

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

CAPSTONE PROJECT



Hand Gesture Controlled Emergency Aerial Assistance Using Smartphone Based 4G Quadcopter

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Outline



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PROBLEM
STATEMENT



DESIGN



SOFTWARE
IMPLEMENTATION



HARDWARE
IMPLEMENTATION



RESULTS &
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PROJECT
MANAGEMENT



CONCLUSION



INTRODUCTION



safety



control



balance

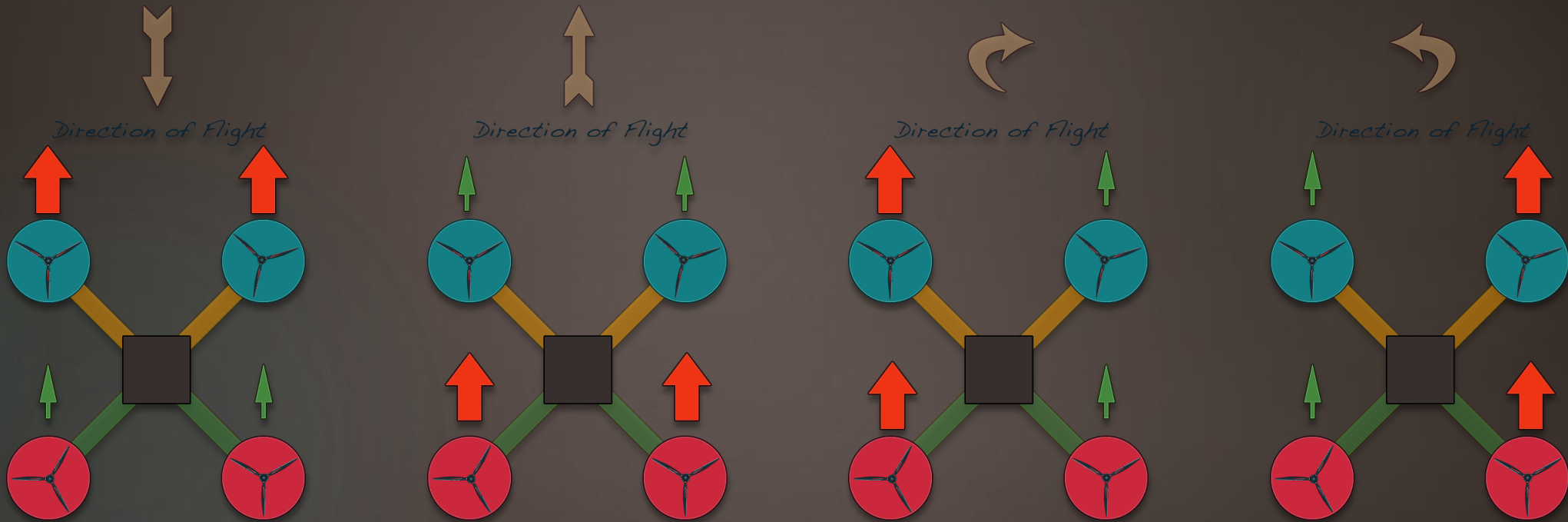


flight

Android Connectivity

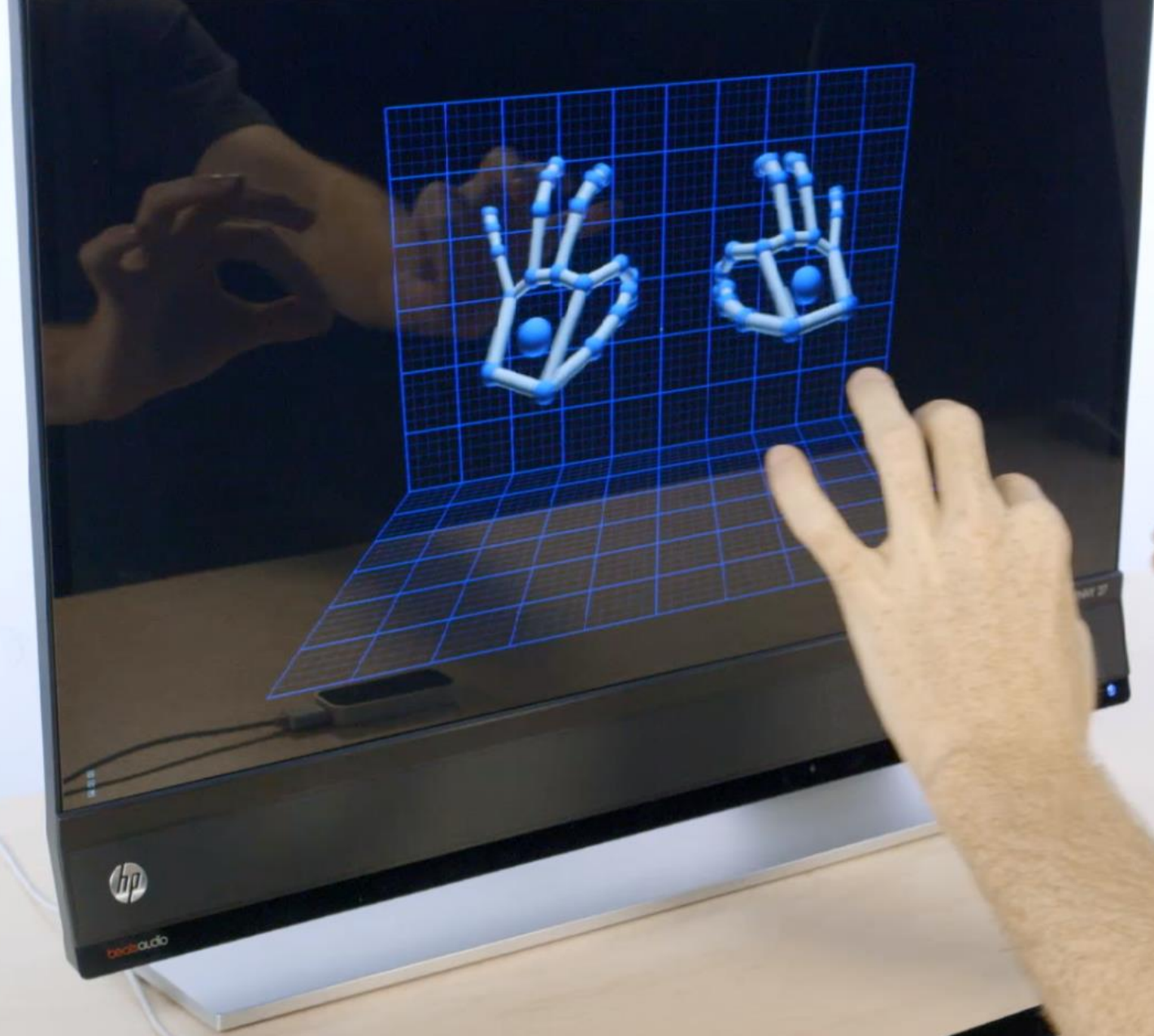


Quadcopter



Leap Motion







PROBLEM STATEMENT

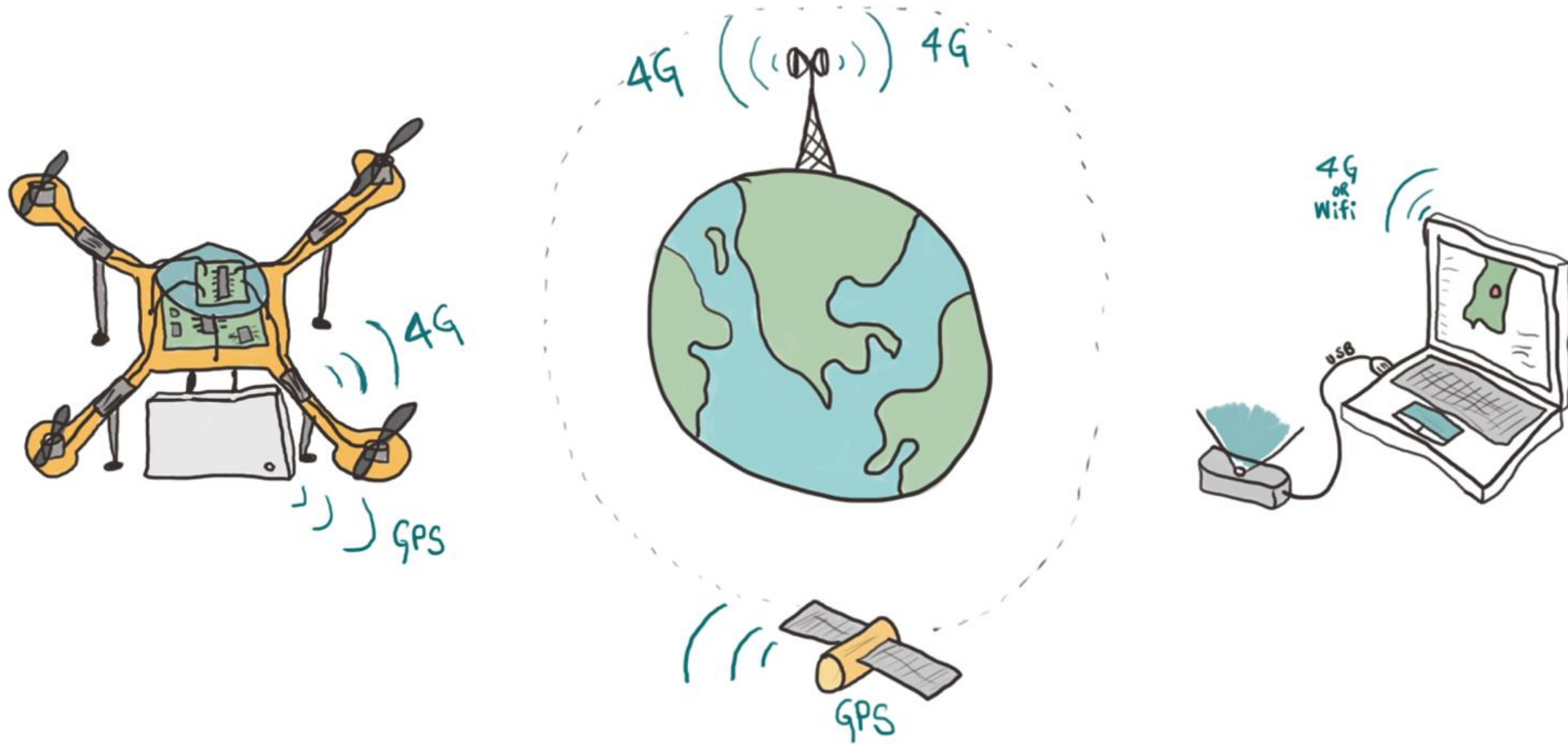


**Accident Rescue Teams are
Primitive and In-efficient**

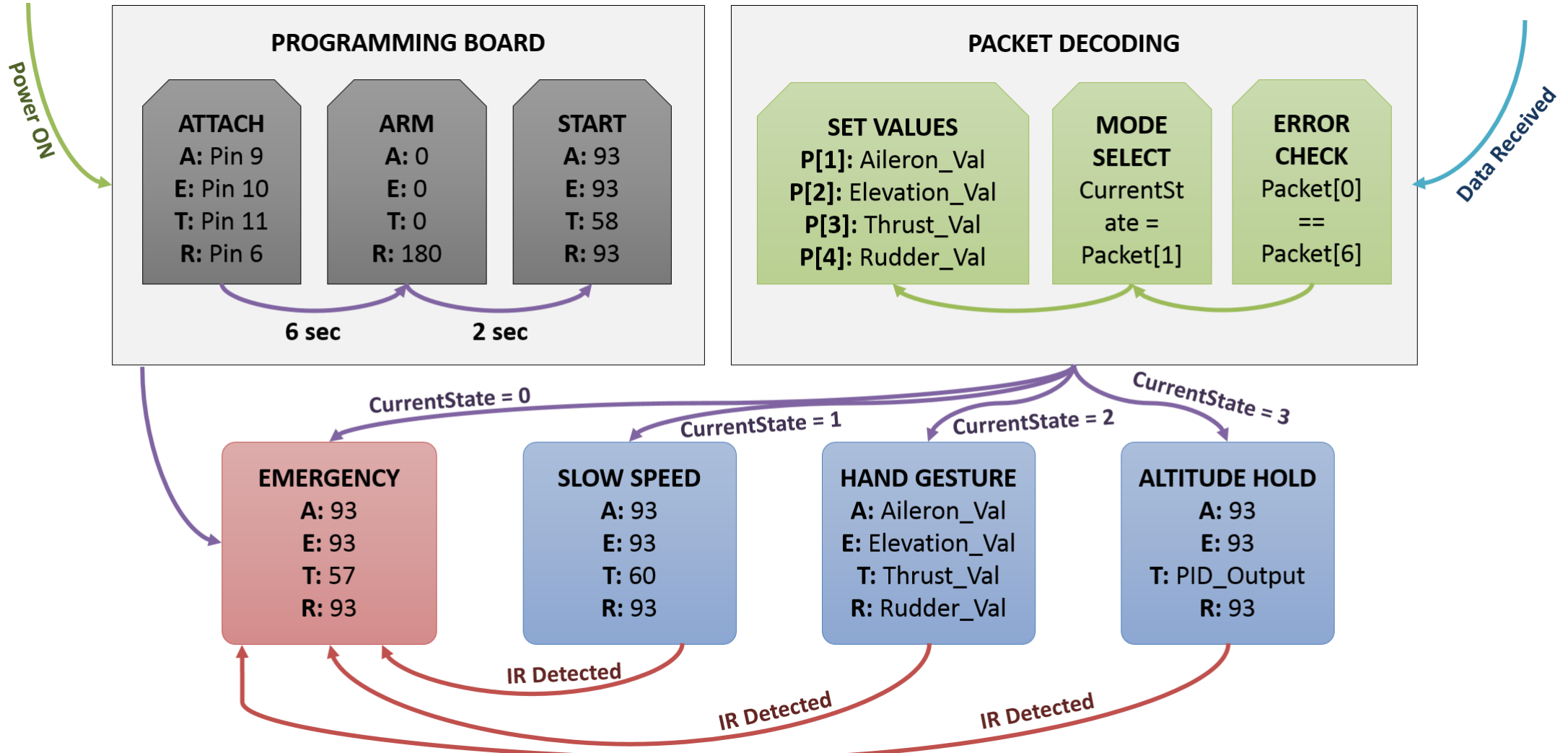


DESIGN

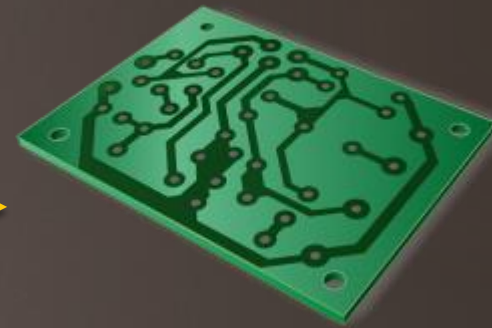
System Diagram



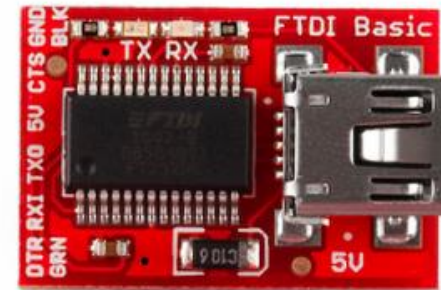
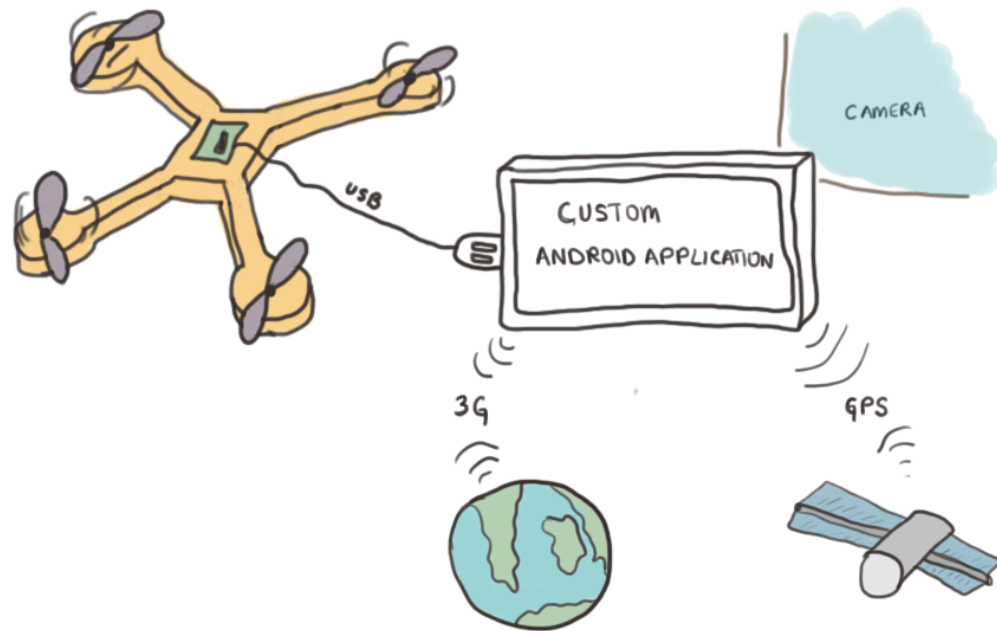
Finite State Machine (FSM)



