

HRIStudio

Collaborative and Reproducible HRI Research Through a Web-Based Wizard-of-Oz Platform

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Bucknell
UNIVERSITY

The Wizard-of-Oz Experimental Method



Challenges

- Environment set up (cameras and microphones) and operation
- Supporting the control of different kinds robots
- Organizing assets generated (consent forms, video and audio captured) keeping in data confidentiality in mind that is appropriate to each role
- Executing faithfully the experimental script that governs the interactions between human subject and robot
- Issuing the same sequence of commands to the robot through every trial of the experiment and recording any deviations in the script that the wizard may introduce

Alternatives for WoZ Framework Development

Technical infrastructure and architectures

- Polonius (Lu and Smart, 2011): graphical wizard interface to define FSM robot behaviors; ROS-based; integrated experimental logging system; accessible to non-programmers
- OpenWoZ (Hoffman, 2016): configurable; multi-client architecture; robot behaviors modifiable in experiment; allows for multiple collaborators

Alternatives for WoZ Framework Development

Interface design and user experience

- NottReal (Percheron, Fischer, and Valstar, 2020): careful interface design; wizard actions made easy; customization features; comprehensive logging
- WoZ4U (Rietz et al., 2021): GUI design to support non-programmers; tightly integrated with Pepper

Alternatives for WoZ Framework Development

Domain Specialization vs. Generalizability

- Ozlab (Peterson and Wik, 2020): systematic review showing that overspecialization leads to lifespan of 2-3 years
 - Aim for a general-purpose approach from the start
 - Build in a flexible wizard interface to adapt to experimental needs

Alternatives for WoZ Framework Development

Standardization Efforts and Methodological Approaches

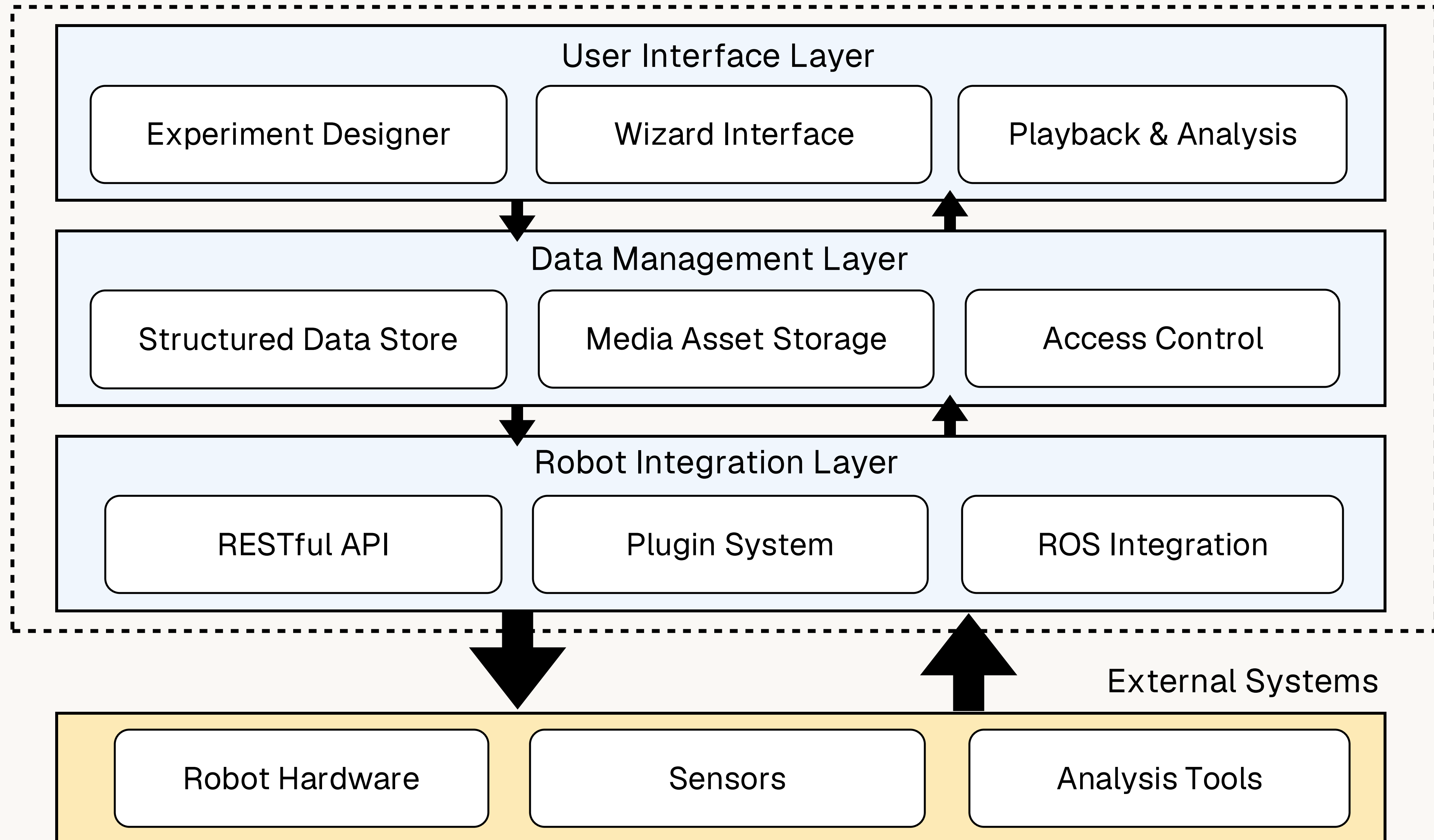
- Porfirio et al., 2023: follow an interaction specification language to define and communicate robot behaviors across different platforms; aim for modularity
- Riek, 2012: aim for methodological transparency to enable reproducibility

