EdgeDroid

An Experimental Approach to Benchmarking Human-in-the-Loop Applications

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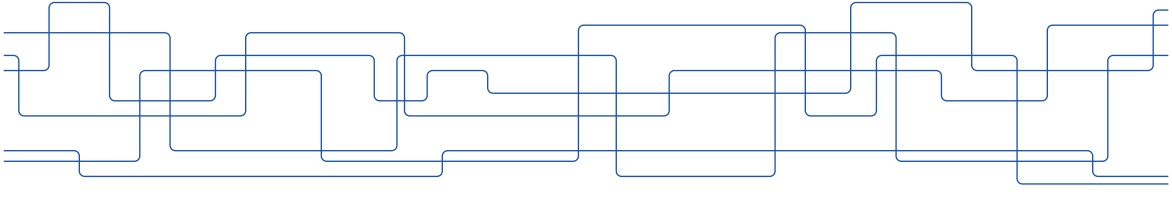



65
126ft
NE
354


SAMSUNG

Sensory Input

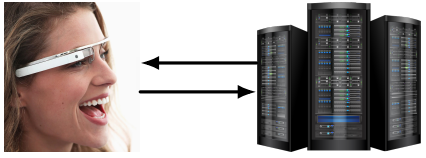
Human-parseable
Feedback

Studying Human-in-the-Loop Applications

Need to understand and optimize these applications:

- How do they interact with each other?
- How do they interact with infrastructure?
- How do they scale?

With which methodology can we study these behaviors?



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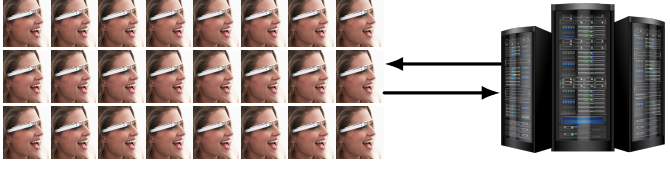

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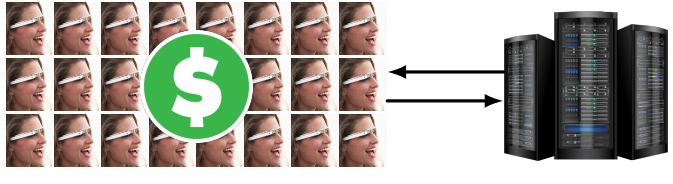

Costly

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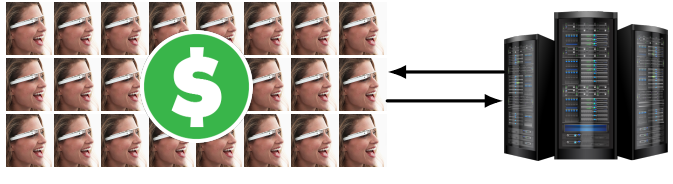

Costly, poor repeatability

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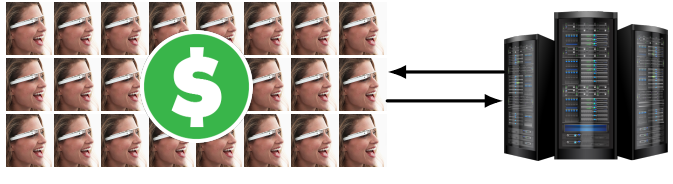
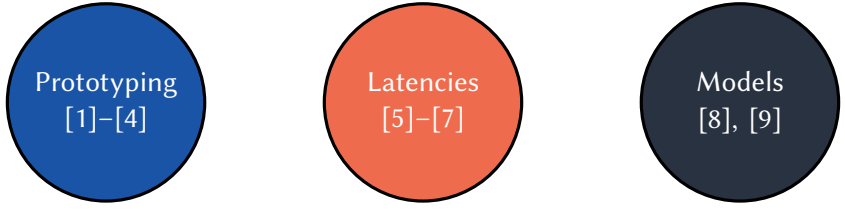


Costly, poor repeatability
Require IRB approval!