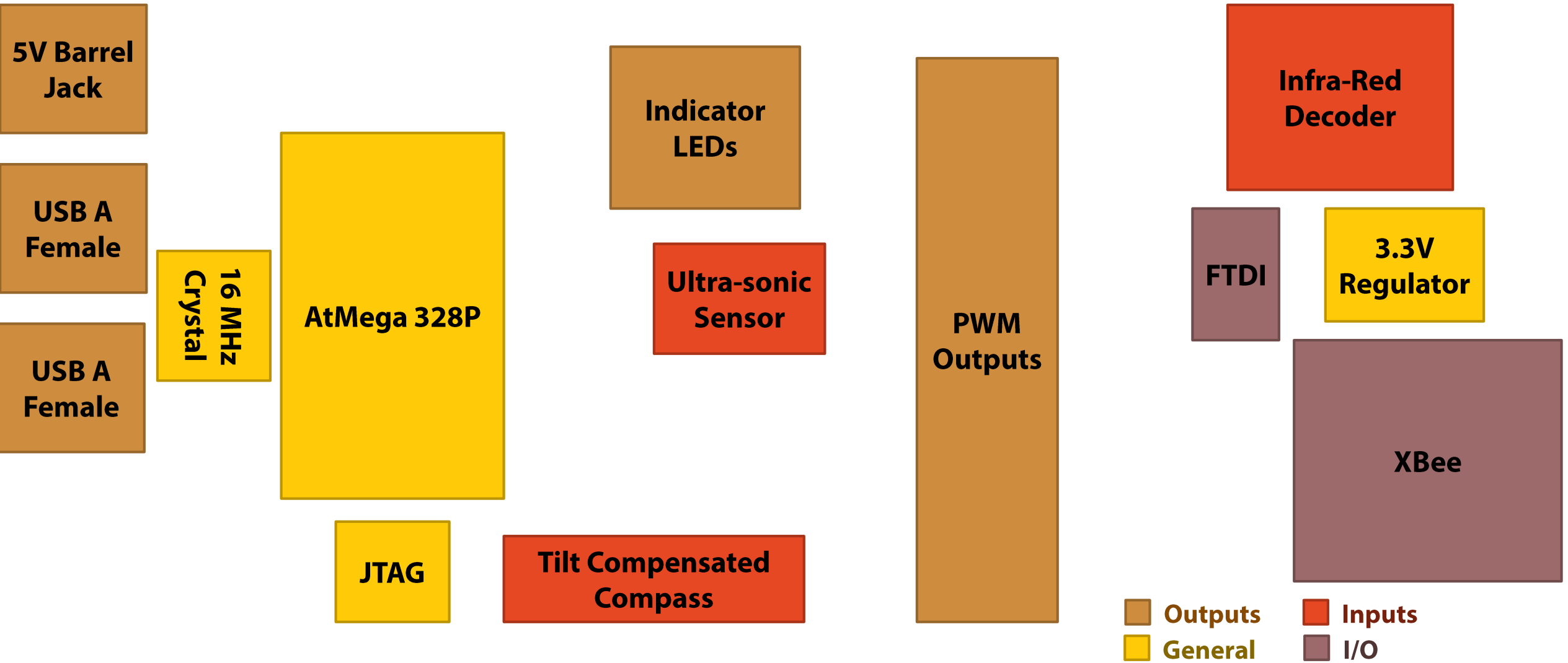
Smartphone – Controller Board



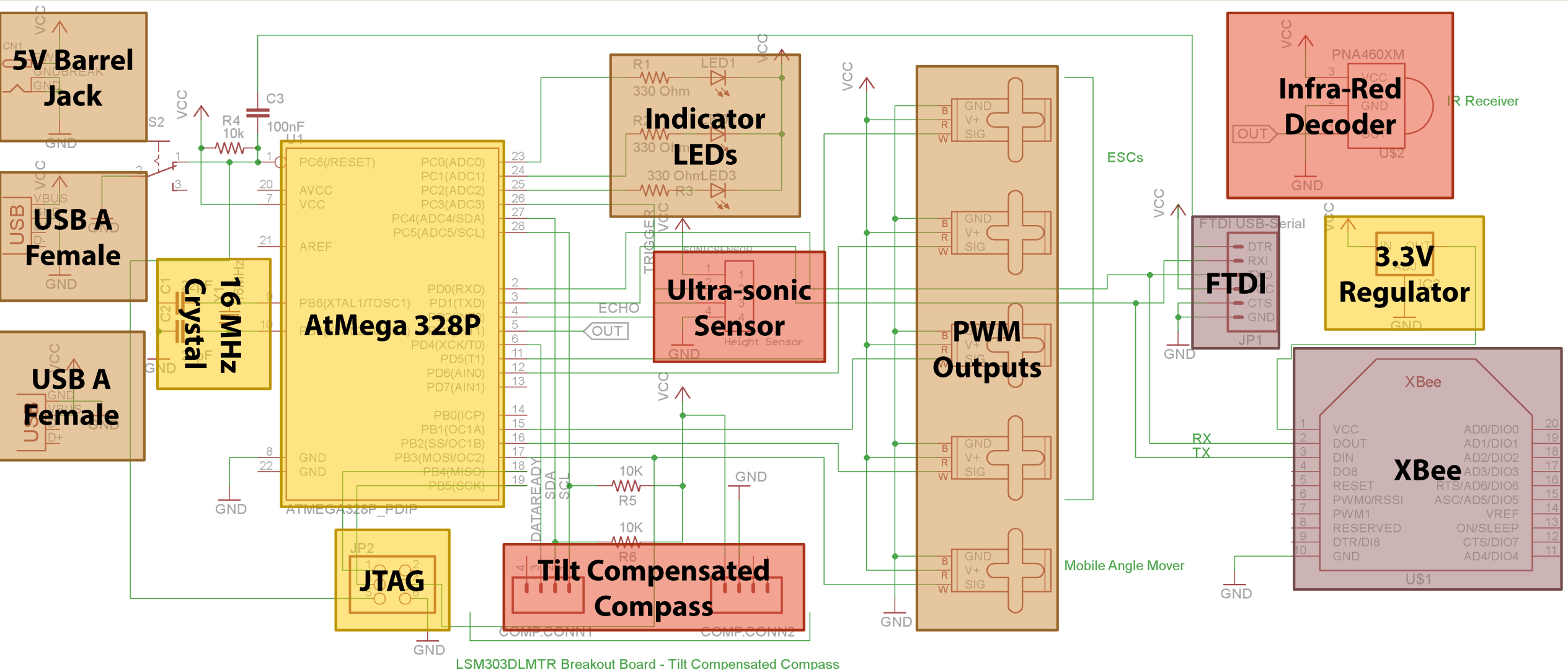
Smartphone – Controller Board



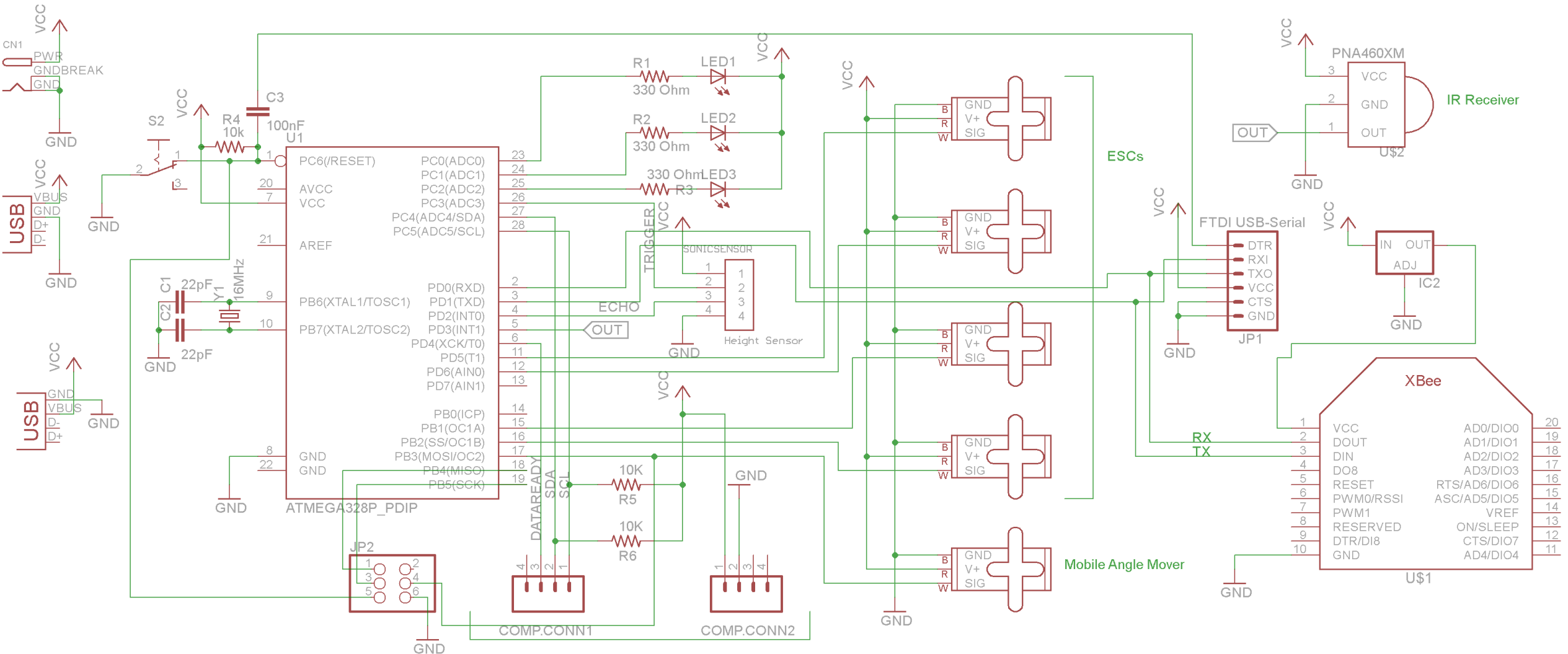
Circuit Blocks



Circuit Blocks



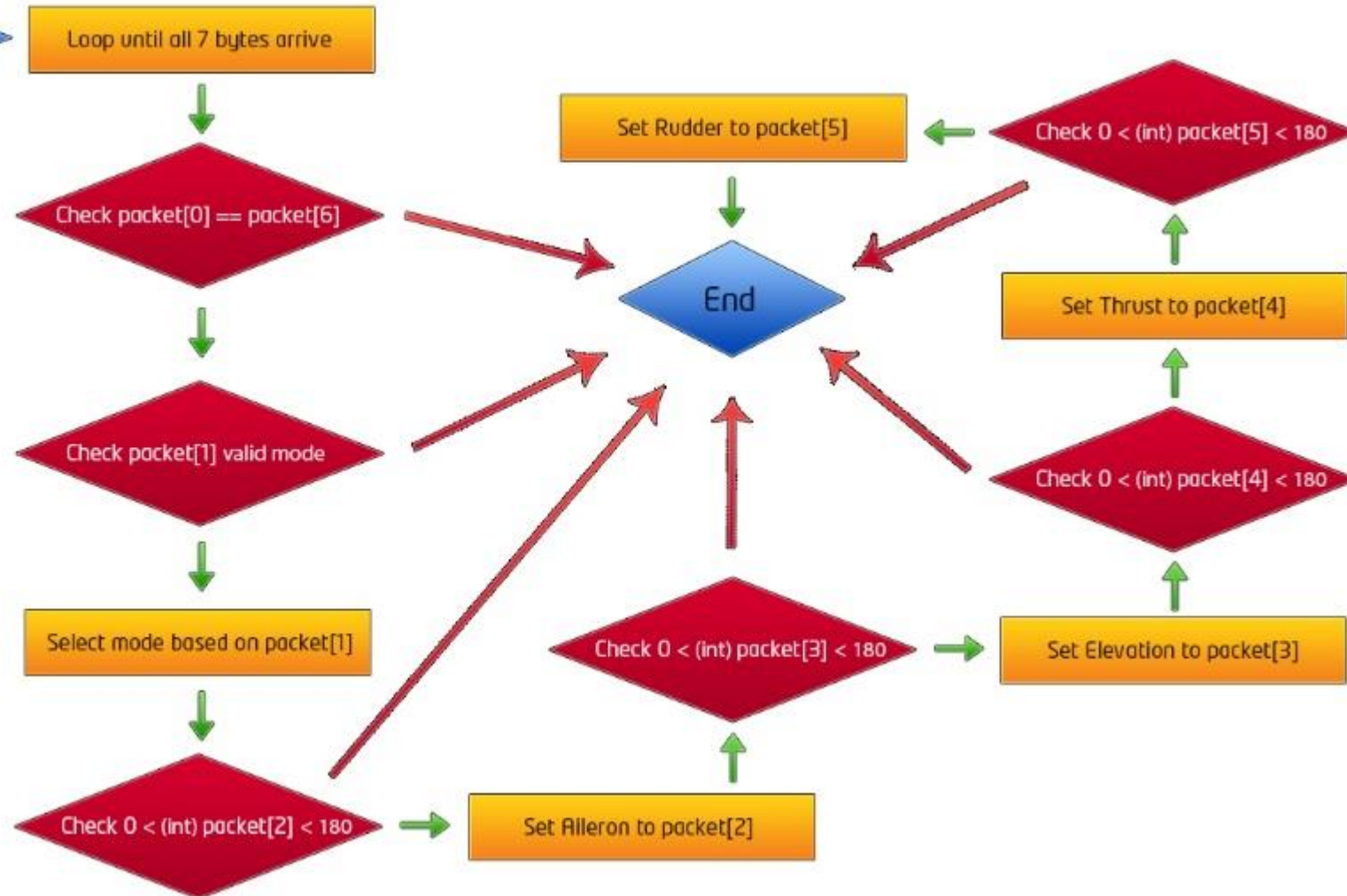
Circuit Diagram



LSM303DLMTR Breakout Board - Tilt Compensated Compass

Protocol Design

1 Byte Arrives
SerialEvent() Called



Ground Station Design

Microsoft Visual Studio
OregoController - Microsoft Visual Studio

FILE EDIT VIEW PROJECT BUILD DEBUG TEAM FORMAT TOOLS TEST ARCHITECTURE ANALYZE WINDOW HELP

Start Debug

Form1.cs [Design] MissionPlanner.cs [Design] StateObject.cs

OREGO X - Dash Board

Serial Socket Bluetooth

Socket Configurations
IP Address: 192.168.1.118 Port No.: 3030

Flight Data
Aileron: 93
Elevation: 93
Thrust: 58
Rudder: 93

Mode
Emergency
Slow Speed
Gesture Control
Altitude Hold

Data Sent: label28

Status
 Armed

Height (cm)
0 50 100 150 200

Live Stream

Properties
Form1 System.Windows.Forms.Form

- AccessibleRole: Default
- Appearance
 - BackColor: Control
 - BackgroundImage: (none)
 - BackgroundImageTile: Tile
 - Cursor: Default
- Font: Microsoft Sans Serif
- ForeColor: ControlText
- FormBorderStyle: Fixed3D
- RightToLeft: No
- RightToLeftLayout: False
- Text: Orego X Control
- UseWaitCursor: False

- Behavior
- AllowDrop: False
- AutoValidate: EnablePreventFocus
- ContextMenuStrip: (none)
- DoubleBuffered: False
- Enabled: True
- ImeMode: NoControl
- Data
- (ApplicationSetting)

Android Application Design

