Prince Mohammad University
Department of Electrical Engineering

Lifeguard Drone

ASSEIII
Fall 2018

Abdullah Ahmed Alansari **201303885**

Abdulrahman Adel Alfridan **201301972**

Abdulaziz Khalid Aljubair **201001245**

Advisor: Mr. Ahmed Abul Hassain

Outline

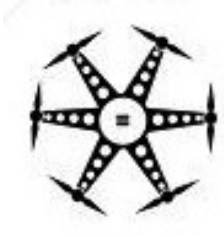
- ❖Project definition & objectives
- ❖Project specifications
- ❖Design Constraints & Standards
- ❖Project architecture
- ❖Background & Previous projects
- ❖Design: subsystems
- ❖Design: Components selection
- ❖Testing
- ❖Project Management
- ❖Budget
- ❖Completed
- ❖Conclusions & Recommendations
- ❖References

Project Definition

To design a hexa-copter drone that is controlled by an RC in which it can carry and deliver a life ring to a certain location. The hexa-copter will have three sub-systems in addition to the main one which is to show live streaming, communication with RC while flying and Motors and Propellers sizing and capacity.

Project Objectives

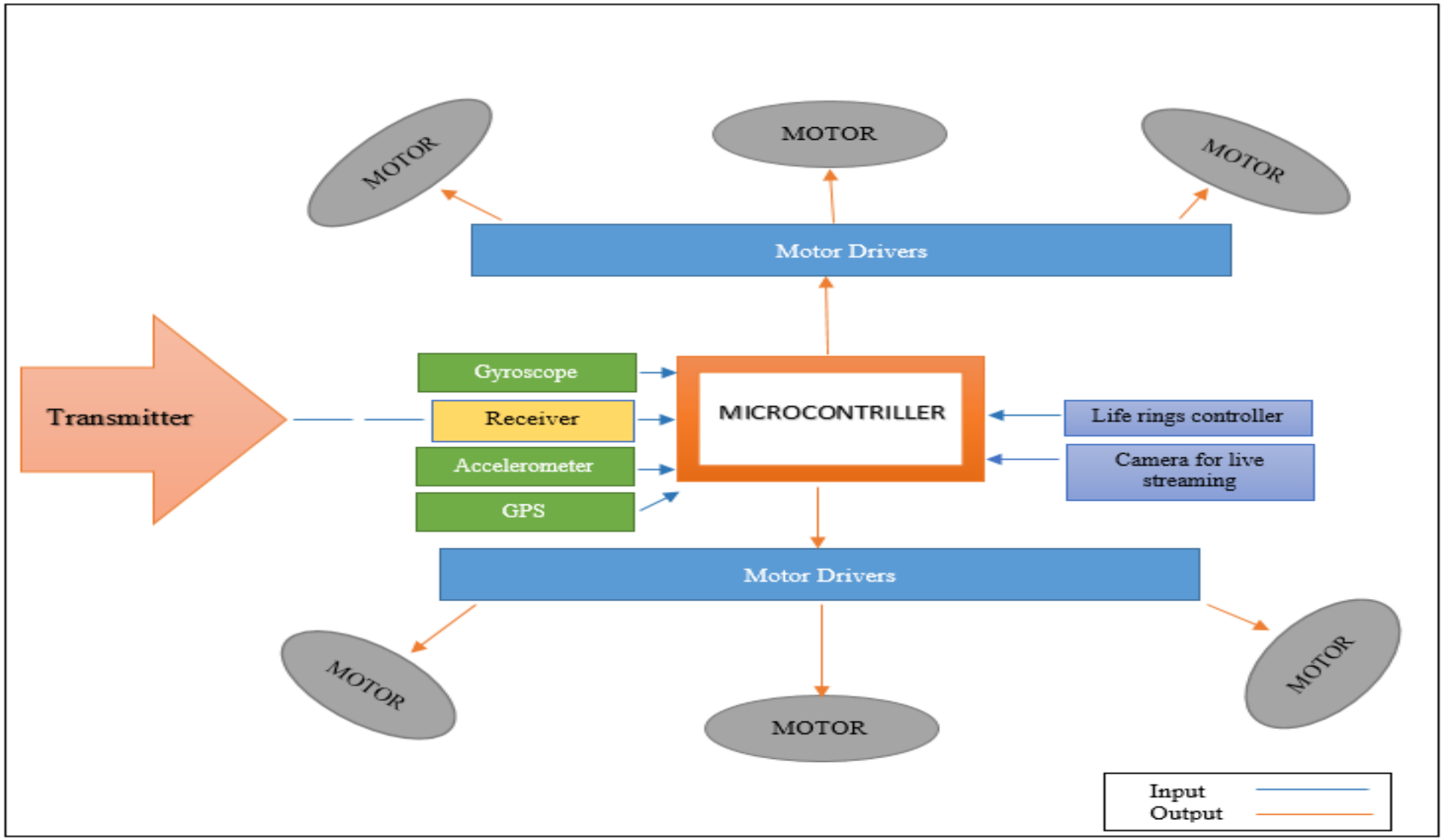
1. Applying the advanced technology in saving lives.
2. Having the minimal time to deliver a life ring.
3. Identifying the actual situation upon arrival.
4. Showing a live streaming of the life ring delivery

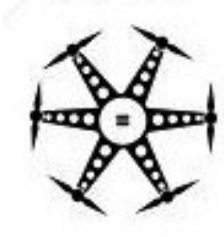


Project Specifications

1. Flying time is up to 19 minutes.
2. Capability of carrying payload up to 5 kg.
3. Wireless communication through an RC (Radio Control).
4. Radio system with a control range: 0.6km on land, 1.0 km on air.
5. Monitor the flying operation through a live streaming.

