

We are evaluating camera options for an indoor drone project requiring a high-resolution camera with a diagonal field of view (FOV) exceeding 90 degrees, high pixel density for detailed imaging, and a good balance between exposure and high shutter speed to capture fast-moving scenes.

- **FOV Requirement:**

- Diagonal FOV: >90 degrees
- Horizontal FOV: Preferably >80 degrees for wide coverage
- Application: Indoor drone navigation and obstacle avoidance, requiring wide-angle vision for confined spaces and real-time environmental mapping

- **Performance Requirements:**

- High pixel density to capture fine details such as Batch and SKU IDs.
- High shutter speed to minimize motion blur during rapid drone movements
- Balanced exposure for consistent performance in varied indoor lighting (e.g., fluorescent, LED, or low-light conditions).
- Excellent image clarity with minimal distortion to ensure we can read barcodes/QRcode from a 1 meter distance or more.

- **Required Specifications**

Optical Format	Type 1/2.3(Diagonal 4.60mm) (preferred)
Resolution	12.3MP (preferred)
Active Pixels	Equal or greater 1920(H) x 1080(V)
Frame Rates	60 FPS (preferred)
Shutter Type	Rolling Shutter/Global
Focal Length	4.38-10.71mm±5%
FOV	> 80° (Horizontal) and > 90° (Diagonal)

Warehouse Testing Criteria:

	76mm*38mm	76mm*38mm	76mm*38mm
Current Sticker			
	LPN	BATCH	SKU



Carton Size(Red Box) -> 27cm – 35 cm *45cm
Pallet Size(Yellow Box) -> 16cm*100cm
Pallet Sticker Region(Green Box) -> 16cm*15cm
Target Region(Purple Box) -> 50cm(H)*45cm(L)
from corner



Carton Size(Red Box) -> 27cm *45cm
Carton Size(Brown Box) -> 35cm*45cm
2*Pallet Size(Yellow Box) -> 16cm*200cm
Pallet Sticker Region(Green Box) -> 16cm*15cm
Target Region(Purple Box) -> 50cm(H)*150cm(L) from corner

Testing Feedback:

We have tested the following configurations :

IMX477 with Arducam PTZ Lens: Incompatible with our OAK-FFC-4P board, resulting in no usable output.

Specifications

Sensor	Sony IMX477
Optical Format	Type 1/2.3(Diagonal 4.60mm)
Resolution	12.3MP
Pixel Size	1.55 μm x 1.55 μm
Active Pixels	4056(H) x 3040(V)
Frame Rates	Raspberry Pi: 2028 × 1080p50, 2028 × 1520p40 and 1332 × 990p120

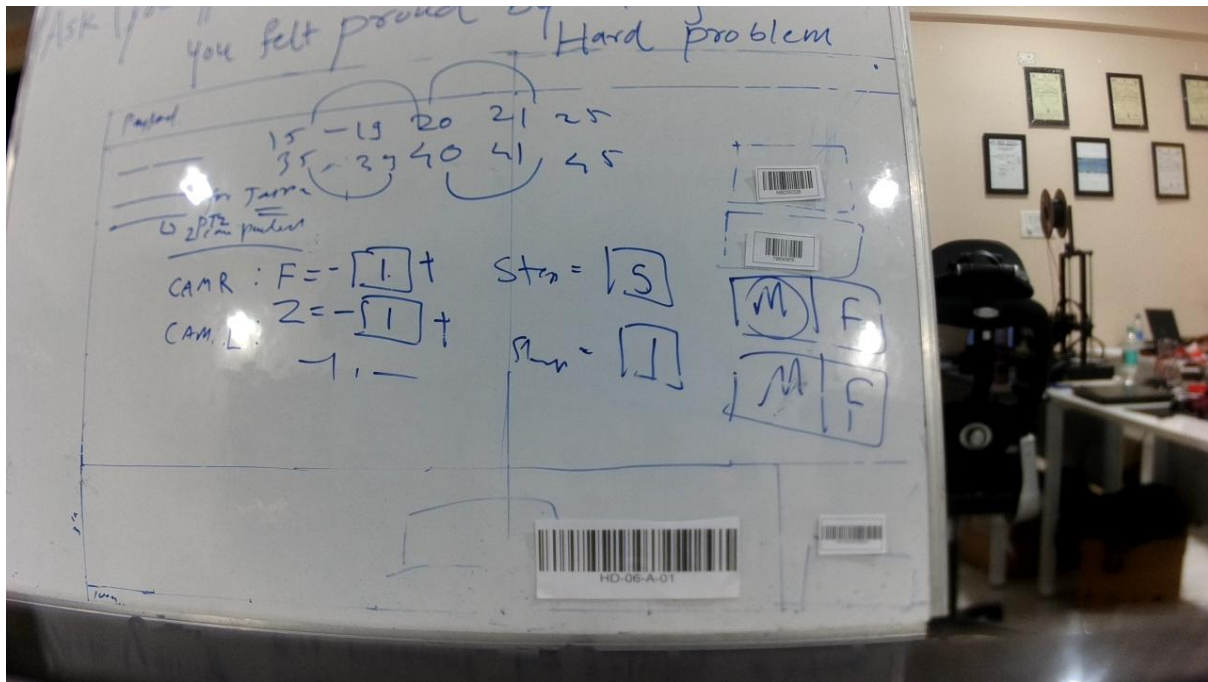
NVIDIA Jetson Orin NX/Orin Nano/AGX Orin:

L4t 32.x: 4032x3040@30fps, 3840x2160@30fps, 1920x1080@60fps

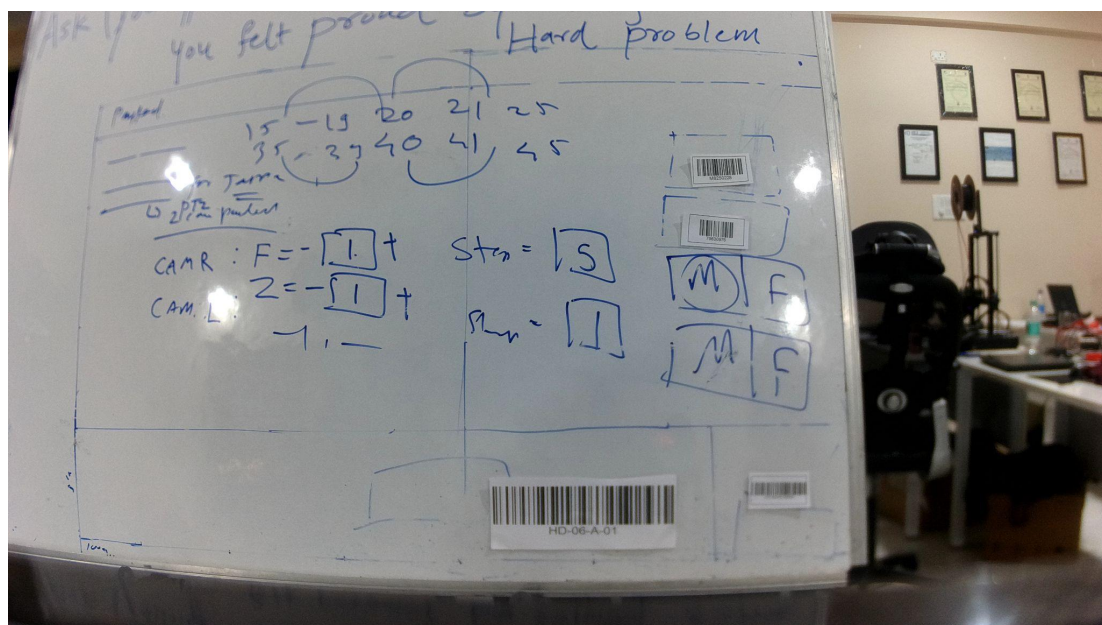
L4t 35.x: 4032x3040@20fps, 3840x2160@30fps, 1920x1080@60fps

