

HER:AI - HEMISPHERICAL EVENT RECORDING AND ANALYZING WITH AI

# METEORS AND BEYOND

ENTER CEDIC'19



Central European Deepsky Imaging Conference

7th CEDIC | 22nd - 24th of March 2024 | Linz | Austria

# MOTIVATION

STAY CURIOUS

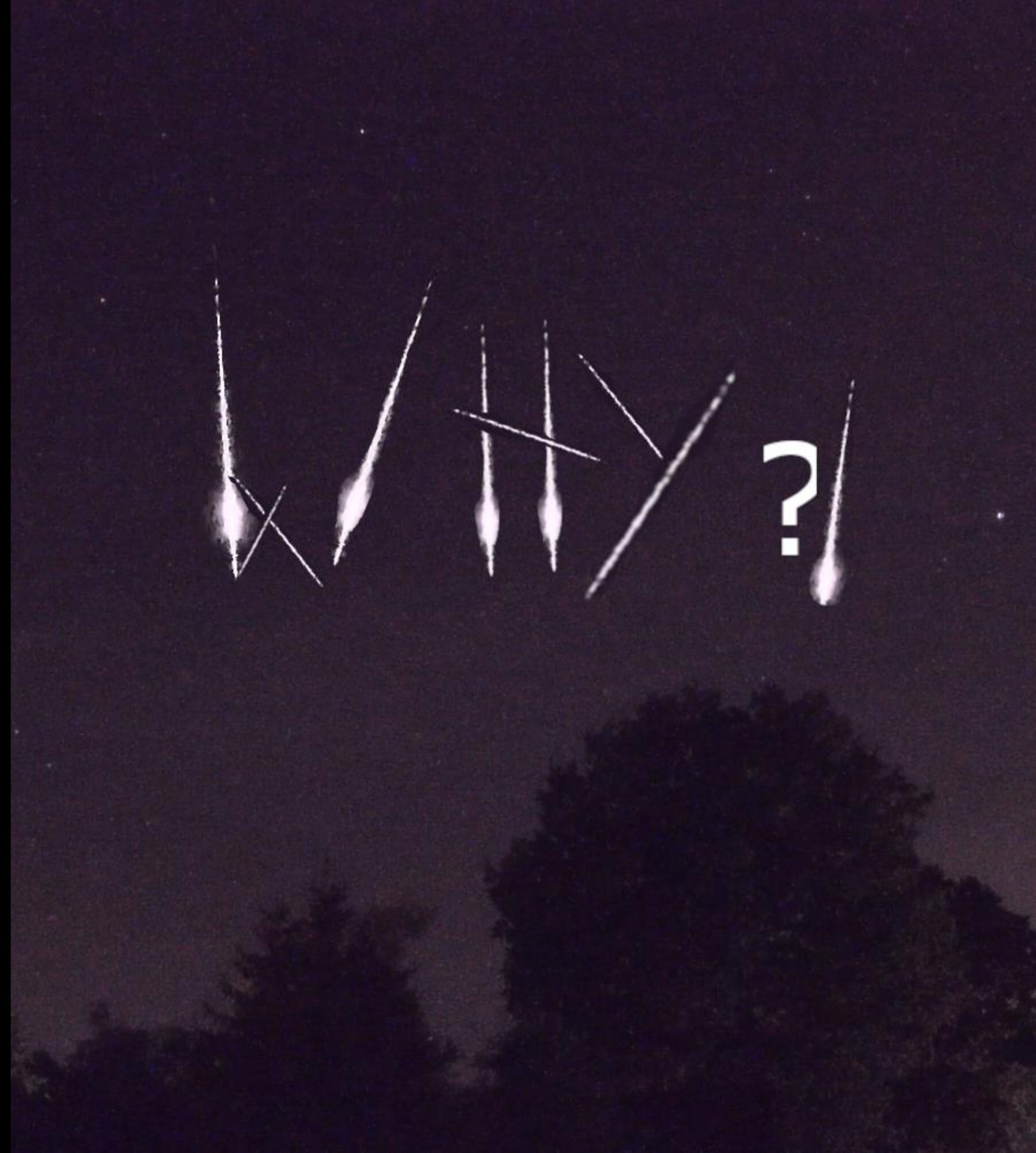
ASTRONOMICAL INTEREST

DIY FACTOR

LEARNING CURVE

FULL CONTROL

SHARE



# PATTERN

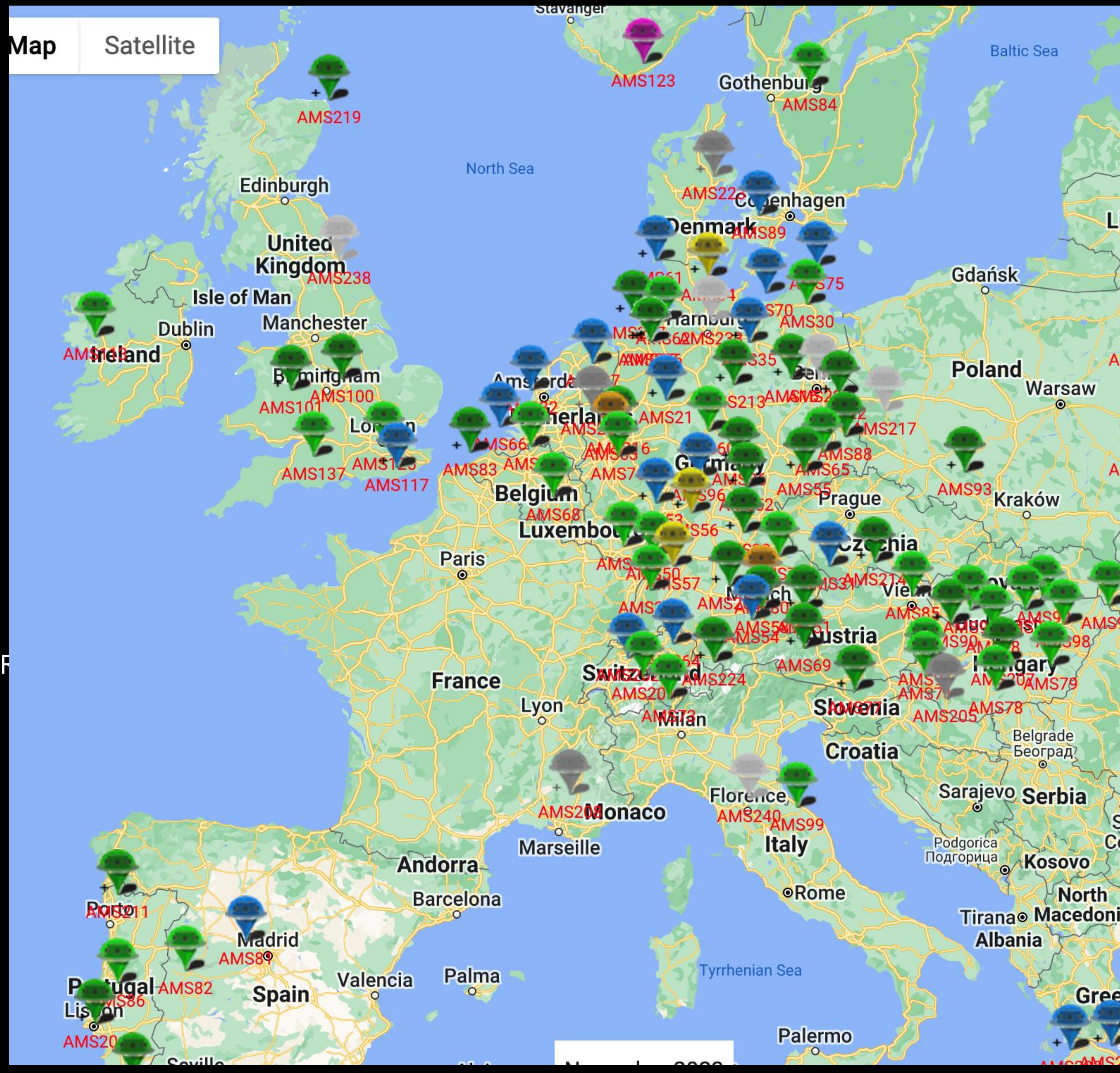
[ALLSKY7.NET](http://ALLSKY7.NET)

