EYE LIGHT

A Comprehensive Surgical Procedure Analysis

Alcon

OUR TEAM

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HUANG

JACOB
ZAMORA

CHRISTOPHER
LIN

JOSH
LAKIN

KEVIN
MATA

NORMAL VISION

VISION
Through
Early
Cataract

VISION
Through
Advanced
Cataract

STATISTICS

90%
of population
develops cataracts

3.8M
cataract surgeries
per year

40
surgeries done by
each surgeons per day

3
Months of
wait time

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CATARACT SURGERY

98%

SUCCESSFUL

Average 10 minutes each

2%

SUBOPTIMAL

76,000 surgeries

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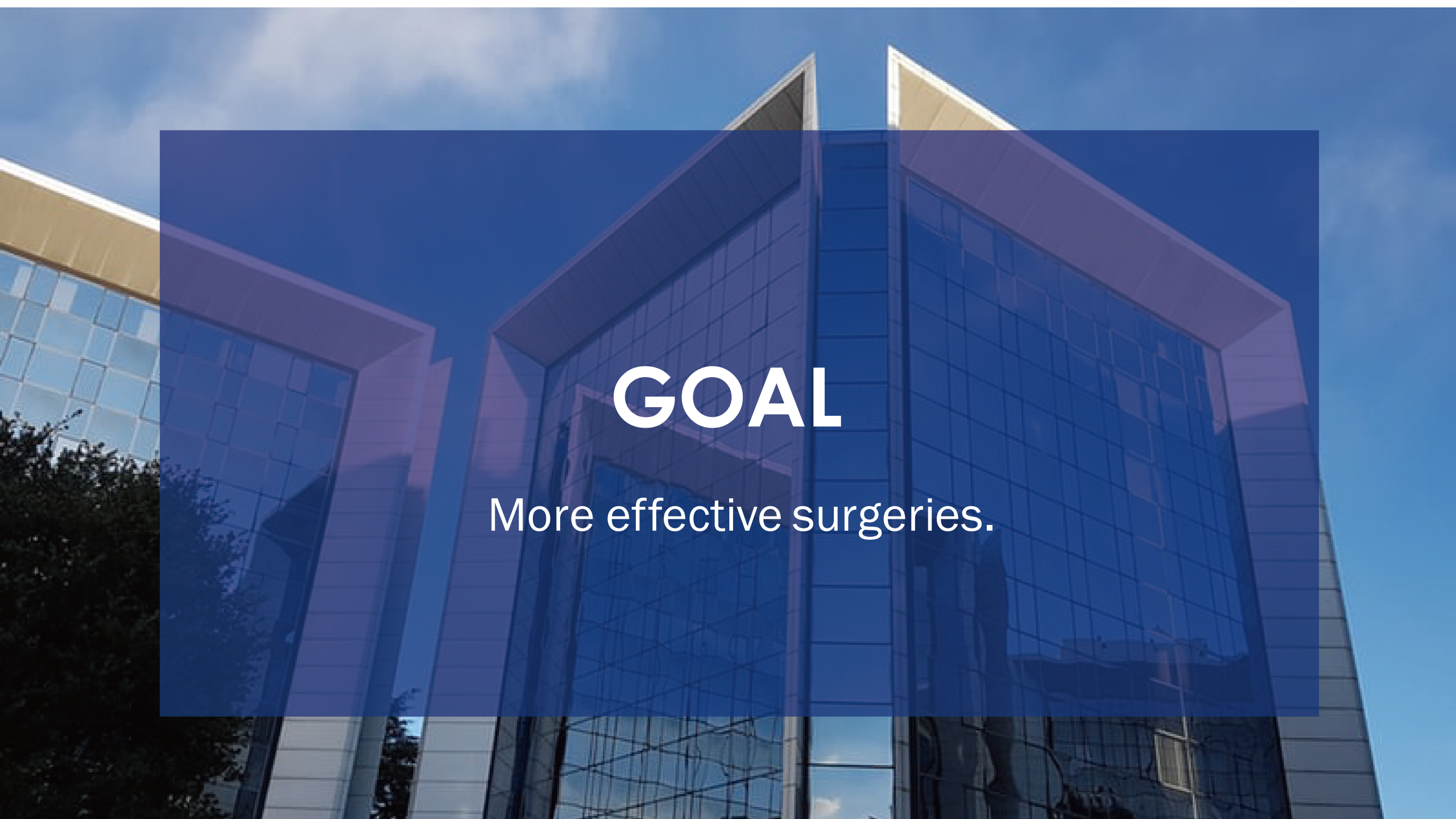

GOAL
More effective surgeries.

Why more effective surgeries

Less time with surgical tools in your eyes

Why more effective surgeries

Less time with surgical tools in your eyes

⬇

Less physical damage

Why more effective surgeries

Less time with surgical tools in your eyes

⬇

Less physical damage

⬇

Better recovery

Why more effective surgeries

More surgeries can be performed

Why more effective surgeries

More surgeries can be performed

1% improvement

Why more effective surgeries

More surgeries can be performed

1% improvement

38,000 more surgeries per year

Why more effective surgeries

Surgeons can spend more time with patients diagnosing their problems.

