Genie: Input Retargeting on the Web through Command Reverse Engineering

Amanda Swearngin, Andrew J. Ko, James Fogarty
Culture¹ and gender² affect usability, appeal, and trustworthiness of a website.

1. Reinecke, et. al., ToCHI ’11
2. Simon, et. al., SIGMIS ’01
People with motor disabilities may need to use alternate devices to interact with the web\(^1\).
Blind people frequently use screen readers to navigate and operate web interfaces¹.

1. Bigham, et. al., IUI '09
Interface Adaptation: 3 prior approaches

Personalized Interfaces
- SUPPLE³

Pixel-Based Analysis
- Prefab²
- PAX³

Runtime Toolkit Modification
- Scotty⁴

1. Gajos, et. al., UIST ’07
2. Dixon, et. al., CHI ’10
3. Chang, et. al., UIST ’11
4. Eagan, et. al., UIST ’11
Program Analysis
Genie

Enables new interactions on the web through program analysis and input retargeting.
Automatic Speech Input

Navigate a website.
Automatic Speech Input

Use your voice to play a game.
Overview

Program Analysis & Input Retargeting

System Details

Demonstration
Program Analysis

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Original Web Interface
- Genie UI
  - Commands
    - Start
    - Pause

Command Metadata
- Start Game
  - onClick = function(e) {
    login();
  }

Command Objects
- Start
- Pause
- ...
Input Retargeting

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Original Web Interface
- Input (click)
  - onClick = function() {
  startGame();
  }

Genie UI
- Commands
  - Start
  - Pause

Voice
Keyboard
Input n
Dynamic Command Objects

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Command Objects
- Start
- Pause

Properties: enabled, visible, input

Behaviors: invoke
Labels

Periodically refreshed

Start Game

Start Game
Overview

Program Analysis & Input Retargeting

System Details

Demonstration
Detecting Commands

What is a command?

Event OR Interactive Element

Detect
Filter
Discover Properties
Describe

Input retargeting
Invoke

Program Analysis

"click"

Click Here

button.onClick = function(evt) {
    startGame();
}

Start Game

File: /Users/Amanda/GitHub...
Detecting Commands

Program Analysis
- Detect
  - Filter
    - Discover Properties
      - Describe
    - Input retargeting
      - Invoke

Event Registration
DOM mutation

Genie

Command Objects
- Command 1
- Command 2

Describe

Filter

Discover Properties
Filtering Commands

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

- click
- focus
- blur
- mouseDown
- error
- load
Discovering Properties

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Commands
- Start
- Pause

enabled

```
onClick = function handleStartGame(e) {
  var startBtn = $("#startBtn");
  if(!startBtn.attr("disabled")) {
    startBtn.attr("disabled", true);
    startGame();
  }
}
```
Discovering Properties

Program Analysis
- Detect
  - Filter
  - Discover Properties
    - Describe
- Input retargeting
  - Invoke

Commands
- Start
- Pause

enabled
visible
CSS
DOM Attributes
Discovering Properties

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Commands
- Start
- Pause

enabled
visible
input

onKeyDown = function keyDownHandler(e) {
    if (e.keyCode == 13) {
        submitOnEnter();
    }
}
Discovering Properties

Program Analysis
Detect
Filter
Discover Properties
Describe

Input retargeting
Invoke

Every 1s
Update Properties

Genie UI
Commands
Start
Pause
onClick = function handleStartGame(e) {
  var startBtn = $('#startBtn');
  if(!startBtn.attr("disabled")) {
    startBtn.attr("disabled", false);
    // start the game if any lives remaining
    if(livesRemaining >= 0) {
      startGame();
    }
  }
}
Invoking Commands

Program Analysis
- Detect
- Filter
- Discover Properties
- Describe

Input retargeting
- Invoke

Genie UI Command

Invoke
- mouseDown
- click
- mouseUp

Commands
- Start: start game
- Pause: pause game

“Start”

Describe
Demonstration

4 example applications
3 types of input

Built with Genie API
• HTML/CSS
• Translation layer
• Small amount of code

Possible Input Types
Keyboard Shortcuts

Type Shift+r to "Try Again"

No shortcut for "New Game"
Keyboard Shortcuts

Type "33"
Type "Ctrl+d"
Type "11"
Type "Enter"

Missing keyboard shortcuts
Command-Line Input

Creating a meeting

Creating a To-Do list

User typed "paperReview"
Keyboard Mouse Input

Type cell number to move mouse
Keyboard Mouse Input

Type cell number to place a node.

Add node – click
Add edge – drag
Genie
Enables new interactions on the web through program analysis and input retargeting.
Genie

Key Takeways

Genie enables interacting with the web in new ways through input retargeting.

Genie enables discovering and monitoring interactive commands through program analysis.

Amanda Swearngin amaswea@cs.washington.edu
Andrew J. Ko ajko@uw.edu
James Fogarty jfogarty@cs.washington.edu