ALLSKY7 METEORITE WORKING GROUP

CENTRAL CONTROLLED PROJECT

FORM OF PARTICIPATION DEPENDS ON YOUR LOCATION

MORE SCIENTIFIC APPROACH



# RESULTS

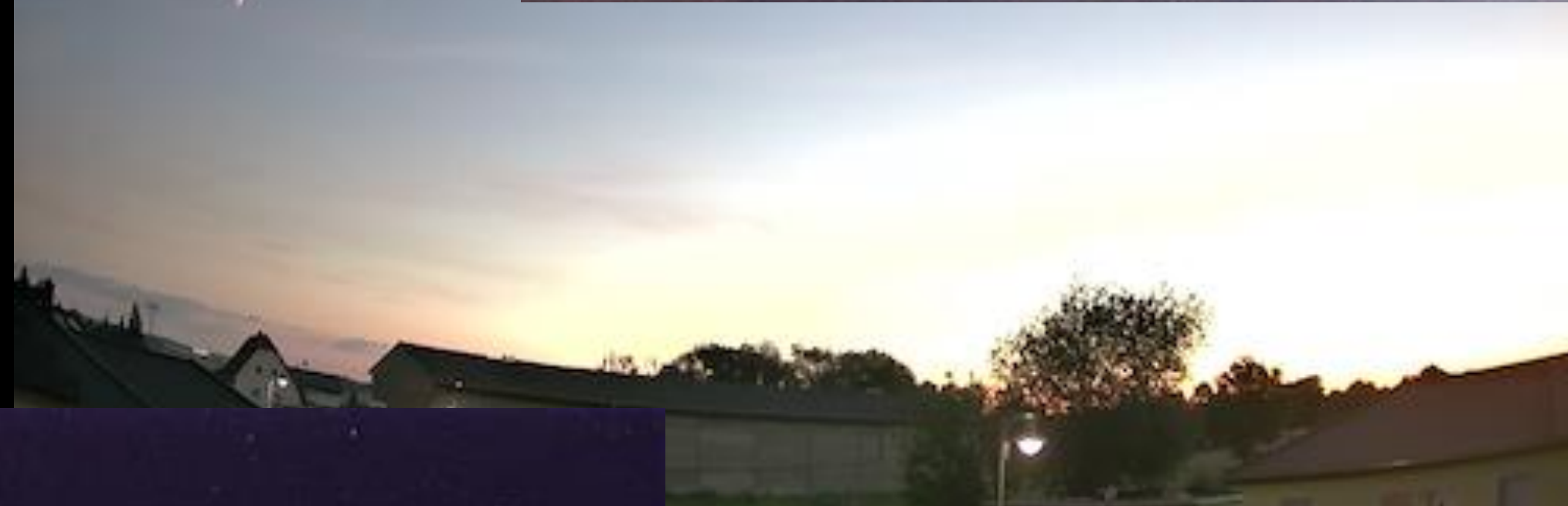
~ 5000 METEORS / Y.

POLARLIGHTS

THUNDERSTORMS

BIRDS

TIMELAPSE





## HER:AI - THE DOME PLATFORM

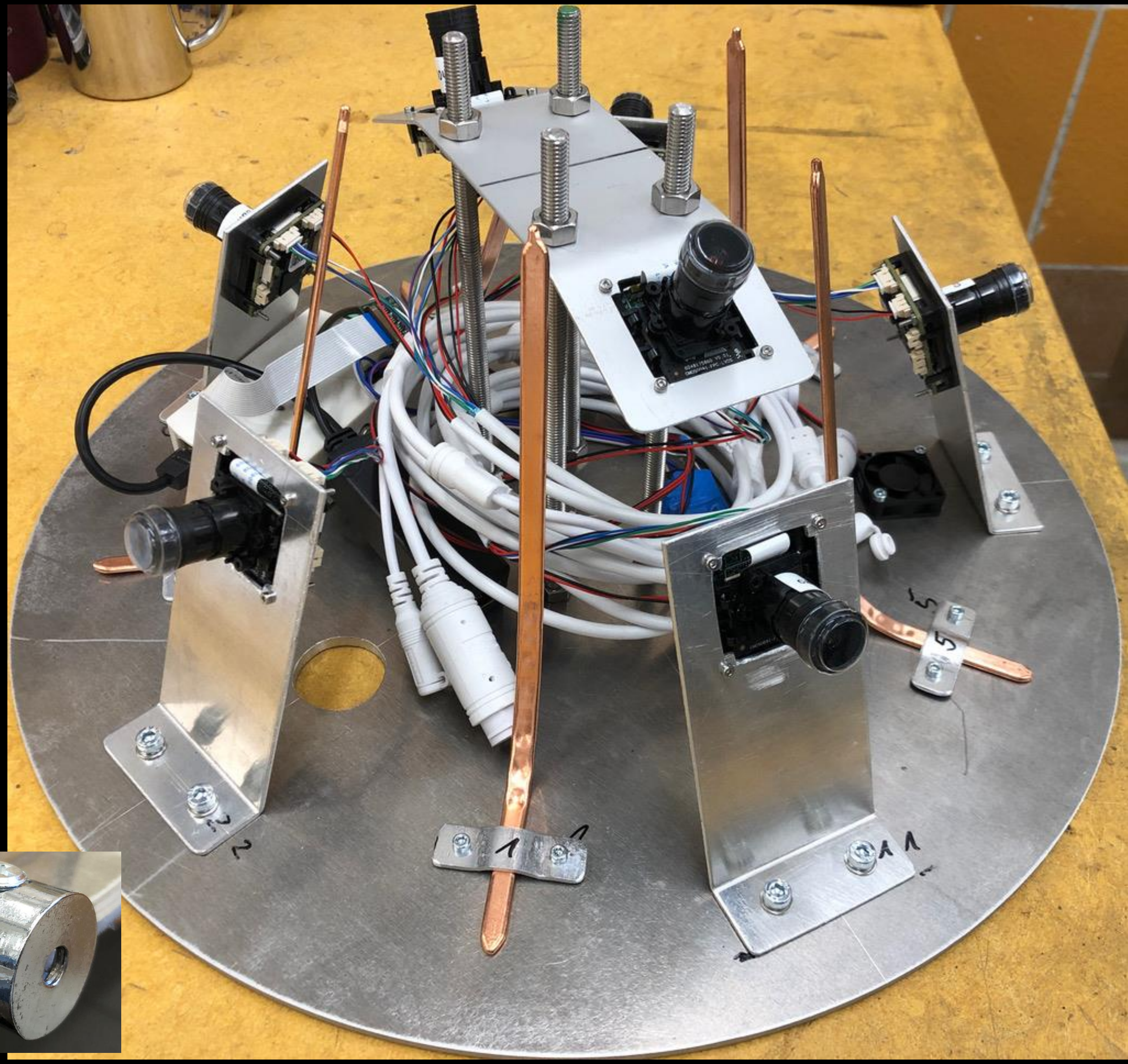
ALUMINIUM PLATFORM 425MM Ø  
AND 5MM THICKNESS (CONTRACT  
MANUFACTURER)

ACRYLIC DOME 400MM (AMAZON)

ALUMINIUM CAM MOUNTS 7X

COPPER HEATPIPES 4X (ALIEXPRESS)

FANS 2X 30MM 5V (EBAY)



HER:AI - THE DOME PLATFORM

MOUNTED ON THE ROOF

BUT

HARDWARE INDEPENDENT

FEEL FREE TO TAKE OTHER HARDWARE  
(IP AND RTSP) THERE ARE REALLY GOOD  
SURVEILLANCE CAMS WITH GOOD CHIPS

SONY STARVIZ  
STARVIEW CHIPS



HER:AI - THE CAMERAS

CAMS 7X MODEL WITH ETHERNET-MODEL

SENSOR SONY STARVIZ IMX29

CHIP 3MP, 25FPS

LENSE F0.95, 4MM (M16), FIELD OF VIEW  
45X80°

STREAMS 2X 1920X1080 AND 704X576

ONVIF SOAP API WITH BASIC FUNCTIONS

POWER SUPPLY OVER POE OR EXTERNAL 12V

POWER CONSUMPTION 3W

HEATSINK ON THE CHIPS (EBAY)



**HISILICON**

**Star-Light illumination**

**Hisilicon Chipset IP Camera Module**

**Hi3516CV300 + IMX291**



**IVG-HP203Y-AE**

**1080P F0.95 4Mm&6Mm Lens**



## HER:AI - INSIDE THE DOME

RASPBERRY PI A+ FOR TEMPERATURE CONTROL

TEMP. SENSOR DHT22

RELAY 5V FOR FAN CONTROL

RASPBERRY IR-CAM FOR DOME-CAM

MAX. TEMP. MEASURED 60°C

ALARMING OVER PUSHOVER AND TELEGRAM-  
BOT



## HER:AI - THE SERVER HARDWARE

### SERVER MINIMUM

CPU 4X

RAM 4GB

HDD 256GB (~1D RETENTION\*)

### SERVER RECOMMENDED

CPU 4X (64BIT) AVX EXTENSION

RAM 16GB (RAMDRIVE)

HDD 14TB (~ 1W RETENTION\*)

RASPBERRY 4 NOT SUPPORTED/TESTED

PROBABLY TOO LOW PERFORMANCE

MAYBE SUPPORTED IN FUTURE VERSION



\* ADVANCED VECTOR EXTENSION - NECESSARY FOR  
TENSORFLOW MACHINE LEARNING FRAMEWORK

HER:AI - THE SERVER SOFTWARE

OS UBUNTU SERVER 2X LTS OR RHEL

DOCKER CE - CONTAINER ENGINE

GIT

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ALL PROCESSES RUN AS CONTAINERS