The screenshot displays the Android Studio IDE for a project named 'UDPServer'. The top toolbar shows various development tools. The project explorer on the left shows the directory structure: `UDPServer (C:\Users\Muhammad\Dropbox\capstone\software\code\UDPServer)` with subfolders for `build`, `src`, and `res`. The `src` folder contains a `main` directory with `java` and `res` subdirectories. The `java` directory contains `com.example.app` with `driver`, `util`, `MainActivit`, and `PIDControll` files. The `res` directory contains a `drawable-hdpi` folder with various image assets.

The code editor shows the `activity_main.xml` file with the following XML code:

```
android:layout_height="wrap_content"
android:weightSum="1"
android:orientation="horizontal">
<Button
    android:layout_weight="0.5"
    android:id="@+id/start_udp"
    android:layout_width="match_parent"
    android:layout_height="50dp"
    android:layout_margin="5dp"
    android:layout_marginRight="15dp"
    android:background="@drawable/orange_btn_xamel"
    android:text="Start Socket"
    android:textColor="#3e2a09"
    android:textStyle="bold"
    android:shadowColor="#FFFFFF"
    android:shadowDx="0"
    android:shadowDy="1"
    android:shadowRadius="1" />
<Button
    android:layout_weight="0.5"
    android:id="@+id/start_cameraStream"
    android:layout_width="match_parent"
    android:layout_height="50dp"
```

The device preview on the right shows a Nexus 4 smartphone displaying the application's UI. The app title is 'UDPServer' and the screen content includes:

- Local IP Address: Calculating...
- Global IP Address: Calculating...
- Connection: Disconnected
- Mode: Emergency
- Aileron: 0
- Elevation: 0
- Thrust: 0

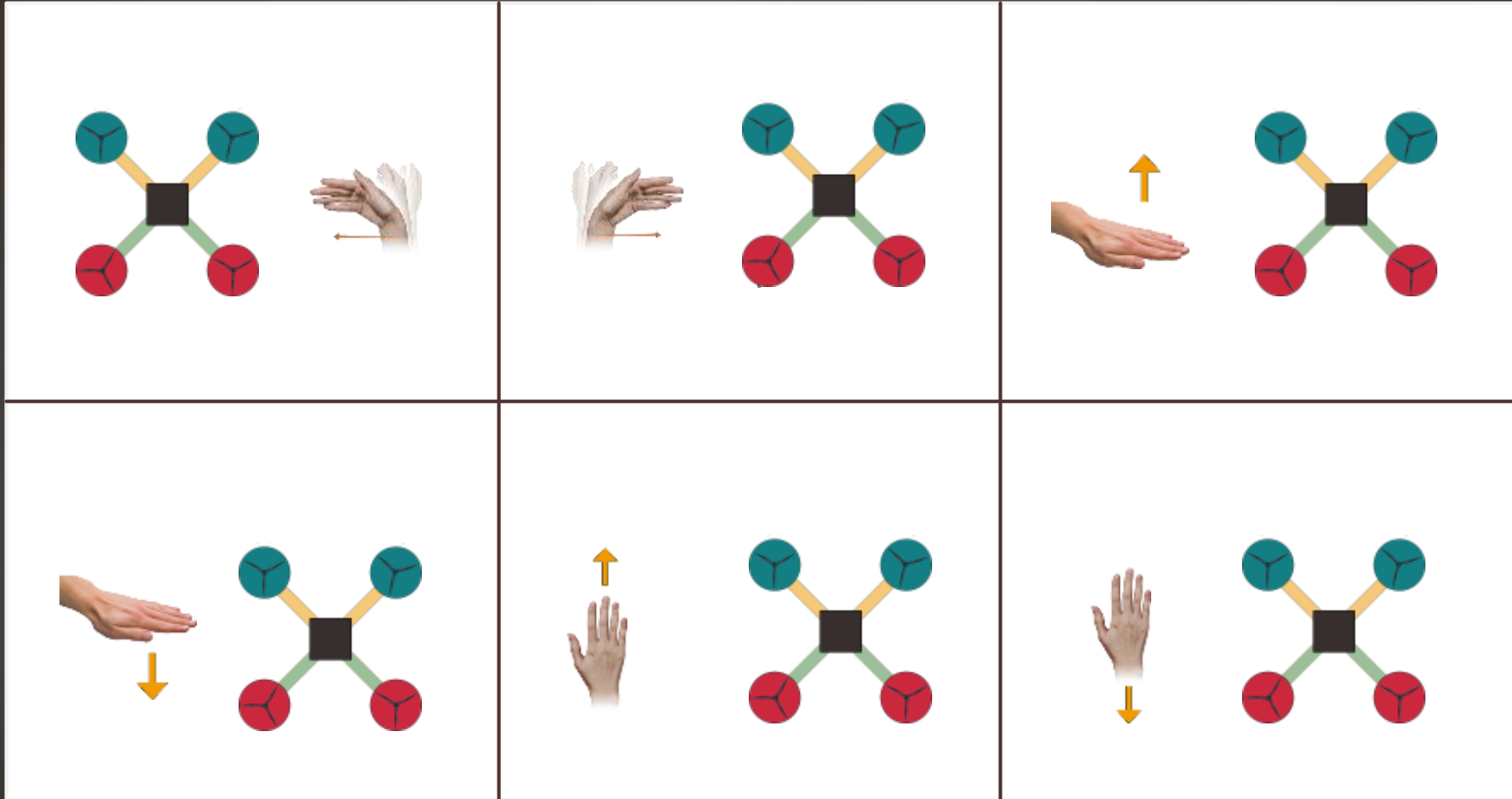
Layout Design

- ✓ Scrollview Parent
- ✓ Beautiful Design
- ✓ Expandable/Dynamic
- ✓ 9 Patch Images