Project architecture



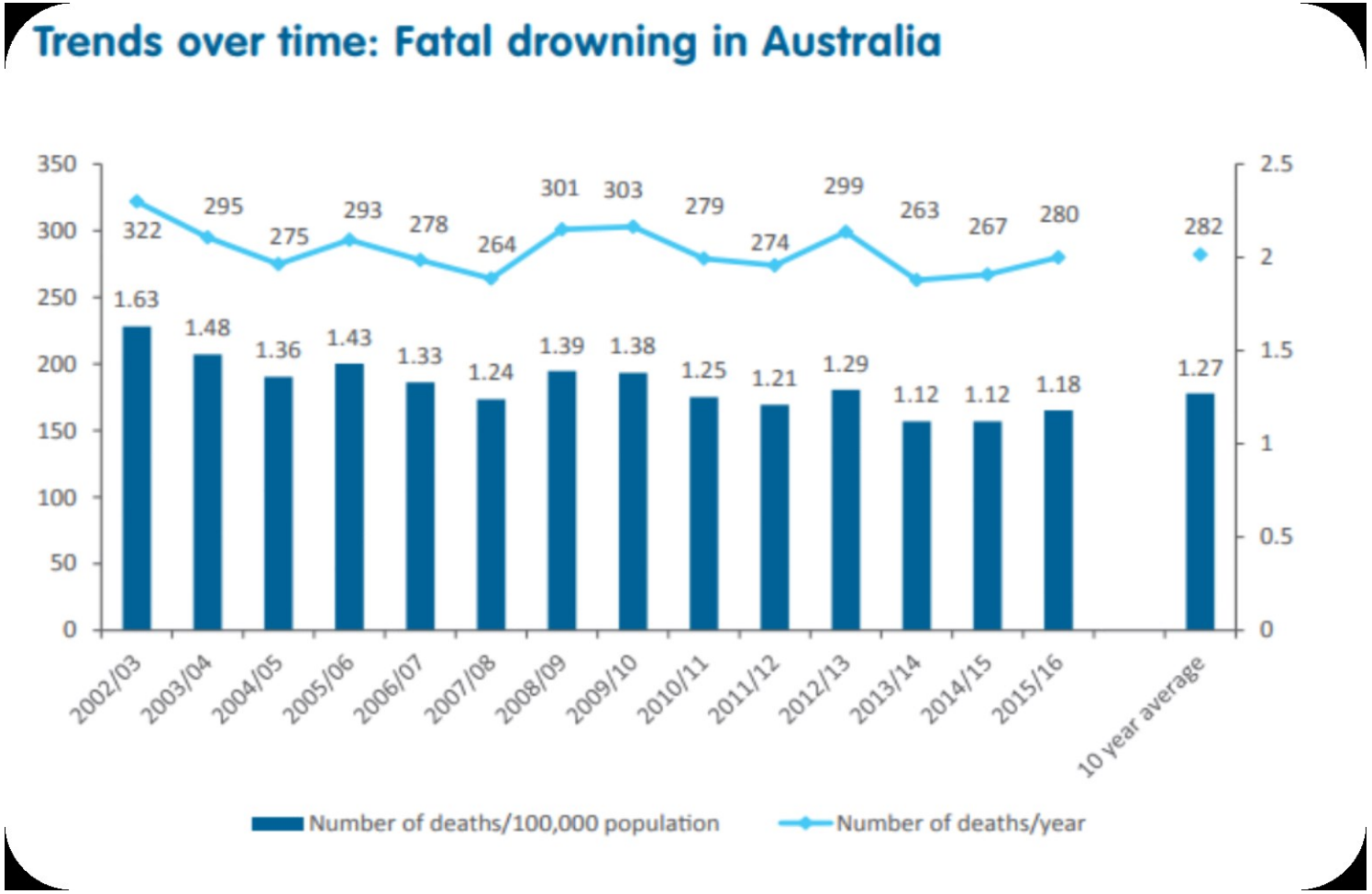


Design Constraints & Standards

1. Economic (Budget).
2. Engineering Standards. (trade weight with motor's torque)
3. Use and possession prohibition.
4. Market for spare parts.

Background: problem

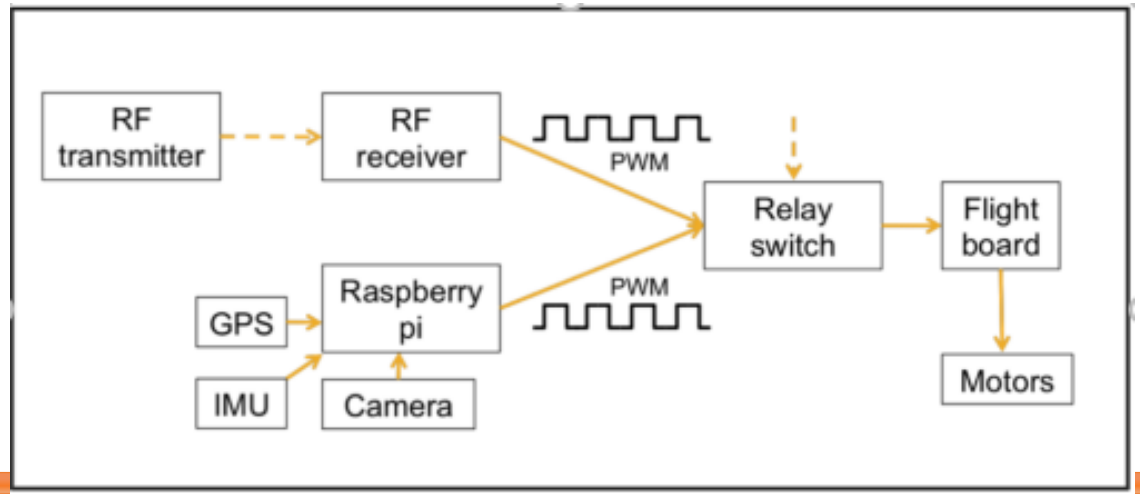
Shows a trend over time of fatal drowning in Australia