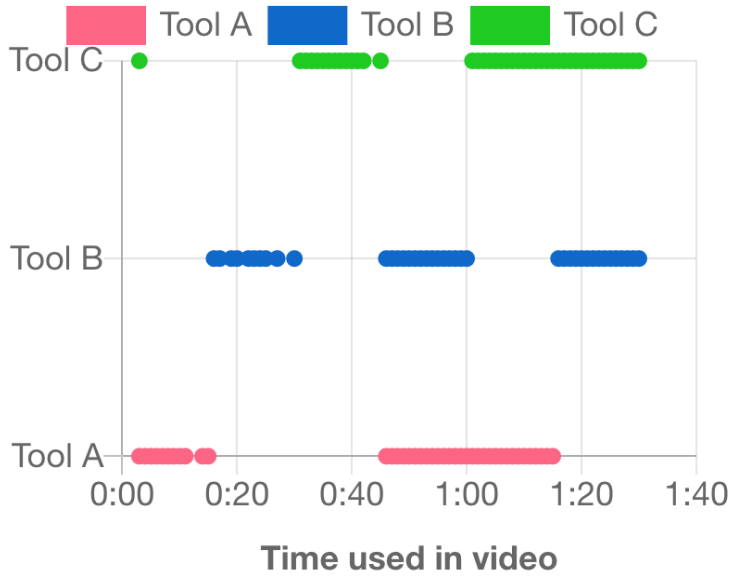
Surgeons and athletes watch replays to improve themselves.

SOLUTION

- Use machine learning to obtain useful data from surgery videos by tool detection
- Provide surgeons surgical analysis for self improvement
- Improve overall surgical performance

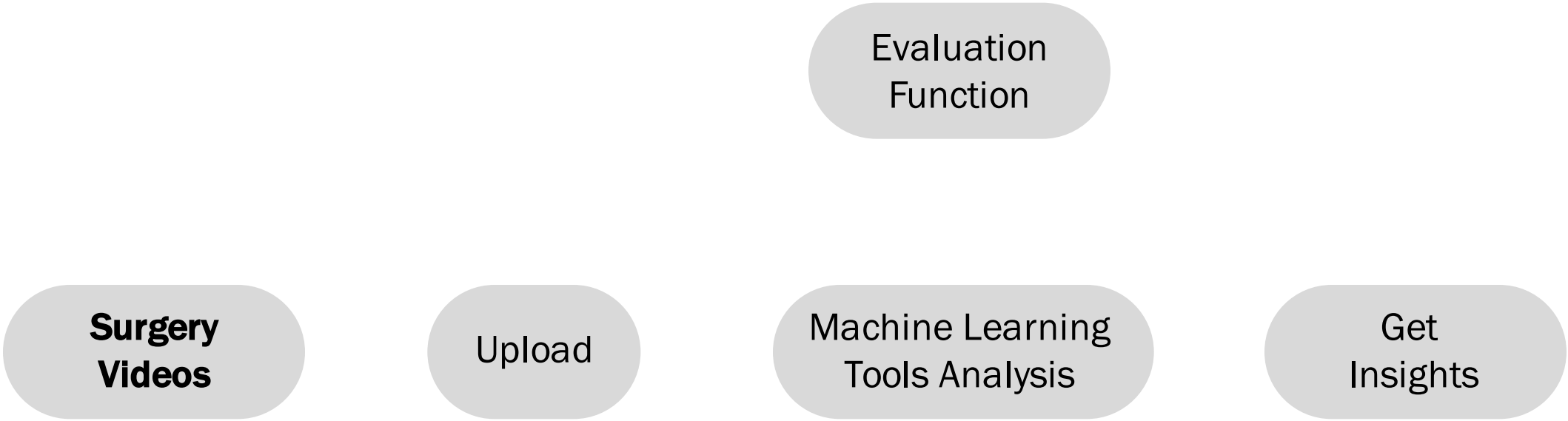
WHY TOOL DETECTION

- Tools can indicate surgery procedures.
  Eg. scalpel means some sort of cutting performed on patient
- Measuring the time of each tool being used will give us an overview of the surgery performed
- Therefore, we successfully extract surgical procedure out of surgery videos

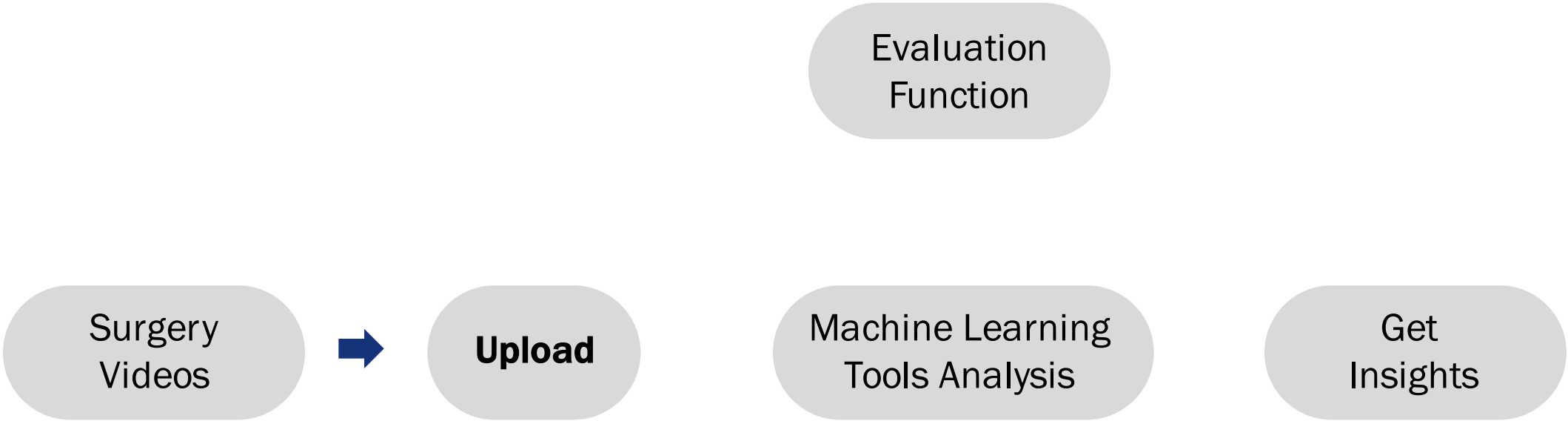


DEMO

USER FLOW


Evaluation Function
Surgery Videos
Upload
Machine Learning Tools Analysis
Get Insights

