identify scientific objectives?
(*maximum words: 50)*

It would be useful to have a Visual Alarm Detection System that will provide information and warnings to the astronauts about possibly problems with some ISS system. By monitoring temperature, humidity, pressure and gyroscope readings several critical ISS systems can be cross checked that operate as expected.

Procedure

Describe the idea and methodology followed to achieve your mission objectives. Identify the sensors that you will use and the data that will be collected.
(*maximum words: 350)*

Following our Phase-1 experiment idea we went into implementing the proposed Alarm Detection System. This is like a guarddog monitoring Temperature, Humidity, Pressure and Gyroscope values. Temperature/Humidity/Pressure are constantly visualised to the LED matrix with pixel bars that take red colours for abnormal values. All readings are logged to a timestamped file for later examination on Earth. Reading temperatures with Sense Hat is a problem due to its design issue. The measured temperatures are too high due to thermal dissipation from the chip. After searching on forums and after experimenting at the lab we ended with a solution to acquire more accurate temperature readings. This involves importing library os to compensate for the CPU's temperature. We have divided the LED matrix display to 4 sections and each section is dedicated to present the values of the particular sensor. If-statements are used to check for the values and assign the colour codes. Some normalization on the sensor values has also taken place in order to visualize better the level of the reading on the 16-LED-scale. As for the IMU the accelerometer and the magnetometer were disabled because these do not work so well in space leaving the gyroscope alone. All our code is commented, so that it is clear what we try to do.

Expected results

Present your prediction of the ISS results and explain your prediction.
(*maximum words: 150)*

ISS maintains temperature to 18.3 - 26.7 Celsius, humidity around 60% and pressure to 979 - 1027 millibars. Our code is expected to work and provide 4 to 1 at a glance status for critical values aboard the ISS. All these 4 sensors display valuable information at the same time on the LED matrix. The temperature sensor is not expected to give reliable values even with our solution where we subtract the CPUthermal temperature. Our Log file when the code finishes execution will look like:
Date, Time, Temperature, Humidity, Pressure, Gyro_x, Gyro_y, Gyro_z
02/22/17, 23:48:14, 24.3, 32.5, 1012.6, 0.0011305604130029678, 0.002779042348265648, 0.0033381059765815735
02/22/17, 23:48:17, 24.5, 32.7, 1012.6, 0.00021066144108772278, 0.0015311390161514282, 0.0029817037284374237