Previous projects (1)

Autonomous Hexa-copter software design
University of Western Australia
October, 2014

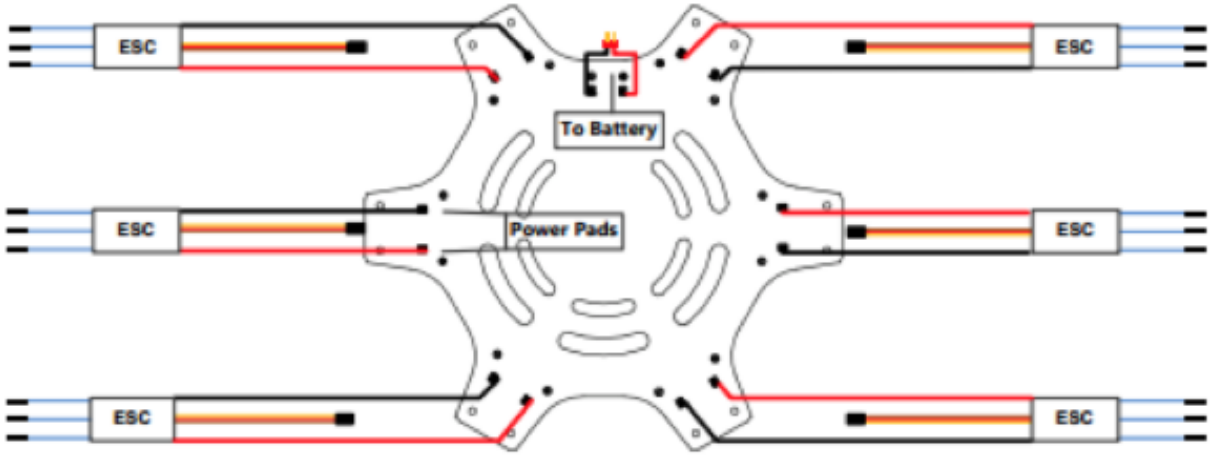
This system is currently in use with a variety of simultaneous projects, including field searching and multiple object tracking, all tied in together with a web-based user interface.



Previous projects (2)

Usage of a hexa-copter platform for Chemical plume detection and photography
California State University Bakersfield
November, 2014

To adapt a hexa-copter drone into a platform which can be used to locate the source of a chemical plume and to photograph the location.



N

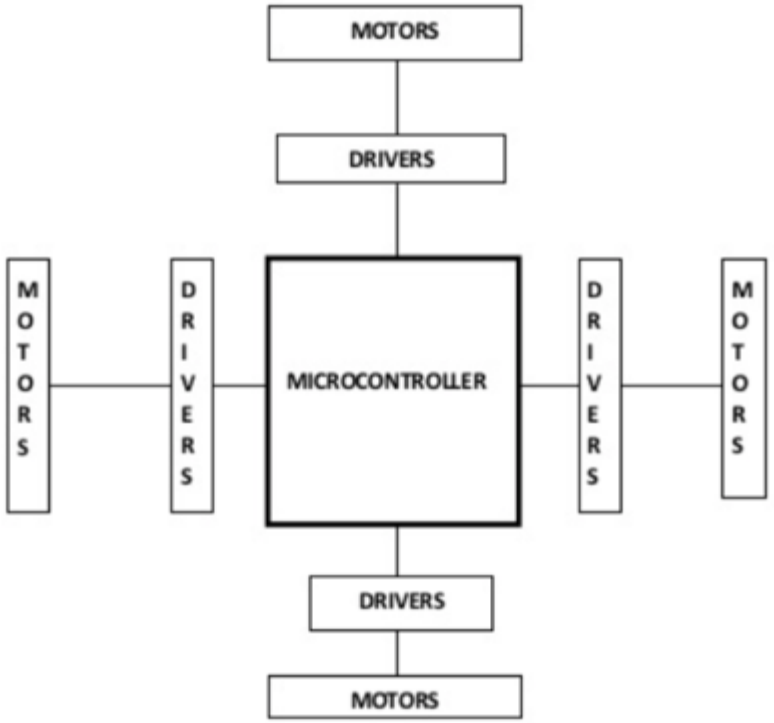
Previous projects (3)

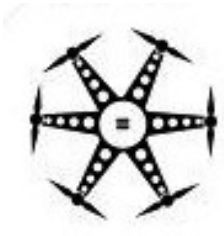
Quadcopter technology
Amity university
January, 2015

3D mapping

Farming

Search and rescue





Previous Projects Summary

Projects	1	2	3	Our project
Six motors	√	√		√
Rescue rings				√
Lifting capability		√	√	√
Live streaming	√	√	√	√

