



REDESIGN, CO.

OPEN SESAME

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- Problem Statement
- Solution
- Design Considerations
- Prototyping
- Impact
- Future Improvements
- Demo



PROBLEM STATEMENT

Unwanted wildlife has encroached
into our living spaces

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INVASIVE WILDLIFE

IN YOUR CORRIDORS.



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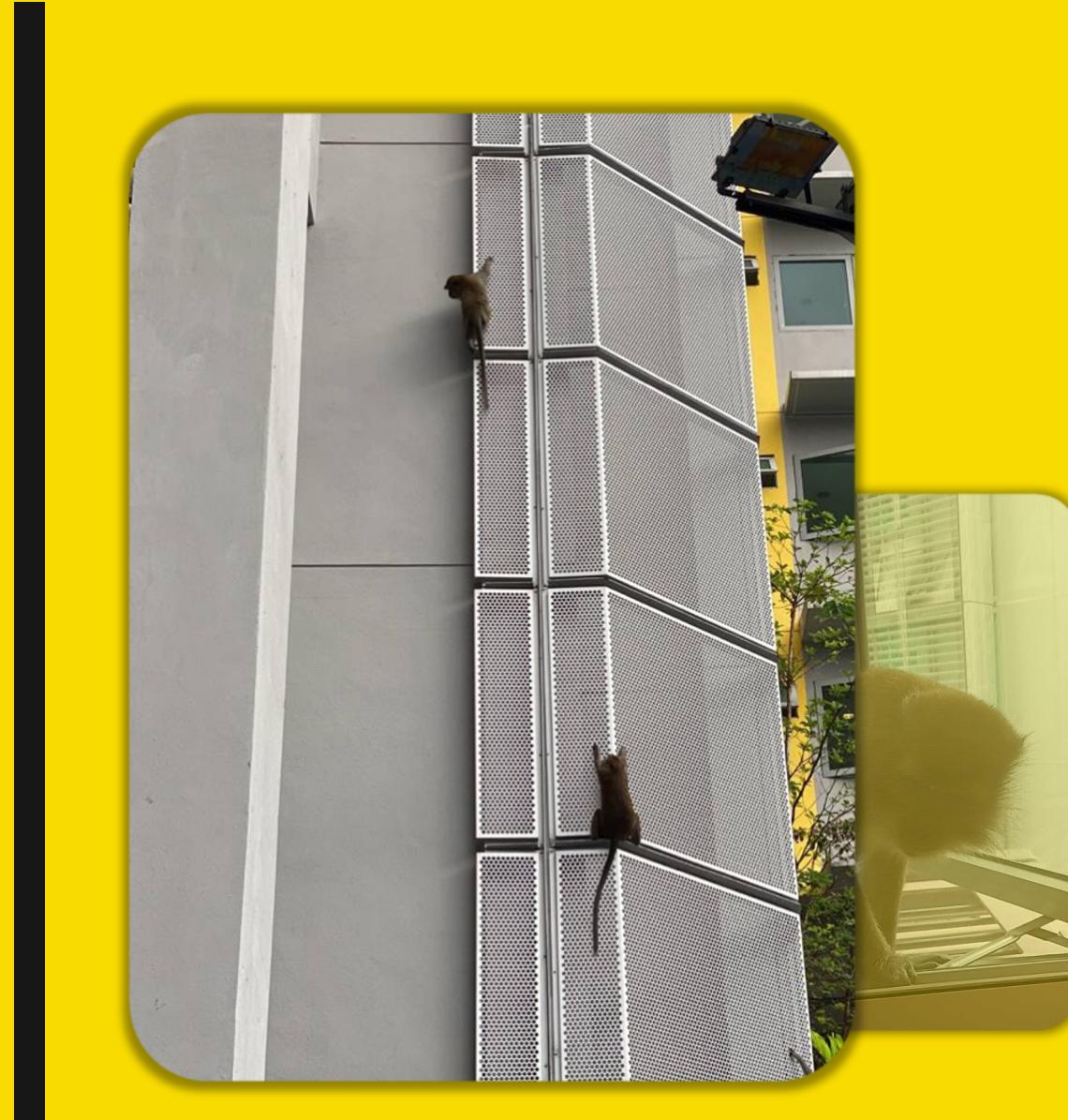
INVASIVE WILDLIFE

IN YOUR CORRIDORS.

IN YOUR HALLS.