Shutter Type	Rolling Shutter
Focus Type	Front group: focus Back group: Zoom
Focal Length	4.38-10.71mm $\pm$ 5%
FOV	96° – 33° (Horizontal)
IR Sensitivity	Optional with additional Motorized IR-Cut filter
Camera Board Size	36mm x 36mm
Pan and Tilt Range	0-180°
Zoom Range (Wide => Tele)	2317 steps 0.00396mm/step
Focus Range(Near => Far)	3009 steps 0.0047mm/step

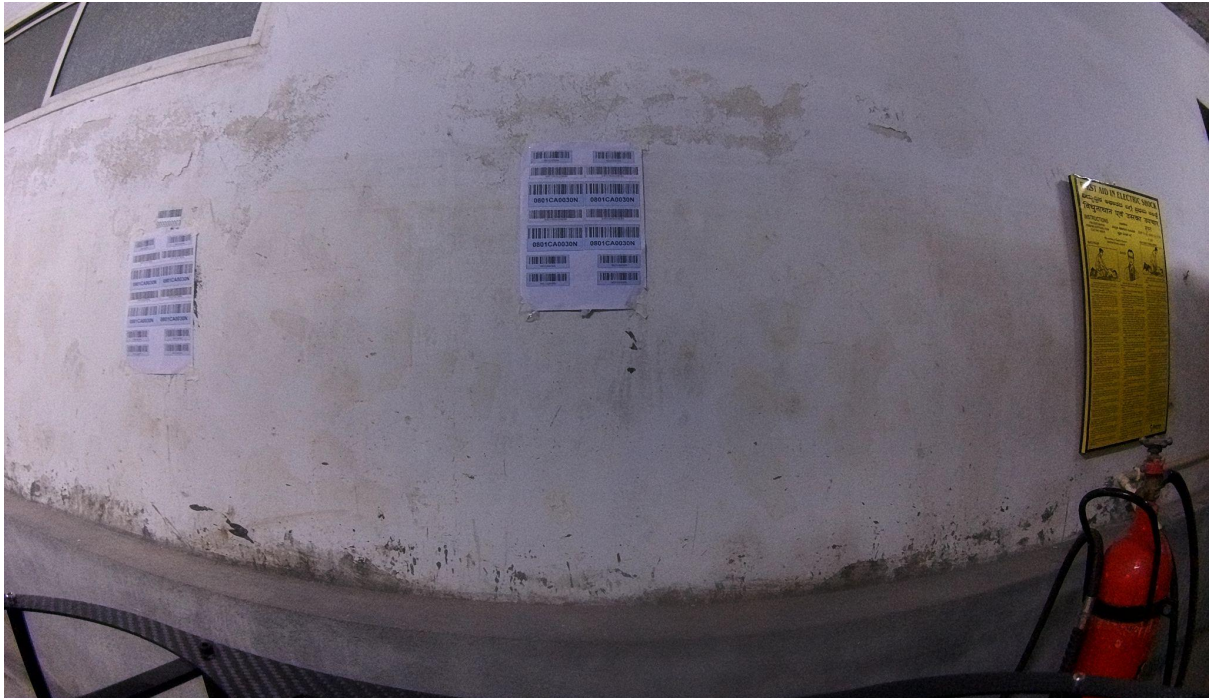
IMX577 with Arducam PTZ Lens: Can't motion blur.



Here are some of the 4K output we took using the IMX577 with the ptz lens attached. This kind of image quality is what we wanted for our use case but the problem with this was focus like after a certain threshold distance it loses all focus and also there's the motion blur which makes it unsuitable for drones



IMX577 with 80 degree FOV M12 Lens: Overall Good quality images but sometimes noise and low light performance issues. Also facing motion blur if we compensate for low light performance. We couldn't find the right balance with this camera.



Fisheye M12 Lenses: With the same camera sensor, we also tried some Fisheye M12 lenses. It provided a wide FOV which we needed, same as insta360 but lacked image clarity, with excessive distortion and poor sharpness, unsuitable for our needs.



Insta360 X4: It was good and actually provided the wide 360 view which we needed for our use case but the problem with this was clarity and the images lack the actual depth. Even with the HDR and 72 MP mode results were not that good as it comes at the cost of motion blur.