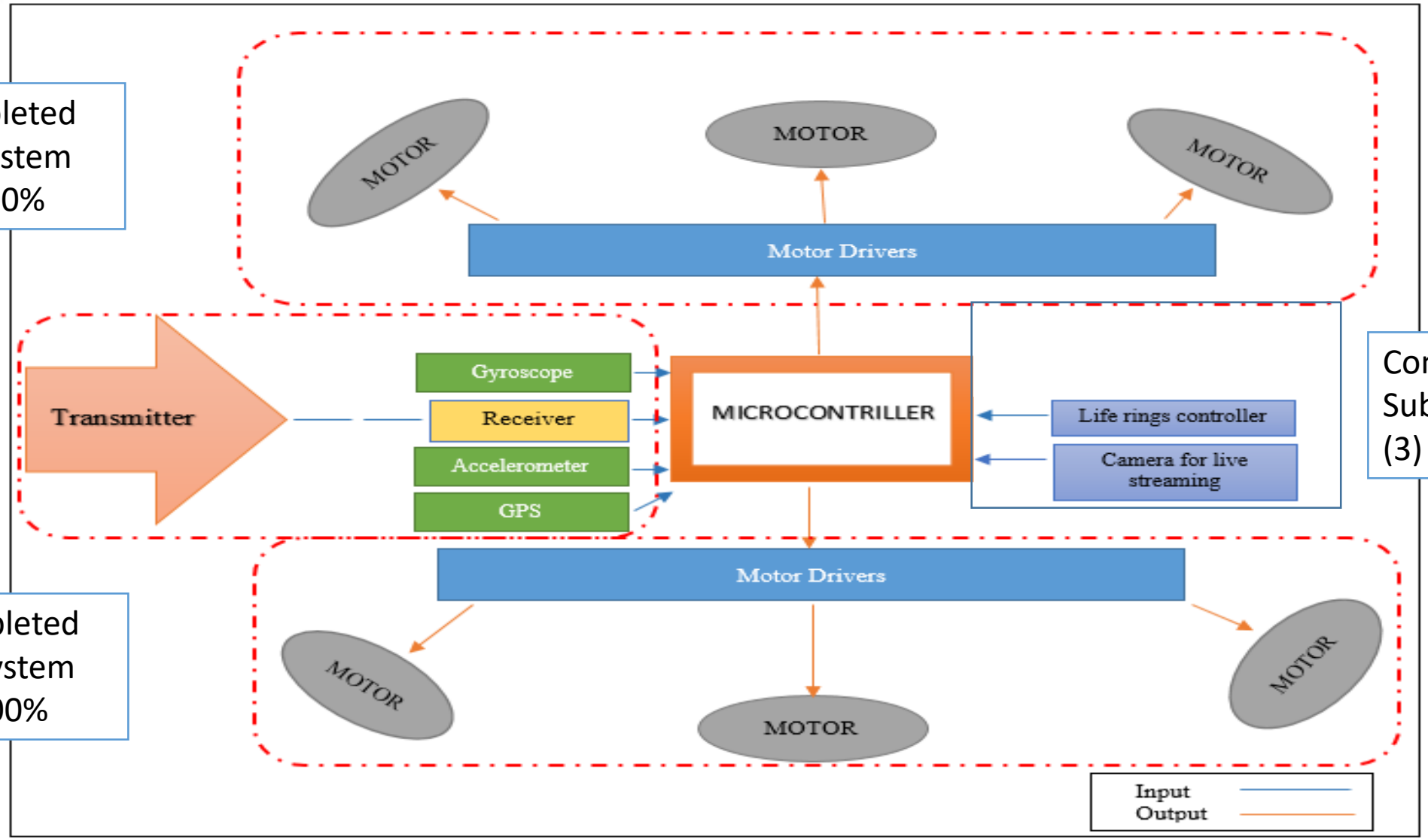
Design: Subsystems

Completed Subsystem (1) 100%

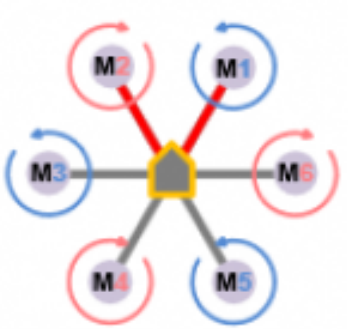
Completed Subsystem (2) 100%

Completed Subsystem (1) 100%

Completed Subsystem (3) 100%



Design subsystem 1 (Frame Structure)



Frame:

After searching and discussion we prefer to use a HIXACOTER frame. This type of drone setup in which there are six arms. Each arm is connected to a single motor.

Material:

Carbon fiber. The reason why we choose the carbon fiber because it is very tough and extremely lightweight. Also, it will make drone fly better and consume less energy.