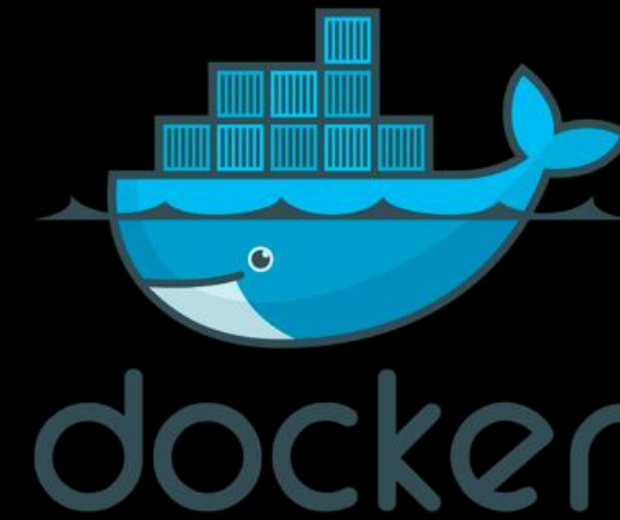
FFMPEG - CAPTURING

INFLUXDB - TIMESERIES DB STATISTICS

\_\_\_\_OPTIONAL\_\_\_\_

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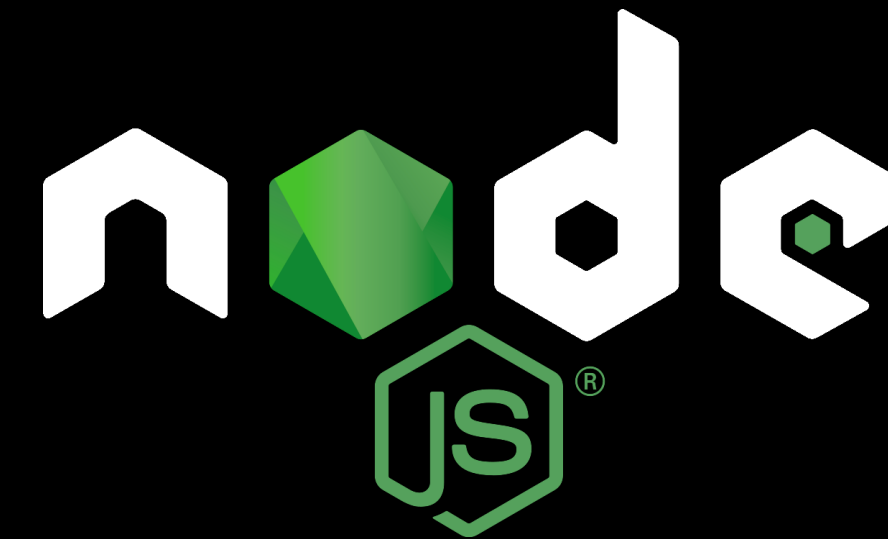
TRAEFIK - REVERSE PROXY FOR WEB



## HER:AI - THE HER:AI SOFTWARE

PYTHON  
MAIN CONTROL-SCRIPTS  
COMPUTER VISION IMAGE-PROCESSING  
TENSORFLOW CNN TRAINING AND  
CLASSIFICATION  
FFMPEG CAPTURING  
7 SD-STREAMS  
7 HD-STREAMS

NODEJS  
WEB-APPLICATION  
EXPRESS  
EXPRESS-HANDLEBARS  
BCRYPT



# HER:AI - THE CONVNET

CONVOLUTIONAL NEURAL NETWORK

OUTPUT 3 CLASSES (ARTIFICIAL, METEOR, ENVIRONMENT)

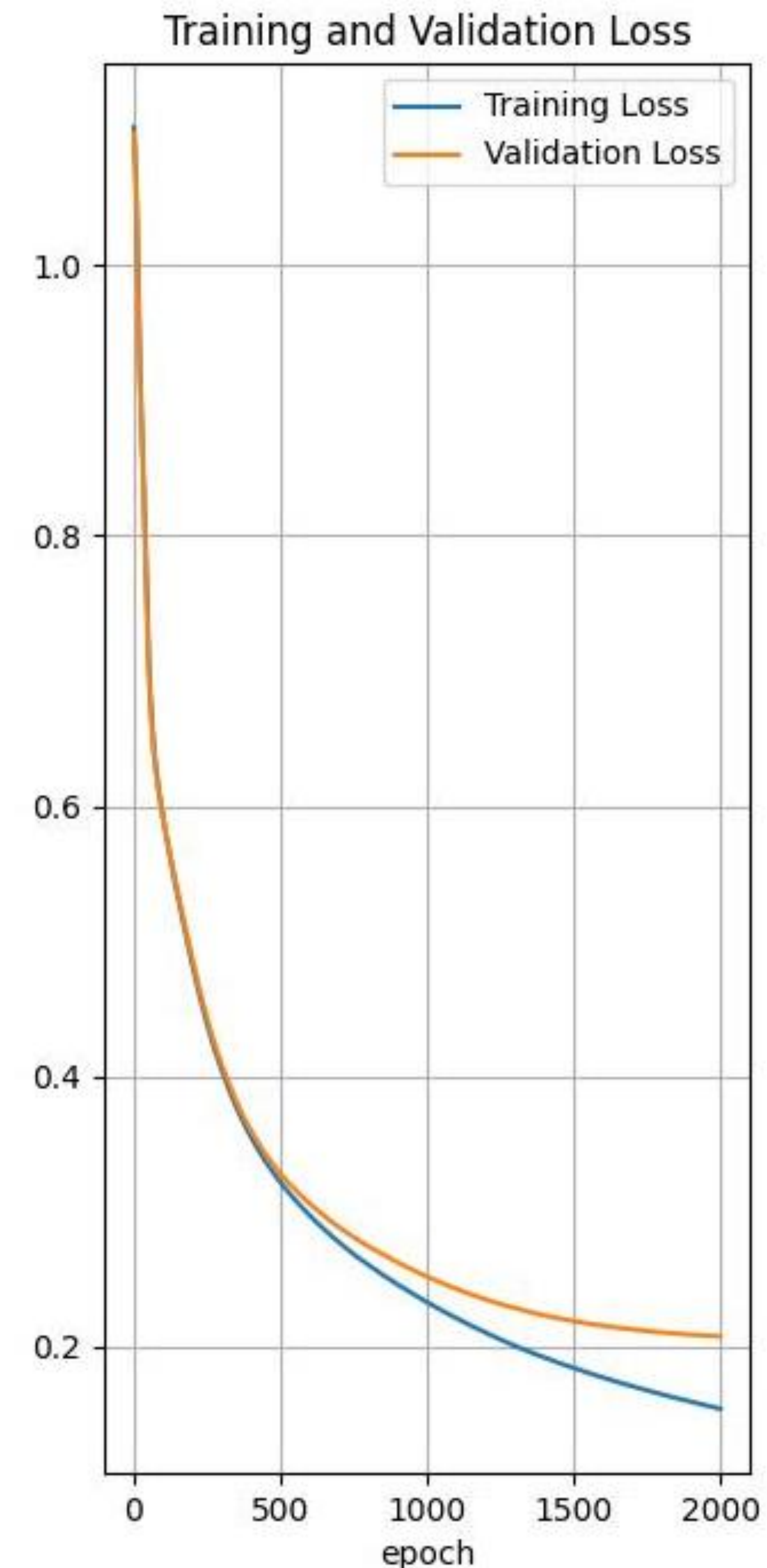
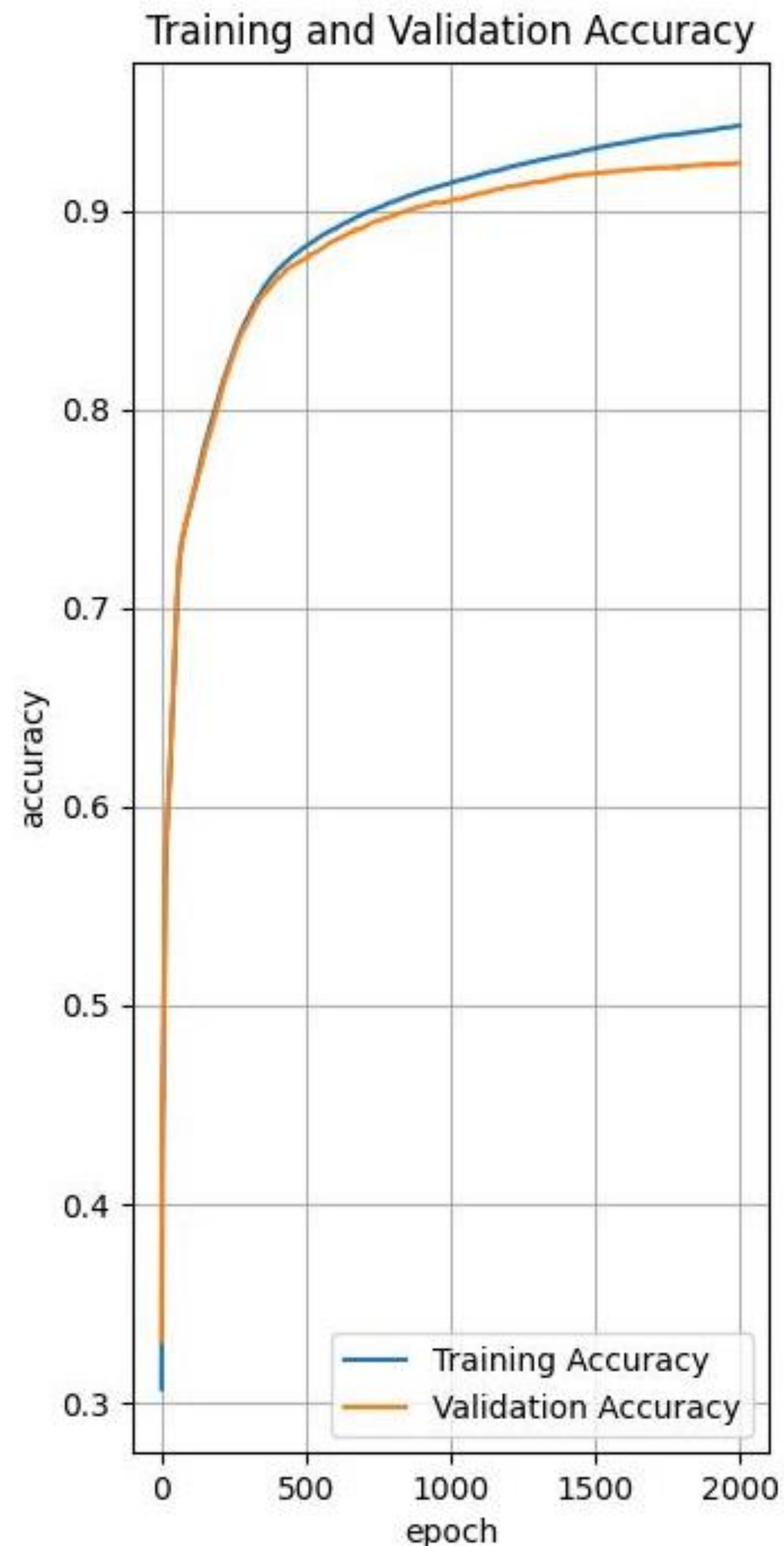
TRAINING DATA 30K SAMPLES OF EACH CLASS