Design Goals

The most desirable WoZ support frameworks should:

- Remain usable over non-trivial periods of time
- Require minimal to no programming expertise so that they are usable by interdisciplinary teams in collaborative work
- Embody methodological standardization of experimental protocols
- Handle comprehensive data collection and organization
- Support the complete lifecycle of experiments from design, to execution, to asset management and documentation, and to data analysis to support reproduction by third parties

HRIStudio



Experiment Design Formalism

Study

*A **study** is the highest level container in a hierarchical description. It contains one or more **experiments**.*

Experiment Design Formalism

Study

***Example:** investigate the most adequate morphology of a robot to act as server in an automated coffee shop.*

Experiment Design Formalism

Study

Experiment i

*An **experiment** embodies one of the goals of the larger study (think of it as ‘what answers a **research question**’). It contains various **trials**.*

Experiment Design Formalism

Study

Experiment i

***Example:** investigate customer trust in the service provided by a non-humanoid robot.*

Experiment j

***Example:** investigate customer trust in the service provided by a humanoid robot without legs (like Pepper).*

Experiment k

***Example:** investigate customer trust in the service provided by a humanoid robot with legs (like NAO).*

Experiment Design Formalism

Study

Experiment i

Trial x

*A **trial** consists of one replication of the experimental script.
It contains one or more **steps**. All trials follow the same script.*

⋮

Experiment Design Formalism

Study

Experiment i

Trial subject x

***Example:** take order from subject, relay to barista, and bring order to subject.*

Trial subject y

***Example:** take order from subject, relay to barista, and bring order to subject.*

⋮

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

*A **step** is a behavior for **either the robot or wizard** to perform comprising one or more **actions**.*

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

*A **step** is a behavior for **either the robot or wizard** to perform comprising one or more **actions**.*

***Example:** the robot greets a newly arrived customer.*

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

Action \boxtimes

*An **action** is a specific, atomic task for **either the wizard or the robot** to perform.*

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

Action ☒

Example: robot moves up to customer

Action ☒

Example: robot greets customer with “hello there”