SCROLLVIEW

Gesture Models



Gesture Models



PITCH



THRUST



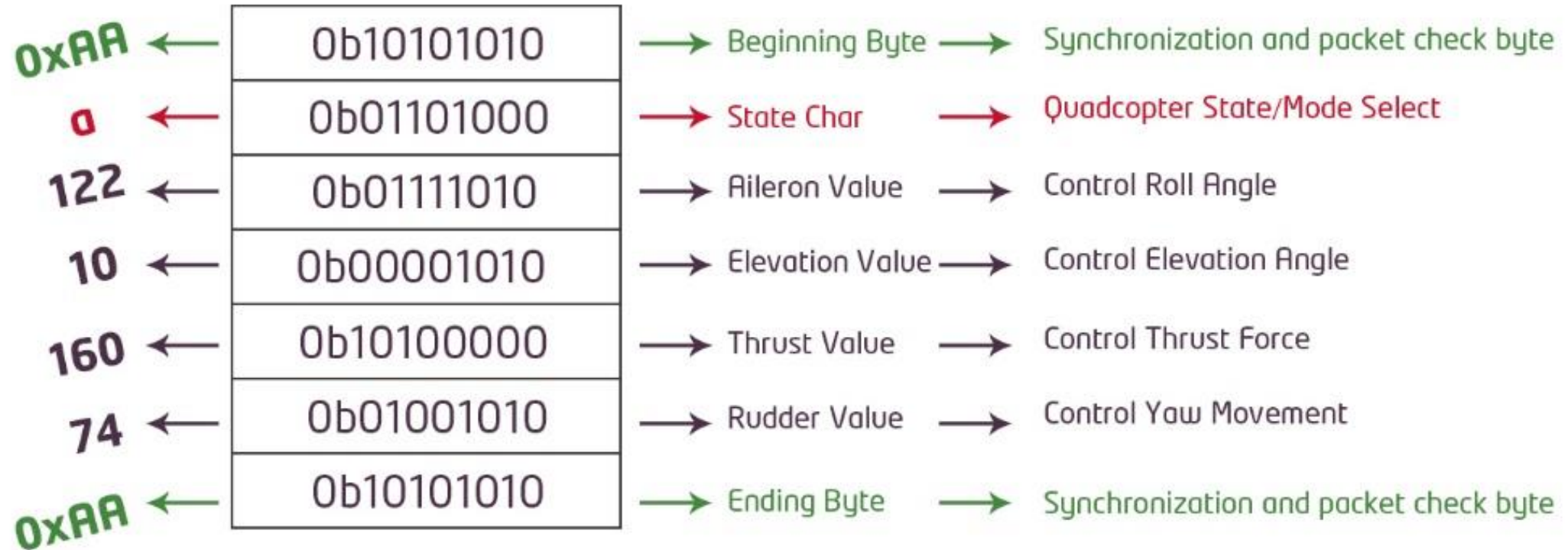
ROLL



SOFTWARE IMPLEMENTATION

Protocol Implementation

OBFlightPacket



C# Ground Station Application

- ✓ Communication through USB and XBee
- ✓ Embedded Maps
- ✓ Waypoint selection
- ✓ Live update of Quadcopter location
- ✓ Select between Xbee/Socket comm.
- ✓ Kill switch
- ✓ Hand Pitch, Roll, & Yaw detection
- ✓ Automatic mapping from hand gestures to Flight Data

The screenshot displays the 'OREGO X Control' application window. The main dashboard is titled 'OREGO X - Dash Board' and features several sections:

- Socket Configurations:** Includes fields for IP Address (192.168.1.118) and Port No. (3030), along with connection icons.
- Flight Data:** Shows progress bars and numerical values for Aileron (93), Elevation (93), Thrust (58), and Rudder (93).
- Mode:** A vertical stack of buttons for 'Emergency' (red), 'Slow Speed' (green), 'Gesture Control' (orange), and 'Altitude Hold' (blue).
- Data Sent:** A text field displaying 'label28'.
- Status:** A checkbox labeled 'Amed'.
- Height (cm):** A horizontal slider ranging from 0 to 200.
- Live Stream:** A large video window showing a first-person view from a drone flying over a residential neighborhood.
- Serial Console:** A black window with white text showing connection status: 'Once the connection is established... The Communication shows up here. Copyright Muhammad Obaidullah. OREGO X'.
- Leap Motion:** A section for hand gesture control with fields for Frame ID (-1), Time Stamp (0), No. of Hands (0), No. of Fingers (0), No. of Tools, and Gestures (0). It also includes Palm Position, Pitch, Roll, and Yaw indicators, each with a green arrow pointing up.

The application status at the bottom left is 'Ready'.