Cont. Design subsystem 1

Drone frame kit

Fixed the completion of the drone frame

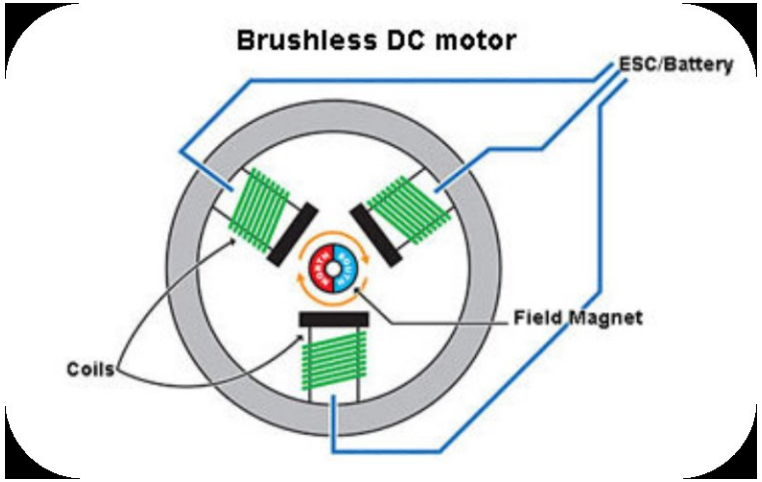
Design subsystem 2 (Motors and Propellers)

Motors:

Brushless motors, because they are durability, versatility, and ability to generate a lot of power.

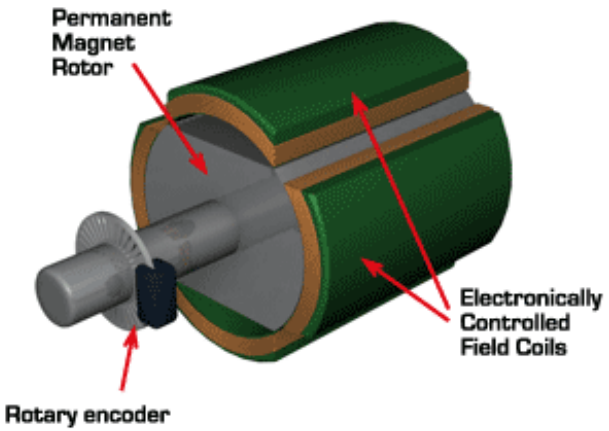
Propeller:

Carbon fiber, because they are very hard to break, and offer much more flex than a standard plastic propeller. Also, there are a relationship between the size of propeller and the motor kV.



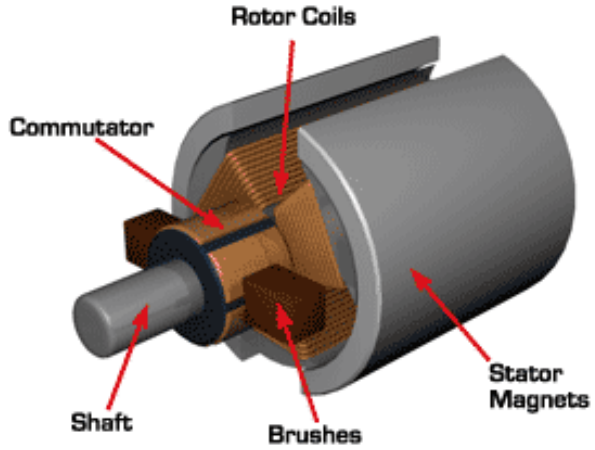
Cont. Design subsystem 2

Brushless motor



Vs

Brush motor



- No brushes to wear out
- No brushes to replace
- High efficiency

- Less efficient
- Electrically noisy
- Brushes and commutators wear out

Cont.

Battery:

Lithium polymer (li-po) batteries. The reason why these batteries are excellent power sources is because they're lightweight, and they give off a lot of power. Ours have the capacity of 16,000 mAh which is compared to other has more capability and efficiency.

Design subsystem 3 (Communication)

Radio Controller:

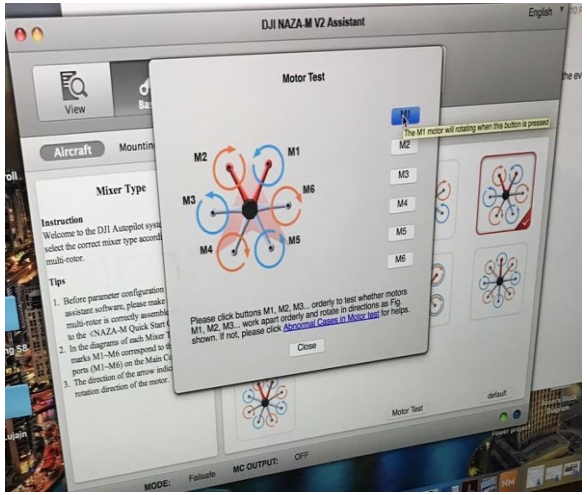
In this subsystem, a wireless communication transmitter and receiver are used to communicate your commands to the drone.

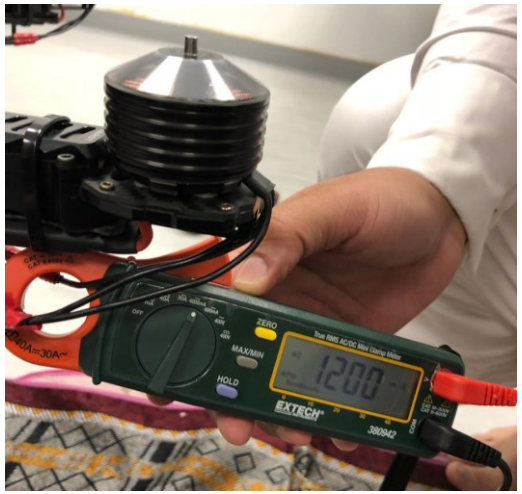
Flight controller:

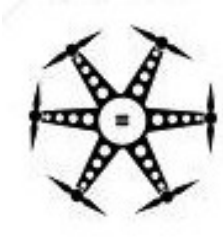
We have chosen Naza for our flight controller since it is well recognized. However the flight controller should include some features like accelerometer, gyroscope, and GPS.

