Problem: Quadcopter gets armed, gets GPS location but I am not able to spin motors or lift it even one meter, I have tested udacidrone, dronekit-python, mavproxy.py, ardupilot in all cases it is not able to takeoff.

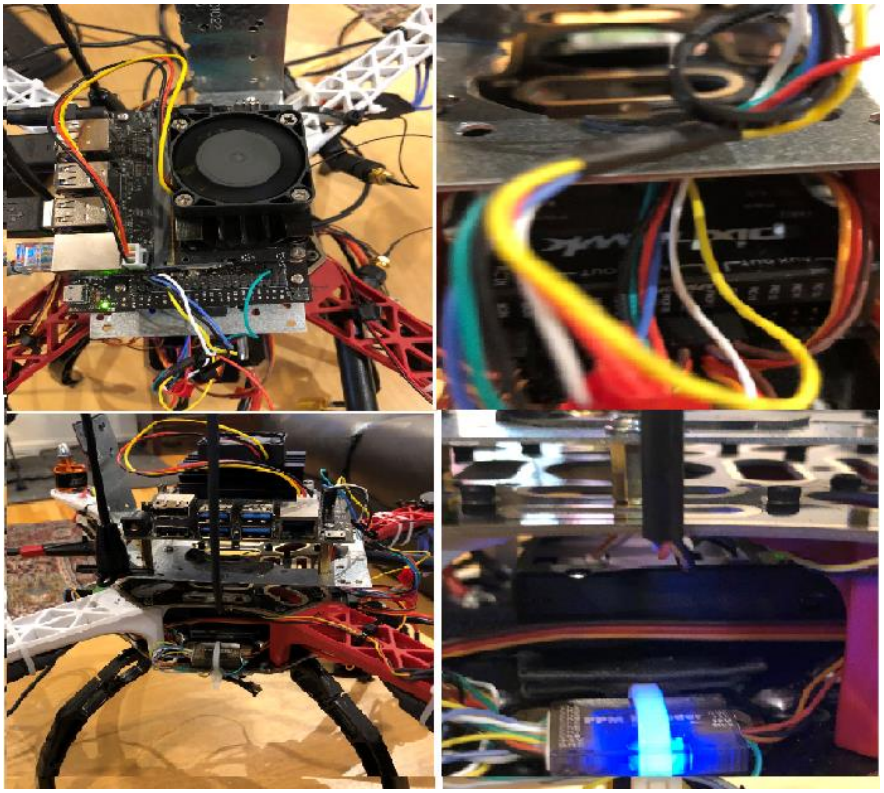
Definitely I am doing something wrong but after days of work I am still not able to figure out what should be changed and what I have to modify. I need help from experts in this area. On web I have not seen implementation of Jetson nano with quadcopter however NVIDIA's redtail github (https://github.com/NVIDIA-AI-IOT/redtail) supports jetsonTX1 and TX2. There is some initiative for jetson nano (https://github.com/mtbsteve/redtail) however its not ready to implement and test.
I have tested this F450 assembly using FS-i6 transmitter and it fly's , so there is no issue with quadcopter , it is something related to connection between jetson-nano and pixhawk .

I NEED HELP AND GUIDANCE FOR *jetson-nano and pixhawk implementation on Quadcopter (please do not point me towards available solution for TX1, TX2, XAVIER or Pi4, I am exclusively trying to implement with nano). I have used the same jetson-nano for jetbots and door camera etc. so i am sure there is no problem or issue with jetson-nano*

I think

Companion computer: Jetson-nano
Quadcopter: F450 Frame + PXI PX4 Flight Control + 920KV Motor + GPS + FS-i6 Transmitter (https://www.amazon.com/gp/product/B01HEQQDNK/ref=ppx_yo_dt_b_asin_title_o06_s00?ie=UTF8&psc=1) .

Jetson nano and F450 assembly photo's/pictures



Jetson Nano has been connected to Pixhawk using Telem2.

PIXHAWK Telem2: Below is the connection point for Telem2 and Telem1

Pinouts

TELEM1, TELEM2 ports

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (OUT)	+3.3V
3 (blk)	RX (IN)	+3.3V
4 (blk)	CTS (IN)	+3.3V
5 (blk)	RTS (OUT)	+3.3V
6 (blk)	GND	GND

Below is the connection for jetson-nano J41

Jetson-nano-j41 and Pixhawk Telem2 connection details:

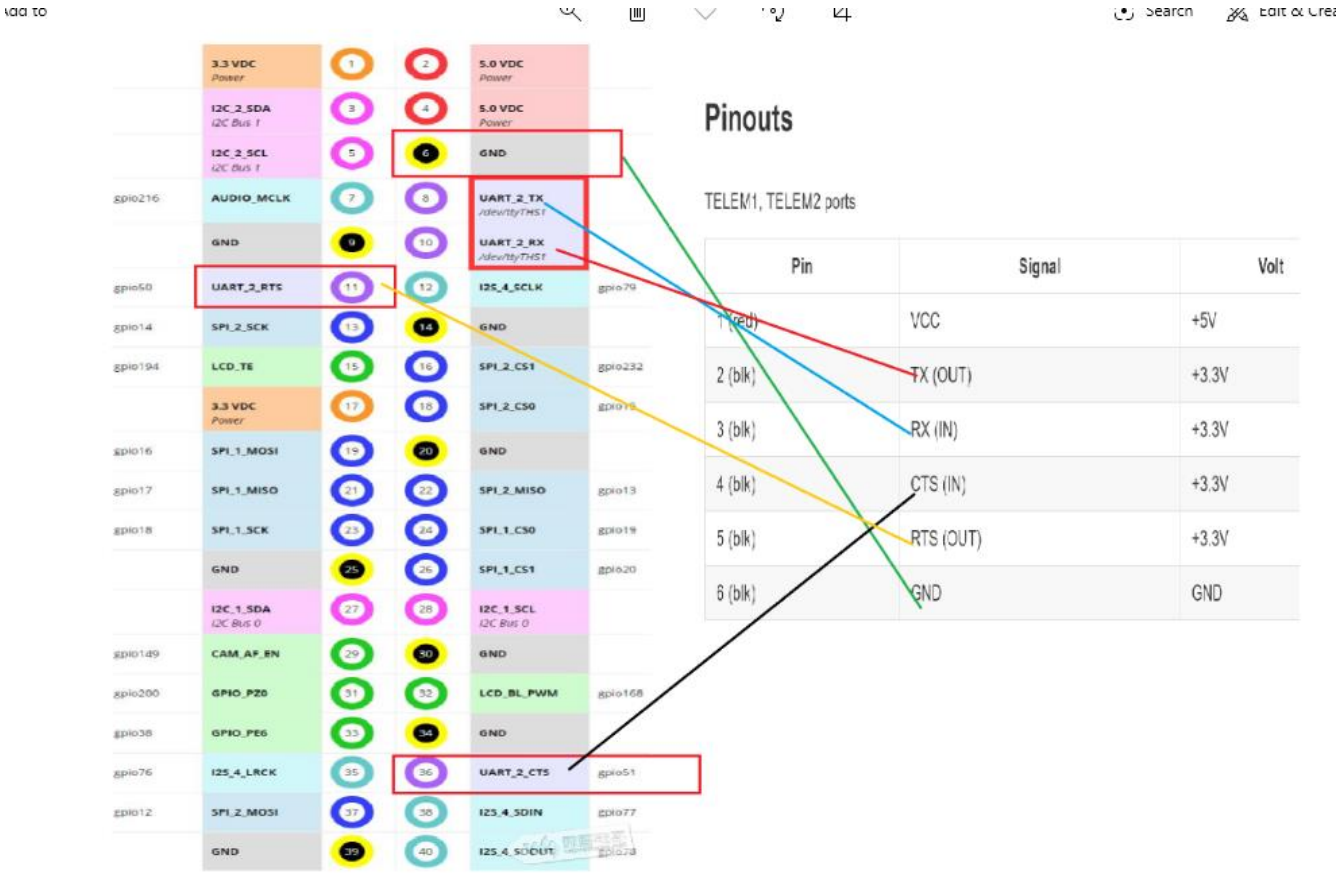
Jetson -nano j-41 power pin (#2 or 4) is not connected to Pixhawk (pin 1) .
Following are my connection details :

1. GND jetson-nano (pin #4) is connected to GND of Pixhawk (6th pin)
2. TX of jetson nano (8th pin) is connected to RX of Pixhawk(3rd pin)
3. RX of jestson nano is connected to TX of Pixhawk (2nd pin)
4. RTS Pin 11 of jetson nano is connected to RTS of Pixhawk (pin #5)
5. CTS pin 36 of jetson nano is connected to CTS of Pixhawk (4th pin)

Pixhawk gets its power sully from quadcopter battery and Jetson nano has a separate (5v 4 amps) power supply.

I have tested all the below mentioned code/program using 3 pin (connecting GND, RX and TX of both systems) and 5 pin ((connecting GND, RX ,TX ,RTS,CTS of both systems) connection with no success of takeoff.

Note:- By connecting Jetson-nano TX to Pixhawk TX and RX of Jetson to RX of Pixhawk , I was not able to communicate with drone as a result I have used TX to RX and RX to TX.



DRONEKIT-PYTHON

For connectivity testing between companion computer (jetson nano) and flight controller I have used dronekit and results have been satisfactory

check_drone_kit.py

```
from dronekit import connect
# Connect to the Vehicle
vehicle = connect('/dev/ttyTHS1', wait_ready=True, baud=57600)
# vehicle is an instance of the Vehicle class
print('Autopilot Firmware version: %s' % vehicle.version)
print('Autopilot capabilities (supports ftp): %s' % vehicle.capabilities.ftp)
print('Global Location: %s' % vehicle.location.global_frame)
print('Global Location (relative altitude): %s' % vehicle.location.global_relative_frame)
print('Local Location: %s' % vehicle.location.local_frame)    #NED
print('Attitude: %s' % vehicle.attitude)
print('Velocity: %s' % vehicle.velocity)
print('GPS: %s' % vehicle.gps_0)
print('Groundspeed: %s' % vehicle.groundspeed)
print('Airspeed: %s' % vehicle.airspeed)
print('Gimbal status: %s' % vehicle.gimbal)
print('Battery: %s' % vehicle.battery)
print('EKF OK?: %s' % vehicle.ekf_ok)
print('Last Heartbeat: %s' % vehicle.last_heartbeat)
print('Rangefinder: %s' % vehicle.rangefinder)
print('Rangefinder distance: %s' % vehicle.rangefinder.distance)
print('Rangefinder voltage: %s' % vehicle.rangefinder.voltage)
print('Heading: %s' % vehicle.heading)
print('Is Armable?: %s' % vehicle.is_armable)
print('System status: %s' % vehicle.system_status.state)
print('Mode: %s' % vehicle.mode.name)    # settable
print('Armed: %s' % vehicle.armed)    # settable
```

```
dlinano@jetson-nano:~$ sudo python3 check_drone_kit.py
[sudo] password for dlinano:
Autopilot Firmware version: APM:Copter-3.4.6
Autopilot capabilities (supports ftp): False
Global Location: LocationGlobal:lat=39.0455337,lon=-77.5109696,alt=102.69
Global Location (relative altitude): LocationGlobalRelative:lat=39.0455337,lon=-77.5109696,alt=-0.96
Local Location: LocationLocal:north=4.214805603027344,east=-6.181936740875244,down=-2.8174514770507812
Attitude: Attitude:pitch=-0.008600138127803802,yaw=2.4240646362304688,roll=0.011644798330962658
Velocity: [0.19, -0.38, 0.01]
GPS: GPSInfo:fix=3,num_sat=9
Groundspeed: 0.3061045706272125
Airspeed: 0.3061045706272125
Gimbal status: Gimbal: pitch=None, roll=None, yaw=None
Battery: Battery:voltage=0.0,current=None,level=None
EKF OK?: True
Last Heartbeat: 0.05023435199998971
Rangefinder: Rangefinder: distance=None, voltage=None
Rangefinder distance: None
Rangefinder voltage: None
Heading: 138
Is Armable?: True
System status: STANDBY
Mode: POSHOLD
```