Android Classes Used



USB



Google Maps



IP Cam



Service



Thread



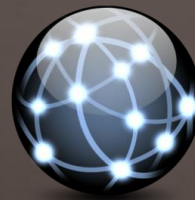
Location Service



Sensor



Widget



Socket

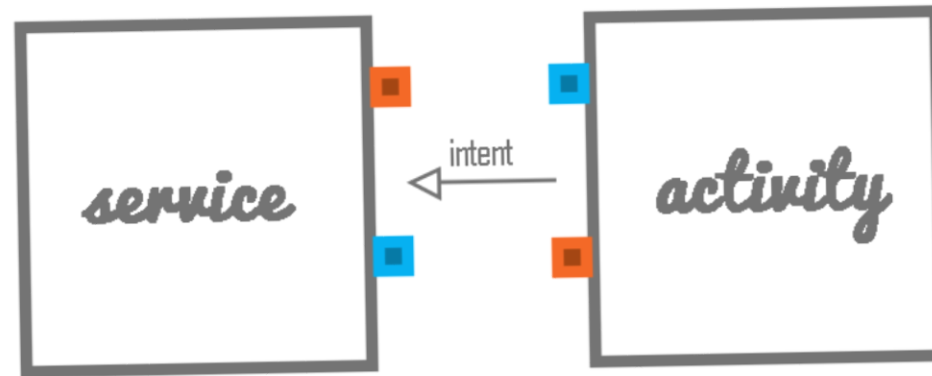


DatagramSocket



JSONObject

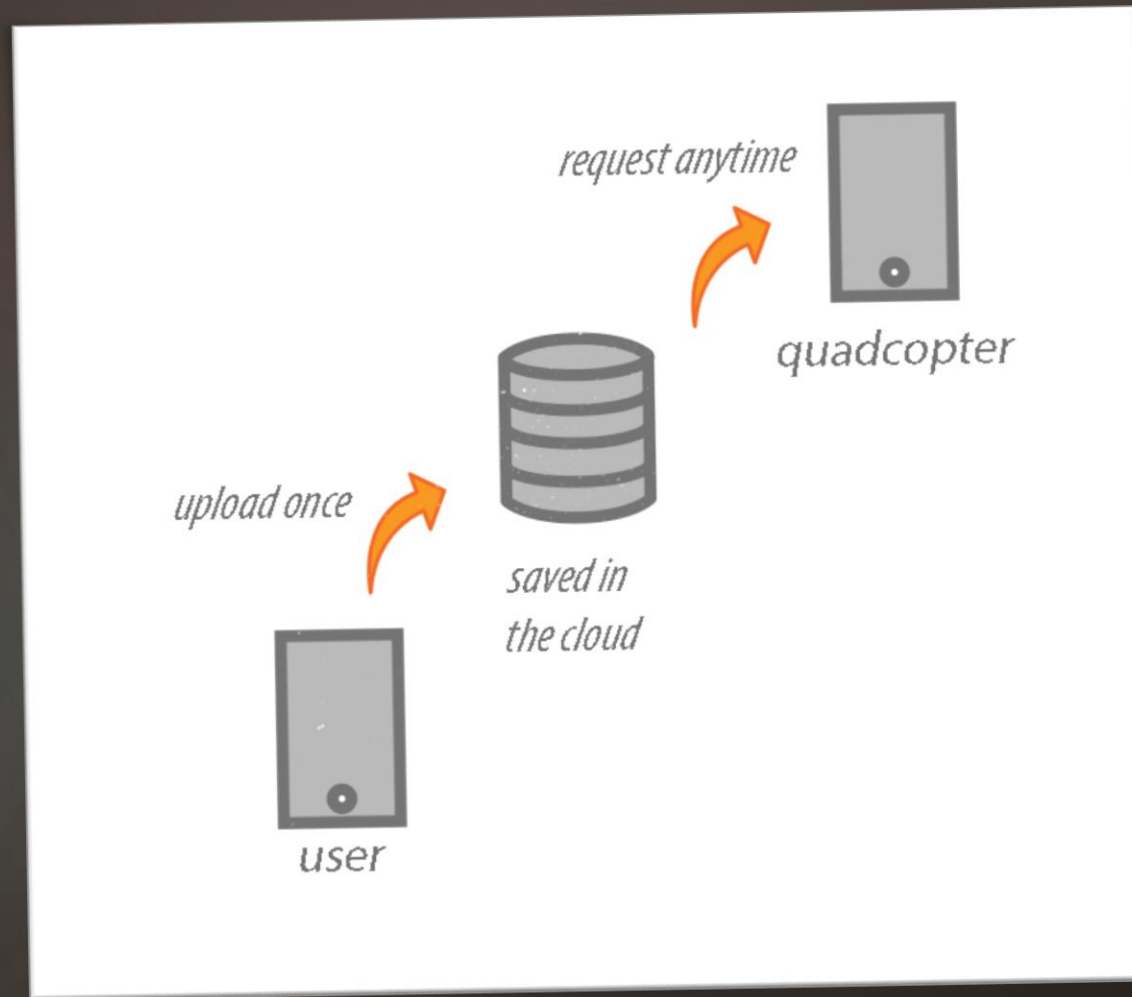
Android Service



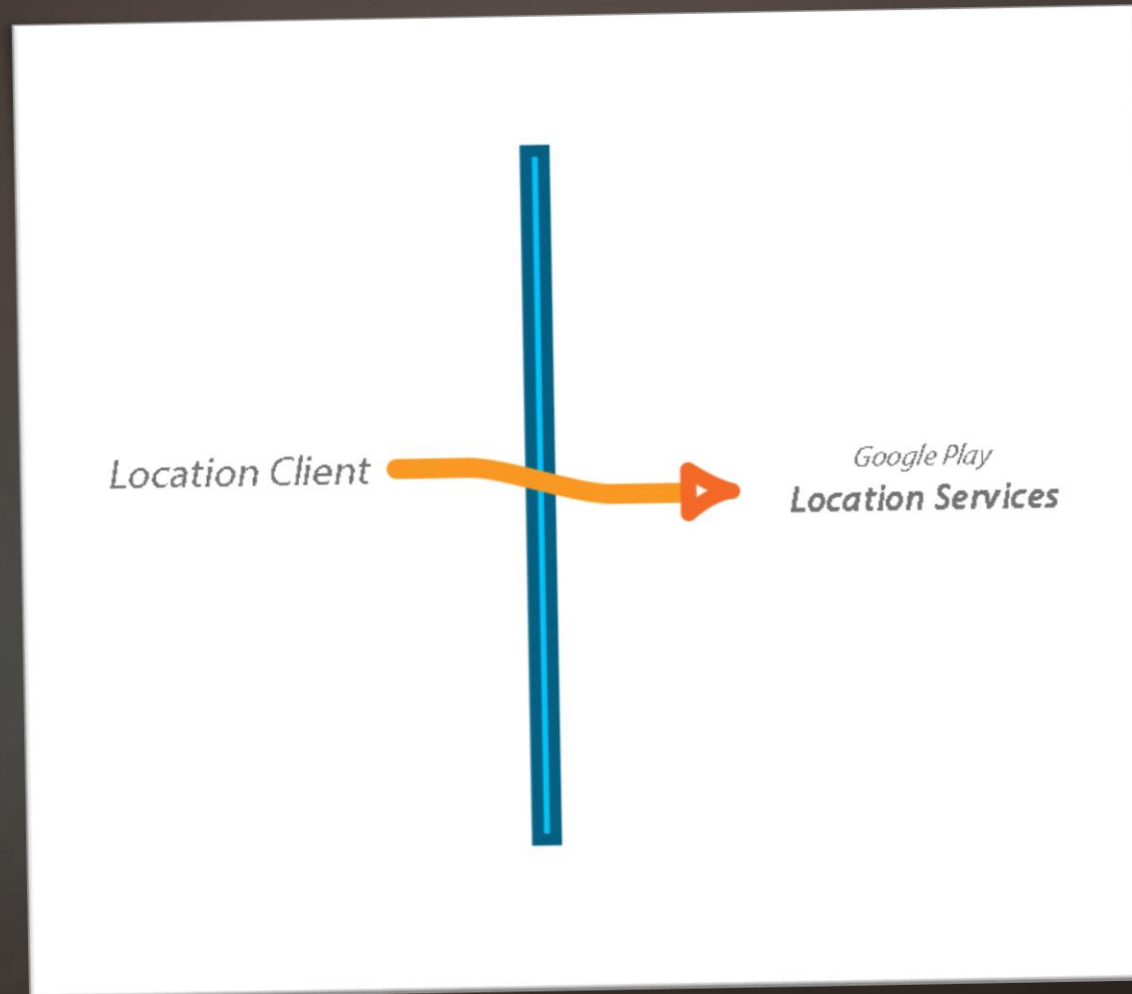
■ *MessageHandler*

■ *Messenger*

json

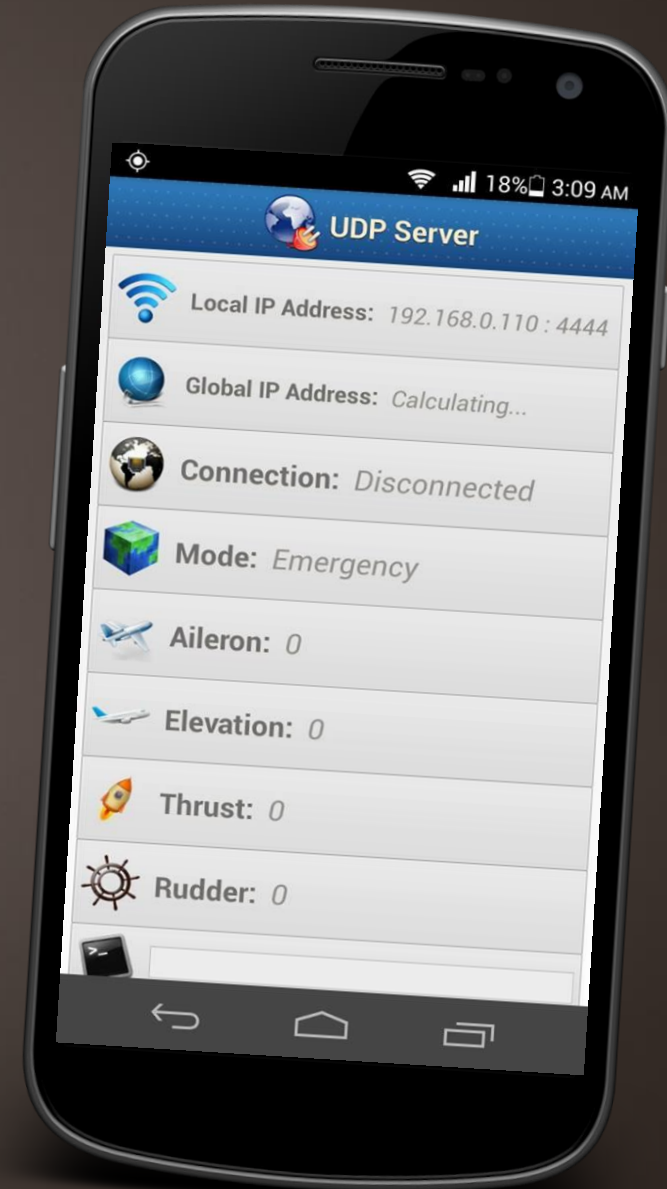


Google Play Services



Android Application

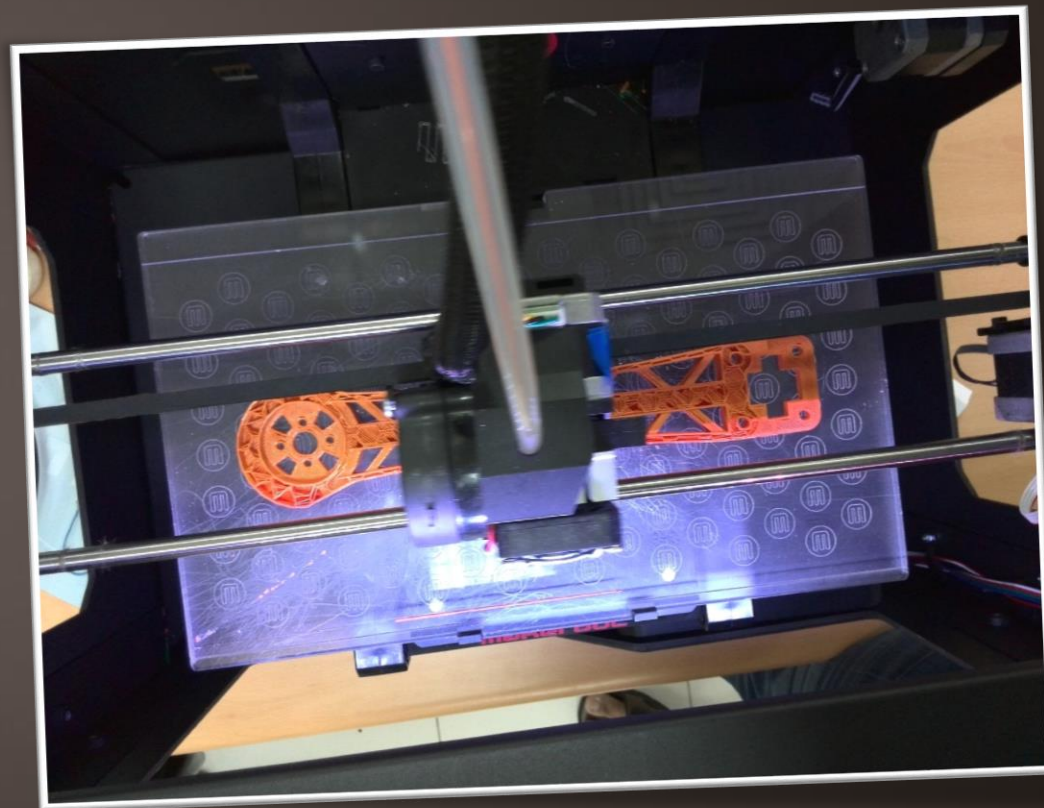
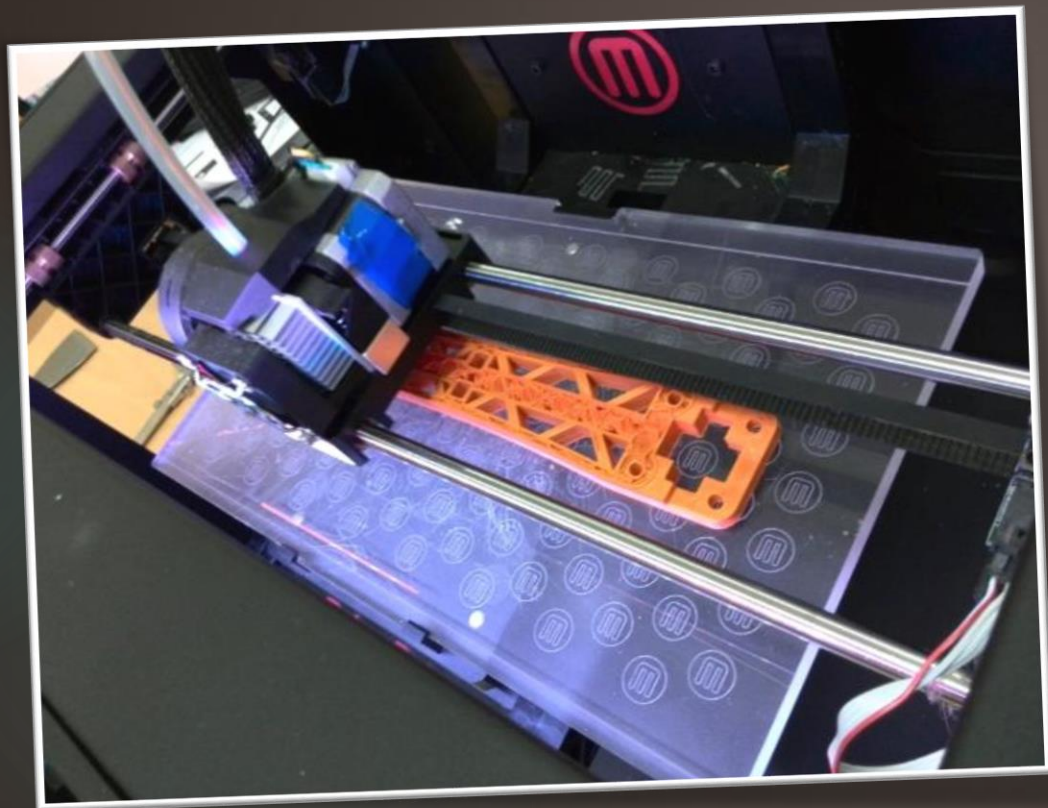
- ✓ Communication through USB and XBee
- ✓ Automatically grabs global & local IP
- ✓ Intelligent connection status detection
- ✓ 3 seconds connection lost emergency mode
- ✓ Shows live flight values
- ✓ USB Terminal
- ✓ Automatic GPS location update