Testing

1. Checking the direction of the motor rotation.
2. Checking the receiving signal from the transmitter.
3. Testing the battery operation.
4. Configuring the transmitter with its receiver.
5. Testing the landing gears.
6. Current passing each motors
7. Flying sessions
8. Testing GBS mode

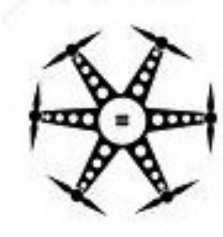






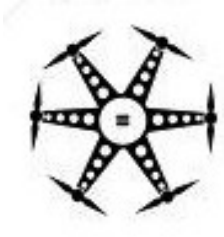
Project Management: Team task division

Task	Abdulrahman	Abdullah	Abdulaziz
Search & and choosing the components	30	40	30
Acquiring the components	40	40	20
Design & build the frame	35	35	30
Testing Motors and connections	30	20	50
Write Reports & Preparing the presentation	40	40	20
Configuring the software	25	25	50



Project Management: Challenges

- Some of the components were not allowed to be available due to some restrictions. We planned to go to UAE to bring these components.
- Some part of the motors was touching the base of the arm and prevent it from rotating smoothly. We have added some washers to make a small gap, so the rotor will run smoothly.
- Landing gear was not suitable for our drone. We figured out a way to connect it to our frame and having a great mechanical movement.



Budget

- List key components and their approximate cost

Item	Quantity	Unit Cost (SR)	Subtotal(SR)
Microcontroller	1	634	634
Frame	6	112.5	675
Hexacopter Kit	1	1500	1500
Motor	6	225	1350
Battery	1	1400	1400
battery Charger	1	300	300
Radio System	1	1630	1630
Landing gear	1	338	338
Camera	1	700	700
Lifering	1	60	60
Handtools	1	100	100
Camera case	1	60	60
Totals			**8747**

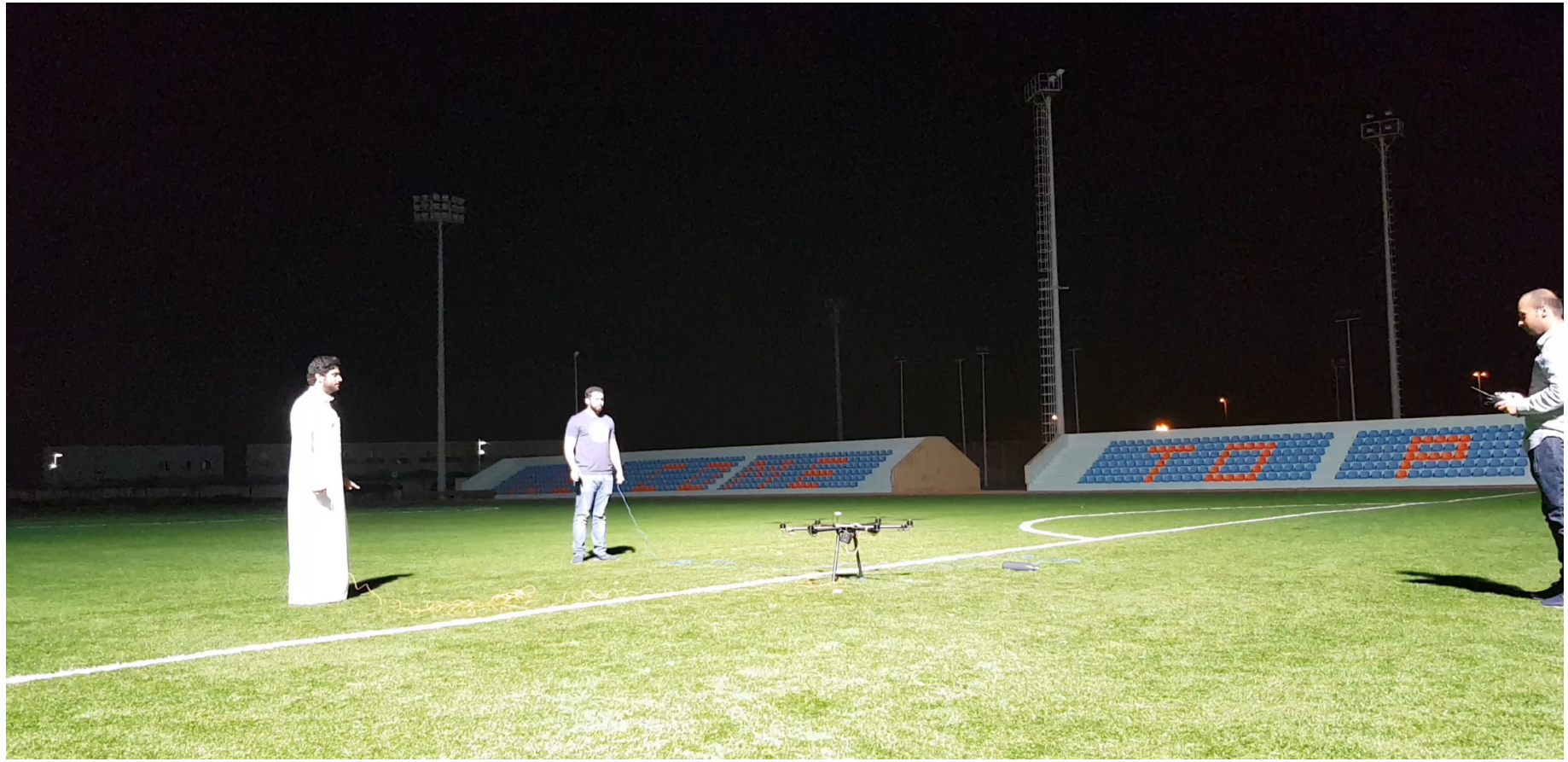
***All indicated prices are in SR and subjected to the taxes and price changes upon the order time.**