Armed: False
dlinano@jetson-nano:~$

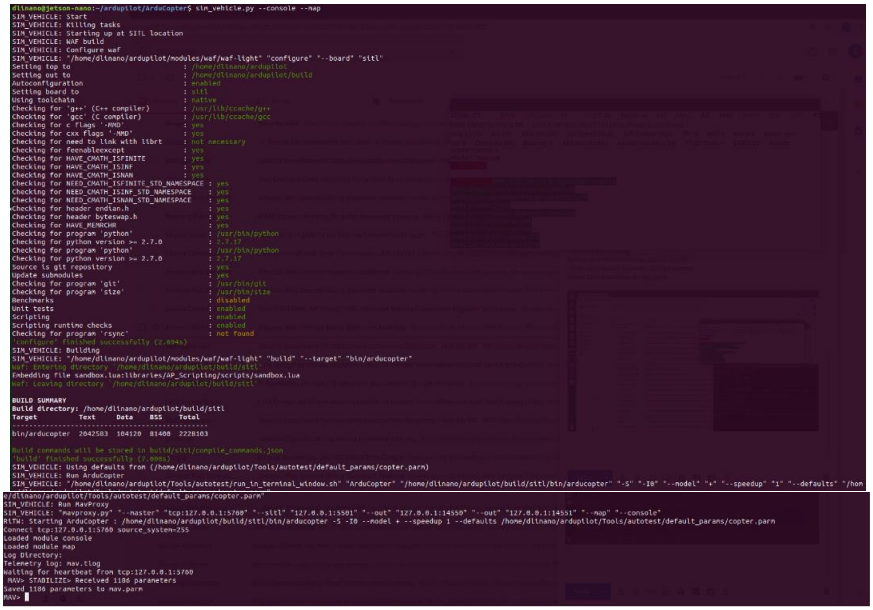
mavproxy.py to arm quadcopter and this test also has been successful

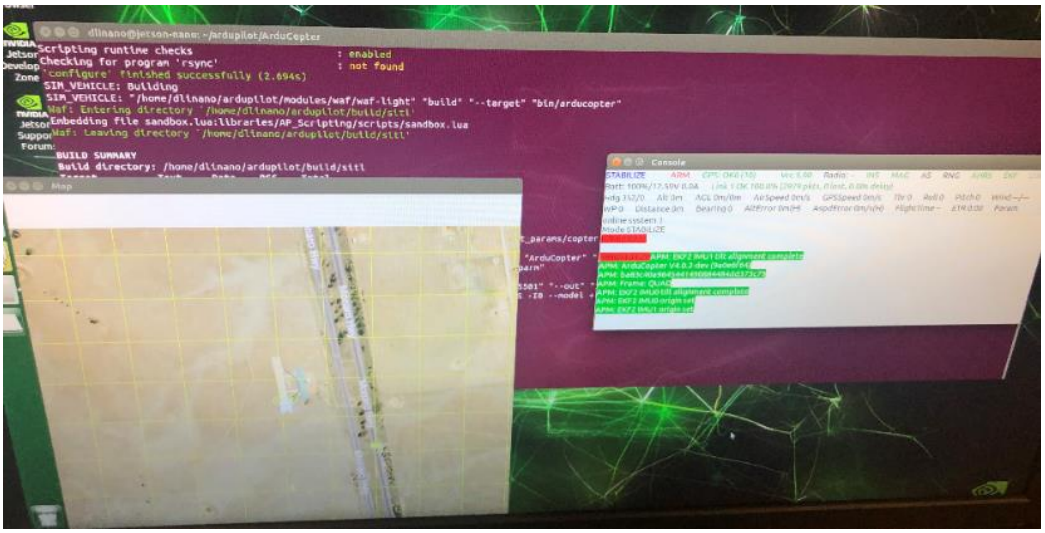
dlinano@jetson-nano:~$ sudo mavproxy.py --master=/dev/ttyTHS1 --baudrate 57600 --aircraft Copter-3.3
Connect /dev/ttyTHS1 source_system=255
no script Copter-3.3/mavinit.scr
Log Directory: Copter-3.3/logs/2020-02-01/flight10
Telemetry log: Copter-3.3/logs/2020-02-01/flight10/flight.tlog
Waiting for heartbeat from /dev/ttyTHS1
MAV> GPS lock at -4 meters
online system 1
POSHOLD> Mode POSHOLD
fence breach
APM: APM:Copter V3.4.6 (e707341b)
APM: PX4: de6b667d NuttX: 8c965992
APM: Frame: QUAD
APM: PX4v2 002A001F 34385113 30323534
Received 593 parameters
Saved 593 parameters to Copter-3.3/logs/2020-02-01/flight10/mav.parm
arm throttle
POSHOLD> Got MAVLink msg: COMMAND_ACK {command : 400, result : 0}
ARMED