This image is from 1m distance



This image is from 0.5 m distance



Specifications:

Sensor Size 1/2"

Aperture F1.9

35mm Equivalent Focal Length 6.7mm

Video Resolution

360° Mode: 8K: 7680x3840@30/25/24fps 5.7K+: 5760x2880@30/25/24fps 5.7K: 5760x2880@60/50/30/25/24fps 4K: 3840x1920@100/60/50/30/25/24fps Single-Lens Mode: 4K: 3840x2160@60/50/30/25/24fps 2.7K: 2720x1536@60/50/30/25/24fps 1080p: 1920x1080@60/50/30/25/24fps Me Mode: 4K: 3840x2160@30/25/24fps 2.7K: 2720x1536@120/100/60/50fps 1080p: 1920x1080@120/100/60/50fps

Photo Resolution Approx. 72MP (11904x5952) Approx. 18MP (5888x2944)

Video Format Single-Lens Mode: MP4 360: INSV

Photo Format INSP (can export via mobile app or Studio desktop software) DNG

Photo Modes Photo, HDR Photo, Interval, Starlapse, Burst

Color Profiles Standard, Vivid, Flat

Video Coding H.264, H.265

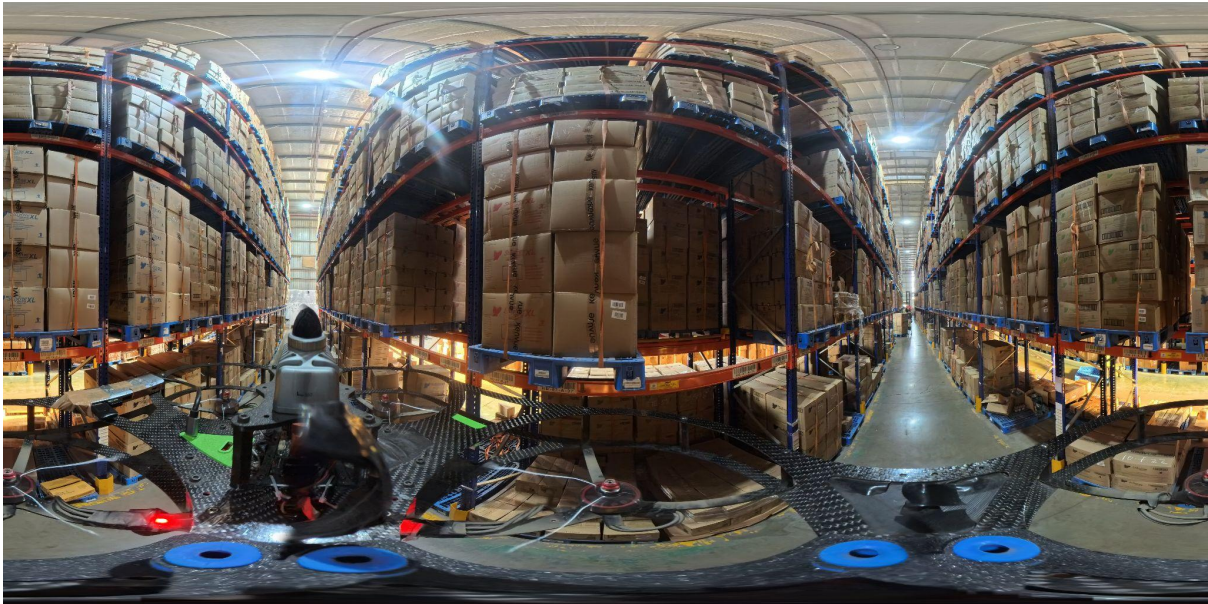
Max. Video Bitrate 200Mbps

Exposure Value ±4EV

ISO Range 100-6400

Shutter Speed Photo: 1/8000 - 120s Video: 1/8000 - to the limit of frames per second

White Balance 2000K-10000K



Criteria	Target Value	IMX577	IMX477	Insta360 X4	Fisheye M12
Diagonal FOV	>90°	✗	✓	✓	✓
Image Clarity (1–5)	5	4	3	2	1
Motion Blur Resistance	Low	✗	✗	✗	✗
Barcode Clarity @1m	Sharp	✓	✓	✗	✗
Distortion Level	Minimal	✓	✓	✗	✗
Focus Stability	Consistent across range	✗	✗	✗	✗

Barcode using for Testing:

The barcode clarity for images depends on barcode size, distance taken and the mil size*. This is totally different from capturing QR codes and normal text.

