AI-Assisted Pre-Screening of Predator-Like Robots

A Computational Framework for Biomimetic Visual Assessment

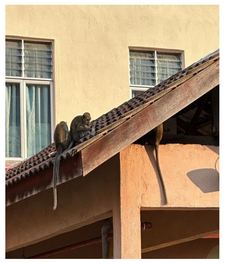
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How can AI help compare tiger-inspired robot designs before field testing?

01 MOTIVATION & CASE STUDY

Non-lethal wildlife management motivates predator-inspired robots.

We need structured appearance comparison before the next field visit.



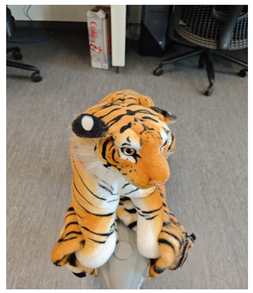




Four physical robot embodiments



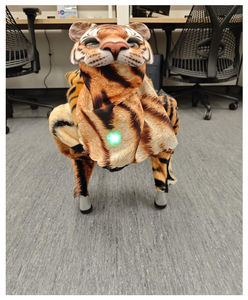
GO2



Plushy on Robot



Robot Dog



Robot Tiger

RESEARCH SCOPE

Visual pre-screening and hypothesis generation.

Not prediction of animal fear, perception, or deterrence efficacy.

02 TWO-TIER FRAMEWORK

Tier 1: Global Semantic Assessment



full-body photograph

Textual references

"a real tiger"
"a plush tiger"
"a quadruped robot"

Image–text similarity (s_text)

Visual reference prototypes

Real tiger · Plush tiger… Mean reference-image embedding

Image–prototype similarity (s_proto)

Equal-weight fusion (TrustVLM)
s = 0.5 × s_text + 0.5 × s_proto

Tiger- score | **Top category** | **Target margin**

Tier 2: Feature-Domain Compatibility



full-body photograph

Eye instruction → Cosine similarity



Paw/foot instruction → Cosine similarity



Surface instruction → Cosine similarity



Eye · Paw/foot · Surface profiles similarity

From Similarity to Feature Profiles

Feature-specific instructions produce different representations of the same full-body image.

Similarities are calibrated against Quad Robot (0) and Real Tiger (100) reference means.

Only assessable domains contribute to the summaries.

03 FINDINGS & CONTRIBUTION

Different assessments favour different designs

Tier 1: global tiger-target similarity

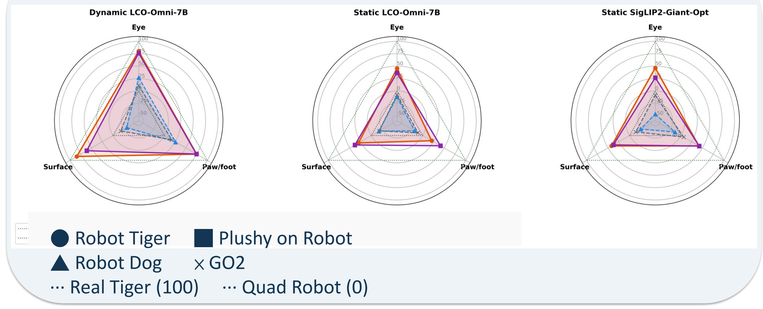
Robot Tiger: 0.4140 ± 0.0462

Plushy on Robot: 0.4677 ± 0.0557

Dynamic Tier 2: conditional overall NBFI

Robot Tiger: 84.4 ± 12.1

Plushy on Robot: 70.1± 5.9



Tier 1 and Tier 2 are complementary—not interchangeable.

Scores use different scales; comparisons are descriptive.

NEXT STEPS

- Controlled lower-limb design changes
- Independent references and occlusion controls
- Behavioural validation, habituation and welfare
- Longer-term motion and sound assessment

Structured design comparison before behavioural validation