OPEN SESAME

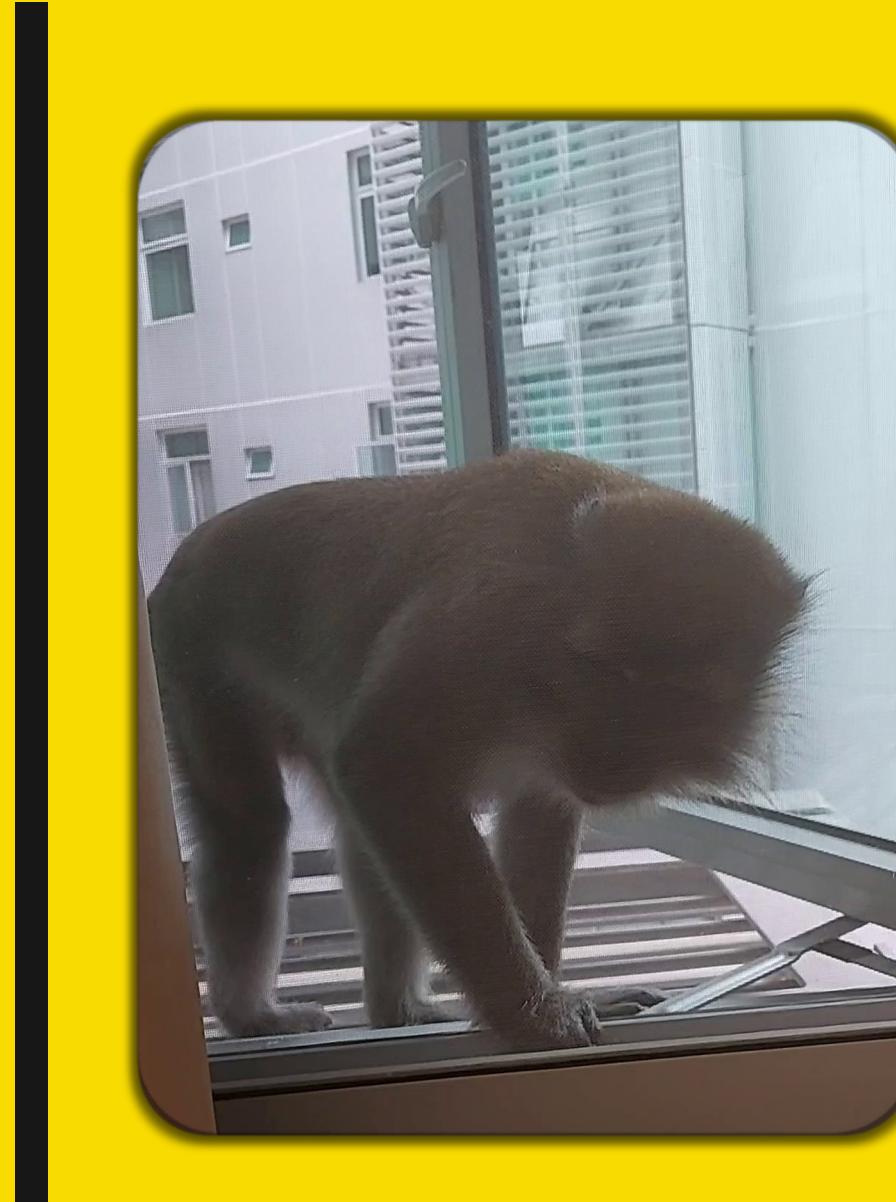


INVASIVE WILDLIFE

IN YOUR CORRIDORS.

IN YOUR HALLS.

AT YOUR WINDOW.



INVASIVE
WILDLIFE

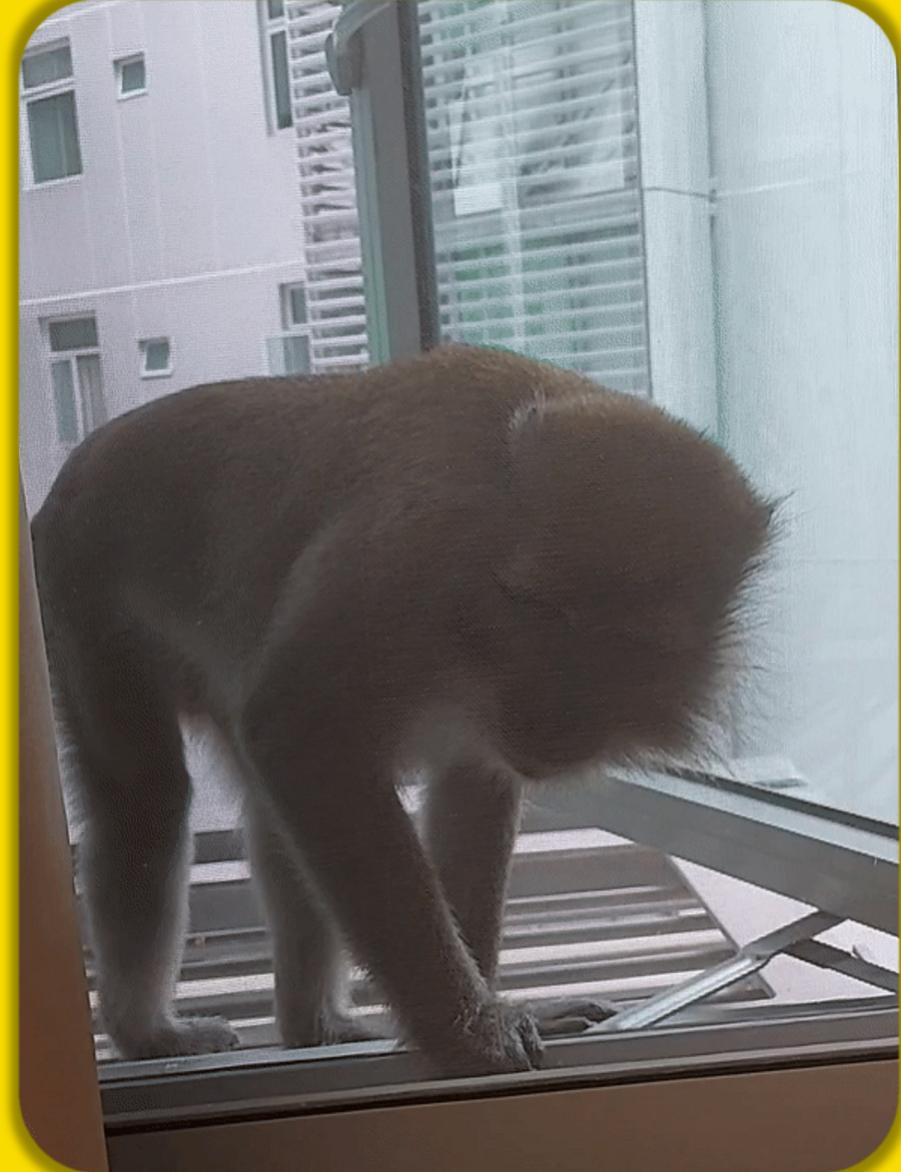
IN YOUR CORRIDORS.

IS HERE.

AT YOUR WINDOW.



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LIVING IN FEAR

FEELING HAPLESS AGAINST
RANDOM MONKEY RAIDS

Here's Christine's story..



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PRIMAL INTRUSION

IS A DEEP-SEATED
PROBLEM IN NTU



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2013

<https://www.asiaone.com/singapore/other-ways-tack...> ::

Other ways to tackle monkey problem: Acres, Singapore News

6 Nov 2013 — Mr Han Cheng Fong suggested culling **monkeys** because they have invaded our living spaces and deprived us of the comforts of our home ("Real ...")

2016

<http://www.jayyeo.com/projects/monkey-sightings-...> ::

The Nanyang Chronicle » Monkey sightings on the rise

16 Oct 2016 — **ACRES** also advised the public to keep a safe distance and refrain from feeding or shouting at the **monkeys**. Other wildlife in **NTU**. But **monkeys** ...