The "mil size" of a barcode refers to the width of the narrowest bar or space within the barcode, measured in thousandths of an inch (mils)

Sticker size 5" X 2" Inch



Font size: 50 (Bold) (Height = 1.3 cm)

Barcode: 11.96 cm x 2.66 cm

X dimension: >45 mil (Preferred)

- Was perfectly visible at a 1.5 meters distance for imx577, 32mp. (bench test)
- For insta360 its visible at 1m or less distance on a bench test
- While camera mounted on drone facing some blur but mostly readable.

Sticker size 5" x 2" Inch



Font size: 25 (Bold)

Barcode: 11.96 cm x 2.8 cm

- Was perfectly visible at a 1.2 meters distance for imx577, 32mp. (bench test)
- For insta360 its visible under 1m distance on a bench test but still barcode is not clear and mostly deformed.
- Haven't tested with the drone for these codes

Sticker size 3" X 1" Inch



Font size: 12 (Height = 0.3 cm)

Barcode: 9.7 cm x 2.19 cm

- Was barely visible under a 1 meters distance for imx577, 32mp. (bench test)
- For insta360 barcode is not clear at all even in bench test under 1m.
- Need to test with a higher mil size for this.
- Haven't tested with the drone for these codes

Sticker size 4" X 1" Inch



Font size: 15 (Bold) (Height = 0.5 cm)

Barcode: 8.89 cm x 1.56 cm

- Was perfectly visible at a 1meters distance for imx577, 32mp. (bench test)
- For insta360 barcode is not clear and only text is visible under 1m distance on bench test.
- While on drone test mostly images are getting blurred with the 32MP camera and only text was visible but if timed perfectly, images are clear under 1m for imx577. (on good lighting condition)
- Need to test with a higher mil size for this.



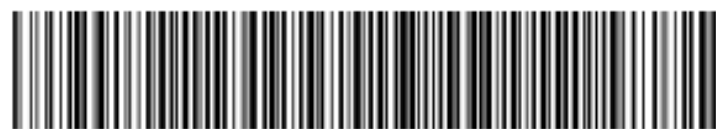
0801CA0030N



0801CA0030N



BLRFC11.INV.D4.L8.R56.09.A



BLRFC11.INV.D4.L8.R56.09.A



0801CA0030N



0801CA0030N



BLRFC11.INV.D4.L8.R56.09.A



BLRFC11.INV.D4.L8.R56.09.A



0801CA0030N



0801CA0030N



0801CA0030N



0801CA0030N



0801CA0030N



0801CA0030N

Broad Requirement:

Working distance :	1-1.5 meters
FOV :	> 80° (Horizontal) and > 90° (Diagonal)
Resolution :	12.3MP (preferred)
Active Pixels :	Equal or greater 1920(H) x 1080(V)
Frame Rates :	60 FPS (preferred)
Shutter Type :	Rolling Shutter/Global

- High pixel density to capture fine details such as Batch and SKU IDs.
- High shutter speed to minimize motion blur during rapid drone movements
- Balanced exposure for consistent performance in varied indoor lighting (e.g., fluorescent, LED, or low-light conditions).
- Excellent image clarity with minimal distortion to ensure we can read barcodes/QRcode from a 1 meter distance or more.
- camera should be able to extract every text from above image

We know there will be some pros and cons of each camera we use in drones. While maintaining high resolution, clarity, and minimal distortion for indoor drone use. **We need a camera which can provide good Balance between the camera's FOV and performance characteristics (e.g., distortion, sharpness, light transmission).**

Additionally, we would appreciate insights on optimizing image quality for indoor drone applications, such as lens selection for minimal distortion or post-processing techniques for real-time navigation.