USER FLOW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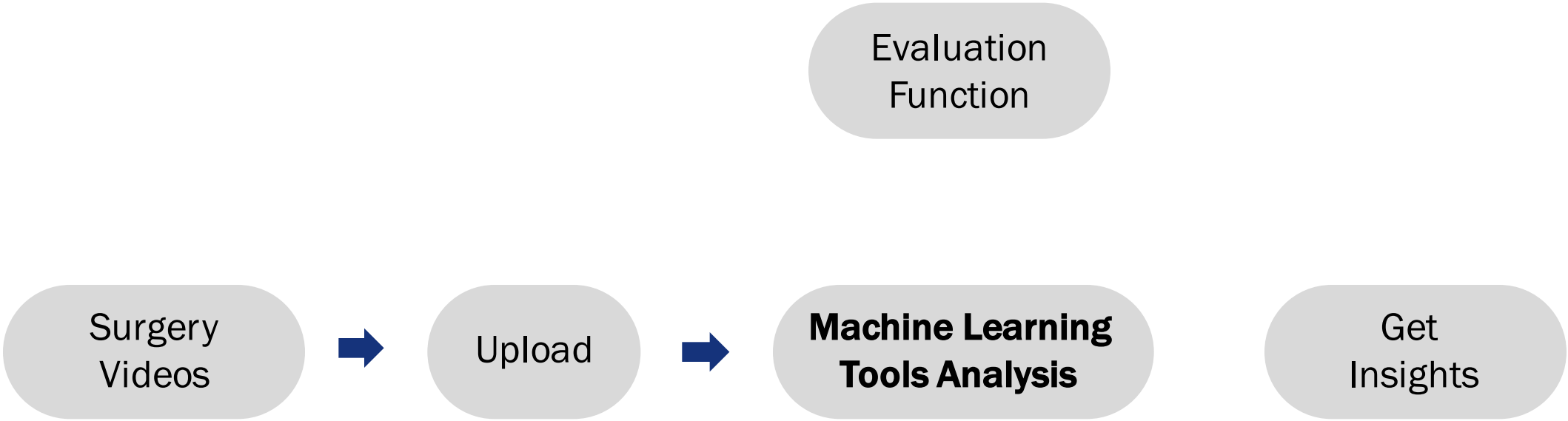
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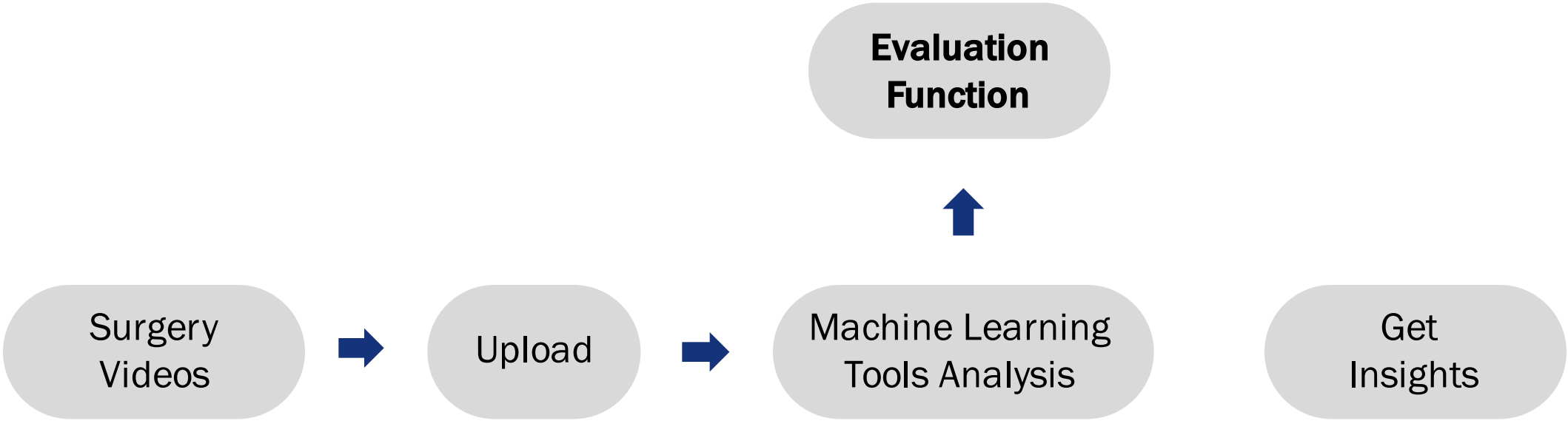
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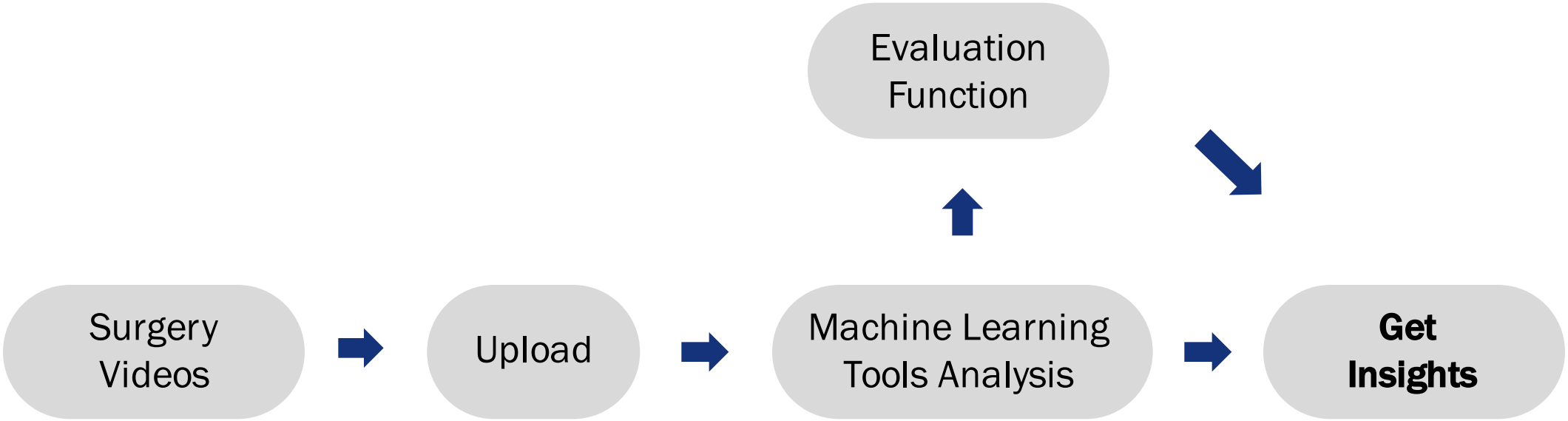
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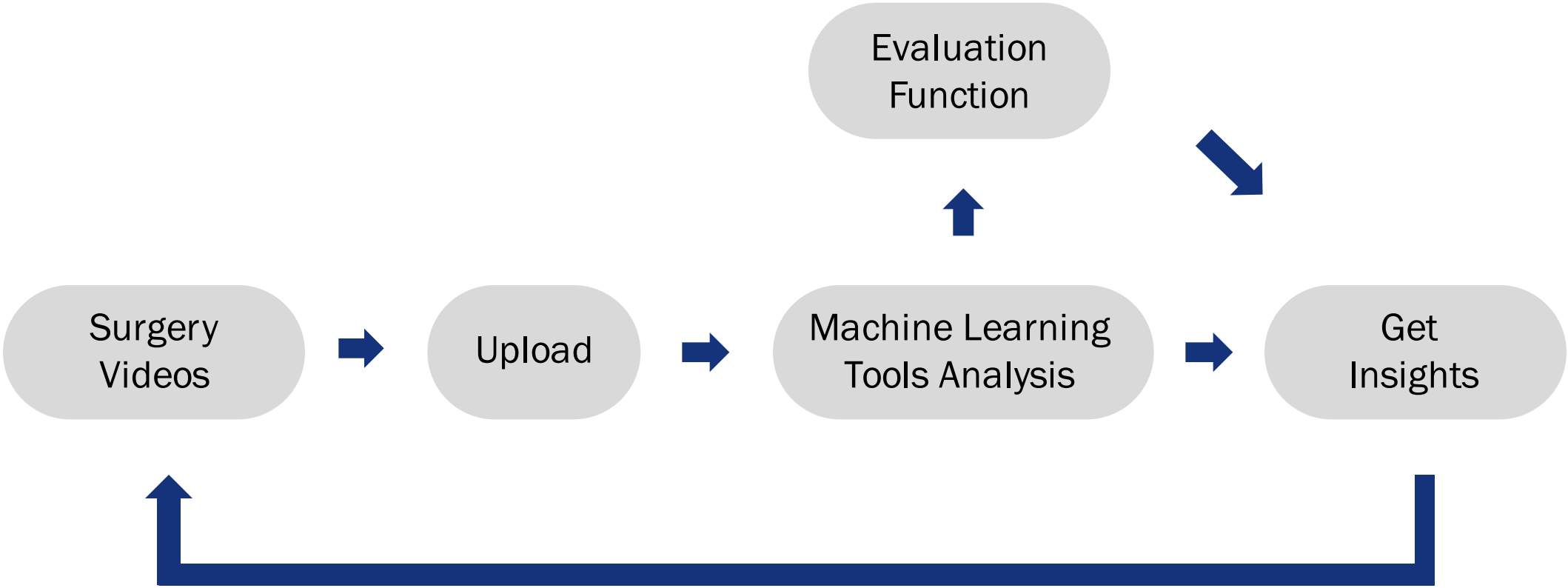