2017

<https://mothership.sg/2017/09/monkey-spotted-at-nt...> ::

Monkey joins students for lunch on NTU campus, eating while ...

19 Sept 2017 — **Monkeys** are not the only animals who have wandered the university's halls. In the past, **NTU** students have seen pangolins;. Photo via **ACRES**.

2020

<http://soapbox.sg/2020/09/13/it-could-have-taken-...> ::

"It could have taken my laptop." Students recall run-ins with ...

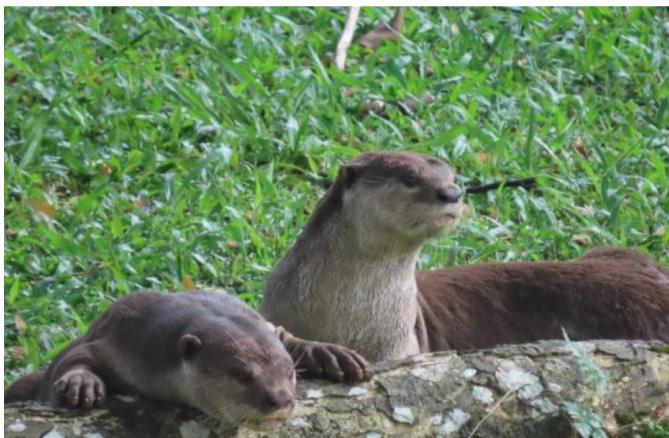
13 Sept 2020 — Students recall run-ins with **monkeys** on campus ... macaques crossing over from their jungle habitat and entering **NTU's** Halls of Residence.

NO EFFECTIVE MEASURES

WE NEED PREVENTION, NOT CURE

THE STRAITS TIMES

NTU taking measures to reduce human-wildlife conflict



The measures range from monkey-proof bins to monkey guarding workshops for university employees that teach a method to guide the animals away from an area.

The school is also making efforts to educate students about the school's rich biodiversity and wildlife etiquette, during induction of new students, and through a handbook being put together by the NTU Earthlink club on what to do when encountering wild animals on campus.

<https://janegoodall.org.sg> › Blog ::

NTU's Notorious Monkey Problem: How is JGIS involved?

Macaques, who are native to Singapore, are forest dwellers. As NTU is located near a recovering secondary forest, it is no surprise that there are rapidly ...



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SOLUTION

Keeping you safe from
surprise primate visits

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USER JOURNEY

HOW IT WORKS



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1

Monkey approaches open window

2

Camera detects monkey intruder

3

Actuator closes the window

USER JOURNEY

HOW IT WORKS



OPEN SESAME

1

Monkey approaches open window

2

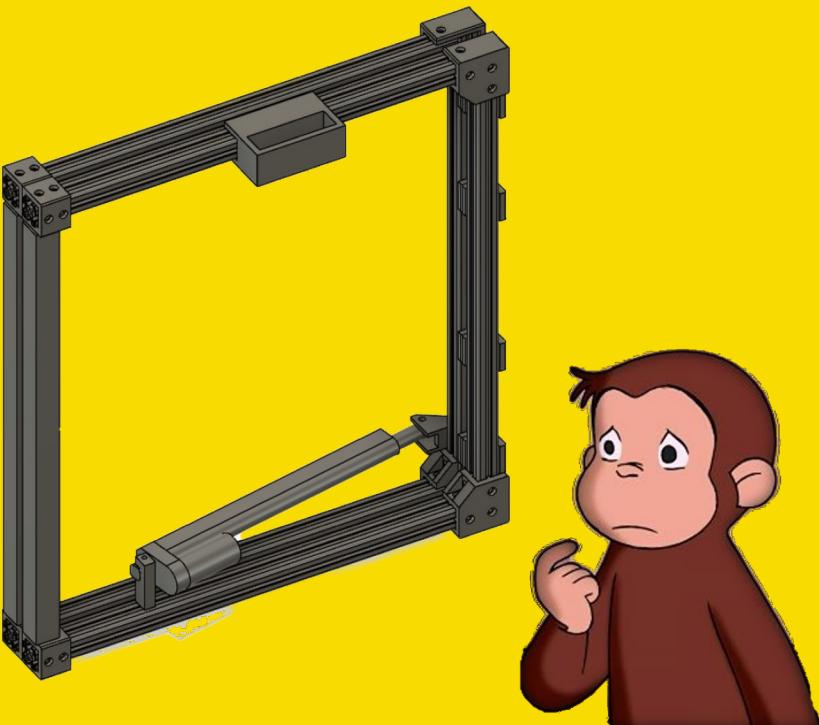
Camera detects monkey intruder

3

Actuator closes the window

USER JOURNEY

HOW IT WORKS



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1

Monkey approaches open window

2

Camera detects monkey intruder

3

Actuator closes the window



DEVELOPMENT PROCESS

Iterations

&

Key design considerations

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MAIN FEATURES

WHAT MAKES US UNIQUE



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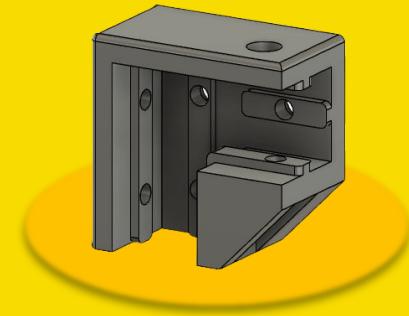
Aluminium Extrusion

3D modelled brackets

Raspberry Pi

Stepper Motor H Bridge Module

Linear Actuator

- A stack of three pieces of silver-colored aluminium extrusion profile, showing the T-slots and mounting holes.
- A black 3D-printed bracket or mounting plate, shown from a perspective view.
- A Raspberry Pi Model B+ board with a white ribbon cable connected to it, shown against a yellow circular background.
- A red printed circuit board (PCB) with blue components, identified as an H-bridge module for stepper motors.
- A long, thin, cylindrical silver linear actuator or servo motor, shown standing upright.