Arming vehicle using Dronekit packages and this has been successful

dlinano@jetson-nano:~$ sudo python3
[sudo] password for dlinano:
Python 3.6.9 (default, Nov 7 2019, 10:44:02)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> from dronekit import connect, VehicleMode, LocationGlobalRelative
>>> from dronekit import connect, Command, LocationGlobal
>>> from pymavlink import mavutil
>>> import time, sys, argparse, math
>>> vehicle = connect('/dev/ttyTHS1', wait_ready=True, baud=57600)
>>> vehicle.mode = VehicleMode("GUIDED")
>>> home = vehicle.location.global_relative_frame
>>> print(home)
LocationGlobalRelative:lat=39.0455834,lon=-77.5109233,alt=3.06
>>> vehicle.armed=True
>>>

Testing using ARDUPILOT : Both sim_vehicle.py -w and sim_vehicle.py --console –map executed successfully.





dlinano@jetson-nano:~/ardupilot/ArduCopter$ sim_vehicle.py --console --map
SIM_VEHICLE: Start
SIM_VEHICLE: Killing tasks
SIM_VEHICLE: Starting up at SITL location
SIM_VEHICLE: WAF build
SIM_VEHICLE: Configure waf
SIM_VEHICLE: "/home/dlinano/ardupilot/modules/waf/waf-light" "configure" "--board" "sitl"
Setting top to : /home/dlinano/ardupilot
Setting out to : /home/dlinano/ardupilot/build
Autoconfiguration : enabled
Setting board to : sitl
Using toolchain : native
Checking for 'g++' (C++ compiler) : /usr/lib/ccache/g++
Checking for 'gcc' (C compiler) : /usr/lib/ccache/gcc
Checking for c flags '-MMD' : yes
Checking for cxx flags '-MMD' : yes
Checking for need to link with librt : not necessary
Checking for feenableexcept : yes
Checking for HAVE_CMATH_ISFINITE : yes
Checking for HAVE_CMATH_ISINF : yes
Checking for HAVE_CMATH_ISNAN : yes
Checking for NEED_CMATH_ISFINITE_STD_NAMESPACE : yes

```
Checking for NEED_CMATH_ISINF_STD_NAMESPACE    : yes
Checking for NEED_CMATH_ISNAN_STD_NAMESPACE    : yes
Checking for header endian.h                   : yes
Checking for header byteswap.h                 : yes
Checking for HAVE_MEMRCHR                      : yes
Checking for program 'python'                  : /usr/bin/python
Checking for python version >= 2.7.0           : 2.7.17
Checking for program 'python'                  : /usr/bin/python
Checking for python version >= 2.7.0           : 2.7.17
Source is git repository                       : yes
Update submodules                              : yes
Checking for program 'git'                     : /usr/bin/git
Checking for program 'size'                    : /usr/bin/size
Benchmarks                                     : disabled
Unit tests                                     : enabled
Scripting                                      : enabled
Scripting runtime checks                       : enabled
Checking for program 'rsync'                   : not found
'configure' finished successfully (2.694s)
SIM_VEHICLE: Building
SIM_VEHICLE: "/home/dlinano/ardupilot/modules/waf/waf-light" "build" "--target" "bin/arducopter"
Waf: Entering directory `/home/dlinano/ardupilot/build/sitl'
Embedding file sandbox.lua:libraries/AP_Scripting/scripts/sandbox.lua
Waf: Leaving directory `/home/dlinano/ardupilot/build/sitl'

BUILD SUMMARY
Build directory: /home/dlinano/ardupilot/build/sitl
Target          Text     Data    BSS    Total
-------------------------------------------------
bin/arducopter  2042583  104120  81400  2228103

Build commands will be stored in build/sitl/compile_commands.json
'build' finished successfully (7.008s)
SIM_VEHICLE: Using defaults from (/home/dlinano/ardupilot/Tools/autotest/default_params/copter.parm)
SIM_VEHICLE: Run ArduCopter
SIM_VEHICLE: "/home/dlinano/ardupilot/Tools/autotest/run_in_terminal_window.sh" "ArduCopter"
"/home/dlinano/ardupilot/build/sitl/bin/arducopter" "-S" "-I0" "--model" "+" "--speedup" "1" "--defaults"
"/home/dlinano/ardupilot/Tools/autotest/default_params/copter.parm"
SIM_VEHICLE: Run MavProxy
SIM_VEHICLE: "mavproxy.py" "--master" "tcp:127.0.0.1:5760" "--sitl" "127.0.0.1:5501" "--out" "127.0.0.1:14550" "--out"
"127.0.0.1:14551" "--map" "--console"
RiTW: Starting ArduCopter : /home/dlinano/ardupilot/build/sitl/bin/arducopter -S -I0 --model + --speedup 1 --defaults
/home/dlinano/ardupilot/Tools/autotest/default_params/copter.parm
Connect tcp:127.0.0.1:5760 source_system=255
Loaded module console
Loaded module map
Log Directory:
Telemetry log: mav.tlog
Waiting for heartbeat from tcp:127.0.0.1:5760
 MAV> STABILIZE> Received 1186 parameters
Saved 1186 parameters to mav.parm
```