Perform Better Surgery In the Future

SURGICAL TOOL RECOGNITION

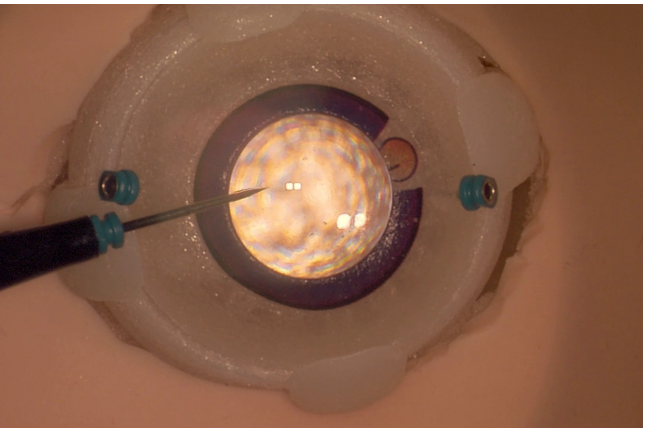

Image
400*400

Convolutional

Neural Network

Slit Knife

Capsule Grabber

Canula

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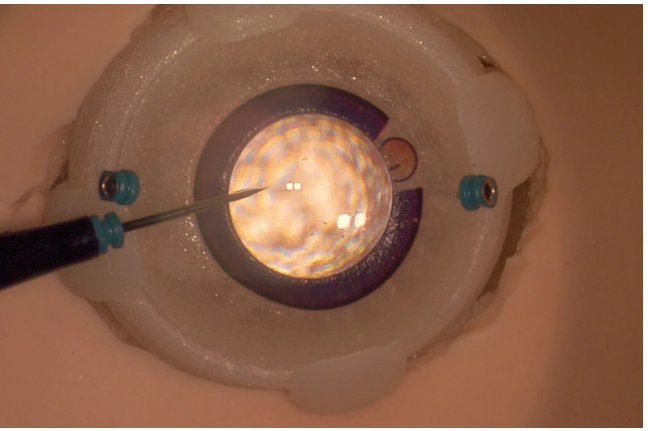