Previous & Related Work



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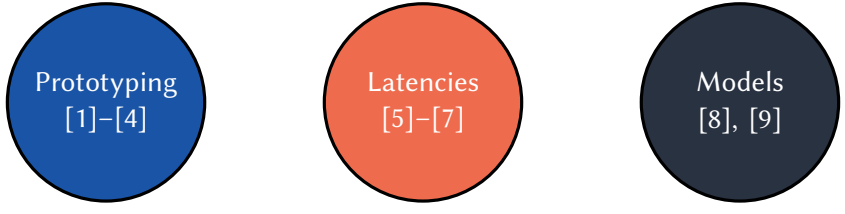
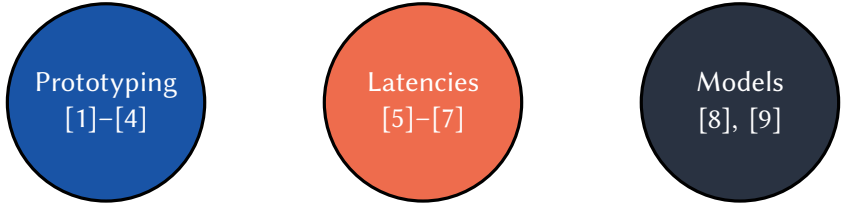


Our Contributions

- A methodology for benchmarking human-in-the-loop applications.

Previous & Related Work



Our Contributions

- A methodology for benchmarking human-in-the-loop applications.
- EdgeDroid: A benchmarking tool-suite.

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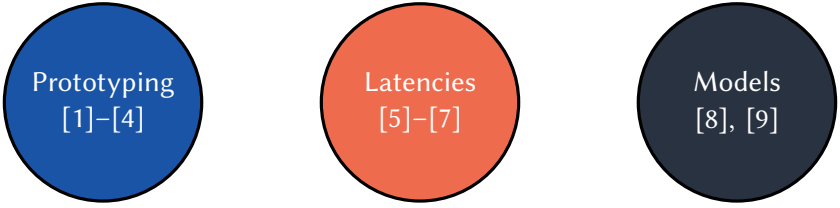
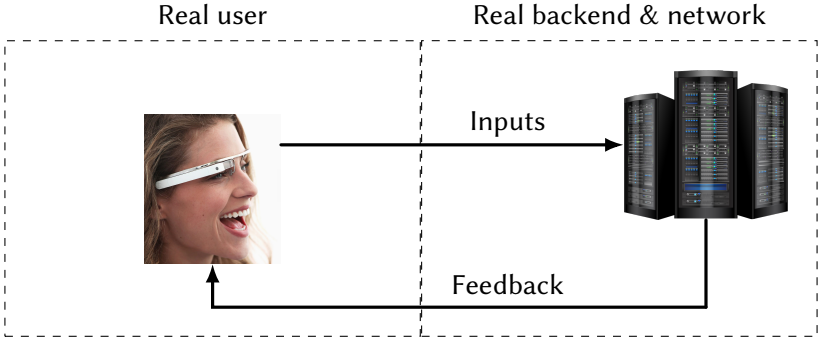


Our Contributions

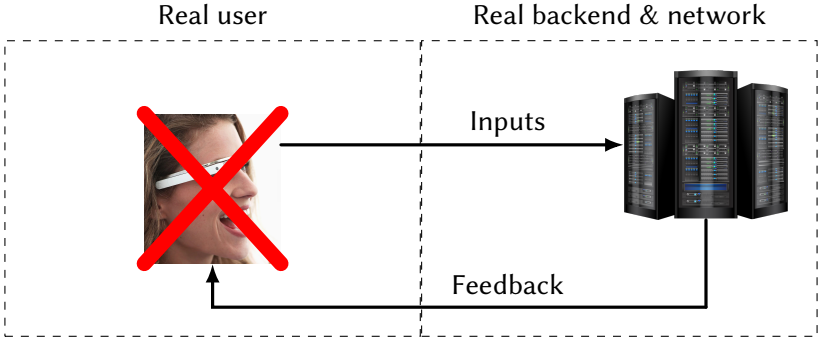
- A methodology for benchmarking human-in-the-loop applications.
- EdgeDroid: A benchmarking tool-suite.
- Experiments and measurements which show the effectiveness of the approach.