Action ☒

Example: wizard waits for customer response

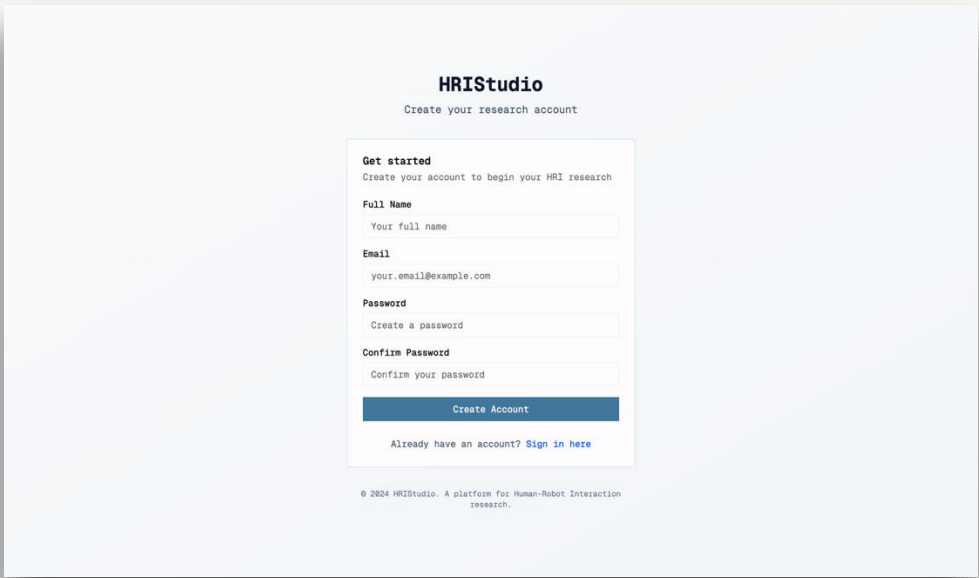
Action ☒

Example: wizard selects new robot utterance

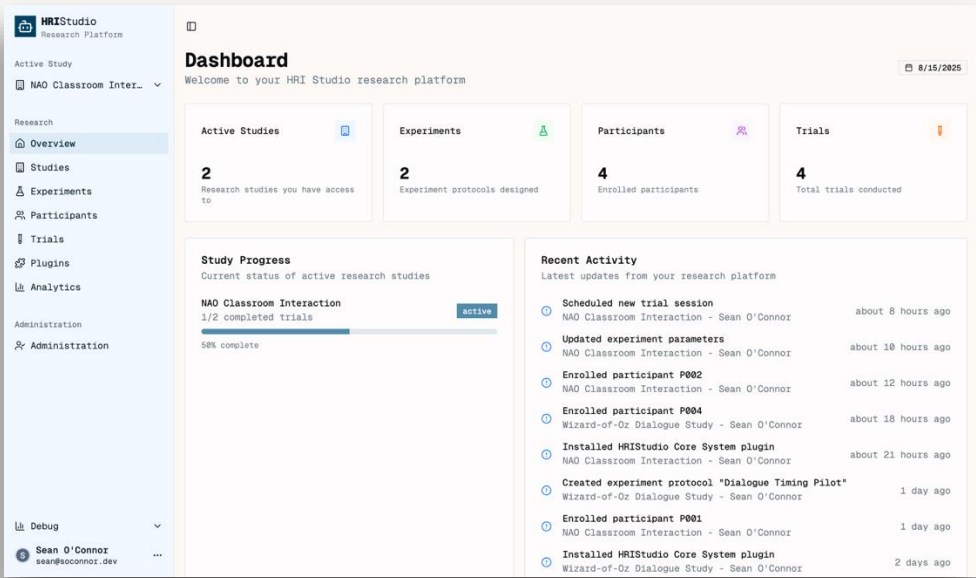
Using the Platform

Running a Sample Experiment

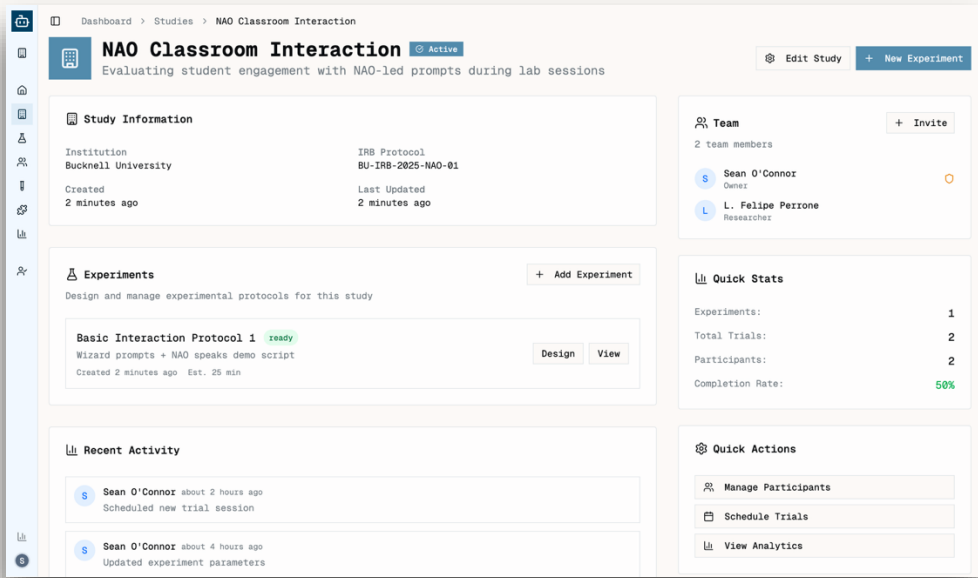
A Sample Experiment



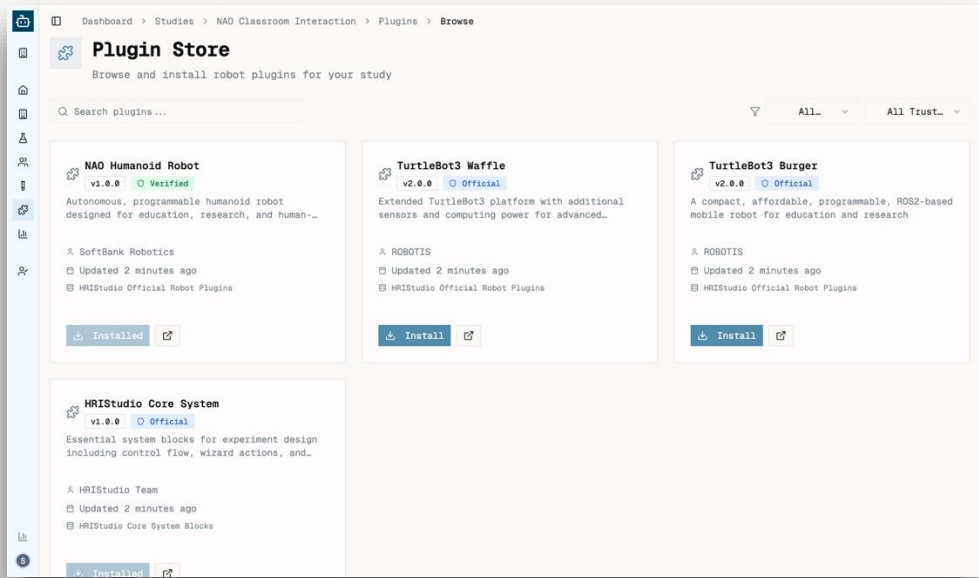
Create Account



