Preliminary Design Information

**Overview**: In this document, preliminary design ideas that the team is working with according to camera, co-processor, and Image Processing Models are provided. The criteria that are of important consideration for downselection of preliminary designs that each design does and does not meet are assembled into “Preliminary Criteria Check” tables. A subset of criteria for each design category are extracted from the “Criteria Check” tables and used to assemble “Critical Criteria Check” tables. These tables contain the most important criteria for the associated design categories that preliminary designs shall satisfy to be downselected for Feasibility Studies. Each design that meets a majority of the design categories’ critical criteria specified below will be down-selected for the Feasibility Analysis to be considered in the final design cut.

**Camera**

1. **Topotek 10x Zoom**
   1. Con
      1. Poor documentation, most of which is in Chinese
      2. Heavy
   2. Pro
      1. Has been used on previous flights, so we know it can work

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution Range (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution Range (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |

1. **Lumenera Lt-C/M2020**
   1. Pros
      1. Light
      2. Small
      3. 5.1 Mp is enough from research
      4. USB 3.1 transfers up to 5.1 Gb/s
   2. Cons
      1. Untested camera
      2. Not sure if it can capture video

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Quantity of HDMI and/or USB outputs (1) |  |
| Operating Resolution (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution Range (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |

1. **Runcam Model**
   1. Pros
      1. Small
      2. Widely Available Documentation
   2. Cons
      1. Poor Operating Resolution
      2. Low frame capture rate

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution Range (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |

1. **Arducam SKU B0240 IMX477 HQ Camera Model**
   1. Pros
      1. Small
      2. Module has 4-lane MIPI CSI-2 interface for quick data transfer
      3. Compatible with all Raspberry Pi models
      4. High frame capture rate (60 fps)
      5. Acceptable Field of View (65 degrees)
      6. High resolution (12.3 Mpx)
   2. Cons
      1. Untested camera
      2. Relatively heavy (70 g)
      3. Not sure if it can capture video

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Type of Interface Output Terminals |  |
| Operating Resolution Range (5 Mpx) |  |
| Frame Capture Rate (20 fps) |  |

**Co-Processor**

1. **Raspberry Pi Model 4**
   1. Pros
      1. Plenty of documentation
      2. Light
      3. Sufficient processing/RAM

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Power Supply Voltage (5 V) |  |
| Compatible with USB and/or HDMI connection |  |
| Transmission Speed to/from autopilot | ? |
| CPU Frequency (Clock Time) (1 GHz) |  |
| CPU RAM (4 GB) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Power Supply Voltage (5 V) |  |
| CPU Frequency (Clock Time) (1 GHz) |  |
| CPU RAM (4 GB) |  |

1. **Jetson TX2**
   1. Pro
      1. Highly optimized for machine learning
      2. Has been used by a team member on UAVs before
   2. Cons
      1. Heavy
      2. Expensive
      3. High power draw

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Power Supply Voltage (5 V) |  |
| Compatible with USB and/or HDMI connection |  |
| Transmission Speed to/from autopilot | ? |
| CPU Frequency (Clock Time) (1 GHz) |  |
| CPU RAM (4 GB) |  |
| Total Weight |  |
| Physical Length Dimensions |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| Power Supply Voltage (5 V) |  |
| CPU Frequency (Clock Time) (1 GHz) |  |
| CPU RAM (4 GB) |  |

**ATR System**

1. **OpenCV**
   1. Pros
      1. Easy to interact with and set up
      2. Can use photos, movies, and live feed as potential inputs
   2. Cons
      1. Training process using machine learning requires accurate initial photos/videos

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Direct Access to Camera to Acquire Image/Video Feed |  |
| Ability to detect targets |  |
| Ability to distinguish between smiley & frowny faces |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Ability to detect targets |  |
| Ability to distinguish between smiley & frowny faces |  |

1. **OpenMV**
   1. Pro
      1. fast latency of high definition images
      2. Small and lightweight
      3. Pre built IDE easy to customize and train on object of interest
   2. Cons
      1. Camera resolution and zoom not desirable
      2. ASE team would have to modify aircraft design to accommodate a camera + coprocessor combo

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Direct Access to Camera to Acquire Image/Video Feed |  |
| Ability to detect targets |  |
| Ability to distinguish between smiley & frowny faces |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Ability to detect targets |  |
| Ability to distinguish between smiley & frowny faces |  |

1. **RGB Based Recognition**
   1. Pro
      1. Very simple to detect which of the blue tarps have contain the TOI’s due to color contrast of the tarps and target against the field
   2. Cons
      1. Difficult to discern the face of each TOI as they are both the same color

**Preliminary Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Direct Access to Camera to Acquire Image/Video Feed |  |
| Ability to detect targets (TBR) |  |
| Ability to distinguish between smiley & frowny faces (TBR) |  |
| Available Documentation |  |

**Critical Criteria Check**

| **Criteria** | **Criteria Satisfied?** |
| --- | --- |
| CPU Memory Needed (4 GB) |  |
| Ability to detect targets |  |
| Ability to distinguish between smiley & frowny faces |  |