ALUMINIUM EXTRUSION

LIGHT & EXTENSIBLE

Durable, reduces
stress on joints

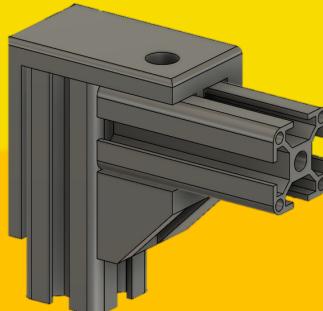


Easy mounting on
grooves

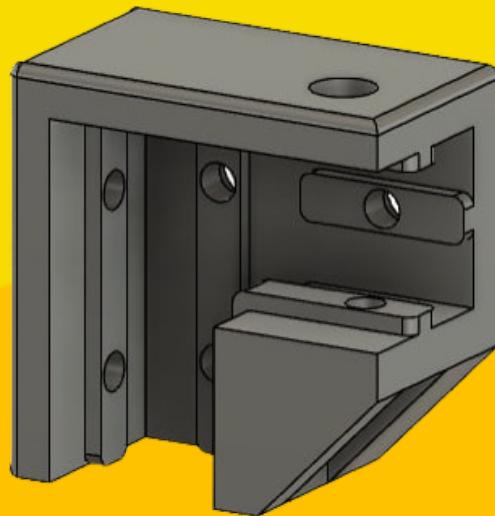
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3D MODELLED BRACKETS

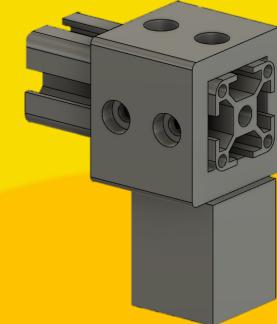
VERSATILE & SECURE



Fit different profiles



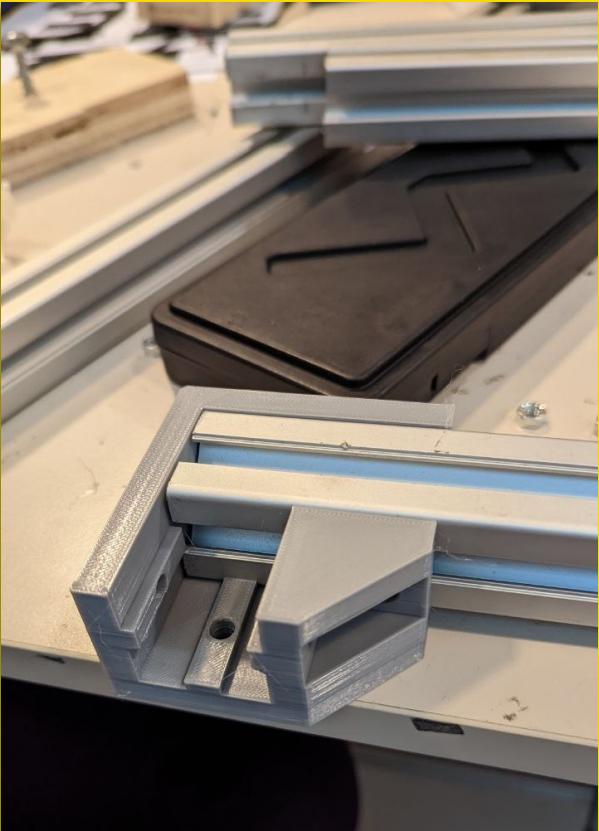
Lock components tightly



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ITERATION GOALS

STURDY & CONSISTENT PERFORMANCE



1

Does not break
after constant
use

2

Minimise
warping

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HARDWARE PLANNING

PRECISE MEASUREMENTS



1

Enable press fit
brackets

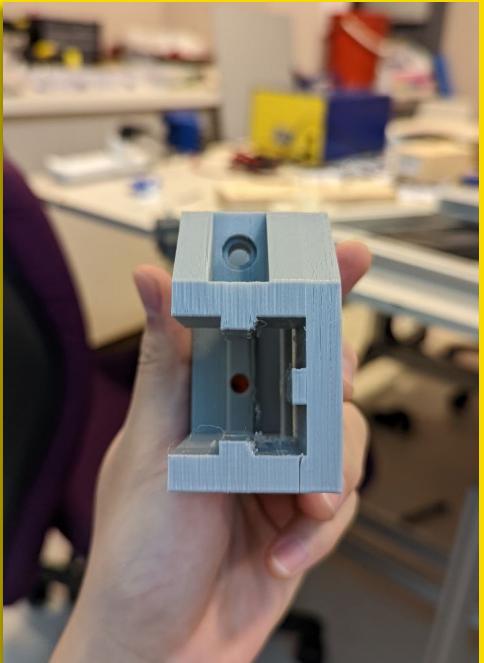
2

Reduce any
systematic
error(s)

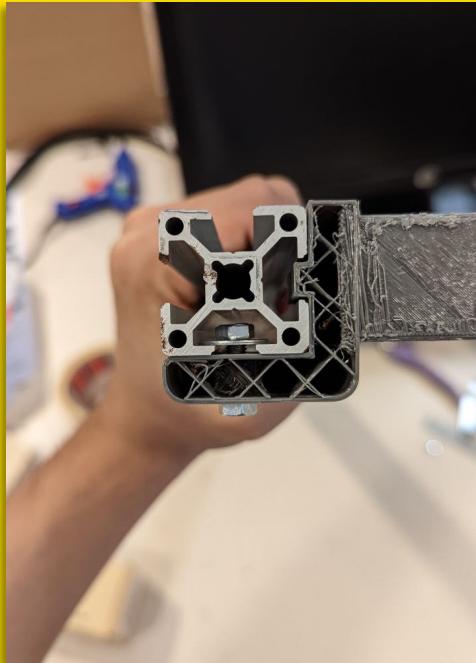
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REINFORCEMENTS