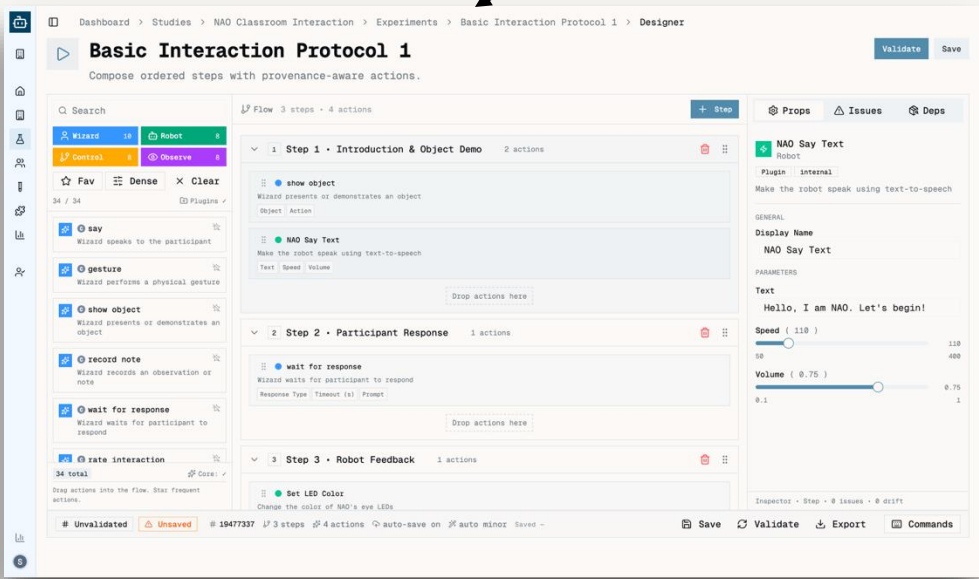
Dashboard



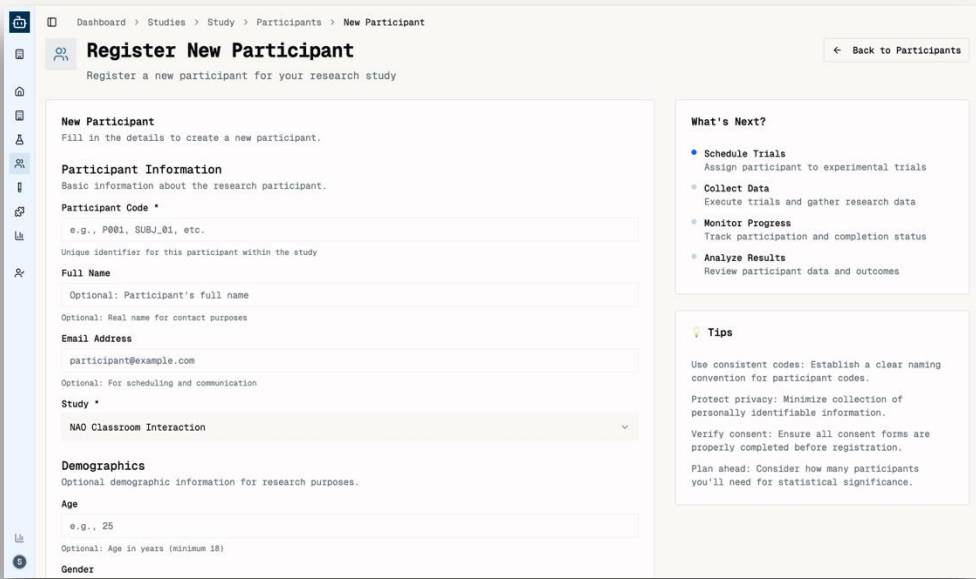
Create Study



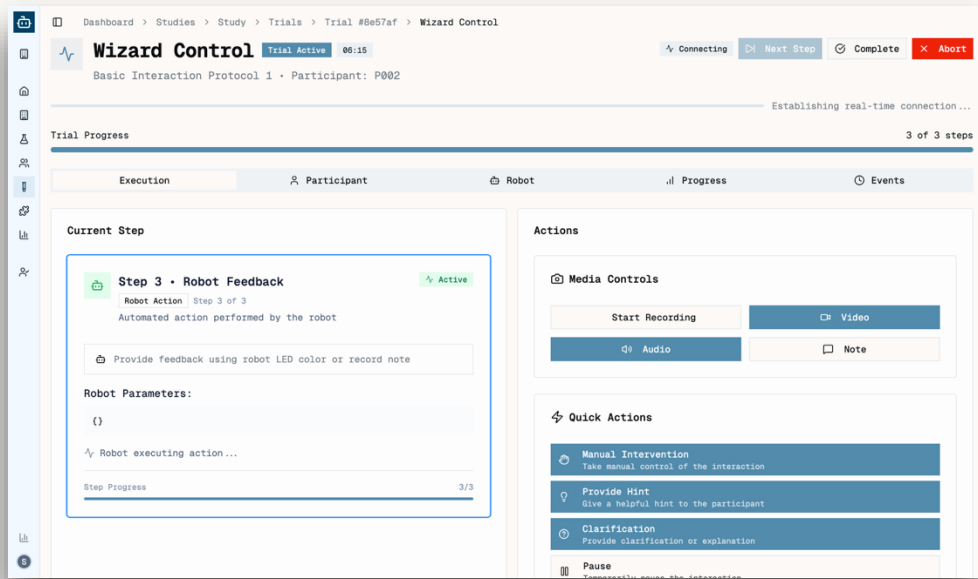
Add Plugins



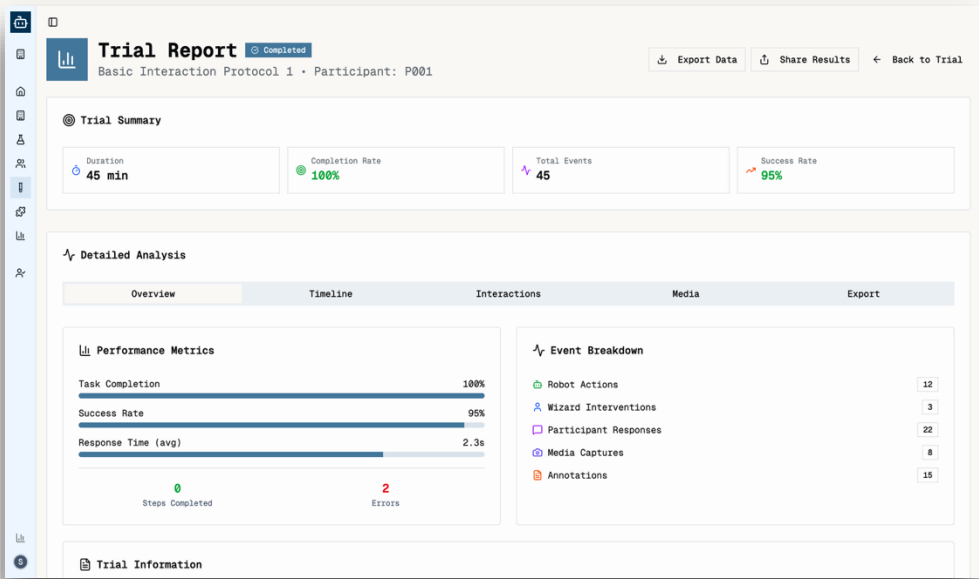
Create Experiment



Add Participants



Run Trial



View Report

Create an Account

HRISudio

Create your research account

Get started