MODEL ACCURACY (TESTED WITH 500 SAMPLES)

METEOR 0.96

AIRPLANE AND SATELLITES 0.93

ENVIRONMENT (CLOUDS, BIRDS, REFLECTIONS) 0.996



## HER:AI - WORKFLOW

CAPTURING

CV: STACKING THE SD-VIDEOS

CV: SEARCH FOR LINES

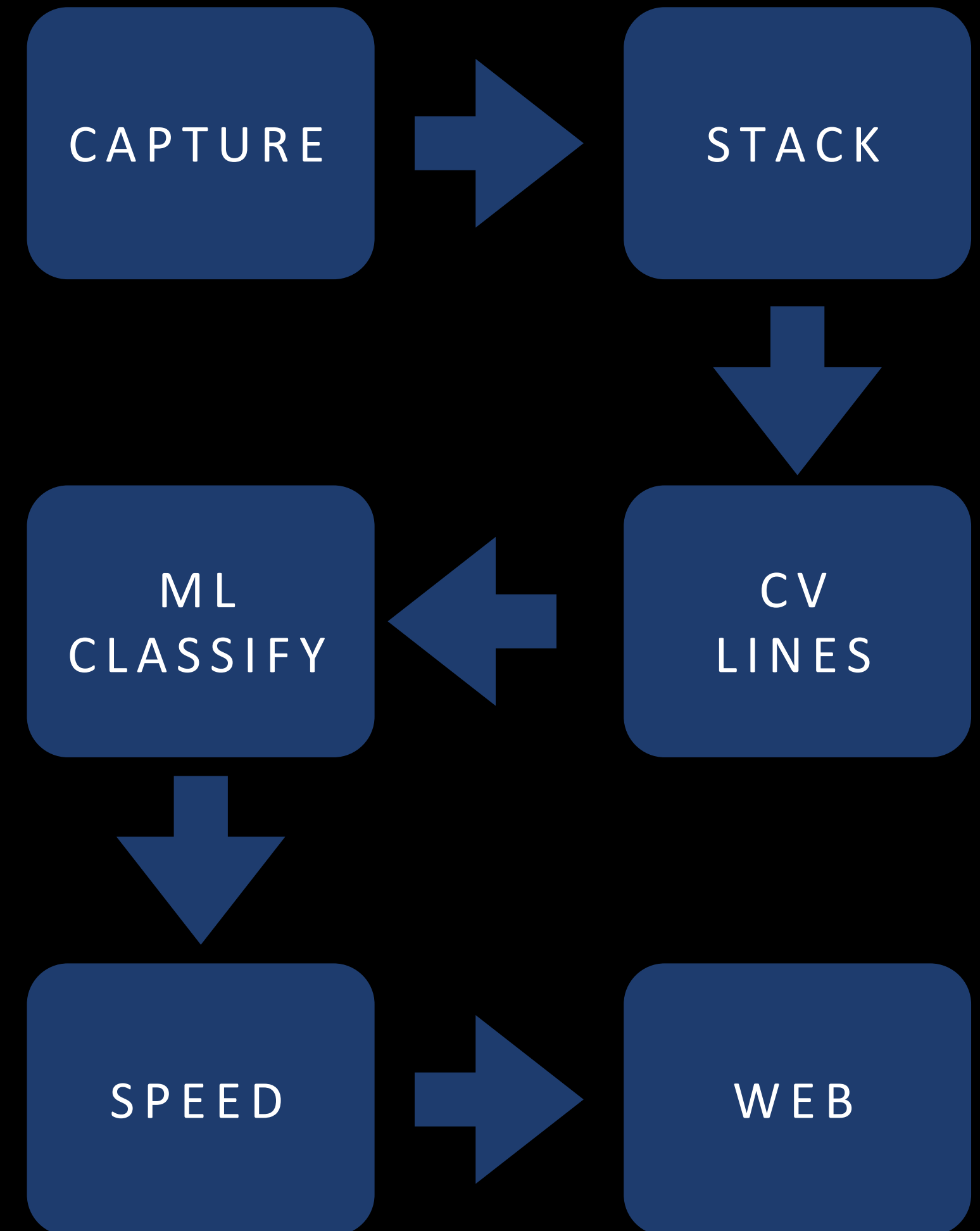
ML: ANALYZE TILES WITH LINES WITH ML

CV: ANALYZE SPEED

WEB: SORT OUT LAST FALSE POSITIVES

WEB: TRIM VIDEOS

WEB: SEND TO GALLERY

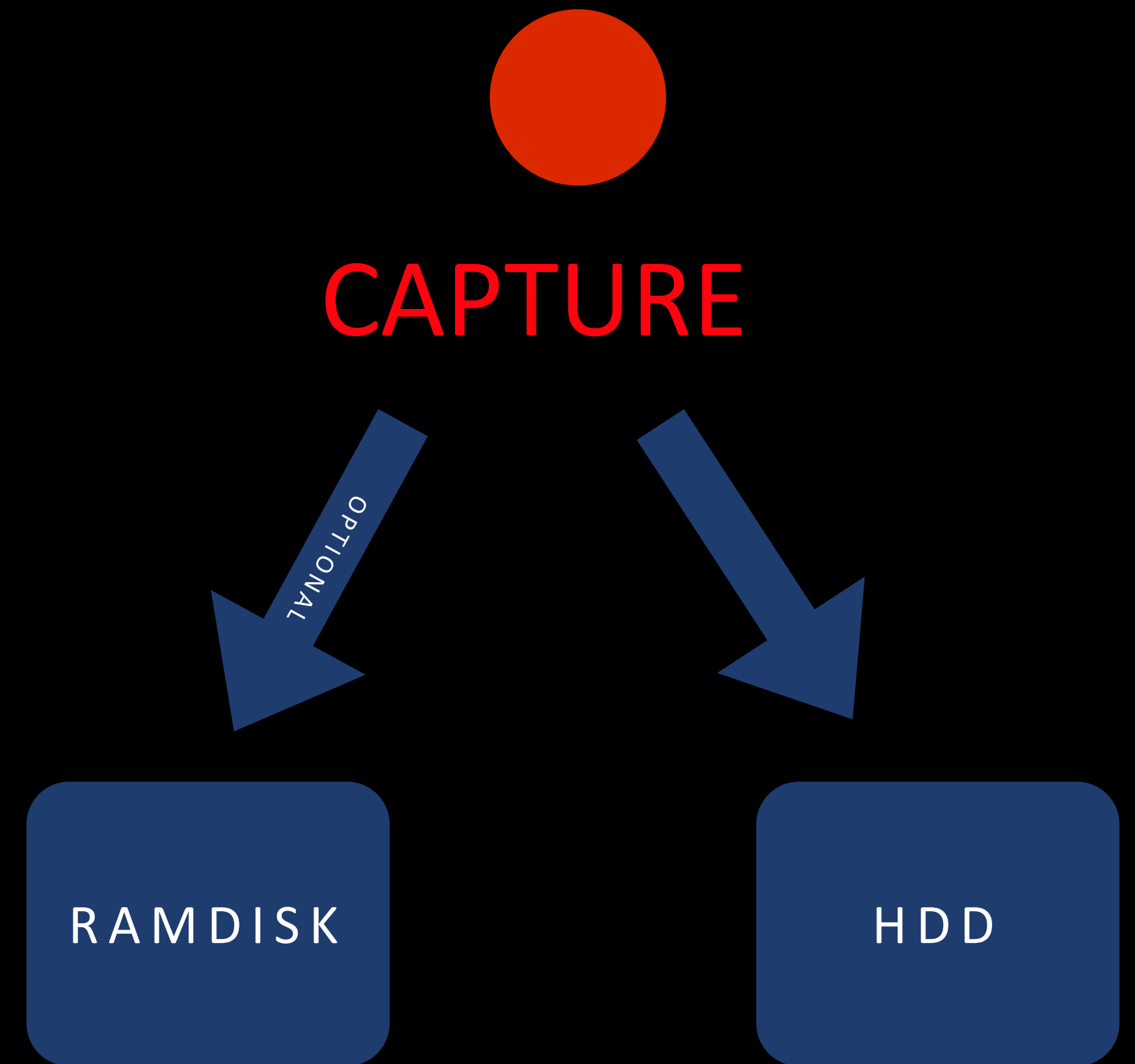
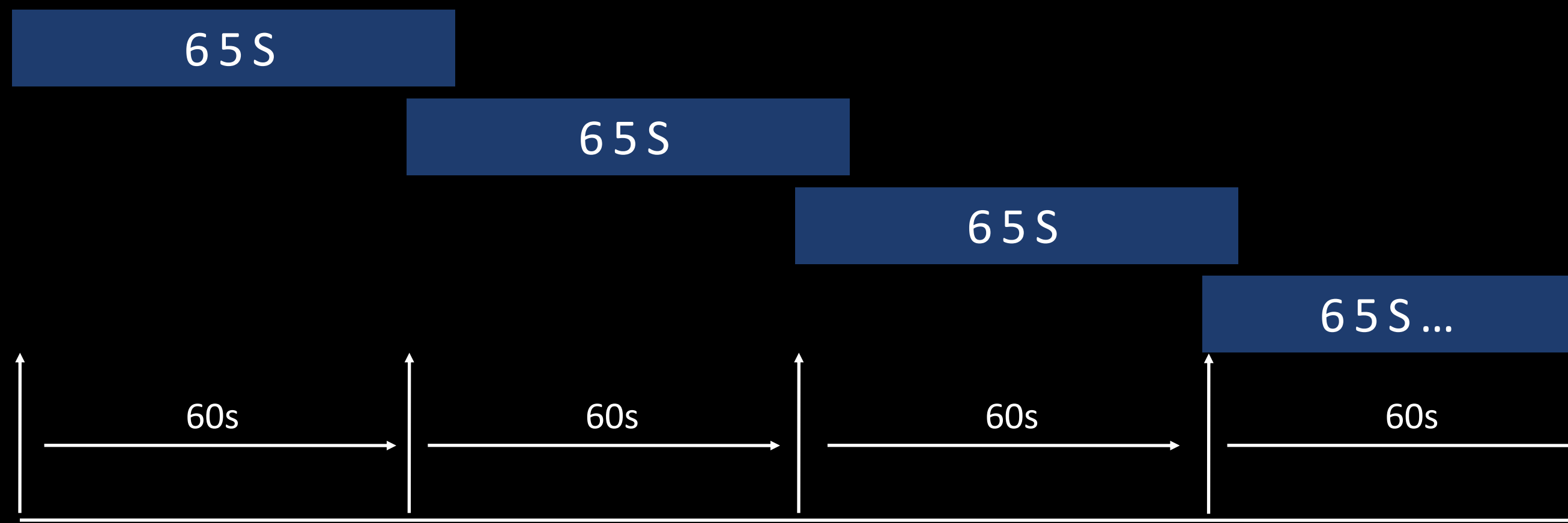


# HER:AI - WORKFLOW - RECORDING

CAPTURING +20° SUN ANGLE

CAPTURING 14 STREAMS - 7 SD + 7 HD  
ANALYZING THE SD STREAMS

SEGMENTATION OF THE VIDEOS - EVERY 60S A  
65S SEGMENT FOR OVERLAPPING

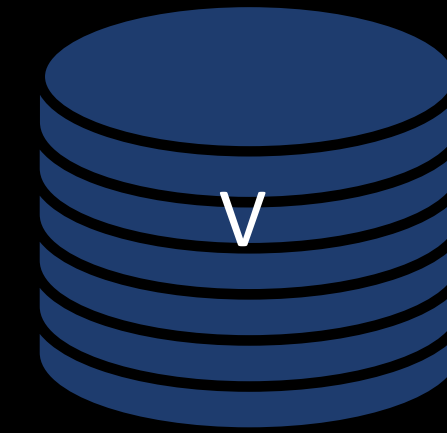


# HER:AI - WORKFLOW - STACK AND DIFF

STACK  