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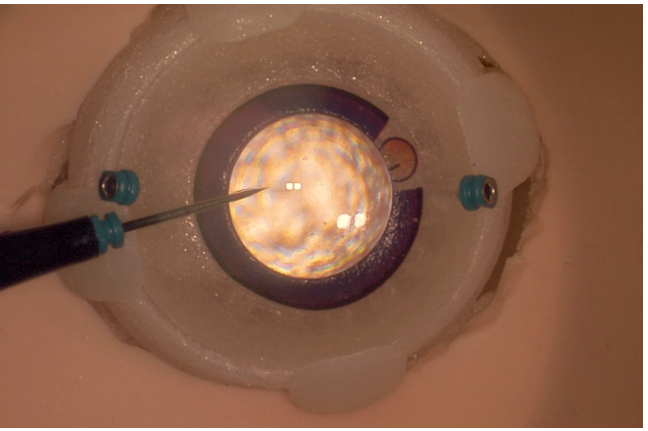

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Convolutional
Neural Network

Probability Score

17% Slit Knife

14% Capsule Grabber

56% Canula

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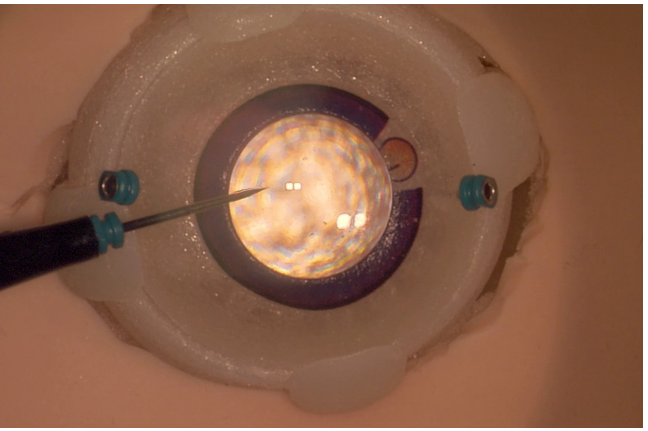

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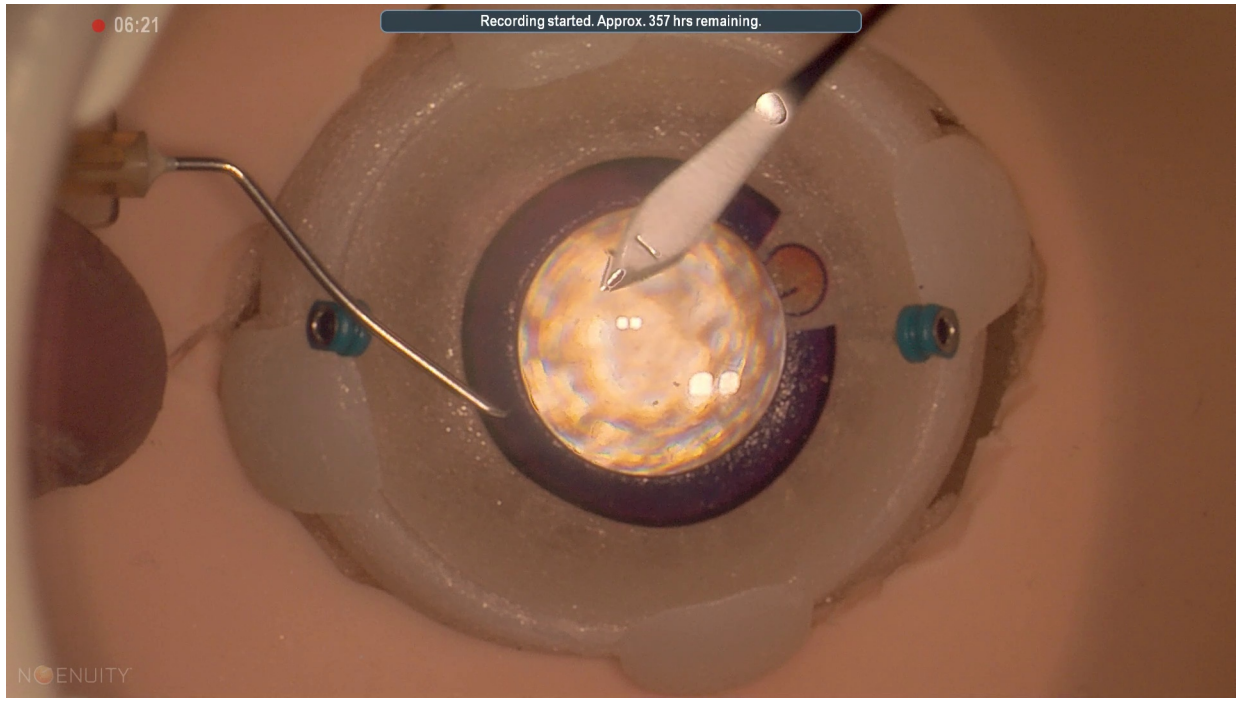
TWO SURGICAL TOOL RECOGNITION