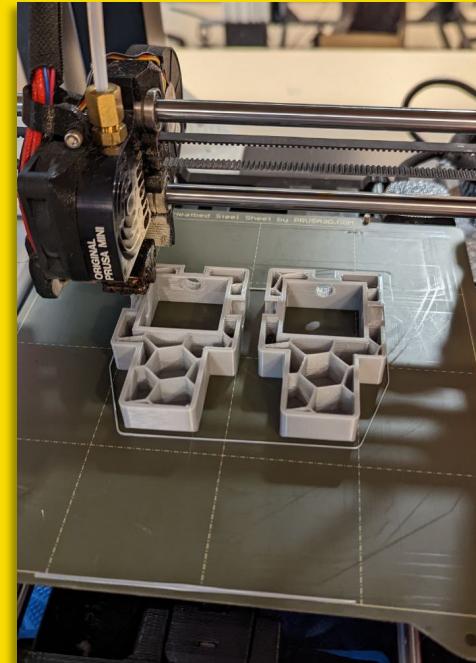
IMPROVING STRUCTURAL INTEGRITY



Fractures caused by unexpected lateral movements



Rectilinear
5%
2 layers perimeters



Honeycomb
15%
4 layers perimeters

1

Change direction
of print

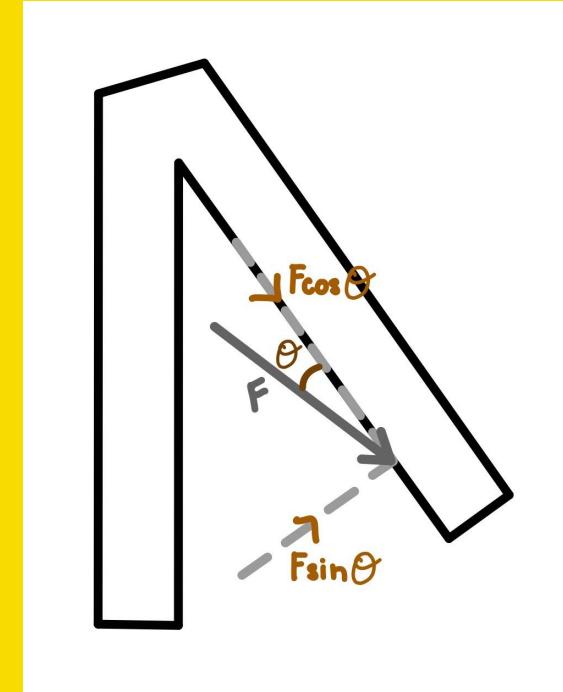
2

Change infill %
and pattern

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OPTIMISATION

MAKING A WINDOW MORE RESPONSIVE



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MATERIALS

LIGHT & STRONG



PETG Filament
Higher strength



Aluminium extrusion
Less dense but strong

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RASPBERRY PI

INDEPENDENT & MODULAR

Local host for
AI Model &
Image Processing



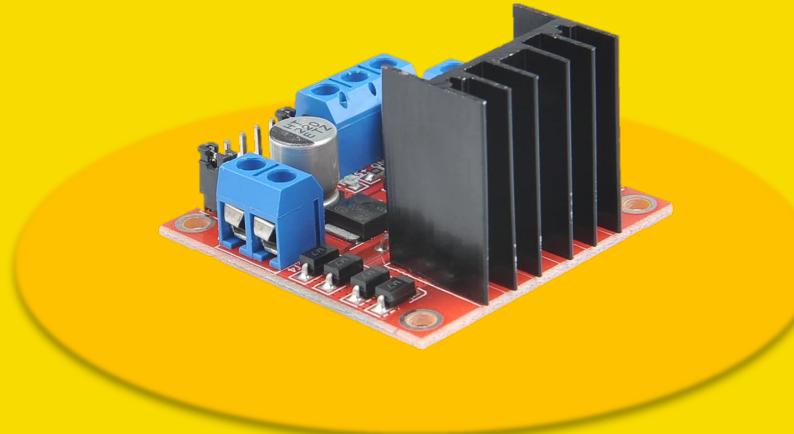
Concurrent activities
with multiprocessing

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STEPPER MOTOR H BRIDGE MODULE

SMALL & EFFICIENT

Condenses
complicated circuit
into small board size

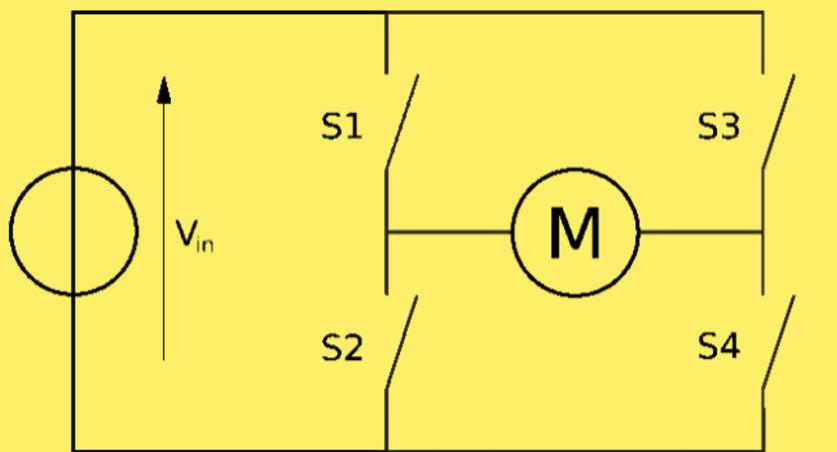


Compatible with both
Arduino and Raspi

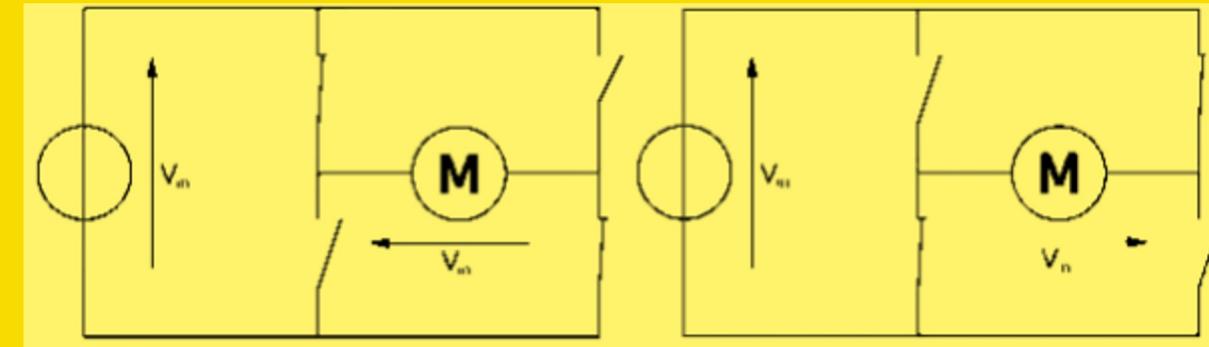
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STEPPER MOTOR H BRIDGE MODULE