STACK SINGLE FRAMES TO ONE IMAGE

DIFF  
TAKE 1ST IMAGE IN VIDEO AND SUBSTRACT THE  
STACK

## STACK SD-VIDEO



DIFF  
DIFF





# HER:AI - WORKFLOW - FIND LINES

CV2 - FIND LINES

GAUSSIAN BLUR MASK - REDUCE BACKGROUND NOISE  
(7,7)

CREATE CANNY EDGES IMG

FIND LINES WITH HOUGH ALLGORITHM  
PARAMS: RHO=1, THETA= $\pi/180$ , THRESHOLD=10,  
MIN-LENGTH=40PX, MAX-GAP=5PX

RESULT: LINE COORDINATES

CANNY EDGES



DIFF

HoughLinesP()

line coordinates

```
{  
  "z_sd_meteor_tile_coordinates": [  
    [  
      616,660,96,144  
    ],  
    [  
      572,616,144,192  
    ]  
  ]  
}
```

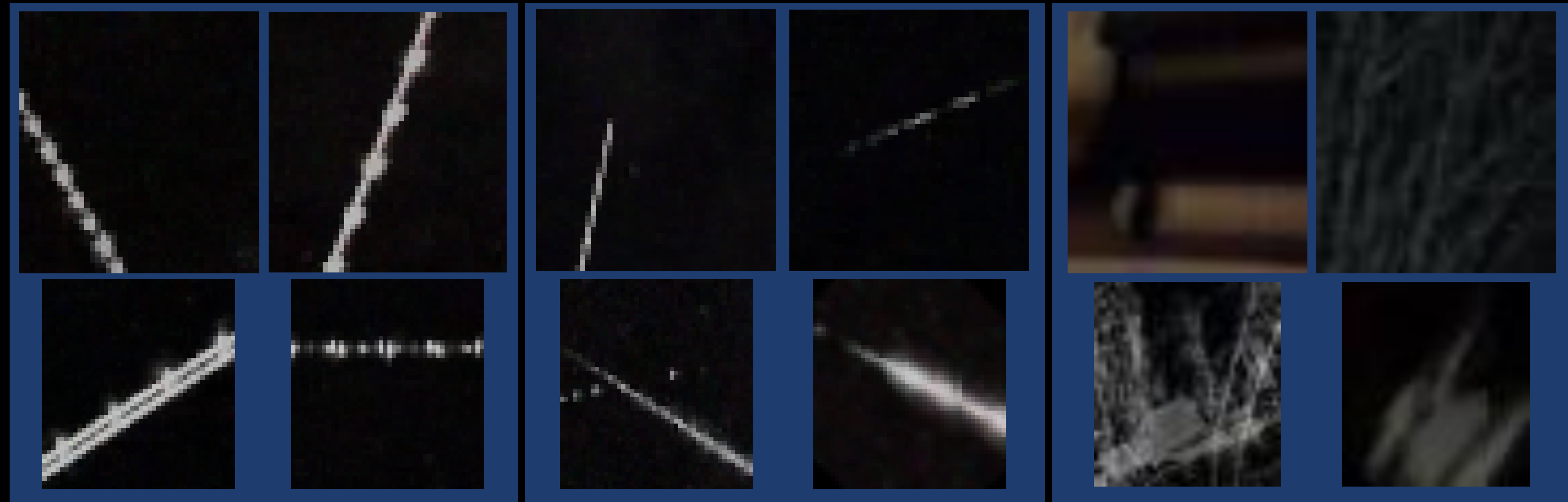
# HER:AI - WORKFLOW - TILE AND CLASSIFY

NUMPY - IMAGE TO NUMPY-ARRAY

TILE ARRAY IN 44X48PX (WITH LINES)