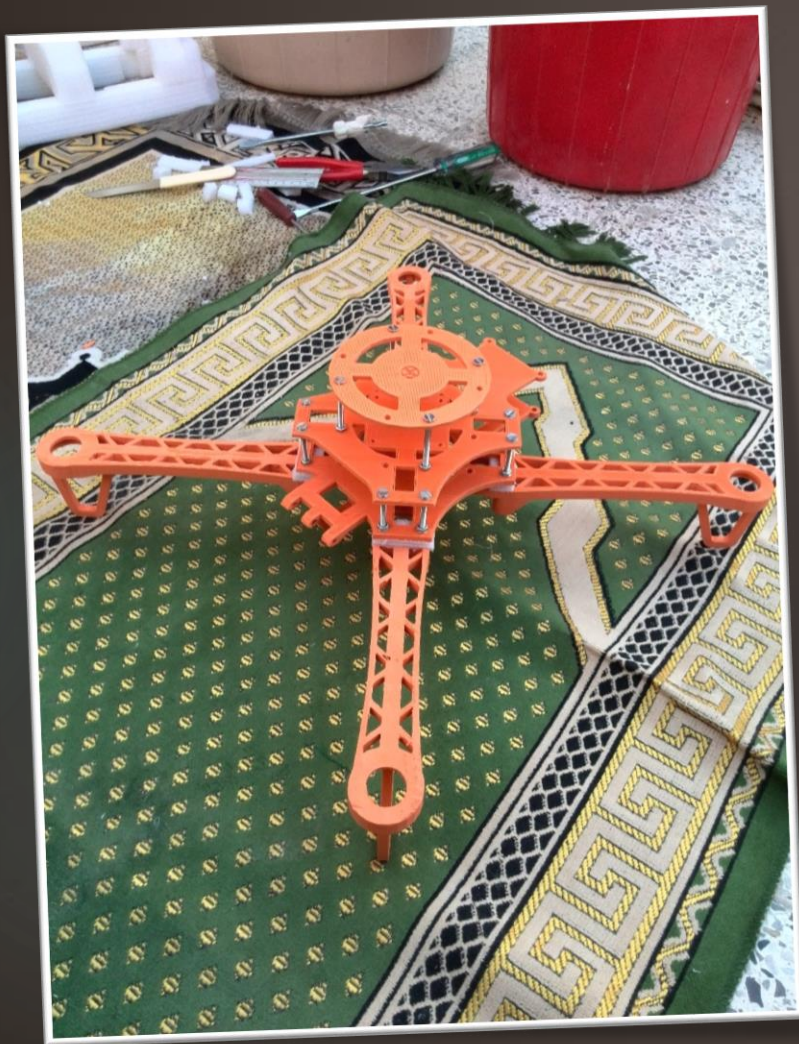


HARDWARE IMPLEMENTATION

3D Plastic Printing

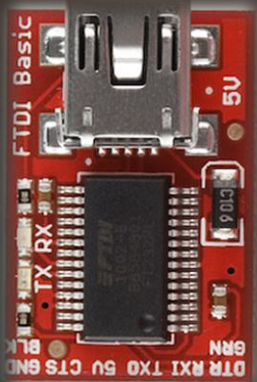


Initial Plastic Design

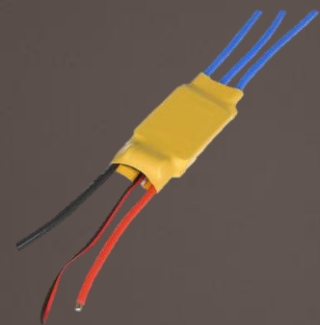




Key Components



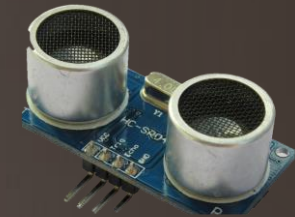
FTDI 5V Breakout



Electronic Speed Controller
30Amps

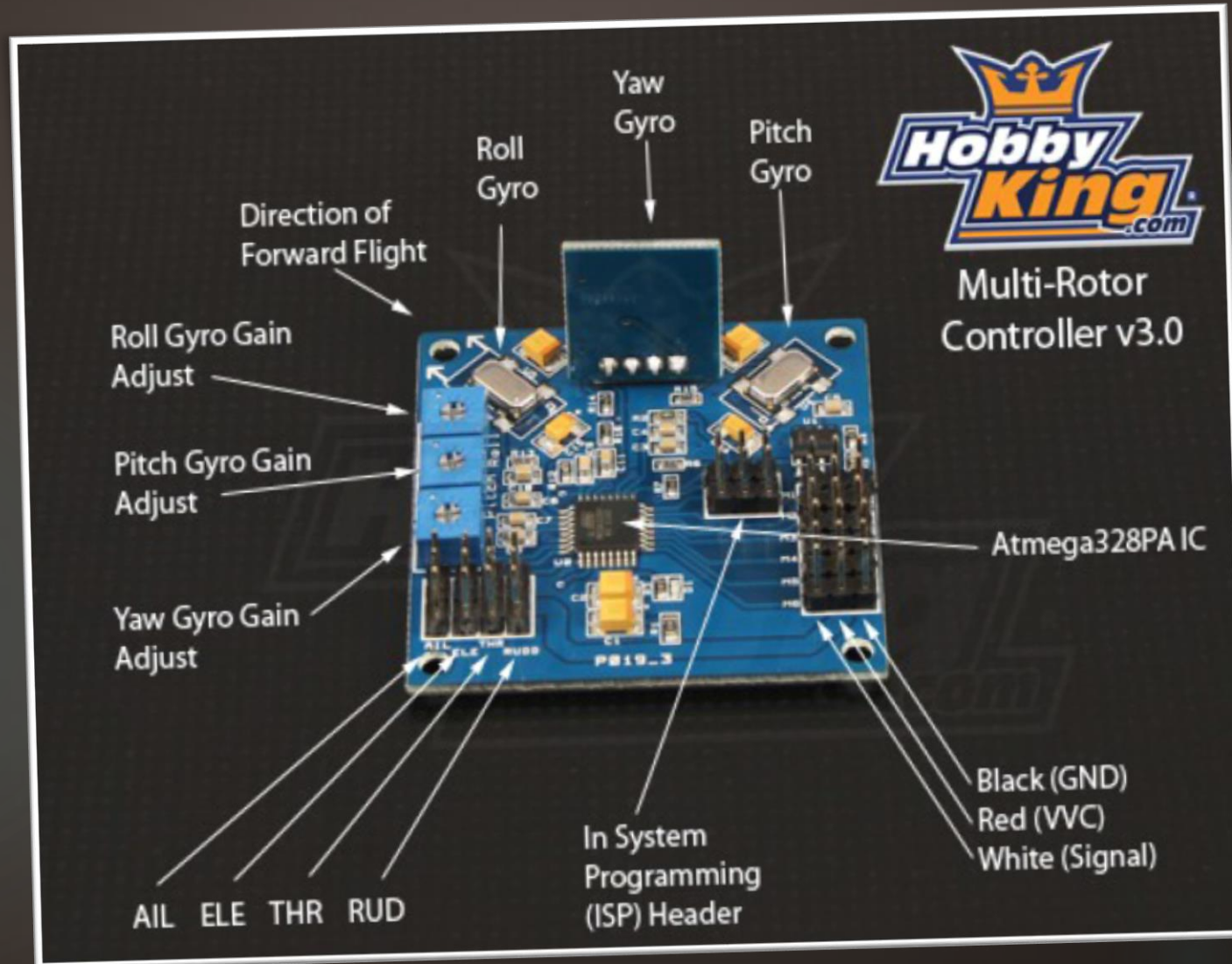


X-Bee

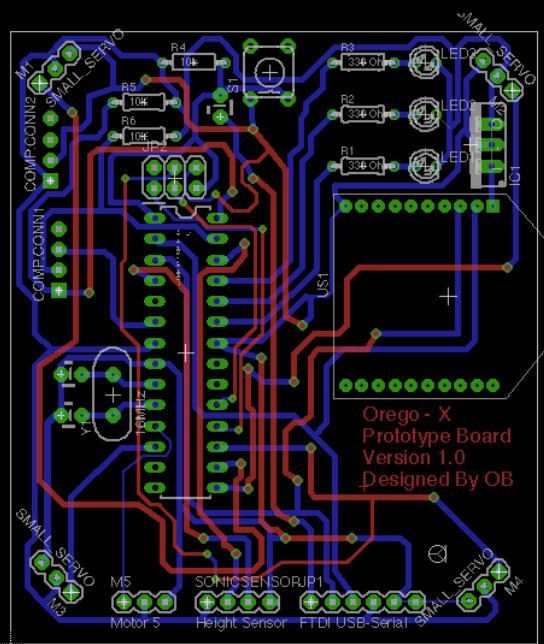


Ultra-Sonic Height Sensor

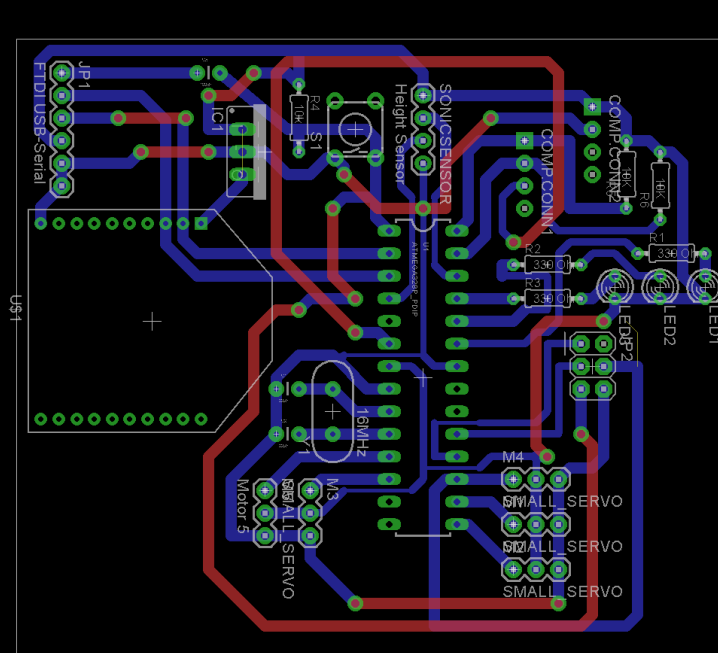
HobbyKing Controller Board



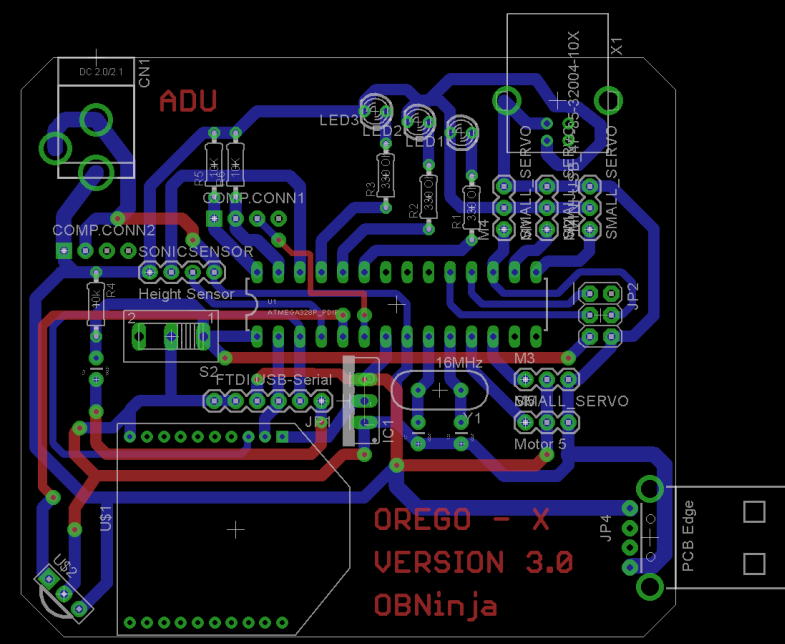