Completed work

- Managed to buy and order the required components for this semester.
- Installed and fix the whole frame of a hexa-copter.
- Installed its motors along with their motor drivers.
- Made the required connection.
- Made the needed soldiering wires.
- Installed the landing gear along with their servo-motors and the synchronization controller.
- Installed the communication systems consisting of transmitter and receiver.
- Installed and test the flight controller and its both connection to the receiver and motors.

First attempt testing

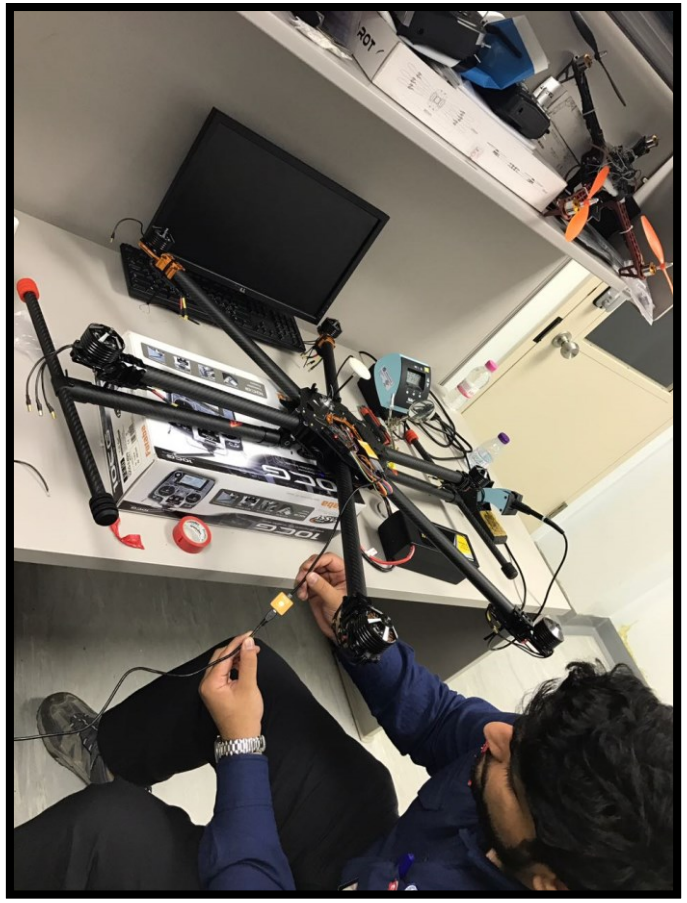
First attempt testing



Second attempt testing

Video of the Second attempt testing

Completed work



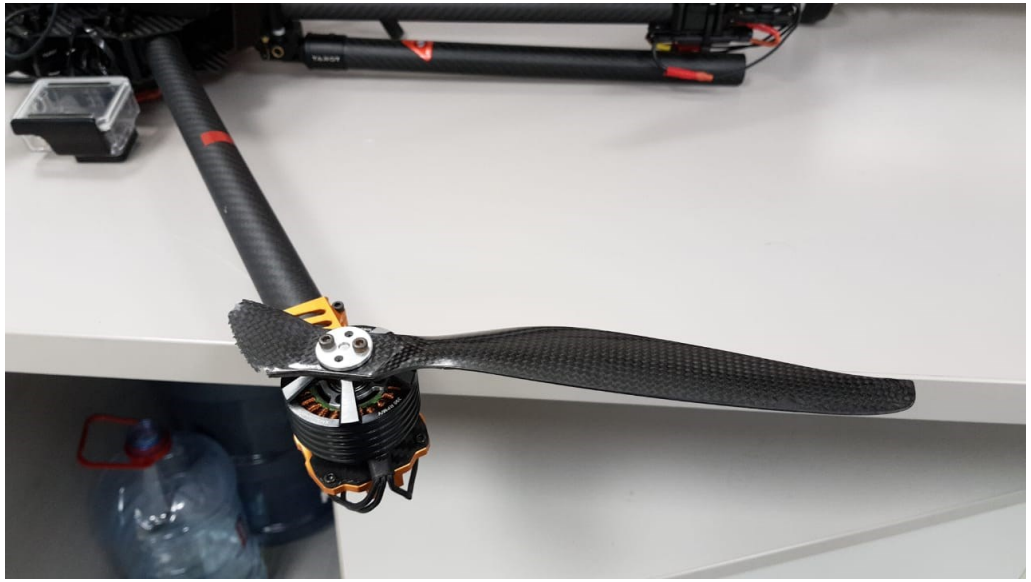
Completed Work

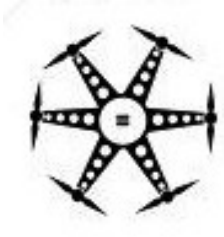
Video while dropping a life ring

Video from the last testing session

Video from camera (testing session)