Probability Score

Slit Knife

Capsule Grabber

Canula

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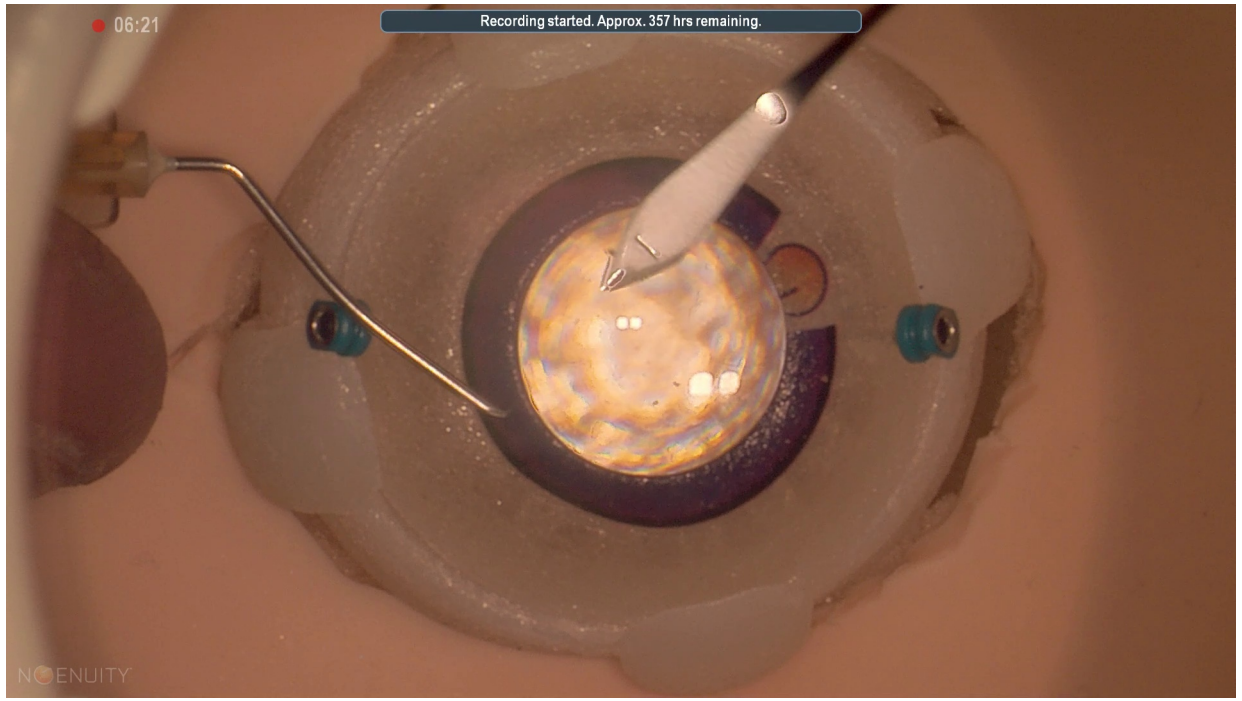


