An Audio-Based 3D Spatial Guidance AR System for Blind Users

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**Abstract.** Augmented reality (AR) has great potential for blind users because it enables a range of applications that provide audio information about specific locations or directions in the user’s environment. For instance, the CamIO (“Camera Input-Output”) AR app makes physical objects (such as documents, maps, devices and 3D models) accessible to blind and visually impaired persons by providing real-time audio feedback in response to the location on an object that the user is touching (using an inexpensive stylus). An important feature needed by blind users of AR apps such as CamIO is a 3D spatial guidance feature that provides real-time audio feedback to help the user find a desired location on an object. We have devised a simple audio interface to provide verbal guidance towards a target of interest in 3D. The experiment we report with blind participants using this guidance interface demonstrates the feasibility of the approach and its benefit for helping users find locations of interest.

**Keywords:** First Keyword, Second Keyword, Third Keyword.

1. First Section
   1. A Subsection Sample

Please note that the first paragraph of a section or subsection is not indented. The first paragraphs that follows a table, figure, equation etc. does not have an indent, either.

Subsequent paragraphs, however, are indented.

### Sample Heading (Third Level). Only two levels of headings should be numbered. Lower level headings remain unnumbered; they are formatted as run-in headings.

#### Sample Heading (Forth Level). The contribution should contain no more than four levels of headings. The following Table 1 gives a summary of all heading levels.

**Table 1.** Table captions should be placed above the tables.

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| Heading level | Example | Font size and style |
| Title (centered) | **Lecture Notes** | 14 point, bold |
| 1st-level heading | **1 Introduction** | 12 point, bold |
| 2nd-level heading | **2.1 Printing Area** | 10 point, bold |
| 3rd-level heading | **Run-in Heading in Bold.** Text follows | 10 point, bold |
| 4th-level heading | *Lowest Level Heading.* Text follows | 10 point, italic |

Displayed equations are centered and set on a separate line.

*x* + *y* = *z* ()

Please try to avoid rasterized images for line-art diagrams and schemas. Whenever possible, use vector graphics instead (see Fig. 1).

**Fig. 1.** A figure caption is always placed below the illustration. Short captions are centered, while long ones are justified. The macro button chooses the correct format automatically.

For citations of references, we prefer the use of square brackets and consecutive numbers. Citations using labels or the author/year convention are also acceptable. The following bibliography provides a sample reference list with entries for journal articles [1], an LNCS chapter [2], a book [3], proceedings without editors [4], as well as a URL [5].

References

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