PCB Prototypes



Version 1

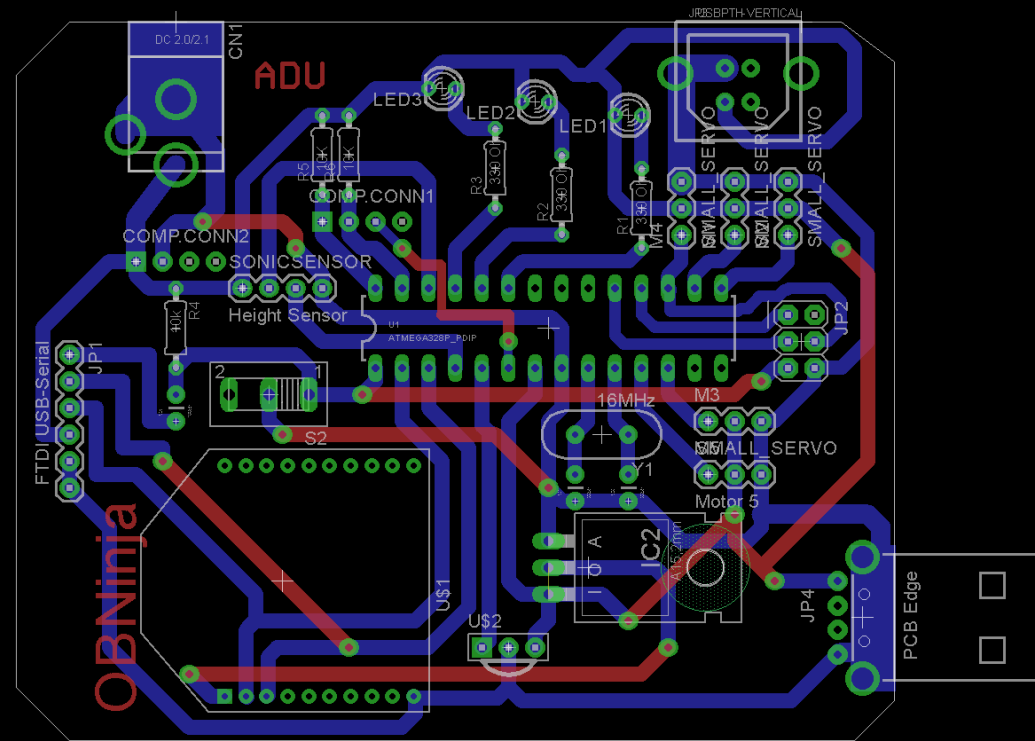


Version 2



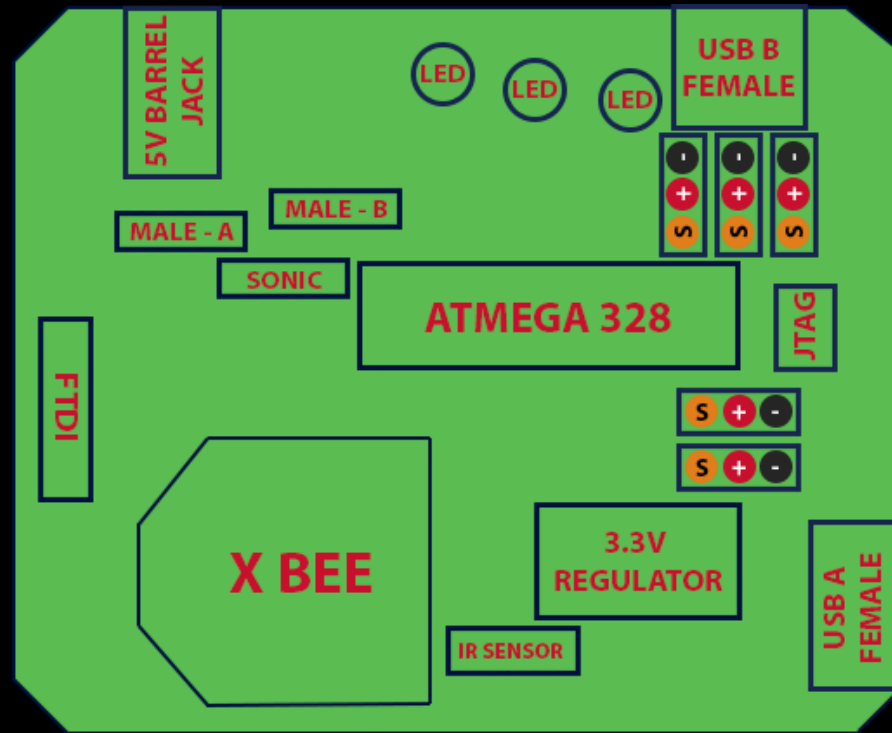
Version 3

Final PCB



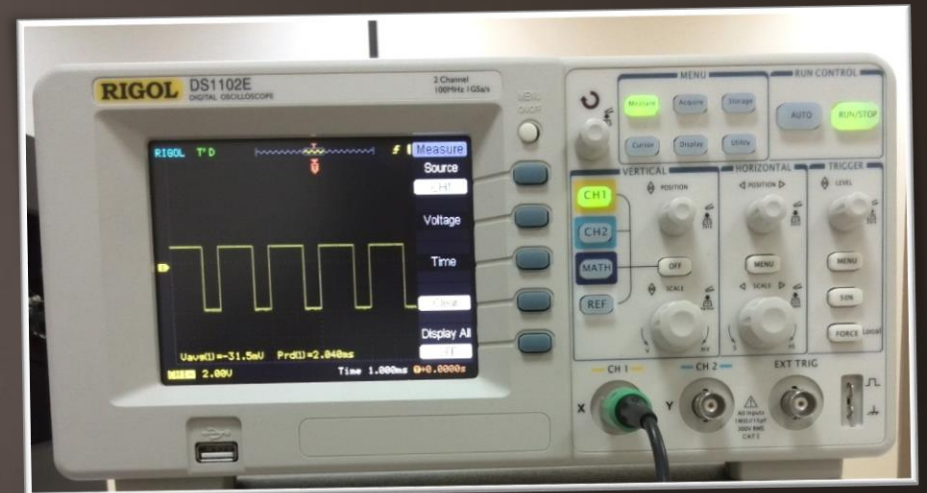
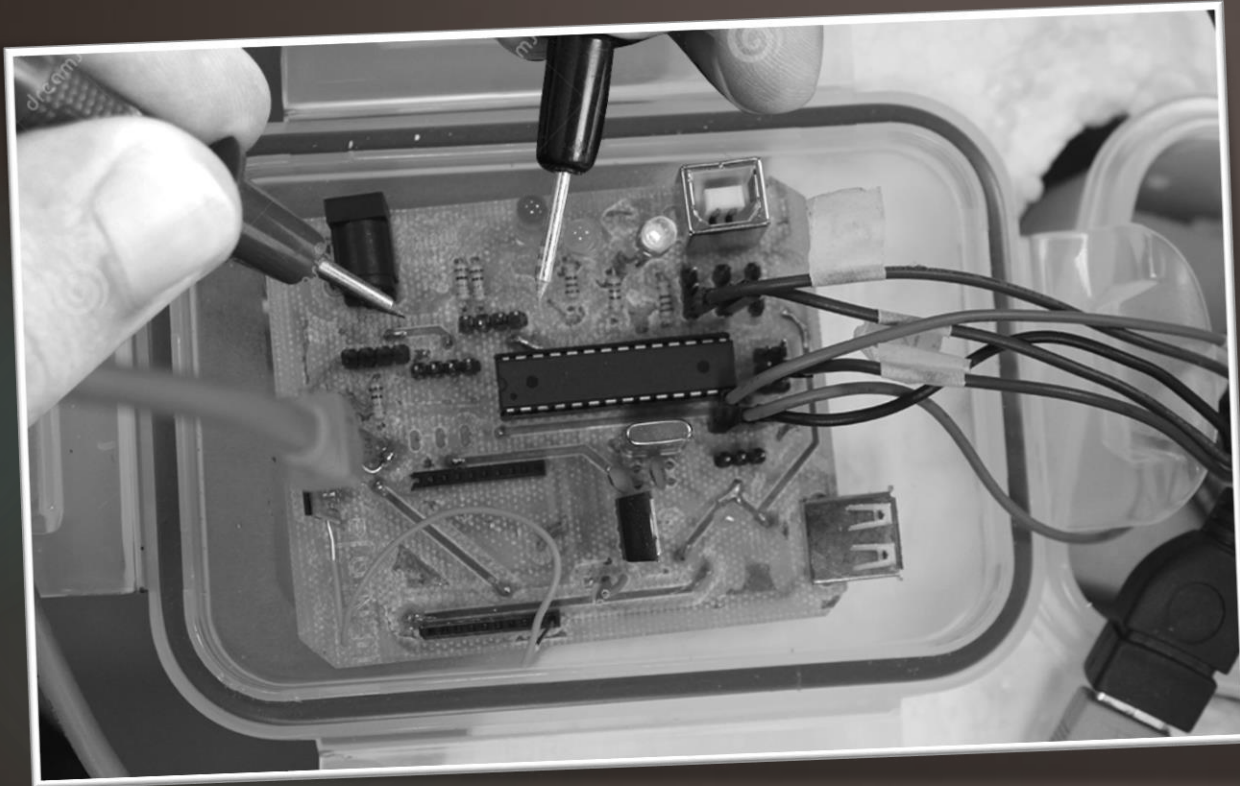
Final Version

Final PCB Layout Guide



Final Version

Circuit Board Testing



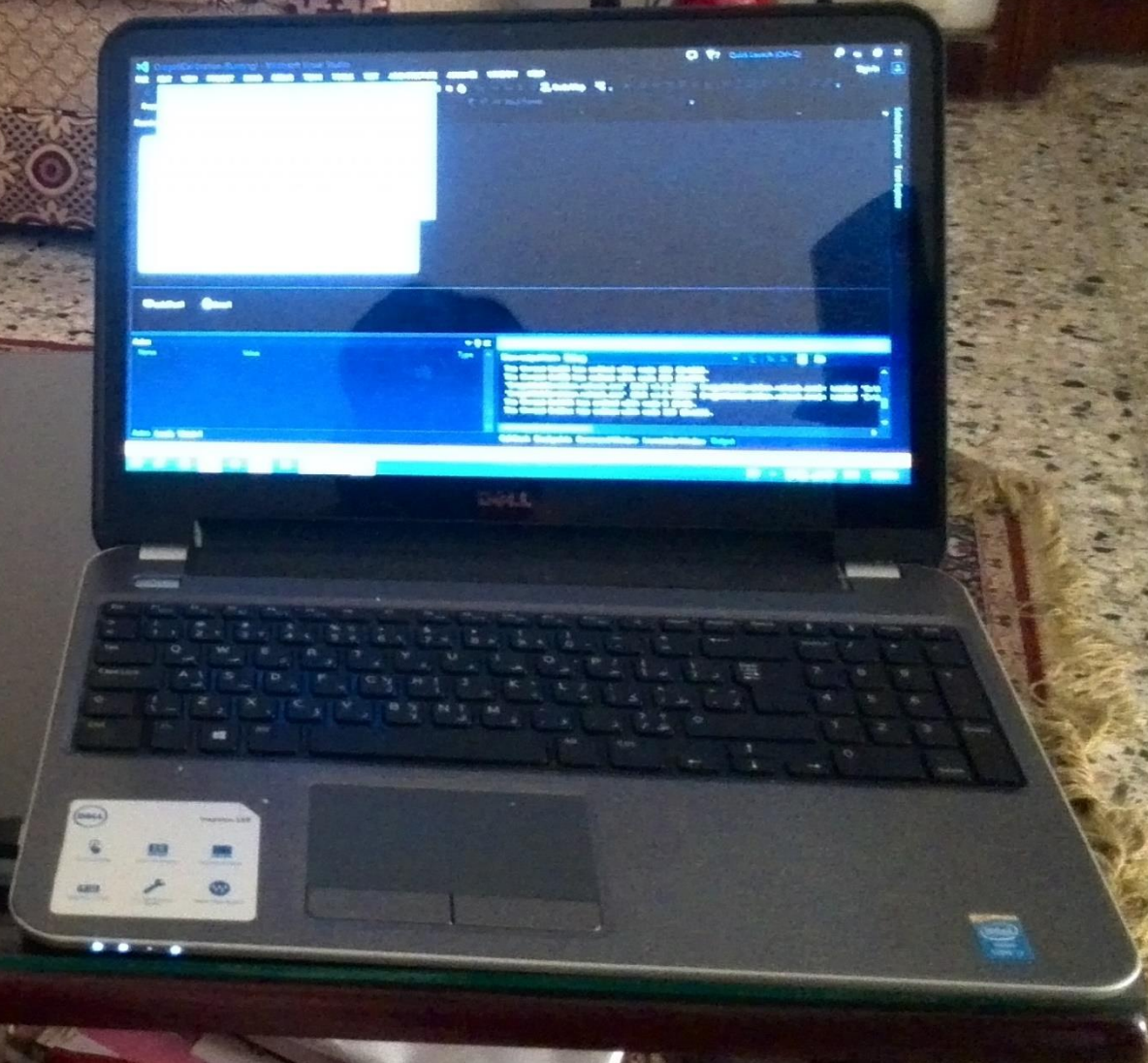
Traditional 2.4 GHz Radio Controller

- ✓ 1~1.5 Km range.
- ✓ 4-8 Different Channels for each value.
- ✓ Open loop control.
- ✓ Signals using PPM.
- ✓ ~2Mb/s data rate.



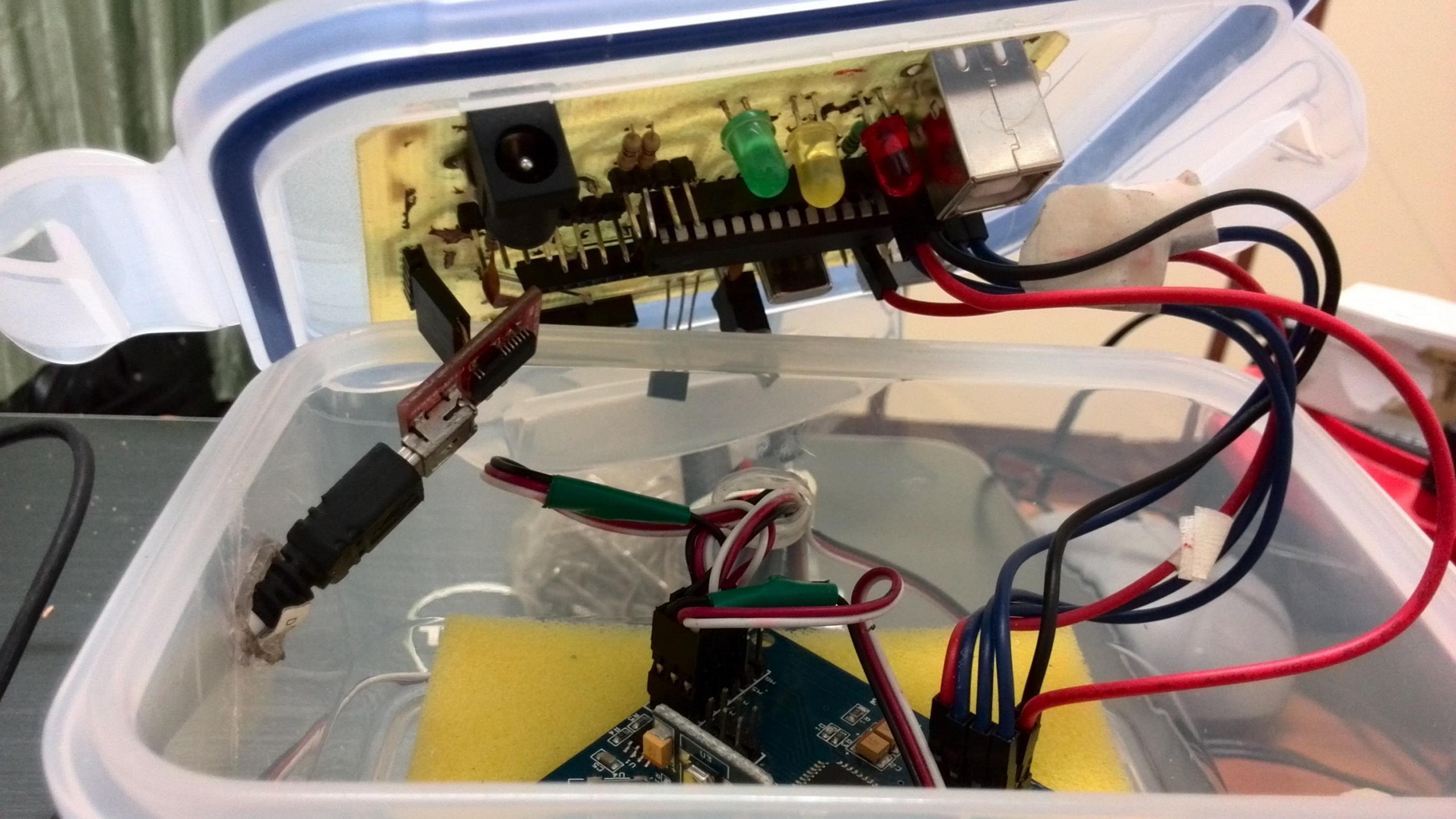


RESULTS & DISCUSSION





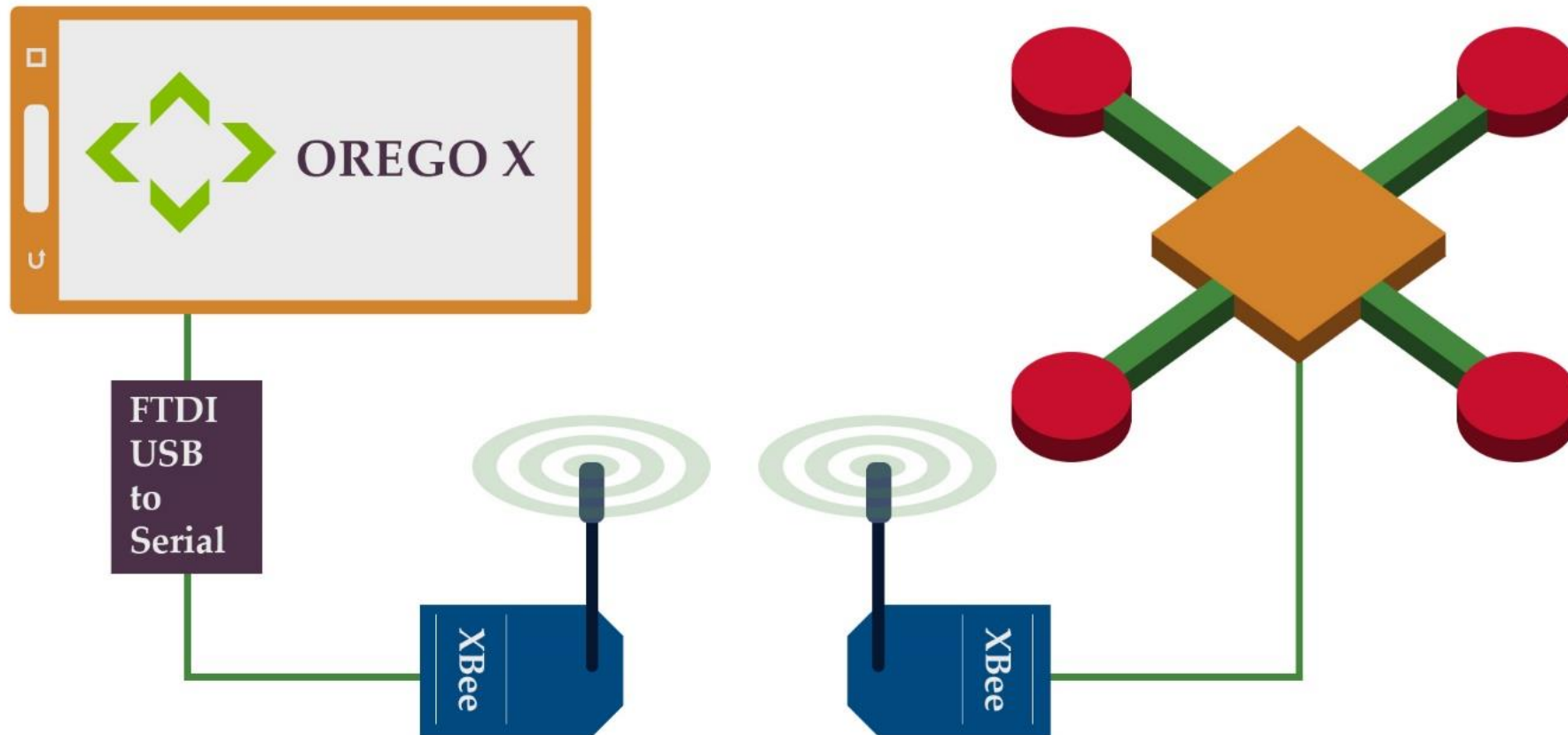




Test Rig

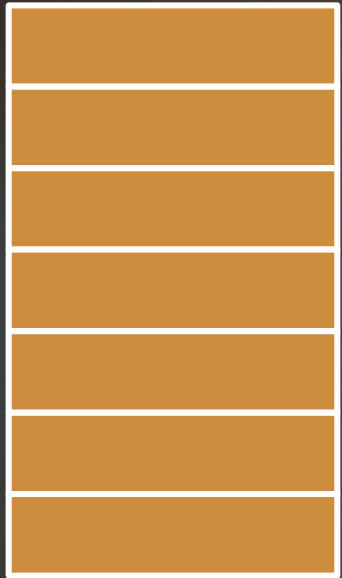


Protocol Test



Protocol Test

Bytes



Bits/Packet = $7 \times 8 = 56$ bits

$Transfer\ Time = \frac{56}{1200} = 0.0467\ seconds \approx 47ms$

Value Sender Timer



Value Sender Timer

Interval: 50ms

Packet Sending Rate: 20 packets/second

Job: Send the values after regular intervals to the quadcopter

A screenshot of the Visual Studio Properties window for a 'valueSender' control. The window title is 'Properties' and the control is identified as 'valueSender System.Windows.Forms.Timer'. The 'Behavior' section is expanded, showing 'Enabled' set to 'False' and 'Interval' set to '50'. Other sections like 'Data' and 'Design' are partially visible.

Properties	
valueSender System.Windows.Forms.Timer	
Behavior	
Enabled	False
Interval	50
Data	
(ApplicationSetting)	
Tag	
Design	
(Name)	valueSender
GenerateMember	True
Modifiers	Private

Leap Frame Update Timer



Leap Frame Update Timer

Interval: 50ms

Job: Capture current frame and deduce the values after remapping

Properties

LeapFrameUpdate System.Windows.For

Behavior

Enabled	False
Interval	50

Data

(ApplicationSettin

Tag

Design

(Name)	LeapFrameUpdate
GenerateMember	True
Modifiers	Private



PROJECT MANAGEMENT

Cost Spent

S.No.	Part Name	Quantity	Total Cost (AED)
1.	ESC – 30 Amps	4	240.00
2.	30C LiPo Battery – 5000mAh	1	230.00
3.	Propeller Pusher Type – 10 x 4.7	2	43.20
4.	Propeller Slo Flyer Type – 10 x 4.7	2	41.70
5.	Propeller Adapter	4	70.60
6.	Screws	30	25.00
7.	ESC – 60 Amps	1	220.16
8.	Hobby King Control Board V3.0	1	66.02
9.	Brushless Motor SUPG8030	4	396.21
10.	Prop Drive Series 2830-1100KV Motor	4	237.72
11.	Prop Drive 28 Series Accessory Pack	4	27.76
12.	Tilt Compensated Compass Breakout	1	89.02
13.	XBee Explorer Dongle	1	91.64
14.	PCB	1	25.00
15.	Electrical Components	1	52.00
16.	Talon Carbon Fiber Quadcopter Frame	1	110.15
	Total		1966.18

PHASE 1 – Communication & PCB

S.No.	Task Name	Status	Completion Time
1.	Design the PCB	Complete	1 st February
2.	Solder the PCB	Complete	16 th February
3.	Writing the Code for Xbee Communication	Complete	18 th February
4.	Fine Tuning and Testing	Complete	1 st March

PHASE 2 – Quadcopter Stabilization

S.No.	Task Name	Status	Completion Time
1.	Buy the Controller Chip	Complete	15 th February
2.	Finding the Control Signals for the Controller Chip	Complete	22 nd April
3.	Writing the Code for Stabilization	Complete	25 th June
4.	Achieve effective Communication between Xbee and Controller Chip	Complete	16 th April

PHASE 3 – Android WiFi Communication

S.No.	Task Name	Status	Completion Time
1.	Establish USB-Serial Communication between Android and Controller Chip	Complete	26 th June
2.	Code in Java for Sending Flight Commands	Complete	10 th July
3.	Service for USB Communication	Complete	28 th February
4.	WiFi Video Streaming	Complete	3 rd April

PHASE 4 – Hand Gesture Mapping

S.No.	Task Name	Status	Completion Time
1.	Establish IP based TCP socket connection	Complete	16 th July
2.	Tune the packet interval for optimal data rate	Complete	18 th July
3.	Tune the leap motion angle values	Complete	29 th August
4.	Hand Gesture Controlled Flight	Complete	30 th August

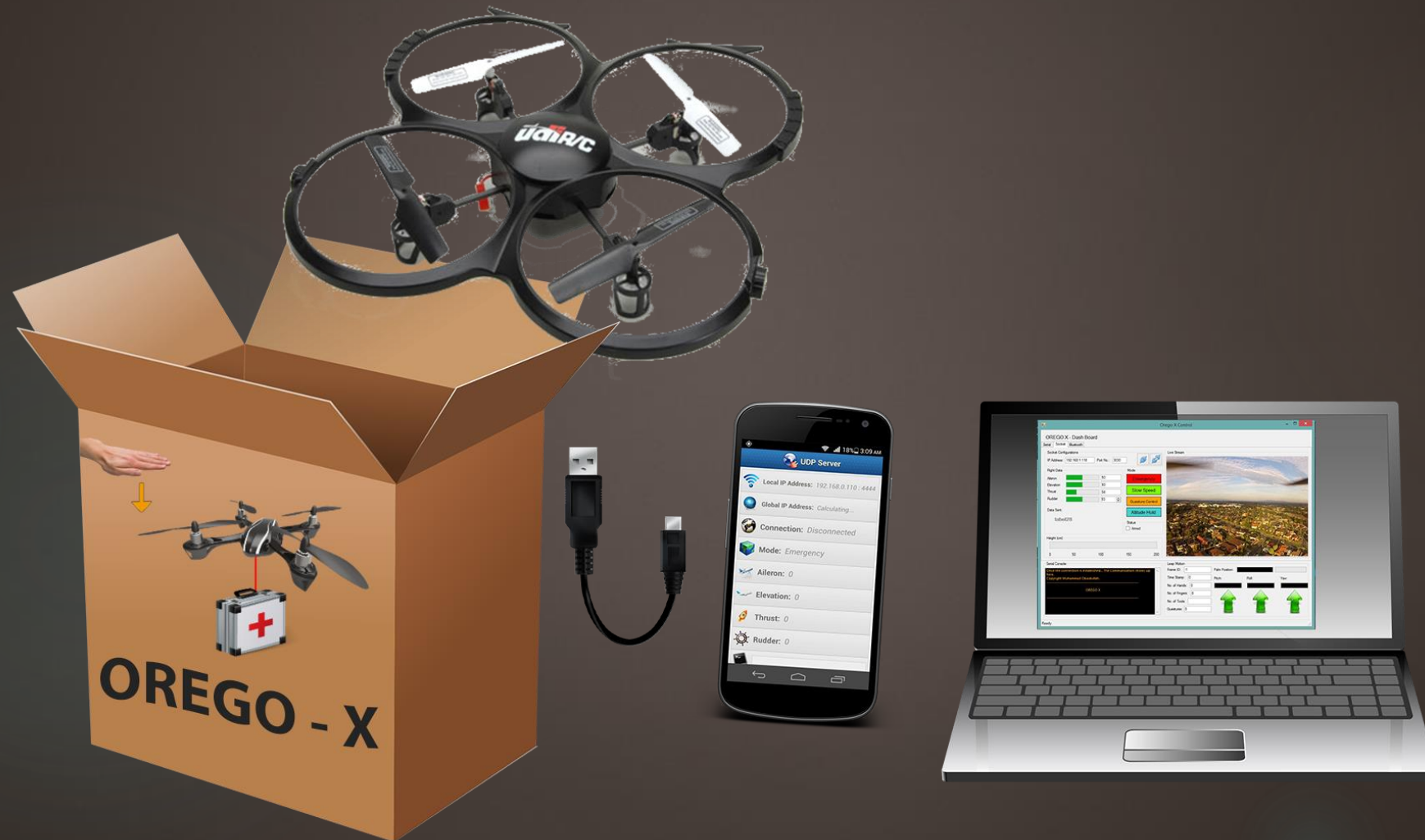
PHASE 5 – Unmanned Flight

S.No.	Task Name	Status	Completion Time
1.	Establish GPS location update service	Complete	25 th August
2.	Grabbing global IP from DNS server	Complete	26 th August
3.	Android orientation service	Complete	29 th August
4.	6 DOF PID for reaching waypoint	Incomplete	-



CONCLUSION

Complete Product



Infra-Red Possibilities

- ON/OFF button for emergency
- Code based IR operation
- Secure Delivery System
- Watch or Key Ring size IR Identification

Toshiba Remote - Excel

Key Name	Hex Value
ON/OFF	2FD48B7
1	2FD807F
2	2FD40BF
3	2FDC03F
4	2FD20DF
5	2FDA05F
6	2FD609F
7	2FDE01F
8	2FD10EF
9	2FD906F
0	2FD00FF
Volume Up	2FD58A7
Volume Down	2FD7887
Channel Up	2FDD827
Channel Down	2FDF807

2FD48B7
2FD48B7
2FD48B7
2FD48B7
FFFFFFFF
FFFFFFFF
FFFFFFFF
FFFFFFFF
FFFFFFFF
FFFFFFFF
FFFFFFFF
2FD48B7
FFFFFFFF
2FD807F
FFFFFFFF
2FD40BF
2FDC03F
2FD20DF
2FDA05F
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THANK YOU



References

- [1] Jennifer Bell. (2013) Road accidents account for almost 70% of head injuries at one UAE hospital [Online]. Available: <http://www.thenational.ae/uae/health/road-accidents-account-for-almost-70-of-head-injuries-at-one-uae-hospital>
- [2] ADAFRUIT (2010) FTDI Friend Breakout Board+ (tutorial) [Online]. Available: <http://www.adafruit.com/blog/2010/09/16/ftdi-friend-breakout-board-tutorial/>
- [3] Prospector. Polylactic Acid (PLA) Typical Properties [Online]. Available: <http://plastics.ides.com/generics/34/c/t/polylactic-acid-pla-properties-processing>
- [4] Mark Johnson Cutler. (2010) Design and Control of an Autonomous Variable-Pitch Quadrotor Helicopter [Online]. Available: http://acl.mit.edu/papers/Cutler_Masters12.pdf
- [5] Leap Motion Documentation. (2013) Understanding the Java Sample Application [On-line]. Available: https://developer.leapmotion.com/documentation/Languages/Java/Guides/Sample_Java_Tutorial.html
- [6] Mando. How a Gyro Works [Online]. Available: <https://learn.sparkfun.com/tutorials/gyroscope/how-a-gyro-works>