CIRCUIT SCHEMATIC



H-BRIDGE
CONFIGURATION



BI-DIRECTIONAL CONTROL

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LINEAR ACTUATOR

POWERFUL & RELIABLE

Low power
consumption

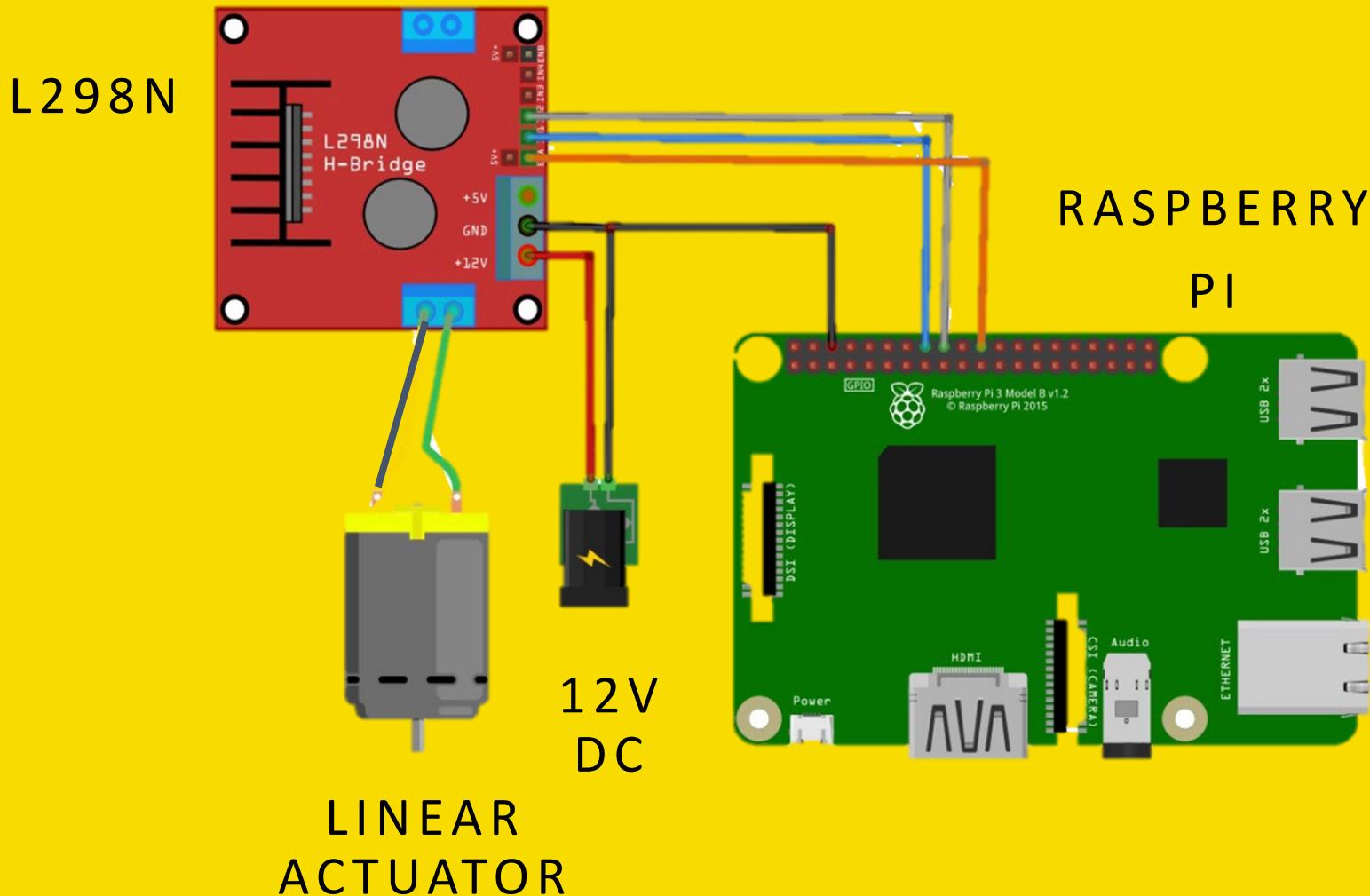


Highly extensible, up to
30cm

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FRITZING DIAGRAM

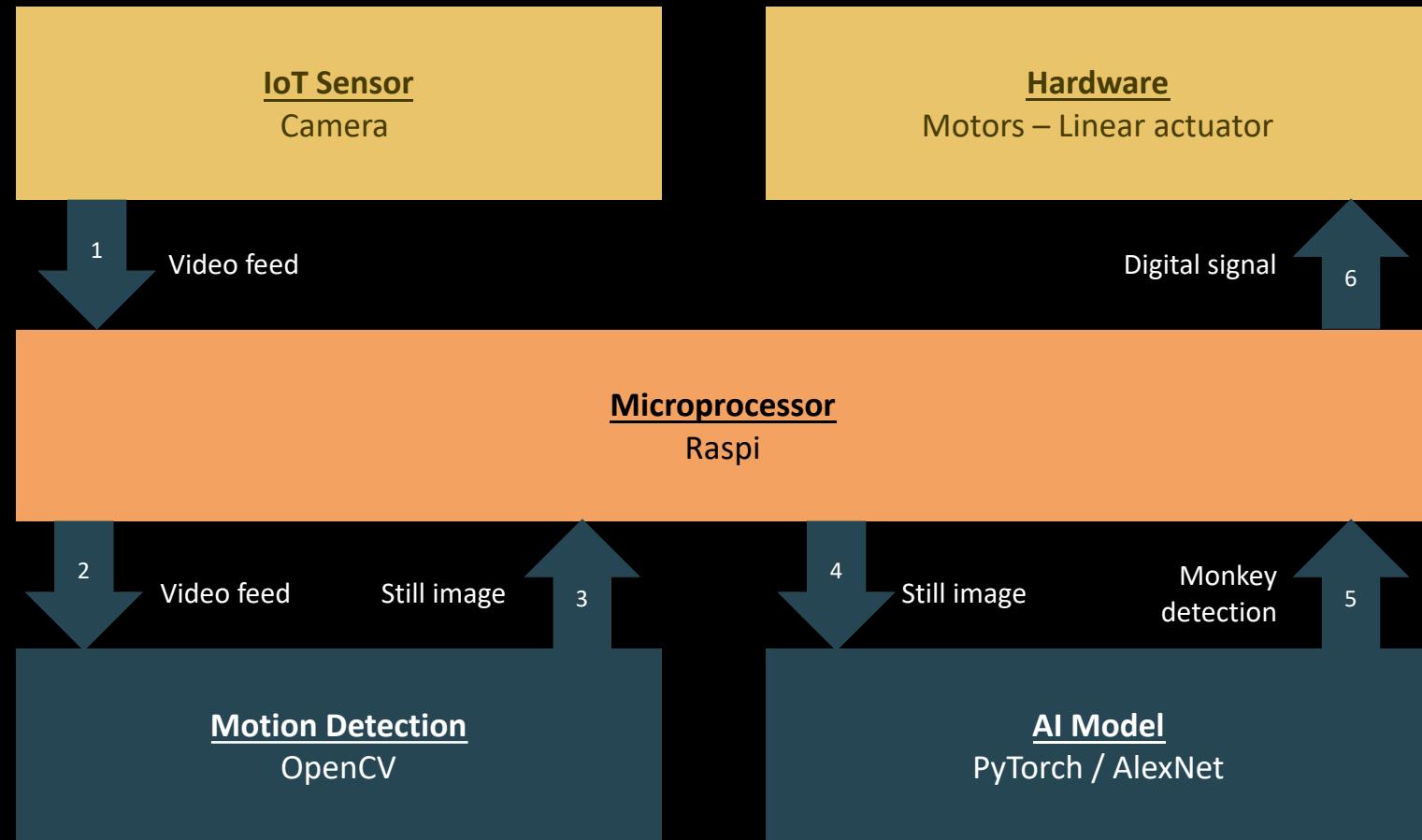
HOOKING UP OUR COMPONENTS



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PROTOTYPING

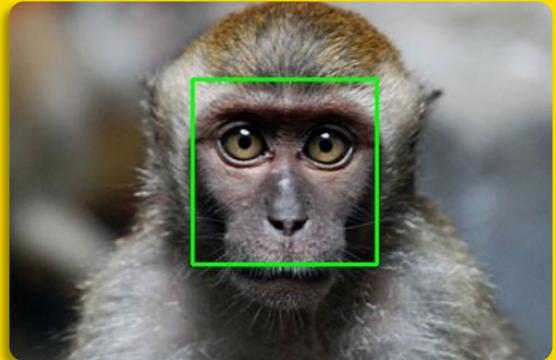