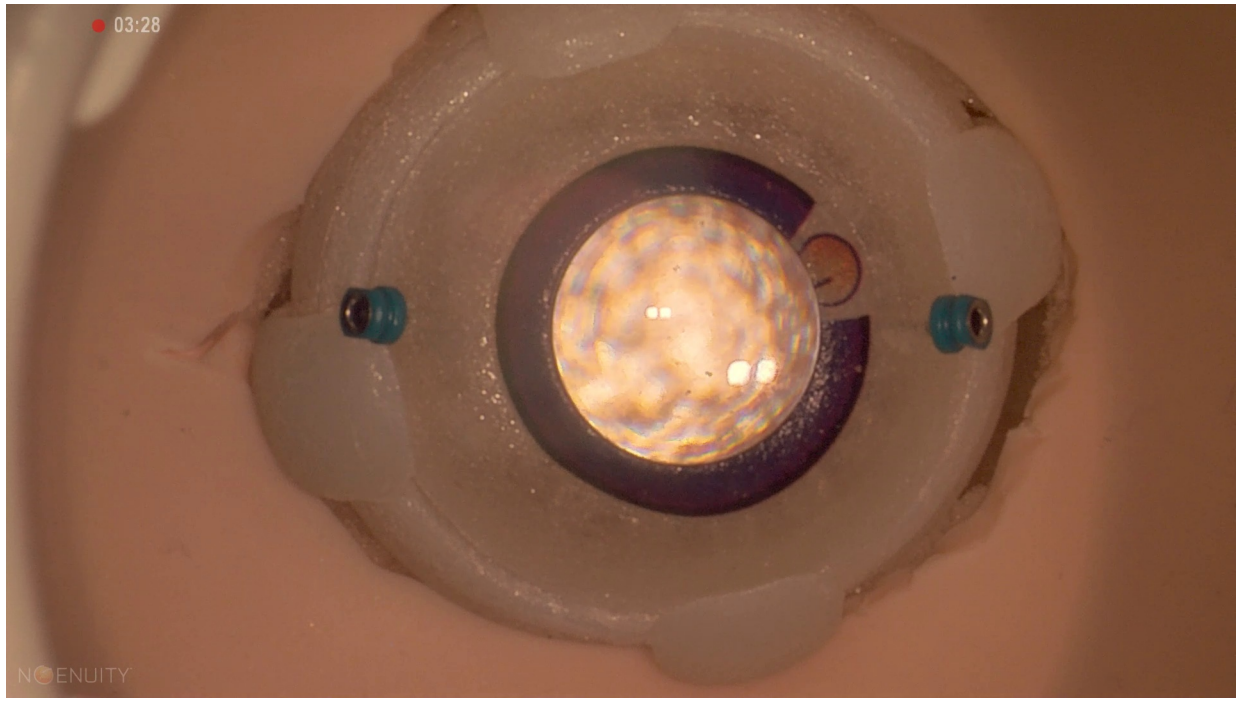
Probability Score

67% Slit Knife

92% Capsule Grabber

23% Canula

NO SURGICAL TOOL RECOGNITION



Probability Score

12%	Slit Knife
9%	Capsule Grabber
17%	Canula

PIPELINE

WEB

React

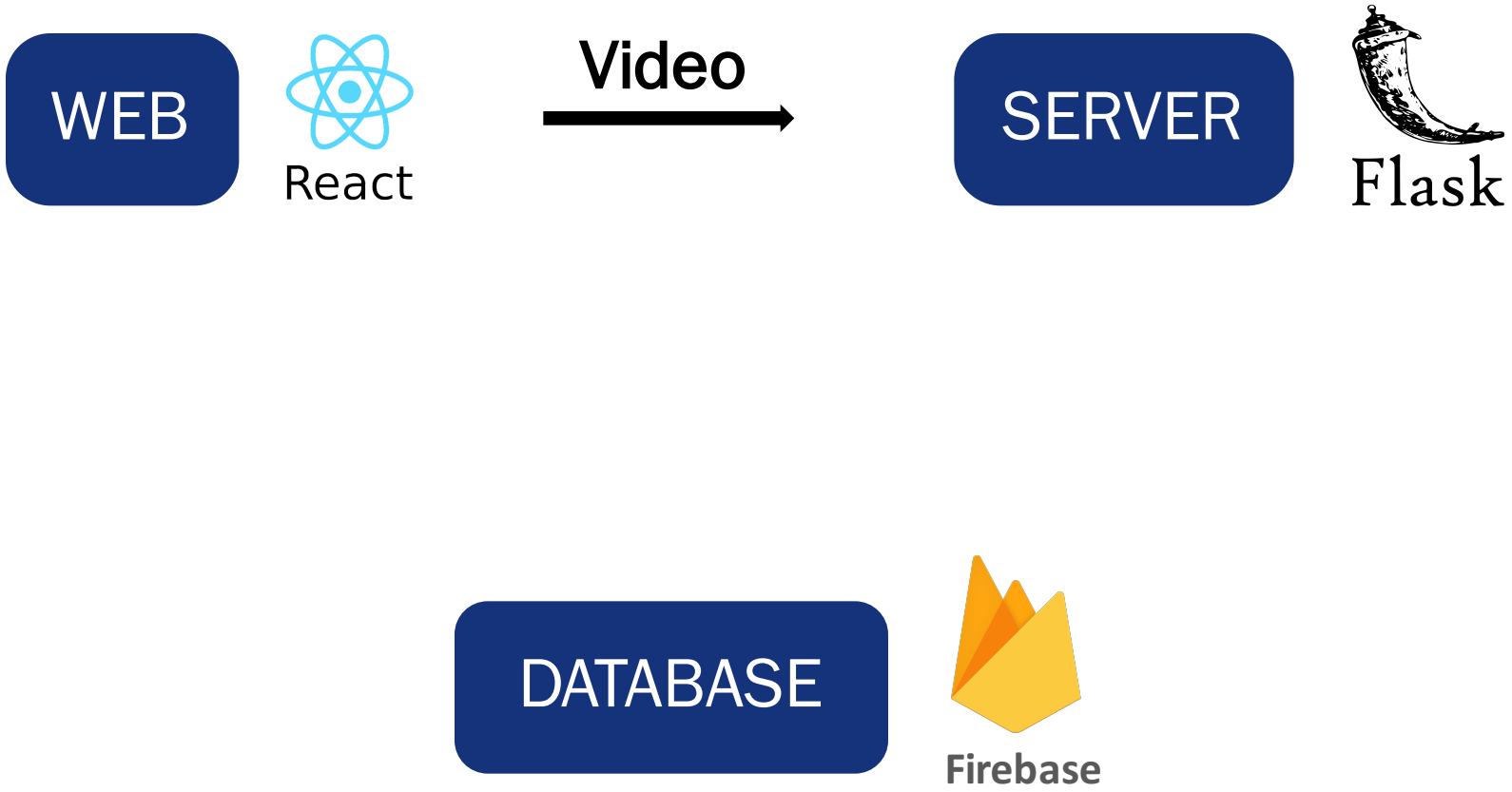
SERVER

Flask

DATABASE

Firebase

PIPELINE



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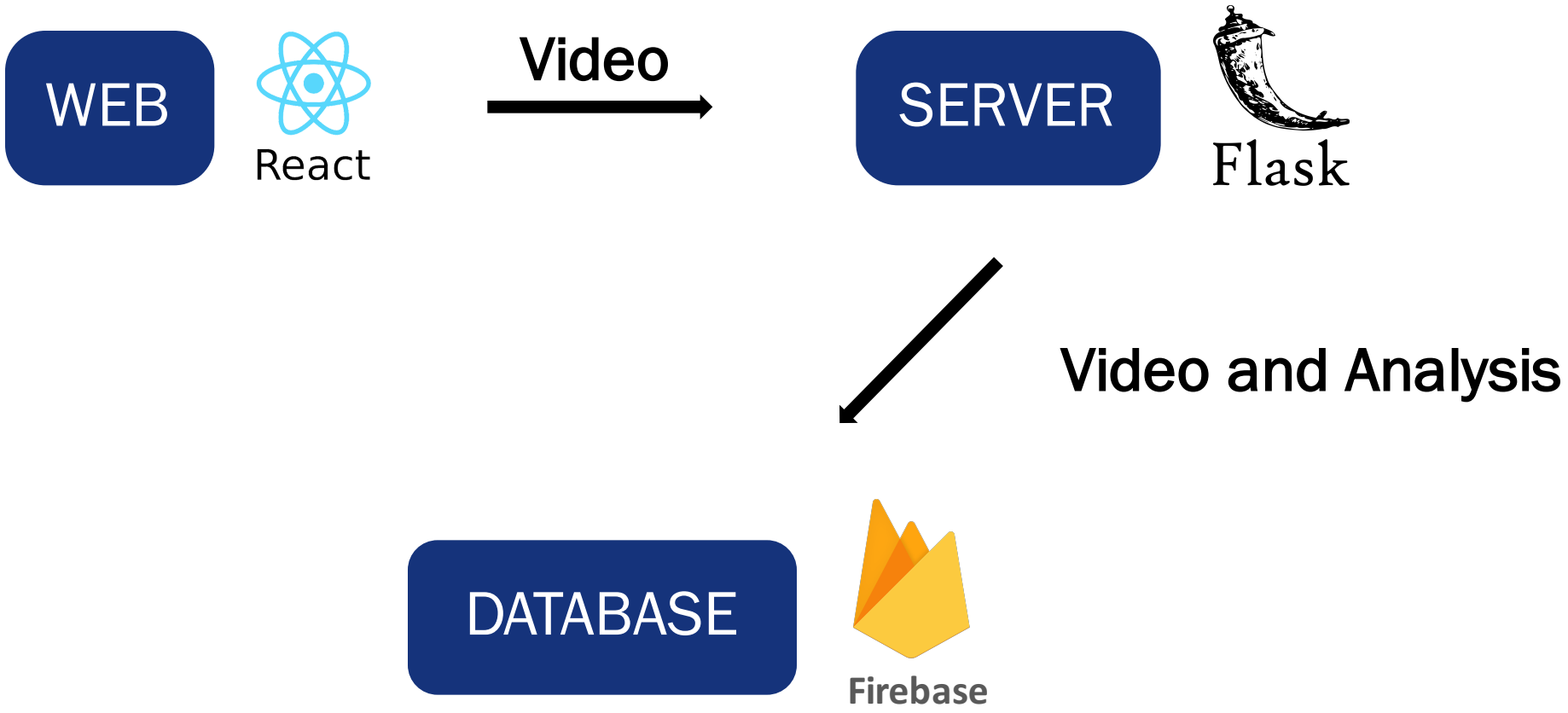
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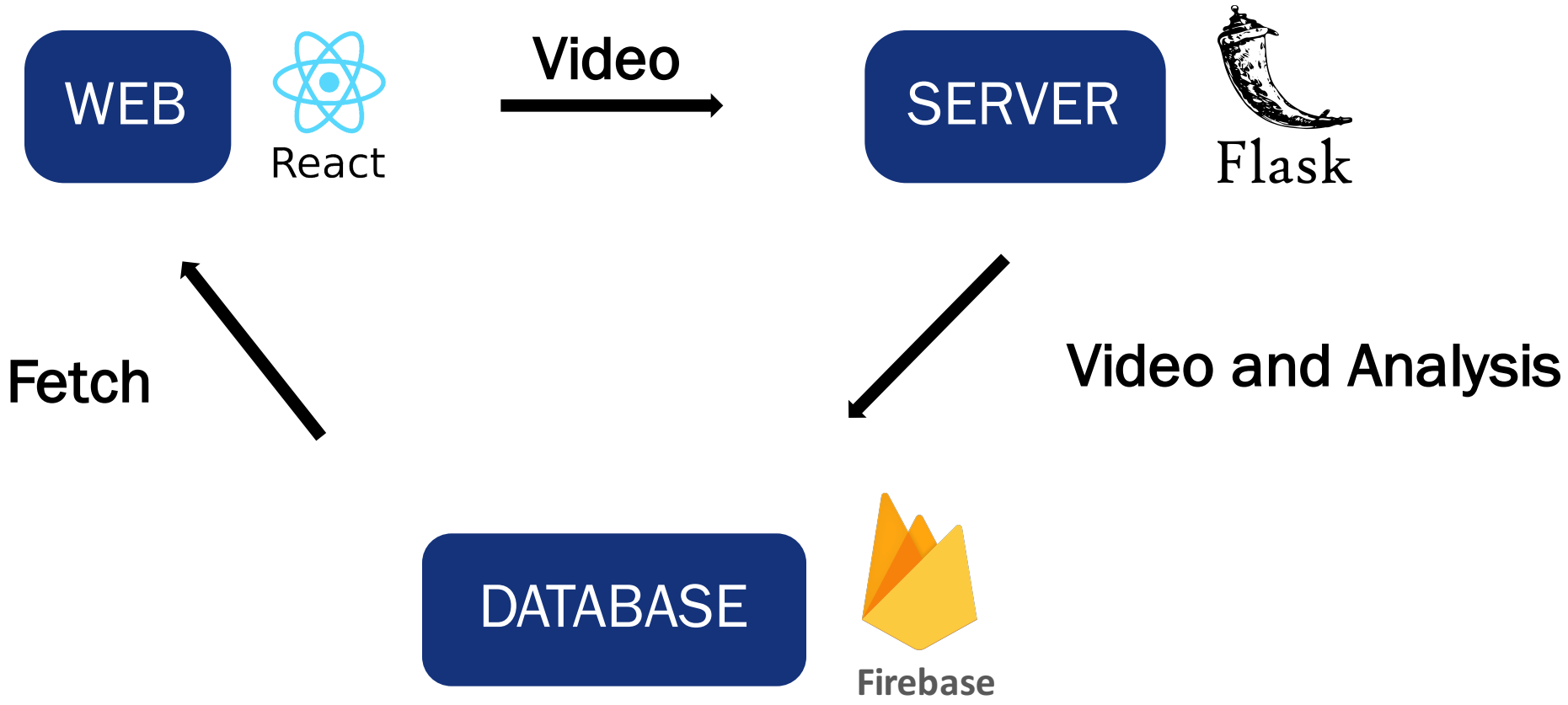
WEB
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DEMO

CHALLENGE

Training Data

- Difficult to access due to patient privacy
- Almost none of them are labeled
- Eventually we have to record the data in Alcon’s surgery room

CHALLENGE

Machine learning design

- Trade off between long training time and better accuracy
- Limit parameters to find the balance
  - input image size
  - hidden layers
- Final result:

6 HOURS
TRAINING TIME

87 %
ACCURACY

FUTURE IMPLEMENTATIONS

- **Extend to more kinds of surgeries**
- Correlate post-surgery outcomes with surgery procedure
- Get more data such as motion detection beyond tool recognition

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CONCLUSION

- **Goal: Better and more efficient surgery**
- A webapp that understands surgical details and provide valid insights.
- Surgeons can then use the insights to self improve
- Benefit both the patients and the surgeons

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QUESTIONS