Test using UDACITY DRONE Packages: Connection to drone has been successful and I was able to arm drone. But again no luck with takeoff

```
dlinano@jetson-nano:~$
dlinano@jetson-nano:~$ sudo python3
Python 3.6.9 (default, Nov  7 2019, 10:44:02)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> from udacidrone import Drone
>>> from udacidrone.connection import MavlinkConnection
>>> conn = MavlinkConnection('/dev/ttyTHS1,57600',PX4=True, threaded=False)
```

>>> drone = Drone(conn)
Logs/TLog.txt
>>> quit()
dlinano@jetson-nano:~$

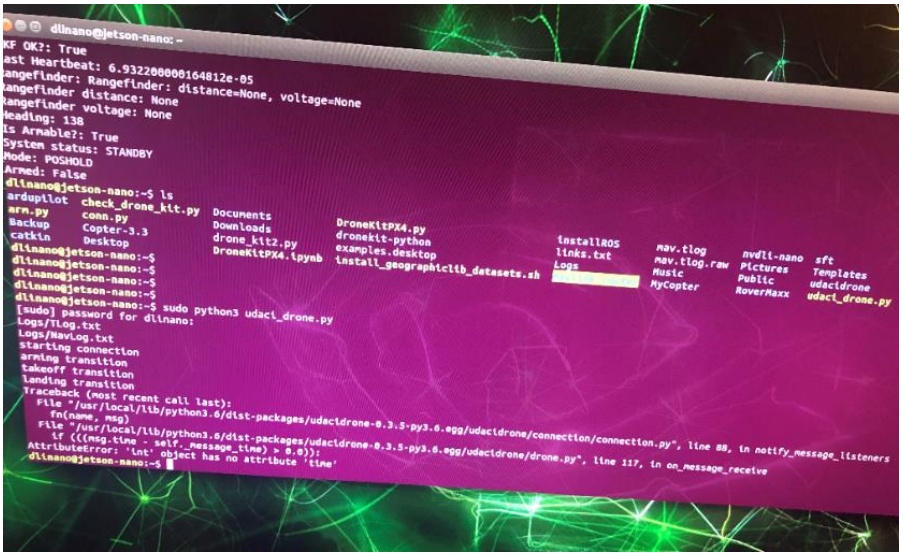
UDACIDRONE packages used to arm take off landing etc. It gets armed but no action on rotor/motor, what am I missing: Program stalls at landing transition and never ends and log files are not generated.
I have used the simple flight up and down program (up_and_down.py) Project1 link/slide 11 A Simple Flight Plan

```
dlinano@jetson-nano:~$ cat udaci_drone.py
import time
from enum import Enum
import numpy as np
from udacidrone import Drone
from udacidrone.connection import MavlinkConnection
from udacidrone.messaging import MsgID
class Phases(Enum):
    MANUAL = 0
    ARMING = 1
    TAKEOFF = 2
    LANDING = 3
    DISARMING = 4
class UpAndDownFlyer(Drone):
    def __init__(self, connection):
        super().__init__(connection)
        self.target_position = np.array([0.0, 0.0, 0.0])
        self.in_mission = True
        # initial state
        self.flight_phase = Phases.MANUAL
        # register all your callbacks here
        self.register_callback(MsgID.LOCAL_POSITION,
                               self.local_position_callback)
        self.register_callback(MsgID.LOCAL_VELOCITY,
                               self.velocity_callback)
        self.register_callback(MsgID.STATE,
                               self.state_callback)
    def local_position_callback(self):
        if self.flight_phase == Phases.TAKEOFF:
            # coordinate conversion
            altitude = -1.0 * self.local_position[2]

            # check if altitude is within 95% of target
            if altitude > 0.95 * self.target_position[2]:
                self.landing_transition()
    def velocity_callback(self):
        if self.flight_phase == Phases.LANDING:
            if ((self.global_position[2] - self.global_home[2] < 0.1) and
            abs(self.local_position[2]) < 0.01):
                self.disarming_transition()
    def state_callback(self):
        if not self.in_mission:
            return
        if self.flight_phase == Phases.MANUAL:
            self.arming_transition()
        elif self.flight_phase == Phases.ARMING:
```

```
            self.takeoff_transition()
        elif self.flight_phase == Phases.DISARMING:
            self.manual_transition()
    def arming_transition(self):
        print("arming transition")
        self.take_control()
        self.arm()
        # set the current location to be the home position
        self.set_home_position(self.global_position[0],
                               self.global_position[1],
                               self.global_position[2])
        self.flight_phase = Phases.ARMING
    def takeoff_transition(self):
        print("takeoff transition")
        target_altitude = 3.0
        self.target_position[2] = target_altitude
        self.takeoff(target_altitude)
        self.flight_phase = Phases.TAKEOFF
    def landing_transition(self):
        print("landing transition")
        self.land()
        self.flight_phase = Phases.LANDING
    def disarming_transition(self):
        print("disarm transition")
        self.disarm()
        self.flight_phase = Phases.DISARMING
    def manual_transition(self):
        print("manual transition")
        self.release_control()
        self.stop()
        self.in_mission = False
        self.flight_phase = Phases.MANUAL
    def start(self):
        self.start_log("Logs", "NavLog.txt")
        print("starting connection")
        super().start()
        self.stop_log()
if __name__ == "__main__":
    conn = MavlinkConnection('/dev/ttyTHS1,57600',PX4=True, threaded=False)
    drone = UpAndDownFlyer(conn)
    time.sleep(2)
    drone.start()
```

First time after an hour I stopped the program and second time I let it run till batteries depleted to non-functional status.