CLASSIFY TILE WITH ML MODEL

3 CLASSES - ARTIFICIAL, METEOR, NATURAL



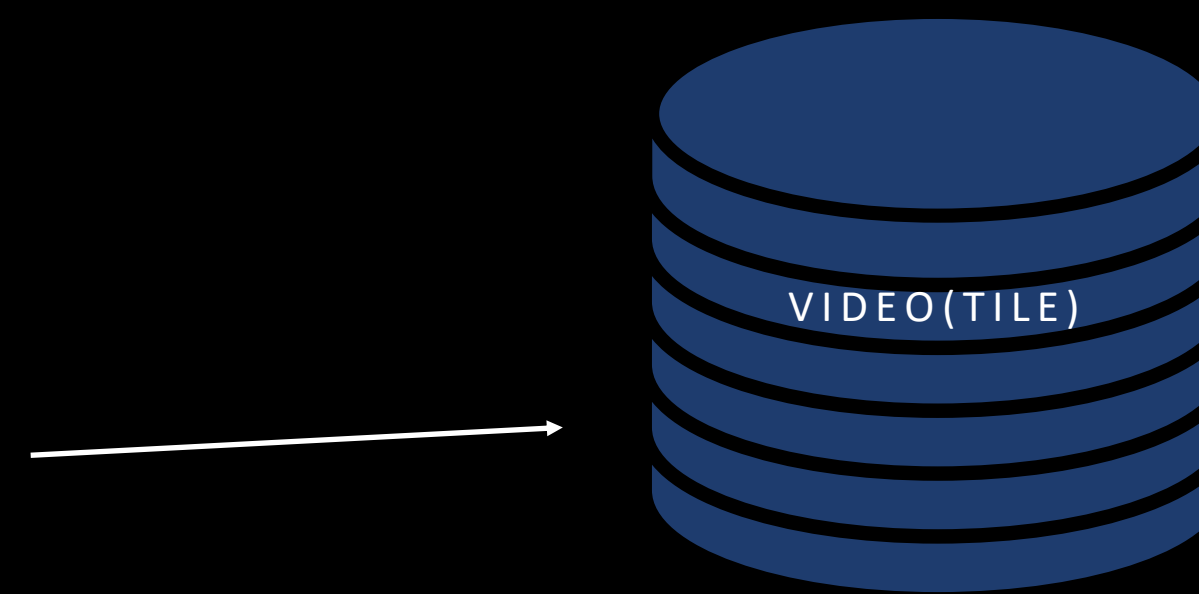
# HER:AI - WORKFLOW - CLASSIFY AND SPEED

3 CLASSES - ARTIFICIAL, METEOR, NATURAL

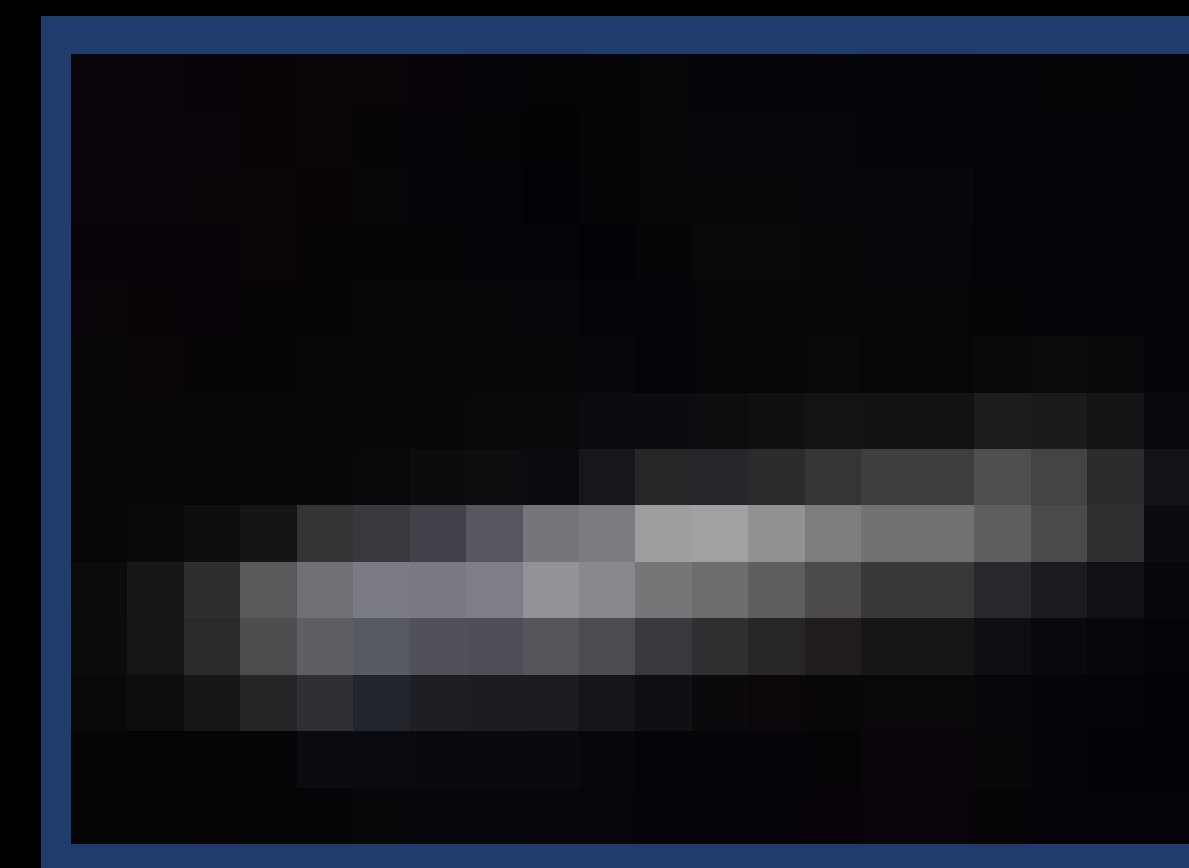
IF METEOR → DETECT SPEED OF MOVEMENT



Untertitel



compare each frame with the next



more bright px = faster movement

HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

HOME

SETTINGS

LOGOUT

login

**login**

user herai

pass .....