TECH ARCHITECTURE



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SOFTWARE

OPENCV & PYTORCH



1

OpenCV for
motion detection

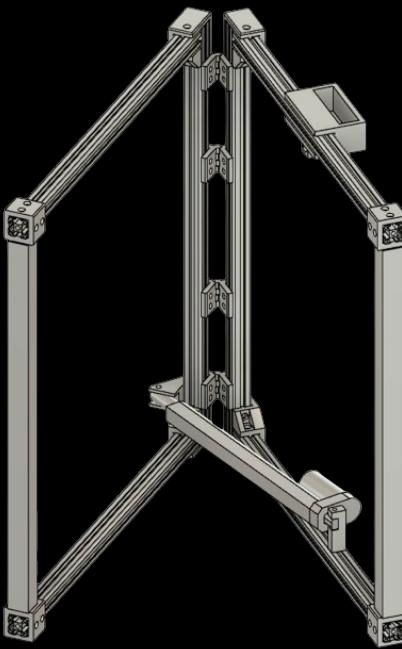
2

PyTorch for
monkey
detection

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IMPACT & IMPLEMENTATION

MAKING A CHANGE



Ideation



Prototype



Deployment at NTU North
Hill Residences

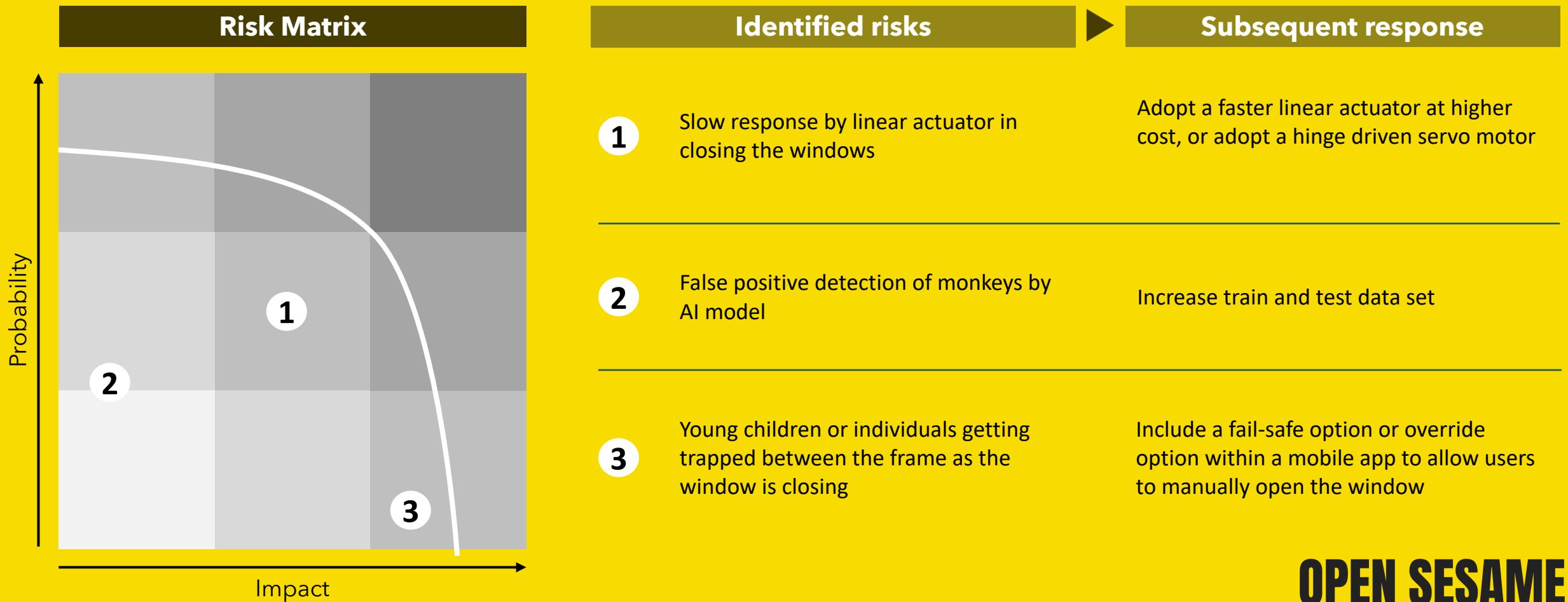
Protecting up to 2000 students from
unwanted primate invasions