Software Installation:

udacidrone, pymavlink, pygame, dronekit-python, ardupilot, ros melodic for jetson nano,

PYTHON 3 Installed packages

absl-py (0.7.1)	actionlib (1.12.0)	Adafruit-GPIO (1.0.4)	Adafruit-PureIO (0.2.3)	Adafruit-SSD1306 (1.6.2)	angles (1.9.11)
apt-clone (0.2.1)	apturl (0.5.2)	asn1crypto (0.24.0)	astor (0.8.0)	attrs (19.3.0)	backcall (0.1.0)
beautifulsoup4 (4.6.0)	bleach (3.1.0)	blinker (1.4)	bondpy (1.8.3)	Brlapi (0.6.6)	camera-calibration-parsers (1.11.13)
catkin (0.7.19)	certifi (2019.11.28)	cflib (0.1.8)	chardet (3.0.4)	conda (4.3.16)	controller-manager (0.15.1)
controller-manager-msgs (0.15.1)	cryptography (2.1.4)	cupshelpers (1.0)	cv-bridge (1.13.0)	cycler (0.10.0)	decorator (4.4.0)
defer (1.0.6)	defusedxml (0.6.0)	diagnostic-analysis (1.9.3)	diagnostic-common-diagnostics (1.9.3)	diagnostic-updater (1.9.3)	distro-info (0.18ubuntu0.18.04.1)
dronekit (2.9.2)	dronekit-sitl (3.3.0)	dynamic-reconfigure (1.6.0)	entrypoints (0.3)	feedparser (5.2.1)	future (0.18.2)
gast (0.2.2)	gazebo-plugins (2.8.4)	gazebo-ros (2.8.4)	gencpp (0.6.2)	geneus (2.2.6)	genlisp (0.4.16)
genmsg (0.5.12)	gennodejs (2.0.1)	genpy (0.6.9)	graphsurgeon (0.3.2)	grpcio (1.21.1)	h5py (2.9.0)
html5lib (0.999999999)	httplib2 (0.9.2)	idna (2.8)	image-geometry (1.13.0)	importlib-metadata (1.5.0)	intelhex (2.2.1)
interactive-markers (1.11.4)	ipykernel (5.1.1)	ipython (7.5.0)	ipython-genutils (0.2.0)	ipywidgets (7.4.2)	jedi (0.13.3)
jetcam (0.0.0)	jetcard (0.0.0)	Jinja2 (2.10.1)	jsonschema (3.0.1)	jupyter (1.0.0)	jupyter-clickable-image-widget (0.1.0.dev0)
jupyter-client (5.2.4)	jupyter-console (6.0.0)	jupyter-core (4.4.0)	jupyterlab (0.35.6)	jupyterlab-server (0.2.0)	kdl-parser-py (1.13.1)
keyring (10.6.0)	keyrings.alt (3.0)	language-selector (0.1)	laser-geometry (1.6.4)	launchpadlib (1.10.6)	lazr.restfulclient (0.13.5)
lazr.uri (1.0.3)	louis (3.5.0)	lxml (4.5.0)	macaroonbakery (1.1.3)	Mako (1.0.7)	MarkupSafe (1.1.1)
matplotlib (2.1.1)	MAVProxy (1.8.18)	mavros (0.33.3)	message-filters (1.14.3)	mistune (0.8.4)	mock (3.0.5)
monotonic (1.5)	more-itertools (8.2.0)	nbconvert (5.5.0)	nbformat (4.4.0)	notebook (5.7.8)	numpy (1.16.4)
oauth (1.0.1)	oauthlib (2.0.6)	olefile (0.45.1)	packaging (20.1)	PAM (0.4.2)	pandocfilters (1.4.2)
parso (0.4.0)	pexpect (4.7.0)	pickleshare (0.7.5)	Pillow (6.0.0)	pip (9.0.1)	pluggy (0.13.1)
portpicker (1.3.1)	prometheus-client (0.7.0)	prompt-toolkit (2.0.9)	protobuf (3.0.0)	psutil (5.6.7)	ptyprocess (0.6.0)
py (1.8.1)	py-cpuinfo (5.0.0)	pycairo (1.16.2)	pycosat (0.6.3)	pycrypto (2.6.1)	pycups (1.9.73)
pygame (1.9.6)	Pygments (2.4.2)	pygobject (3.26.1)	PyICU (1.9.8)	PyJWT (1.5.3)	pymacaroons (0.13.0)
pymavlink (2.4.6)	PyNaCl (1.1.2)	pyparsing (2.4.6)	pyRFC3339 (1.0)	pyrsistent (0.15.2)	pyserial (3.4)
pytest (5.3.5)	python-apt (1.6.5+ubuntu0.2)	python-dateutil (2.8.0)	python-debian (0.1.32)	python-qt-binding (0.3.6)	pytz (2018.3)
pyusb (1.0.2)	pyxdg (0.25)	PyYAML (3.12)	pyzmq (18.0.1)	qt-dotgraph (0.3.16)	qt-gui (0.3.16)
qt-gui-cpp (0.3.16)	qt-gui-py-common (0.3.16)	qtconsole (4.5.1)	requests (2.22.0)	requests-unixsocket (0.1.5)	resource-retriever (1.12.5)
rosbag (1.14.3)	rosboost-cfg (1.14.7)	rosclean (1.14.7)	roscreate (1.14.7)	rosgraph (1.14.3)	roslaunch (1.14.3)
roslib (1.14.7)	roslint (0.11.2)	roslz4 (1.14.3)	rosmake (1.14.7)	rosmaster (1.14.3)	rosmsg (1.14.3)
rosnode (1.14.3)	rosparam (1.14.3)	rospy (1.14.3)	rosservice (1.14.3)	rostest (1.14.3)	rostopic (1.14.3)

