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FiGaRo: A Framework for Gesture-based Interface Development



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Abstract

To talk to computers, one has to interact with them. Human computer interaction (HCI) studies human behavior and develops the technology for making this interaction more efficient and natural. Graphical user interface based and speech-based interactions are reaching their limitations in situations when quick interactions are required in noisy environments, such as factory floors, where workers interact with computers to create products. In these situations, hand gesture-based interfaces are often more appropriate.

Building a hand gesture-based interface for arbitrary applications is time consuming for the developers. It has a steep learning curve because of the complexity of hand gesture recognition algorithms. In addition, developers lack tools for designing and formalizing hand gesture-based interfaces. Another developer challenge is to offer customizable gesture-based interfaces to users, so that they can adapt the gestures and make them easy to memorize.

This dissertation introduces FIGARO, a framework for the development of hand gesture-based interfaces. Its goal is to flatten the learning curve and to enable faster development of gesture-based user interfaces for arbitrary applications. FIGARO facilitates the definition and recognition of new hand gestures. It was designed to be extensible with respect to hand gestures and hand gesture recognition algorithms. FIGARO is based on GIML, a metamodel that allows formalization of hand gesture-based interfaces.

The viability of the FIGARO framework was evaluated through the development of gesture-based interfaces for four legacy applications. The applications originate from four domains: education, entertainment, smart environment control and medical equipment operation. The goal was to demonstrate that FIGARO can be used for the development of gesture-based interfaces for arbitrary applications. Furthermore, we compare the development times of the legacy gesture-based interfaces with the development times using the FIGARO framework. The first gesture-based interface enabled conducting a virtual orchestra with a 3D printed baton. The second gesture-based interface was for an augmented reality application teaching human anatomy by visualizing organs inside a body. The third gesture-based interface was for a remote control of an x-ray machine with

a mobile device. The fourth gesture-based interface targeted controlling of the light bulbs and blinds in a smart house. The development of each of these four gesture-based interfaces with FIGARO led to a reduction of the development time compared to the legacy interfaces by at least 67 percent.

Contents

Acknowledgements	iii
Abstract	v
1. Introduction	1
1.1. Research Approach	4
1.2. Contribution	4
1.3. Dissertation Outline	5
2. Foundations	7
2.1. Hand Movements and Gestures	7
2.2. Context Awareness	8
2.3. Hand Gestures in Human Computer Interaction	9
2.3.1. Applications of Hand Gestures	11
2.3.2. Taxonomy of Hand Gestures	13
2.3.3. Sensors for Hand Gesture Recognition	15
2.4. Hand Gesture Recognition Using Inertial Sensor Data	19
2.4.1. Inertial Sensors	19
2.4.2. Semaphore Hand Gesture Recognition	22
2.4.3. Deictic and Manipulative Hand Gesture Recognition	24
2.5. Workflow for Gesture-based Interface Development	25
3. Requirements for the Development of Hand Gesture-based Interfaces	27
3.1. Scenario-based Requirements Elicitation	27
3.1.1. Visionary Scenarios	27
3.2. Requirements	31
3.2.1. Functional Requirements	31
3.2.2. Non-Functional Requirements	33

4. Analysis	37
4.1. Gesture-based Interface Development Workflow	37
4.1.1. Gesture-based Interface Design	39
4.1.2. Gesture Data Preparation	39
4.1.3. Gesture Recognition Algorithm Development	40
4.1.4. Interface Design Development	42
4.1.5. Gesture-based Interface Evaluation	45
5. FIGARO Framework	47
5.1. Subsystem Decomposition	47
5.1.1. Design and Evaluation Subsystem	48
5.1.2. Recognition Subsystem	52
5.1.3. Interaction Subsystem	53
5.2. Hardware/Software Mapping	54
6. FIGARO Metamodel	57
6.1. Gesture-based Interface Modeling Language	57
6.1.1. Gesture-based Interface Modeling Language as a MOF	58
6.1.2. Gesture-based Interface Modeling Language Metamodel	58
6.1.3. GIML Model Transformation	60
6.2. Gesture-based Interface Design Development with DECAGON	61
6.2.1. DECAGON as a GIML Editor	61
6.2.2. Gesture-based Interface Testing	63
6.3. Gesture Data Preparation Using VIDANNO	65
6.4. Figaro Hand Gesture Recognition Algorithms	67
6.4.1. Data Buffering	67
6.4.2. Data Transformation	68
6.4.3. Gesture Spotting	70
6.4.4. Gesture Classification	71
6.4.5. Hand Orientation Tracking	76
7. FIGARO Applications	79
7.1. Extending the GIML	79
7.2. PINOCCHIO	80
7.3. Smart Room Controller	87
7.4. Smart Remote	92

7.5. Smart Mirror	100
8. Conclusion and Future Work	105
8.1. Conclusion	105
8.2. Future Work	106
Appendix	111
A. DECAGON User Interface and FIGARO Architecture Overview	111
Bibliography	115