Login

HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

HOME

SETTINGS

LOGOUT

home

presort

sort

meteors

highlights

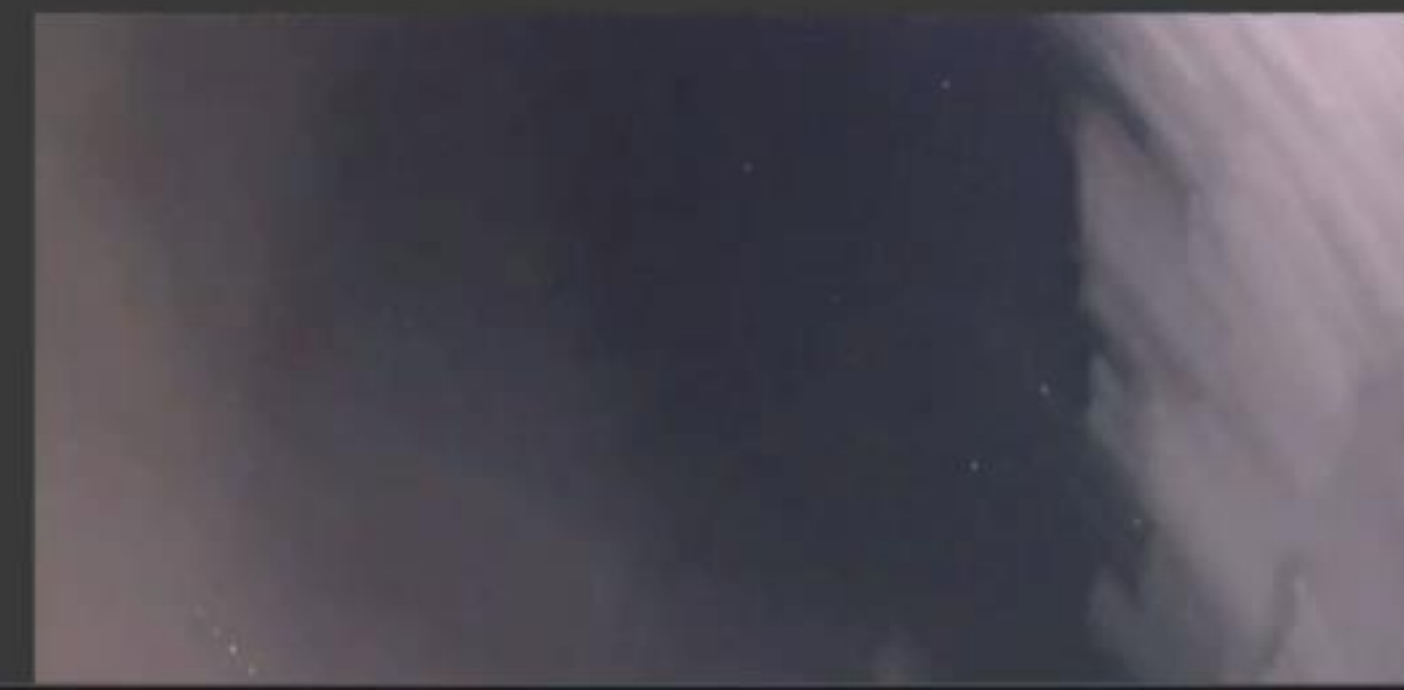
hall of fame

dome

settings

logout

22 IMGs remaining



# HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

HOME

SETTINGS

LOGOUT

home | presort | sort | meteors

highlights | hall of fame | dome

settings | logout

2024-03-20-19-50-50-cam6-SD-stackedTile.jpeg



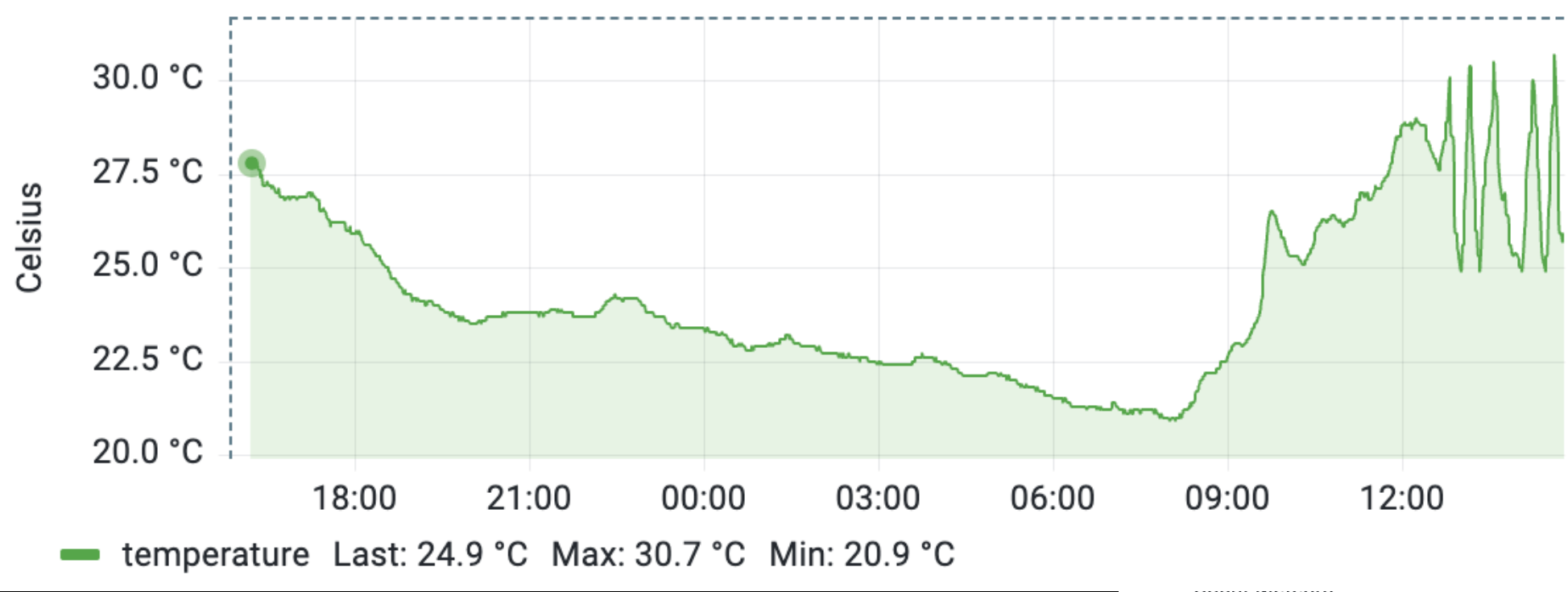
2024-03-20-19-50-50-cam6-HD.mp4

duration in s: 5 highlight markieren

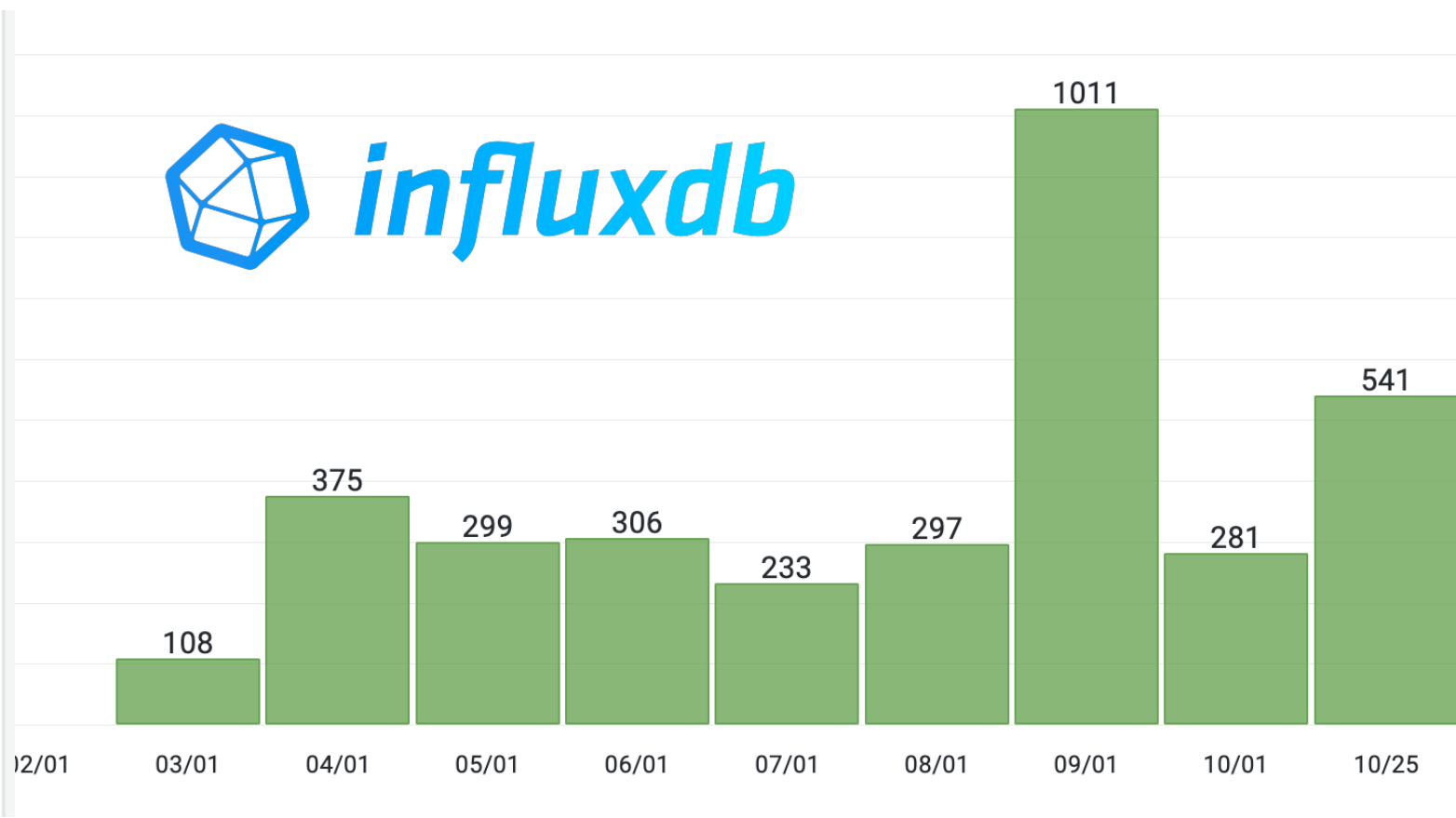
trimmen nächstes 2 Files left

< 2s > || 2s >

dome temperature



Meteors per Month



HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

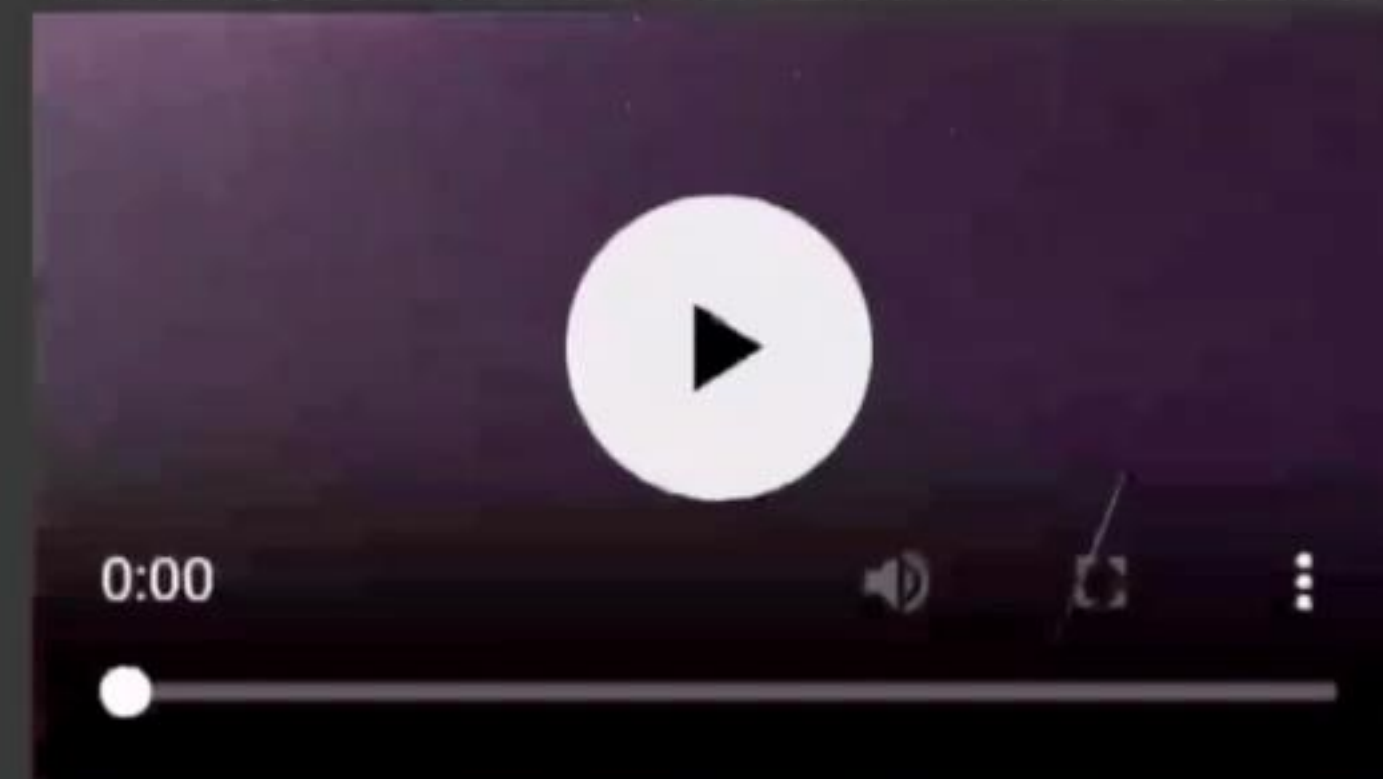
HOME

SETTINGS

LOGOUT

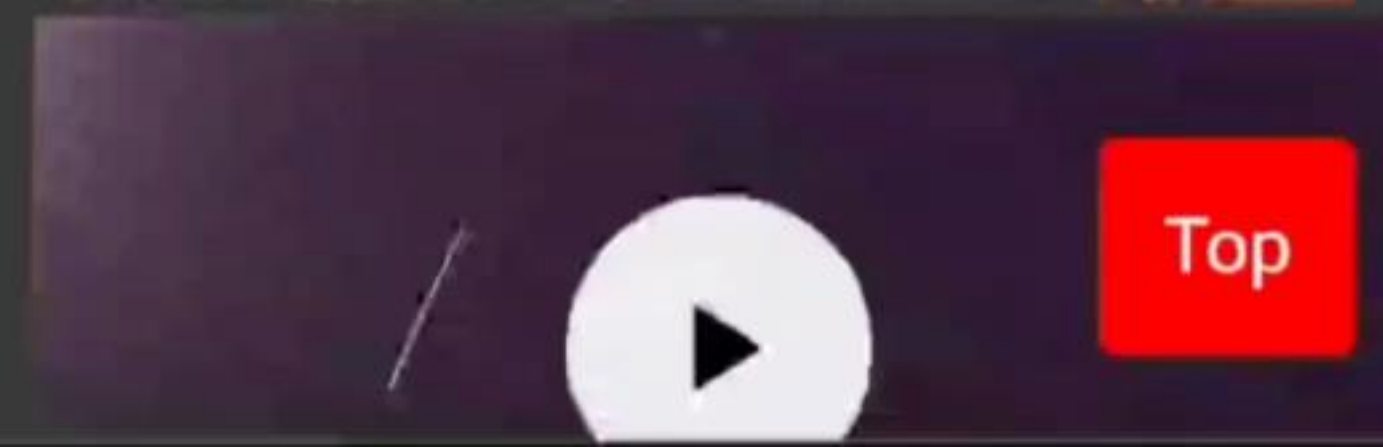
144 145 146 147 148 149 150 151 152 153 154  
155 156 157 158 159 160 161 162 163 164 165  
166 167 168 169 170 171 172 173 174 175 176  
177 178 179 180 181 182 183 184 185 186 187  
188 189 190 191 192 193 194 195 196 197 198  
199 200 201 202 203 204 205 206 207 208 209  
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243 244 245 246 247 248 249 250 251 252 253  
254 255 256 257 258 259 260 261 262 263 264  
265 266 267 268 269 270 271 272 273 274 275  
276 277 278 279 280 281 282 283 284 285 286  
287

Datum: 2024.03.20 00:12:58 Kamera: cam7