Create your account to begin your HRI research

Full Name

Email

Password

Confirm Password

[Create Account](#)

Already have an account? [Sign in here](#)

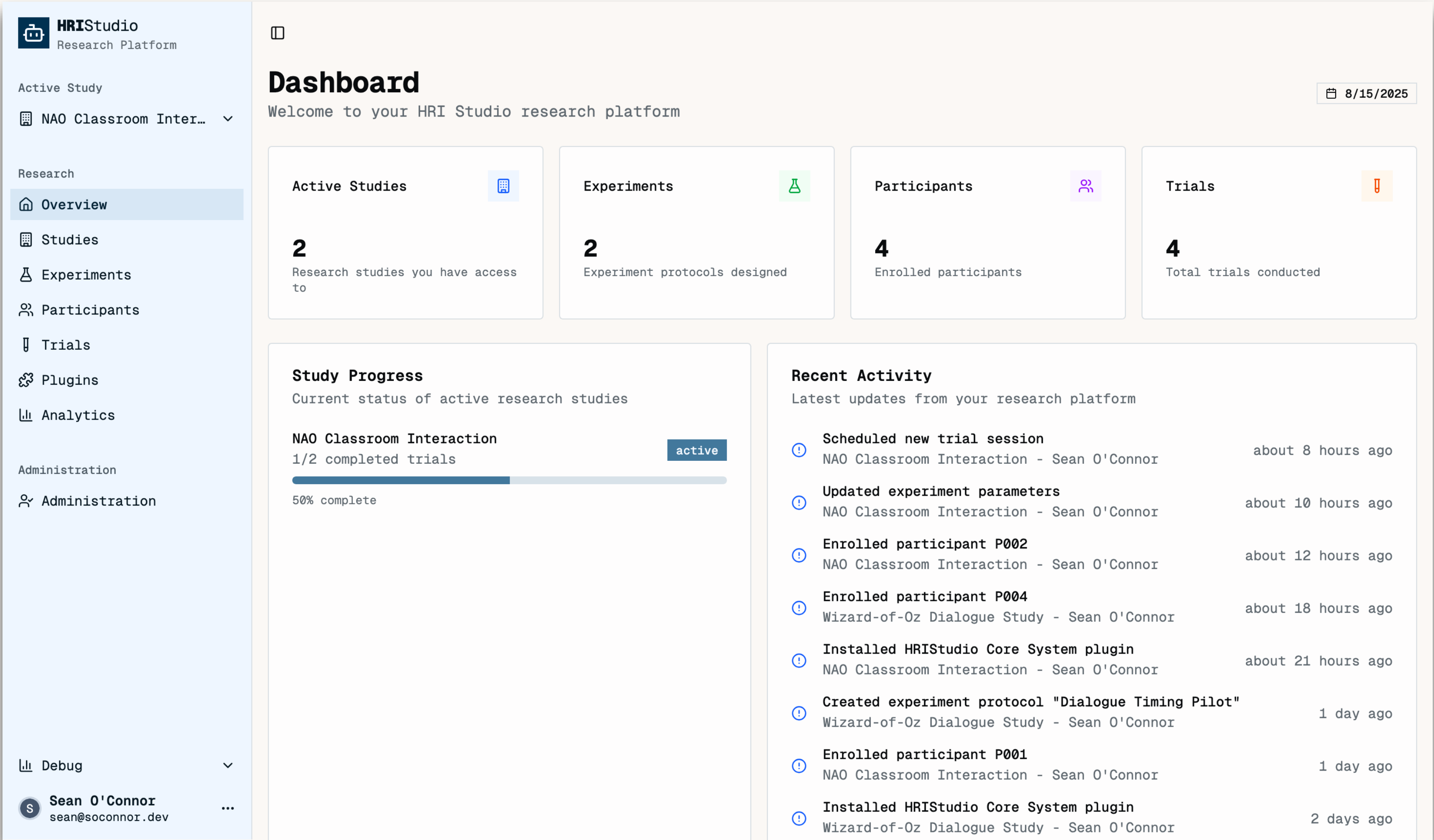
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Account info:

- Name
- Email
- Password

Accounts are needed to assign roles to users; PI, wizard, observer, designer, etc.