Approach



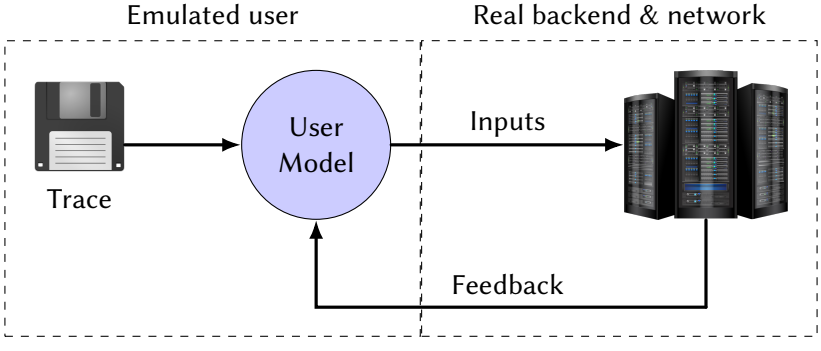
Benchmarking human-in-the-loop applications is HARD

Approach



What if we could do away with the human users?

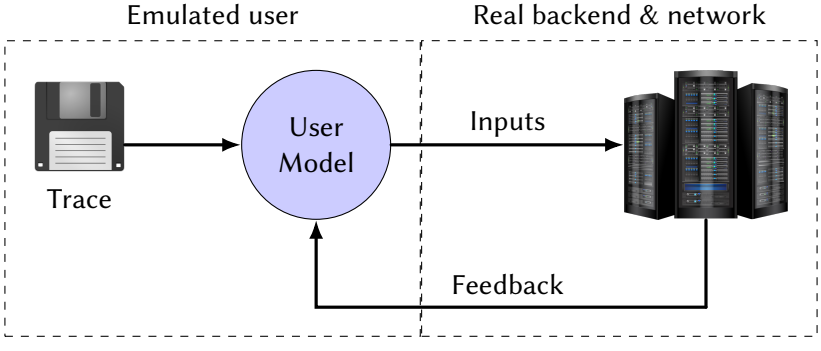
Approach



What if we could do away with the human users?

Repeatable, scalable, no IRB!

Approach

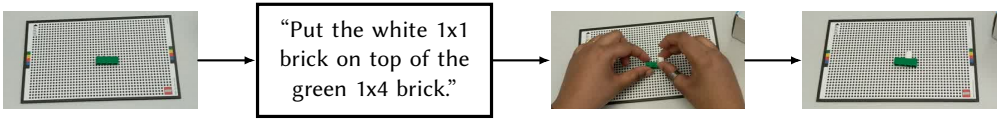


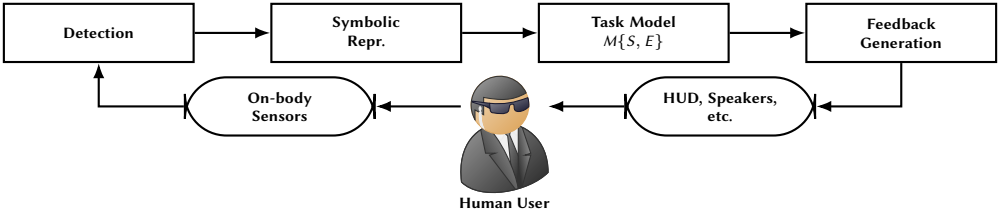
What if we could do away with the human users?

Repeatable, scalable, no IRB!