| Download Video | Highlight Video | Delete Video |

Datum: 2024.03.19 00:56:28 Kamera: cam7



# HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

HOME

PRE-SORTER

SORT

- home
- presort
- sort
- meteors
- highlights
- hall of fame
- dome
- settings
- logout

## Dome Measurement values

Temperature: 20.0°C

Humidity: 42.4%

FAN is: OFF

Last Update: 2024-03-22 20:40:12

Live View

Dome



cam1 (NW-N-NE)



# HER:AI - WORKFLOW - WEBPORTAL

HOME: OVERVIEW AND SOME STATISTICS

PRE-SORTER FOR QUICK VIEW AND SELECT

SORT: VIEW & TRIM

GALLERY, HIGHLIGHTS, HALL OF FAME

HOME

SETTINGS

LOGOUT

home

presort

sort

meteors

highlights

hall of fame

dome

settings

logout

Value

Ein/Aus

25

20230408102642\_model.npp

51.1945

12.5600

156

## HER:AI - ALTERNATIVES - START SIMPLE

THE TOTAL COST IS APPROXIMATELY €1000 - IT COULD BE CHEAPER

USE SURVEILLANCE CAMS

USE WIFI INSTEAD OF WIRED POE

START WITH ONE OR 2 CAMS

RECORD JUST IN DARKEST HOURS

KEEP FOOTAGE JUST FOR ONE DAY

HER:AI - PARTICIPATE

[xdev@e.mail.de](mailto:xdev@e.mail.de)

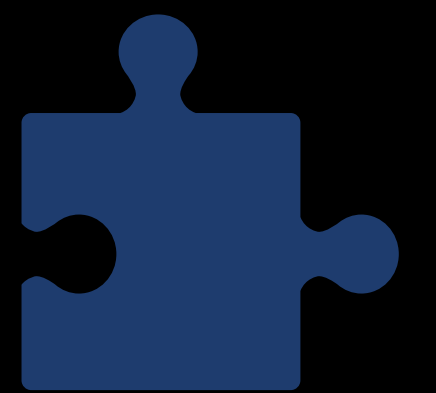
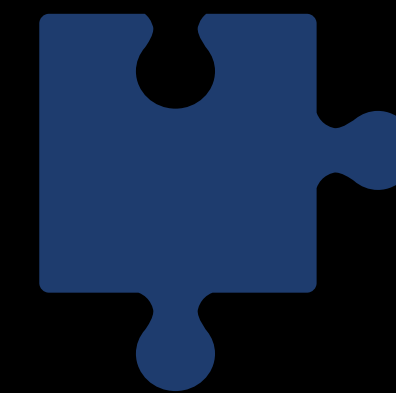
GET **INVOLVED**

CAMS/CHIPS, VIDEO-PROCESSING

PYTHON, CV, ML, JS, CONTAINERS

WEB (HTML, MEDIA, CSS, NODEJS)

LINUX - SECURITY / HARDENING / PROXY



GITHUB

[HTTPS://GITHUB.COM/DREVIL75/HERAI.GIT](https://github.com/drevil75/herai.git) (GNU GENERAL PUBLIC LICENSE V3.0)

HER:AI

Q & A