View the Dashboard



Dashboard aggregates data about all studies. “Up Next view”

- Active studies
- Progression metrics
- Notifications

Create a new Study

Dashboard

Studies

NAO Classroom Interaction

NAO Classroom Interaction

Active

Edit Study

New Experiment

Study Information

Institution

Bucknell University

IRB Protocol

BU-IRB-2025-NAO-01

Created

2 minutes ago

Last Updated

2 minutes ago

Experiments

+ Add Experiment

Design and manage experimental protocols for this study

Basic Interaction Protocol 1

ready

Wizard prompts + NAO speaks demo script

Created 2 minutes ago Est. 25 min

Design

View

Recent Activity

Sean O'Connor

about 2 hours ago

Scheduled new trial session

Sean O'Connor

about 4 hours ago

Updated experiment parameters

Team

+ Invite

2 team members

S

Sean O'Connor

Owner

L

L. Felipe Perrone

Researcher

Quick Stats

Experiments:

1

Total Trials:

2

Participants:

2

Completion Rate:

50%

Quick Actions

Manage Participants

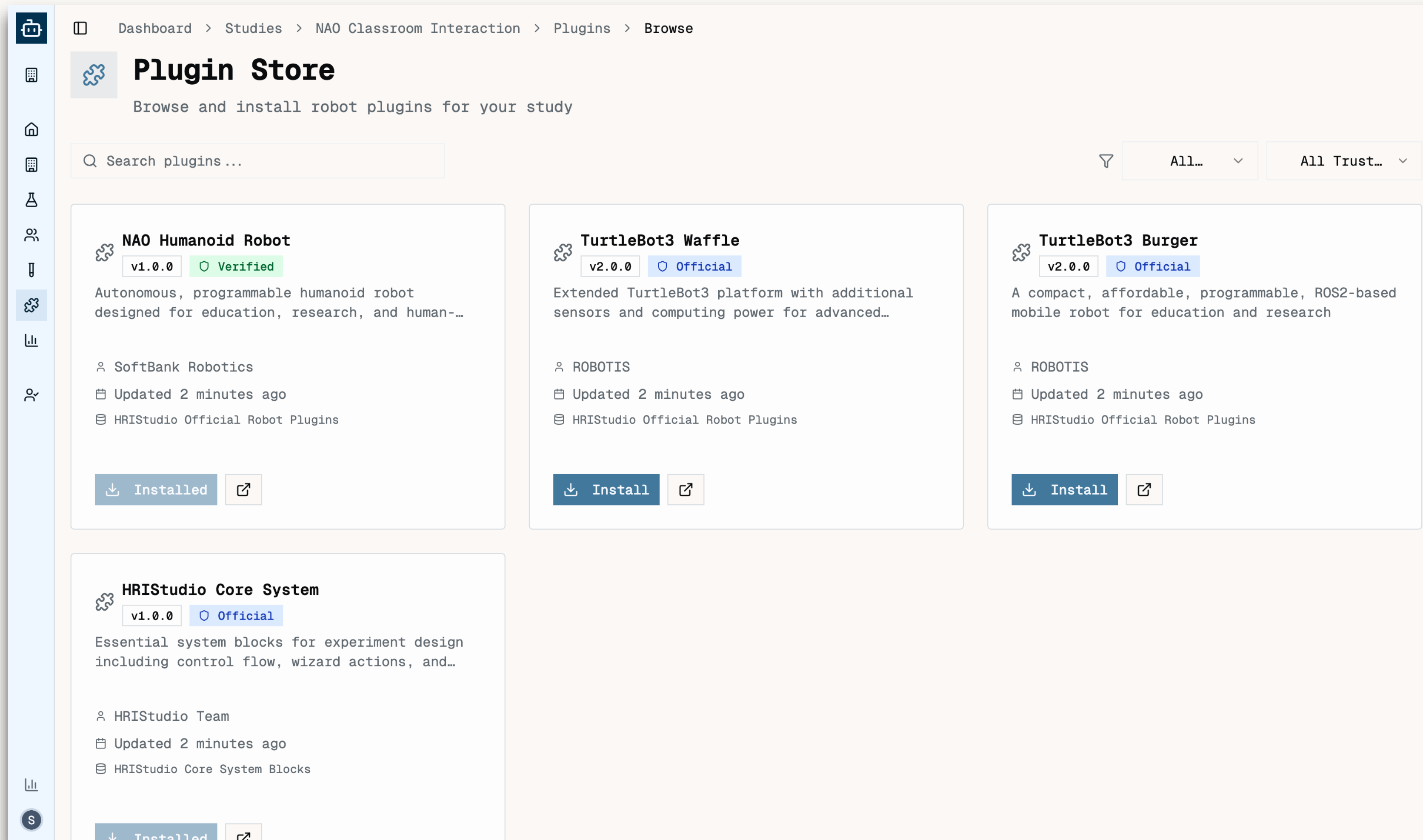
Schedule Trials

View Analytics

The Study details page allows for basic study data to be viewed and modified.