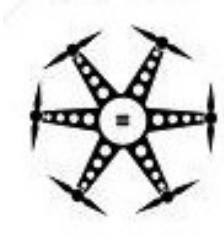
Damage from the testing session





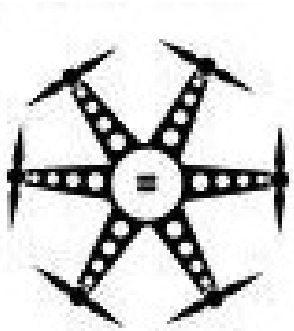
Conclusion

- The project was successfully working and flying smoothly.
- Was a very challenging project as we spend two semesters working on it.
- Were introduced to various things like calibrate a gyroscope, and motors using an application.
- Managed to work as a team and meet deadlines and set goads.
- Got to meet professionals in the drone fields and were advised in regard.
- Lastly, we enjoyed a lot despite the difficulties faced during testing, designing, acquiring components and assembling it.



Recommendations

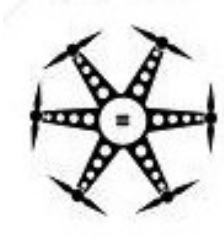
- Using mechanical arm to hold the life ring.
- Using carbon fiber holder with a servo to release the life ring.
- Using thicker soldering wires.
- Buy extra spare parts for the most likely to be damaged while testing.
- Need large area to do the testing.



Thank you

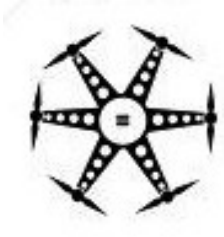
References

1. University of Western Australia (October 2014). "Autonomous Hexacopter software design" (PDF). http://robotics.ee.uwa.edu.au/theses/2014-Hexacopter-GPS-Baxter.pdf (Access date : 02/10/2018)
2. CLIFORNIA STATE UNIVERSITY BAKERSFIELD . (2014, November 20). Retrieved from http://www.cs.csubak.edu/~mheaton/490B%20report.pdf (Access date : 02/10/2018)
3. Amity University. (2015, Jan 9). Quadcopter technology. Retrieved from https://www.slideshare.net/michaelbseliss/quadcopter-technology?next_slideshow=1 (Access date : 02/11/2018)
4. https://www.royallifesaving.com.au/__data/assets/pdf_file/0004/18085/RLS_NDR2016_ReportLR.pdf (Access date : 02/11/2018)
5. http://beginnerflyer.com/build-a-drone/ (Access date: 10/03/2018)



Implementation

- Using the robotic lab for working on the software and hardware.
- Using some of out personal hand tools for fixing, testing, and laptop for programming and configuration.
- Assigning convenient time and manage it with the team for meeting and working.
- Buying the missing components and ordering the locally unavailable once.
- Might be using PMU stadium for testing.
- For the final report writing, will be divided equally among the team members.



Needed initial components

- Proper drone camera
- Camera holder
- Life ring holder
- Life ring
- Connectors/ wires

Project first semester plan

SN	Tasks & Responsibilities		Semester Weeks
			1 2 3 4 5 6 7 8 9 10 11 12 13 14
1	Planning; Feasibility and Reading	All	100%
2	Idea generation and selection	All	100%
3	Project Proposal	All	100%
4	Project management Plan	All	100%
5	Identifying the structure and material	All	100
6	Identifying the Components of SS1 (Flying and Carrying up to 3 life rings (5kg),)	AA, AF	100%
7	Design subsystem SS1	All	100%
8	Select, acquire components for SS1, and order them form online	AF, AJ	100%
9	Implement Design for SS1	All	90%
10	Test and refine design for SS1	All	85%

Project second semester plan

SN	Tasks & Responsibilities		Begin**	End**	% Completion
1	Finish design subsystem SS2 (Motor drivers and motors)	AA,AJ, AF	Sep. 10	Sep. 27	100%
2	Implement Design for SS2	AA,AJ, AF	Sep. 27	Oct. 30	100%
3	Test and refine design for SS2	AA,AJ, AF	Sep. 10	Nov. 6	100%
4	Design subsystem SS3 (Communication)	AA,AJ, AF	Oct. 31	Nov. 18	100%
6	Implement Design for SS3	AA,AJ, AF	Nov. 18	Nov. 29	100%
7	Test and refine design for SS3	AA,AJ, AF	Nov. 21	Nov. 29	100%
8	Integrate subsystems SS2 & SS3	AA,AJ, AF	Nov. 5	Nov. 9	100%
9	Design subsystem SS4 (Camera)	AA,AJ, AF	Nov. 18	Nov. 29	100%
10	Implement Design for SS4	AA,AJ, AF	Nov. 21	Nov. 29	100%
11	Test and refine design for SS4	AA,AJ, AF	Nov. 21	Nov. 29	100%
12	Integrate all subsystems	AA,AJ, AF	Oct. 7	Nov. 21	100%
13	Test and make final changes	AA,AJ, AF	Nov. 28	Dec. 6	100%
14	write progress reports (weekly)	AA,AJ, AF	Sep 27	Dec 6	100%
15	Prepare midterm presentations	AA,AJ, AF	Oct. 25	Nov. 12	100%
16	Prepare Demo. (prototype)	AA,AJ, AF	Nov. 12	Nov. 22	100%
17	Prepare Final presentation	AA,AJ, AF	Nov. 23	Dec. 8	100%
18	Prepare final report	AA,AJ, AF	Nov. 2	Dec. 10	100%