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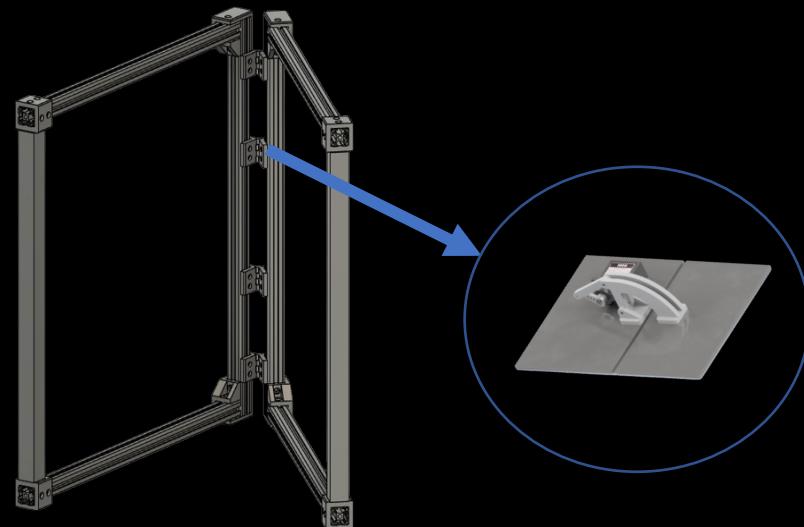
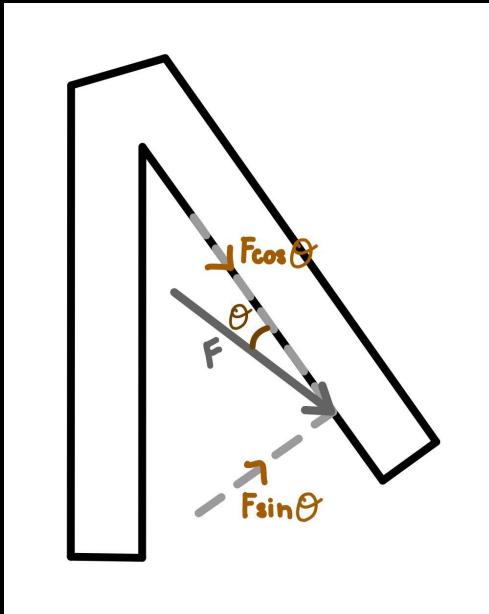
IMPACT & IMPLEMENTATION

RISK & MITIGATION



FUTURE IMPROVEMENTS

HARDWARE



SERVO MOTOR-DRIVEN HINGE

- REDUCE PROTRUSIONS
- LESS STRAIN

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FUTURE IMPROVEMENTS

HARDWARE



| Voltage | 12 VDC | 12 VDC | 12 VDC |
|---------------------|-----------|-----------|-----------|
| Dynamic Force | 11 lbs | 22 lbs | 33 lbs |
| Static Force | 11 lbs | 22 lbs | 33 lbs |
| Speed - No Load | 9.05°/sec | 5.50°/sec | 3.20°/sec |
| Speed - Full Load | 4.70°/sec | 4.00°/sec | 2.00°/sec |
| Current - No Load | 2.0 A | 2.0 A | 2.0 A |
| Current - Full Load | 9.0 A | 9.0 A | 9.0 A |

FASTER LINEAR ACTUATORS

- FASTER RESPONSE
- PA-15 HIGH SPEED LINEAR ACTUATOR



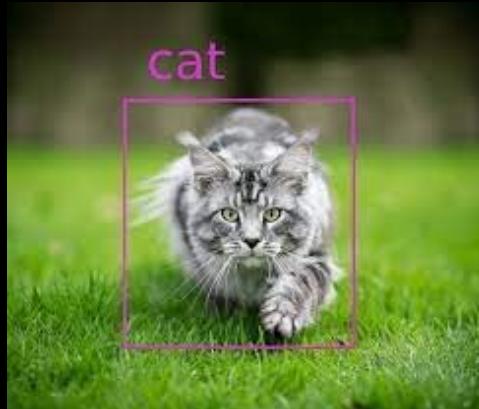
SURVEILLANCE CAMERAS

- REDUCE COST
- IMPROVE VIEWING QUALITY/ANGLE

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FUTURE IMPROVEMENTS

SOFTWARE



MORE DIVERSE SPECIES
RECOGNITION

DATASET WITH
MULTIPLE
VIEWPOINTS

REAL-TIME
VIDEO
FEEDBACK

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KEEPING THE ZOO



AWAY FROM YOU



D E M O

Keeping you safe from
surprise primate visits

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THANK
YOU

Hope you enjoyed our Monkey Business.