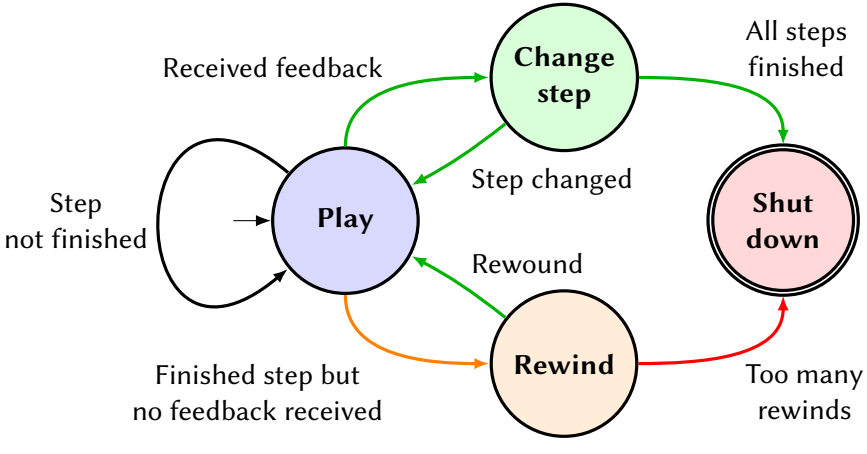
Key question: Credibility.

Example: Task Guidance WCA [1]

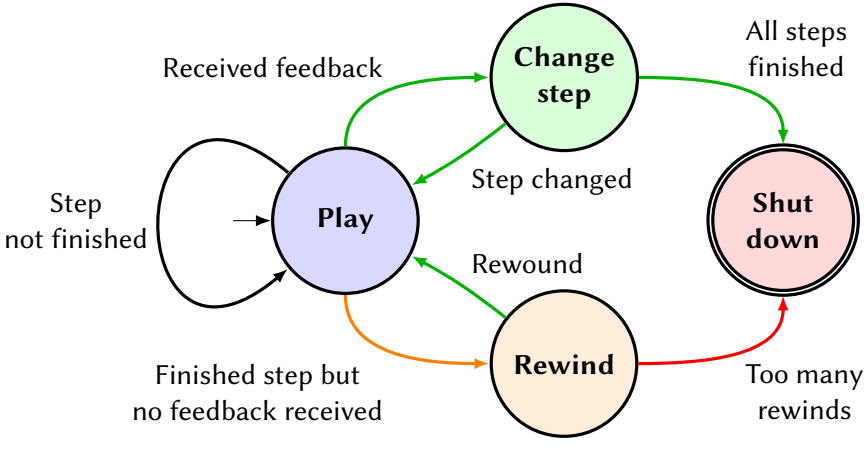




User Model

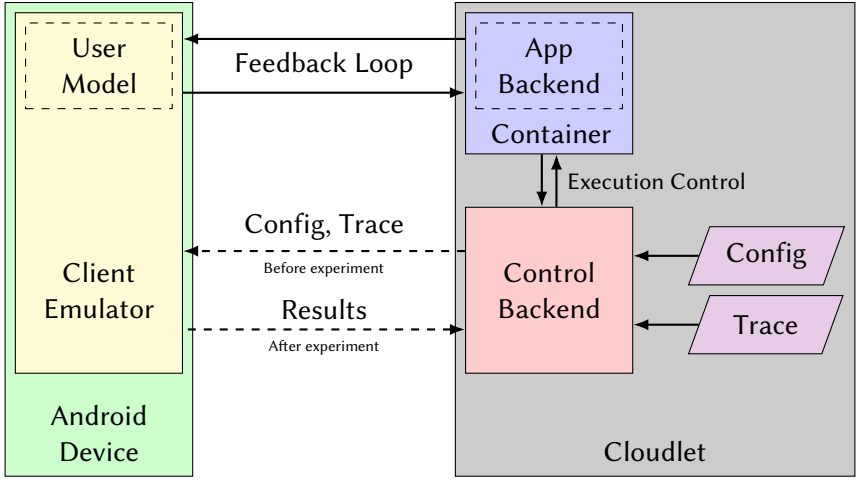

Change step
All steps finished
Received feedback
Step changed
Step not finished
Play
Shut down
Rewound
Rewind
Finished step but no feedback received
Too many rewinds

User Model



Future work: more elaborate models.

Implementation

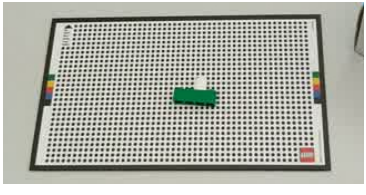


https://github.com/molguin92/EdgeDroid

Key purpose:
Demonstrate utility of EdgeDroid.

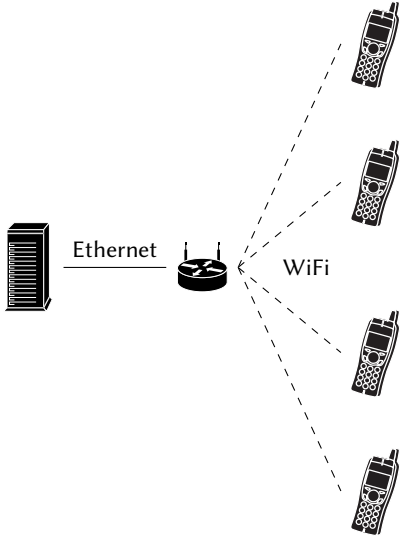
Evaluation: Setup

Application & Scenarios



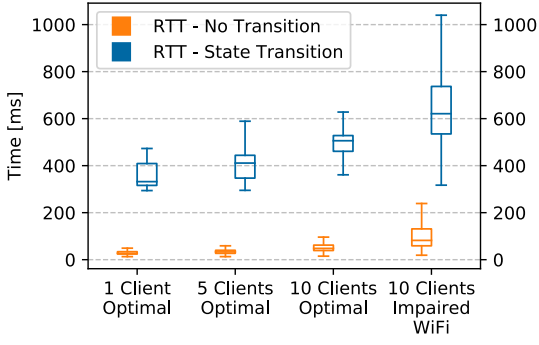
LEGO Assistant

- Three *optimal* scenarios with 1, 5 and 10 devices.
- Weakened wireless link with 10 devices.



Results

State change vs. no state change.

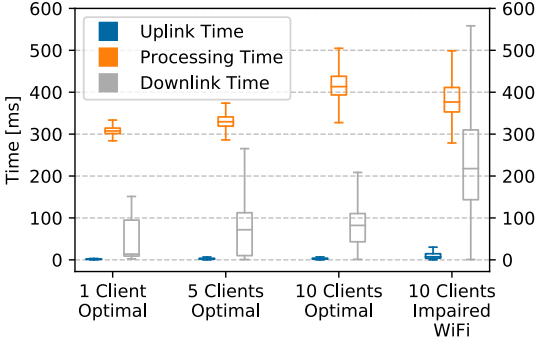


Reference latency bounds (Chen *et al.* [5]).

Latency [ms]	Quality
< 600	Excellent
$600 - 2700$	Impaired
> 2700	Unusable

Results

RTT by pipeline segments.



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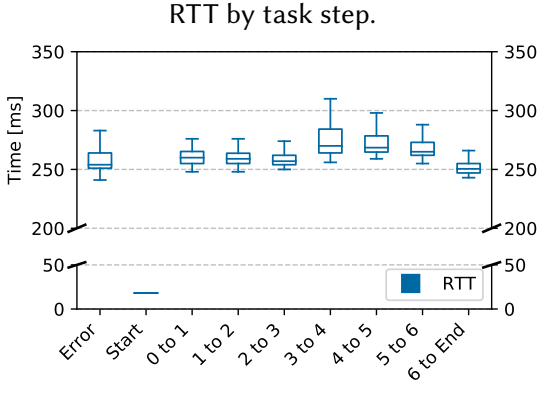

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Conclusions

Future Work

- More accurate user model.
- Expand to other types of Applications.

Summary

- There's a need to study the scaling of Human-in-the-Loop applications.
  - This is difficult due to human users.
- We present a methodology + tool suite for benchmarking:
  - **EdgeDroid**
  - Trace based.
  - Model of human behavior.
- We present results which show the utility of EdgeDroid.

Thank you.

Contact

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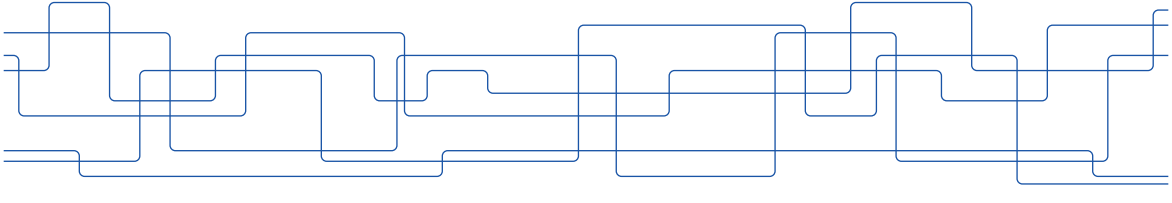
Website: https://olguin.se

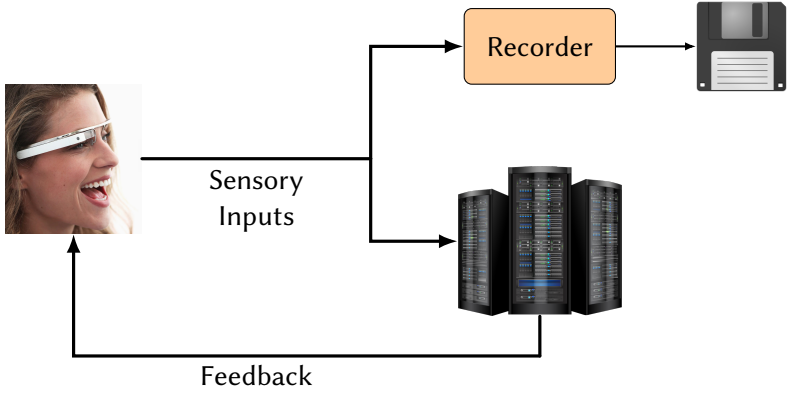


Requirements

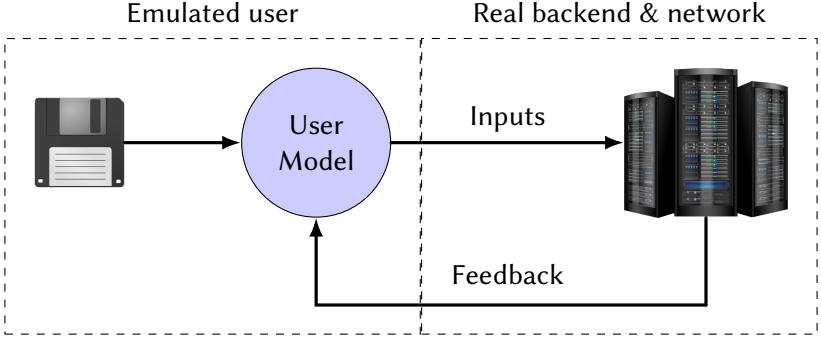
- Generate realistic, high-dimensional, real-time inputs.
- Correctly and realistically react to feedback.
- KPI: Delays.

Trace of pre-recorded inputs & a model of user behavior

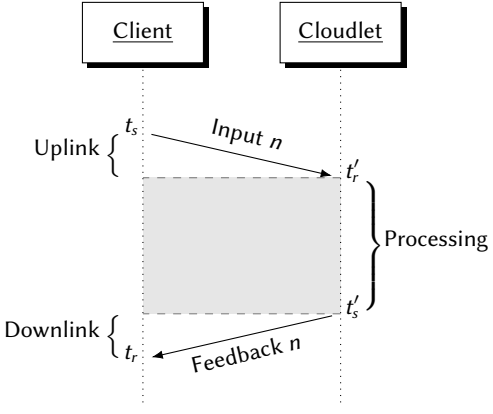
Tracing



Trace Replay



Timestamping



Clocks are synchronized previous to the experiment.

Timestamps at key points to obtain:

$$\Delta T_{\text{up}} = t'_r - t_s \tag{1}$$
$$\Delta T_{\text{proc}} = t'_s - t'_r \tag{2}$$
$$\Delta T_{\text{down}} = t_r - t'_s \tag{3}$$

$$\Delta T_{\text{total}} = \Delta T_{\text{up}} + \Delta T_{\text{proc}} + \Delta T_{\text{down}} = t_r - t_s \tag{4}$$

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