Foreword

The field of sketch-based interfaces and modeling (SBIM) has had a long history. Since the early 1960s, which saw the birth of interactive computer graphics through Ivan Sutherland's Sketchpad and Jacks' DAC-1 system at General Motors, we have seen researchers developing methods and techniques to let users interact with a computer through sketching, a simple, yet highly expressive medium. Initially, SBIM was not a field in and of itself, but a set of distinct areas where researchers from different backgrounds worked in isolation, without a real community to share ideas. Areas within SBIM included sketch-based modeling, where the goal was to easily create 3D models, and sketch-based interfaces, where the goal was to develop systems for recognizing, for example, hand-writing, command gestures, 2D diagrams, and mathematics. Today, SBIM has emerged as a subfield of computer science that blends concepts from computer graphics, human-computer interaction, artificial intelligence, and machine learning and has brought the two areas of sketching—interface and model specification—together. This synergy was spearheaded by Joaquim Jorge and John Hughes, who started the first SBIM conference in 2004.

Over the years, SBIM has had some great successes (e.g., hand-printing and more recently cursive hand-writing recognition) as well as notable failures where the problem is still intractable in the general case (e.g., 3D sketch understanding). As with most of promising technology, it may take multiple decades for the technology to become mature enough to become viable. Speech recognition is a classic example of this, having taken more than four decades of research and productization before becoming commoditized, and SBIM is just starting to be mature enough to enable us to see that it can be used mainstream. Hand-writing and mathematical expression recognition and simple modeling tools like Google's SketchUp are some examples.

It is interesting to look at the history of using sketching to create graphical models and have the computer recognize hand-written text, mathematics, and diagrams. Any 2D visual language lends itself to sketch-based input, given that it is much easier to enter such languages (e.g., musical scores, mathematics or chemical molecule diagrams) by simply entering them with a pen or stylus than having to convert the language into a encoded 1D form entered on the keyboard. SBIM can trace its roots

not just to Ivan Sutherland's seminal Sketchpad but also to his brother Bert Sutherland's system for sketching out logic diagrams and to Robert Anderson's Ph.D. research at Harvard in the late 1960s on mathematics recognition and subsequent evaluation using the RAND tablet, the earliest predecessor to the digitizing tablets of today. It is interesting to note that the areas pioneered by the Sutherlands and Anderson still represent significant research problems today in both recognition and modeling. Fontaine Richardson's Applicon CAD modeling tool was the first commercial product to feature gesture recognition for model elements and commands using a digitizing tablet. There was relatively little research, let alone commercial exploitation, during the 1970s, although Negroponte's Architecture Machine Group at MIT did do some important work on recognizing architectural diagrams. In particular, in 1976 the SIGGRAPH papers by Weinzapfel on Architecture-By-Yourself and by Herot on the HUNCH system began to explore how computers could interpret hand-drawn diagrams and what inference mechanisms and domain knowledge were needed to do so.

In the 1980s and 1990s, we began to see a number of pen-based forerunners to TabletPCs and PDAs, as well as pen-based PC software appear in the market place, commercial implementations inspired by Alan Kay's Dynabook vision of the late sixties. These included Wang FreeStyle, Microsoft Pen Windows, Go's Penpoint, and Apple's Newton. The new devices showed that the commercial sector was starting to see the potential benefits of pen input and gesture-based interfaces. Unfortunately, essentially all these commercial efforts failed for various reasons such as inadequate computing speed and memory, insufficient battery life, and lack of sophisticated recognition technology. Despite these too-early attempts, digitizing tablets continued to be routinely used by artists and designers to create digital ink that remained uninterpreted (e.g., in painting systems) or as a substitute for the mouse with standard WIMP GUIs—robust character, symbol and gesture recognition, let alone sketch understanding, had to wait for more powerful hardware and recognition algorithms.

In the late 1990s we saw two seminal contributions in sketch-based interfaces for 3D modeling. The SKETCH system, developed by Zeleznik et al. in 1996, used a gestural interface and inferencing mechanisms to create 3D objects out of standard 3D geometric primitives such as cuboids, cylinders, and cones for conceptual 3D modeling. In 1999, the Teddy system, developed by Igarashi et al., let users make more free-form, organic 3D models. Both of these interfaces showed that sketch-based interfaces for this type of task is a very natural one since users could make rough drawings of the models they are interested in and have the computer interpret them to generate the 3D geometry. These systems led to a significant amount of new work on sketch-based interfaces for creating and manipulating 3D models.

In the last decade, we have seen an explosion of both sketch-based interfaces and pen-based computing devices. Better and faster hardware coupled with new machine learning techniques for more accurate recognition and more robust depth inferencing techniques for sketch-based modeling have enabled SBIM to enter a new era in research and development. This is one of the main reasons why this is a timely book: it provides us with a very useful collection of state-of-the-art technology from leaders of the SBIM field.

Although great strides have been made, there is still a lot to do to bring SBIM to the mainstream. Faster CPUs, better digitization technology, better battery life are just some of the areas that must be improved from a hardware perspective. More robust recognition algorithms that can handle subtle variability in user hand-writing as well as better depth inferencing in sketch-based modeling are still unsolved problems. Integration with other interaction modalities such as multi-touch and speech recognition to create multi-modal interfaces is now an important research area. Usability analysis of these interfaces is also critically important to advancing SBIM. The current book presents a snapshot of the state of the art in the area. I look forward to the advances that will be made in SBIM in the coming years and I hope that the readers will find inspiration in the valuable collection of articles gathered herein to stimulate their endeavors and advance this important field.

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