- Metadata
- Experiments
- Team members
- Activity

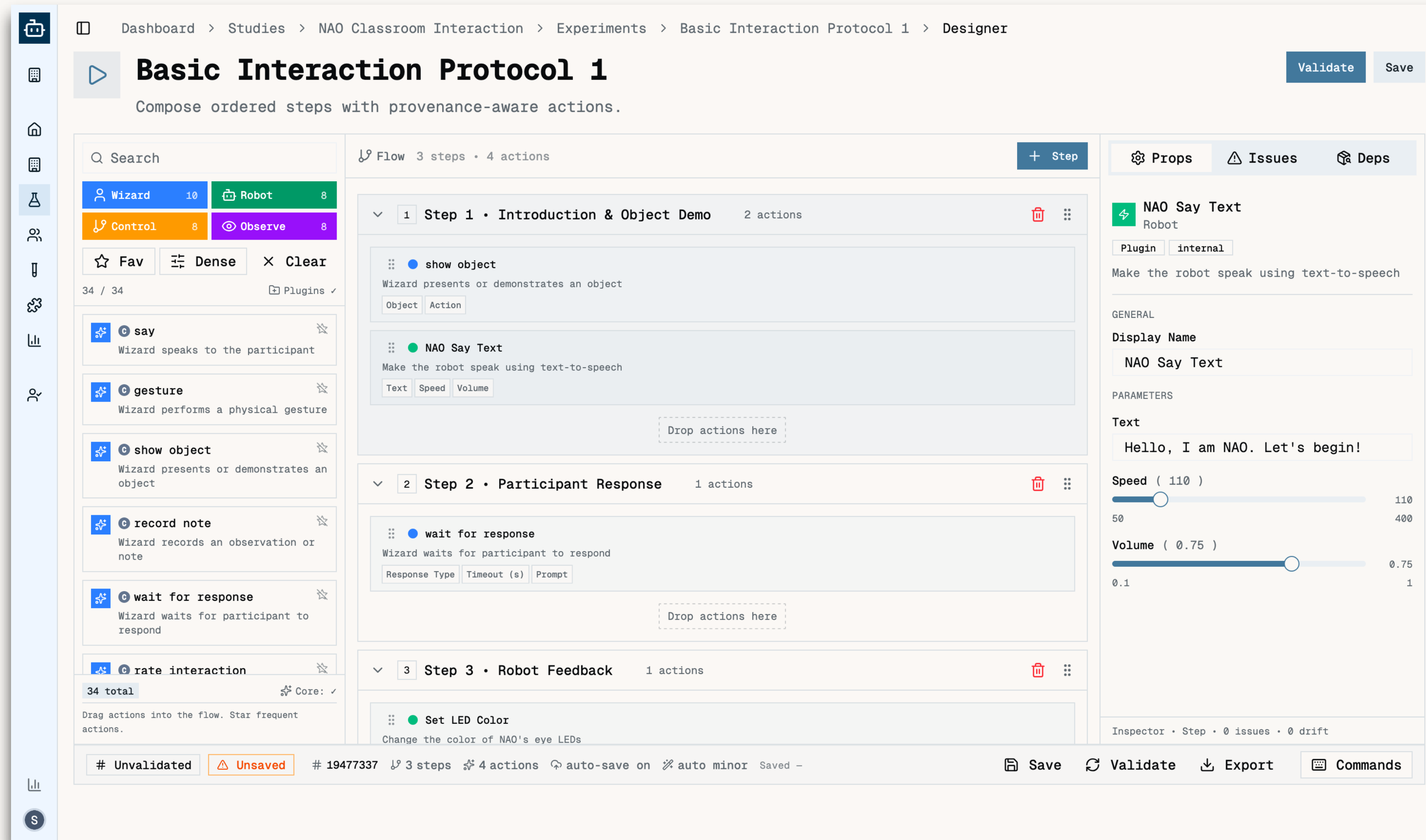
Install Plugins



The plugin store allows for plugins to be installed.

- Plugins contain robot-specific actions
- Allows for selection of platform(s)
- Community contributions encouraged!

Design a new Experiment



The Experiment designer is split up into three panes:

- Action pane
- Flow pane
- Properties pane

Validation ensures experiments are runnable before save.

Register a new Participant

Dashboard >
 Studies >
 Study >
 Participants >
 New Participant

Register New Participant

Register a new participant for your research study

Back to Participants

New Participant

Fill in the details to create a new participant.

Participant Information

Basic information about the research participant.

Participant Code *

e.g., P001, SUBJ_01, etc.

Unique identifier for this participant within the study

Full Name

Optional: Participant's full name

Optional: Real name for contact purposes

Email Address

participant@example.com

Optional: For scheduling and communication

Study *

NAO Classroom Interaction

Demographics

Optional demographic information for research purposes.

Age

e.g., 25

Optional: Age in years (minimum 18)

Gender

What's Next?

- Schedule Trials
Assign participant to experimental trials
- Collect Data
Execute trials and gather research data
- Monitor Progress
Track participation and completion status
- Analyze Results
Review participant data and outcomes

Tips

Use consistent codes: Establish a clear naming convention for participant codes.

Protect privacy: Minimize collection of personally identifiable information.

Verify consent: Ensure all consent forms are properly completed before registration.

Plan ahead: Consider how many participants you'll need for statistical significance.

Participant registration:

- Internal reference code (anonymization)
- Name
- Contact
- Optional additional study-specific fields