rosunit (1.14.7)	roswtf (1.14.3)	rqt-action (0.4.9)	rqt-bag (0.4.12)	rqt-bag-plugins (0.4.12)	rqt-console (0.4.8)
rqt-dep (0.4.9)	rqt-graph (0.4.10)	rqt-gui (0.5.0)	rqt-gui-py (0.5.0)	rqt-image-view (0.4.13)	rqt-launch (0.4.8)
rqt-logger-level (0.4.8)	rqt-moveit (0.5.7)	rqt-msg (0.4.8)	rqt-nav-view (0.5.7)	rqt-plot (0.4.9)	rqt-pose-view (0.5.8)
rqt-publisher (0.4.8)	rqt-py-common (0.5.0)	rqt-py-console (0.4.8)	rqt-reconfigure (0.5.1)	rqt-robot-dashboard (0.5.7)	rqt-robot-monitor (0.5.9)
rqt-robot-steering (0.5.10)	rqt-runtime-monitor (0.5.7)	rqt-rviz (0.6.0)	rqt-service-caller (0.4.8)	rqt-shell (0.4.9)	rqt-srv (0.4.8)
rqt-tf-tree (0.6.0)	rqt-top (0.4.8)	rqt-topic (0.4.10)	rqt-web (0.4.8)	ruamel.yaml (0.16.6)	ruamel.yaml.clib (0.2.0)
rviz (1.13.6)	SecretStorage (2.3.1)	Send2Trash (1.5.0)	sensor-msgs (1.12.7)	setuptools (41.0.1)	simplejson (3.13.2)
six (1.14.0)	smach (2.0.1)	smach-ros (2.0.1)	smclib (1.8.3)	spidev (3.4)	ssh-import-id (5.7)
system-service (0.3)	systemd-python (234)	tensorrt (5.0.6.3)	termcolor (1.1.0)	terminado (0.8.2)	testpath (0.4.2)
tf (1.12.0)	tf-conversions (1.12.0)	tf2-geometry-msgs (0.6.5)	tf2-kdl (0.6.5)	tf2-py (0.6.5)	tf2-ros (0.6.5)
topic-tools (1.14.3)	torch (1.1.0a0+b457266)	torchvision (0.2.2.post3)	tornado (6.0.2)	traitlets (5.0.0.dev0)	ubuntu-drivers-common (0.0.0)
udacidrone (0.3.5)	uff (0.5.5)	ufw (0.36)	unattended-upgrades (0.1)	unity-scope-calculator (0.1)	unity-scope-chromiumbookmarks (0.1)
unity-scope-colourlovers (0.1)	unity-scope-devhelp (0.1)	unity-scope-firefoxbookmarks (0.1)	unity-scope-manpages (0.1)	unity-scope-openclipart (0.1)	unity-scope-texdoc (0.1)
unity-scope-tomboy (0.1)	unity-scope-virtualbox (0.1)	unity-scope-yelp (0.1)	unity-scope-zotero (0.1)	urdfdom-py (0.4.1)	urllib3 (1.25.8)
utm (0.4.0)	uvloop (0.9.1)	wadllib (1.3.2)	wcwidth (0.1.8)	webencodings (0.5.1)	websockets (4.0.1)
wheel (0.34.2)	widgetsnbextension (3.4.2)	xacro (1.13.4)	xkit (0.0.0)	zipp (2.1.0)	zope.interface (4.3.2)

PYTHON 2 Packages Installed

actionlib (1.12.0)	angles (1.9.11)	asn1crypto (0.24.0)	attrs (17.4.0)	autobahn (17.10.1)	Automat (0.6.0)
backports.functools-lru-cache (1.4)	beautifulsoup4 (4.6.0)	bondpy (1.8.3)	bzr (2.8.0.dev1)	camera-calibration-parsers (1.11.13)	catkin (0.7.19)
catkin-pkg (0.4.15)	catkin-pkg-modules (0.4.15)	cbor (1.0.0)	chardet (3.0.4)	click (6.7)	colorama (0.3.7)
configobj (5.0.6)	constantly (15.1.0)	controller-manager (0.15.1)	controller-manager-msgs (0.15.1)	cryptography (2.1.4)	cv-bridge (1.13.0)
cycler (0.10.0)	Cython (0.26.1)	decorator (4.1.2)	defusedxml (0.5.0)	diagnostic-analysis (1.9.3)	diagnostic-common-diagnostics (1.9.3)
diagnostic-updater (1.9.3)	docutils (0.14)	dronekit (2.9.2)	dronekit-sitl (3.3.0)	dynamic-reconfigure (1.6.0)	empy (3.3.2)
enum34 (1.1.6)	funcsigs (1.0.2)	future (0.18.2)	futures (3.2.0)	gazebo-plugins (2.8.4)	gazebo-ros (2.8.4)
gcovr (3.4)	gencpp (0.6.2)	geneus (2.2.6)	genlisp (0.4.16)	genmsg (0.5.12)	gennodejs (2.0.1)
genpy (0.6.9)	gps (3.17)	graphsurgeon (0.3.2)	gyp (0.1)	html5lib (0.999999999)	httplib2 (0.9.2)
hyperlink (17.3.1)	idna (2.6)	image-geometry (1.13.0)	incremental (16.10.1)	intelhex (2.2.1)	interactive-markers (1.11.4)
ipaddress (1.0.17)	kdl-parser-py (1.13.1)	keyring (10.6.0)	keyrings.alt (3.0)	laser-geometry (1.6.4)	launchpadlib (1.10.6)
lazr.restfulclient (0.13.5)	lazr.uri (1.0.3)	lxml (4.5.0)	lz4 (0.10.1)	matplotlib (2.1.1)	MAVProxy (1.8.18)
mavros (0.33.3)	mercurial (4.5.3)	message-filters (1.14.3)	monotonic (1.5)	mpi4py (2.0.0)	netifaces (0.10.4)
nose (1.3.7)	numpy (1.13.3)	oauth (1.0.1)	olefile (0.45.1)	PAM (0.4.2)	paramiko (2.0.0)
pexpect (4.8.0)	Pillow (5.1.0)	pip (9.0.1)	pluggy (0.6.0)	psutil (5.6.7)	ptyprocess (0.6.0)
py (1.5.2)	py-ubjson (0.8.5)	pyasn1 (0.4.2)	pyasn1-modules (0.2.1)	pycairo (1.16.2)	pycrypto (2.6.1)
pydot (1.2.3)	pygame (1.9.6)	Pygments (2.2.0)	pygobject (3.26.1)	pymavlink (2.4.6)	PyNaCl (1.1.2)
PyOpenGL (3.1.0)	pyOpenSSL (17.5.0)	pyparsing (2.2.0)	pyserial (3.4)	pytest (3.3.2)	python-dateutil (2.6.1)
python-gnupg (0.4.1)	python-qt-binding (0.3.6)	python-snappy (0.5)	PyTrie (0.2)	pytz (2018.3)	pyxdg (0.25)
PyYAML (3.12)	qrcode (5.3)	qt-dotgraph (0.3.16)	qt-gui (0.3.16)	qt-gui-cpp (0.3.16)	qt-gui-py-common (0.3.16)
resource-retriever (1.12.5)	roman (2.0.0)	rosbag (1.14.3)	rosboost-cfg (1.14.7)	rosclean (1.14.7)	roscreate (1.14.7)
rosdep (0.18.0)	rosdep-modules (0.18.0)	rosdistro (0.8.0)	rosdistro-modules (0.8.0)	rosgraph (1.14.3)	rosinstall (0.7.8)
rosinstall-generator (0.1.18)	roslaunch (1.14.3)	roslib (1.14.7)	roslint (0.11.2)	roslz4 (1.14.3)	rosmake (1.14.7)
rosmaster (1.14.3)	rosmsg (1.14.3)	rosnode (1.14.3)	rosparam (1.14.3)	rospkg (1.2.2)	rospkg-modules (1.2.2)
rospy (1.14.3)	rosservice (1.14.3)	rostest (1.14.3)	rostopic (1.14.3)	rosunit (1.14.7)	roswtf (1.14.3)
rqt-action (0.4.9)	rqt-bag (0.4.12)	rqt-bag-plugins (0.4.12)	rqt-console (0.4.8)	rqt-dep (0.4.9)	rqt-graph (0.4.10)
rqt-gui (0.5.0)	rqt-gui-py (0.5.0)	rqt-image-view	rqt-launch (0.4.8)	rqt-logger-level	rqt-moveit (0.5.7)

		(0.4.13)		(0.4.8)	
rqt-msg (0.4.8)	rqt-nav-view (0.5.7)	rqt-plot (0.4.9)	rqt-pose-view (0.5.8)	rqt-publisher (0.4.8)	rqt-py-common (0.5.0)
rqt-py-console (0.4.8)	rqt-reconfigure (0.5.1)	rqt-robot-dashboard (0.5.7)	rqt-robot-monitor (0.5.9)	rqt-robot-steering (0.5.10)	rqt-runtime-monitor (0.5.7)
rqt-rviz (0.6.0)	rqt-service-caller (0.4.8)	rqt-shell (0.4.9)	rqt-srv (0.4.8)	rqt-tf-tree (0.6.0)	rqt-top (0.4.8)
rqt-topic (0.4.10)	rqt-web (0.4.8)	rviz (1.13.6)	scipy (0.19.1)	SecretStorage (2.3.1)	sensor-msgs (1.12.7)
service-identity (16.0.0)	setuptools (39.0.1)	simplejson (3.13.2)	six (1.14.0)	smach (2.0.1)	smach-ros (2.0.1)
smclib (1.8.3)	subprocess32 (3.2.7)	tensorrt (5.0.6.3)	tf (1.12.0)	tf-conversions (1.12.0)	tf2-geometry-msgs (0.6.5)
tf2-kdl (0.6.5)	tf2-py (0.6.5)	tf2-ros (0.6.5)	topic-tools (1.14.3)	trollius (2.0.1)	Twisted (17.9.0)
txaio (2.8.1)	u-msgpack-python (2.1)	udacidrone (0.3.5)	uff (0.5.5)	unity-lens-photos (1.0)	urdfdom-py (0.4.1)
vcstools (0.1.42)	wadllib (1.3.2)	webencodings (0.5)	wheel (0.34.2)	wsaccel (0.6.2)	wstool (0.1.17)
wxPython (3.0.2.0)	wxPython-common (3.0.2.0)	xacro (1.13.4)	zope.interface (4.3.2)		