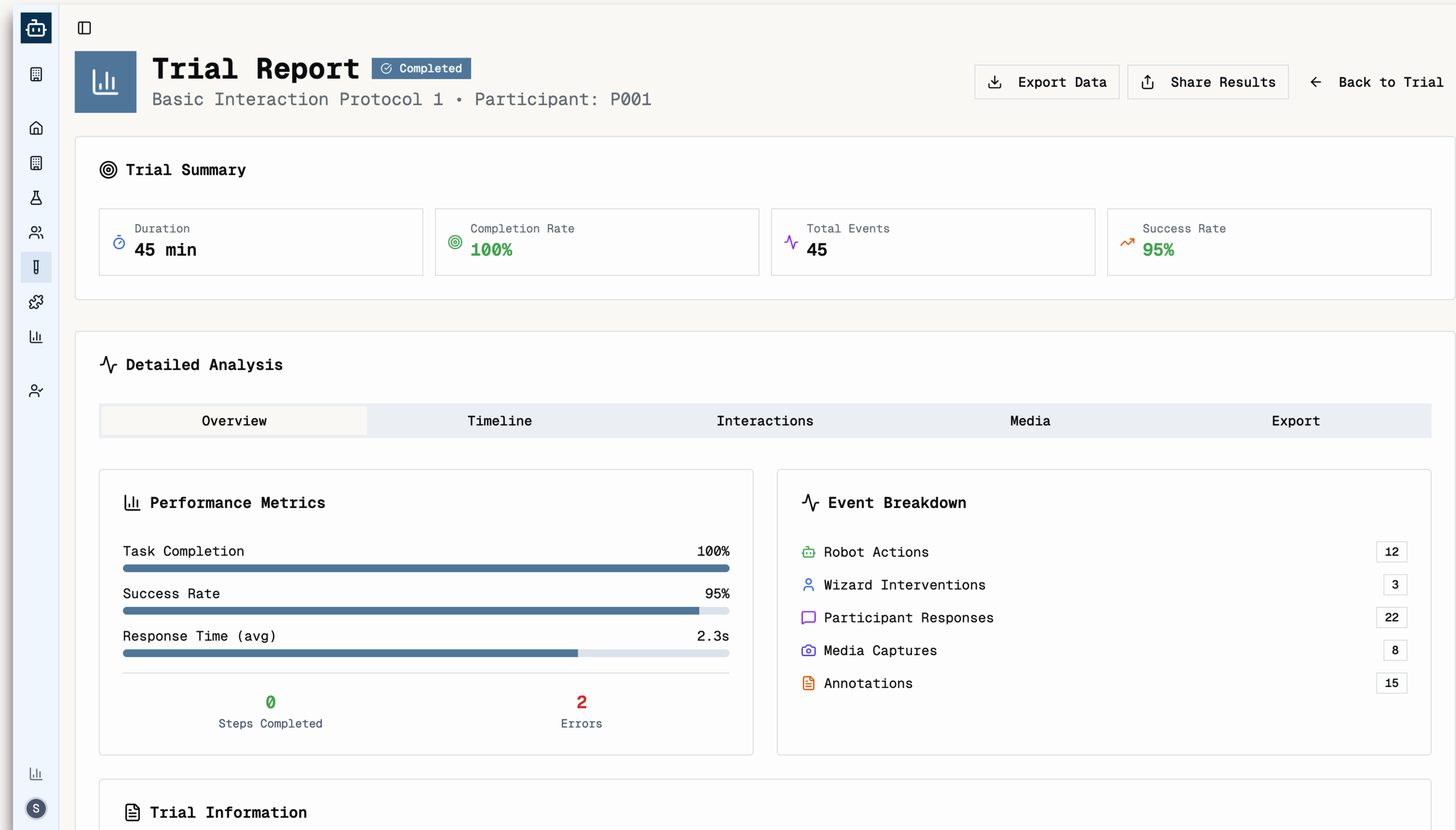
Run the Trial

The screenshot displays the 'Wizard Control' interface for a trial. The top navigation bar shows the path: Dashboard > Studies > Study > Trials > Trial #8e57af > Wizard Control. The main header area includes the title 'Wizard Control', a status indicator 'Trial Active' with a timer '06:15', and control buttons: 'Connecting', 'Next Step', 'Complete', and 'Abort'. Below this, a progress bar indicates 'Establishing real-time connection...' and '3 of 3 steps'. A tabbed interface shows 'Execution', 'Participant', 'Robot', 'Progress', and 'Events'. The 'Current Step' section, titled 'Step 3 • Robot Feedback', shows 'Robot Action' as 'Step 3 of 3' and 'Automated action performed by the robot'. It includes a text input field with the placeholder 'Provide feedback using robot LED color or record note', a 'Robot Parameters' section with a code editor containing '{}', and a status 'Robot executing action...'. A 'Step Progress' bar at the bottom of this section shows '3/3'. The 'Actions' section on the right contains 'Media Controls' with buttons for 'Start Recording', 'Video', 'Audio', and 'Note', and 'Quick Actions' with buttons for 'Manual Intervention' (Take manual control of the interaction), 'Provide Hint' (Give a helpful hint to the participant), 'Clarification' (Provide clarification or explanation), and 'Pause' (Temporarily pause the interaction).

Wizard Control:

- Progresses through experiments step-by-step
- Allows for manual intervention, records script deviations
- All events are logged for future analysis

View the Trial Report



Trial Report:

- View trial events over a timeline
- Basic performance metrics calculated from wizard input
- See any manual interventions and problems that occurred
- Allows for further analysis

Contribution

- Our approach was integrative (based on prior work in the literature) and our aim is to take a further step toward a system that guides non-experts to perform collaborative HRI research
- Our contribution: in the near term it is a software tool that consolidates design objectives into a proof of concept platform; in the long term, we left the community with the lessons we learned

Future Work

- Complete implementation: We will finalize remaining platform features and conduct incremental testing throughout development
- Internal validation: We will conduct controlled case studies to evaluate platform effectiveness across diverse HRI research scenarios
- Open beta program: We will launch community testing and recruit HRI researchers to gather real-world feedback and refine the platform before general release

Thank you!

Any questions?

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Link to paper:

