autoUI-ML: A design language for the flexible creation of automotive GUIs based on semantically represented data

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ABSTRACT
We propose an XML-based user-interface markup language for prototyping and designing graphical user interfaces (GUI) in the automotive domain, called autoUI-ML. This markup language will help to accelerate and optimize the development workflow for both, designers and HCI developers. Furthermore the language implicitly constitutes an interface to the semantic based multimodal dialog system SiAM-dp. The autoUI-ML provides a high variability and offers the possibility to integrate an own corporate design. Moreover, the seamless and flexible connection of autoUI-ML to state-of-the-art rendering solutions allows the generation of professional and modern graphical user interfaces.

Author Keywords
Automotive; user interface design; markup language; apps.

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

INTRODUCTION

When developing automotive UIs within research projects the sets of GUI elements offered by design tools are very broad. However, these sets are mainly targeted either for mobile or desktop applications leaving the automotive field behind. Developers of automotive user interfaces must readapt these GUI libraries and extend the WIMP paradigms in order to match the usability constraints that are inherent for the usage of UIs in vehicles. Moreover current commercial available tools for designing graphical user interfaces are not taking in account the concepts of multimodal inputs [1] [2] such as speech recognition, knobs (e.g. BMW's iDrive controller), touch inputs (e.g. touchable screens zones or tactile zones) or physical and acoustical output modalities like LEDs, Text-to-Speech or even HUD (Head-Up displays). All these missing features lead us to define an extensible language for prototyping graphical user interfaces that is compatible to a multimodal dialogue platform and can directly integrate information from knowledge about the car and its close environment.

APPROACH

In order to identify the concepts that should be integrated in autoUI-ML, we have first analyzed current graphical structures of automotive user interface elements of several brands and manufacturers. This fine granular analysis helped us to identify concepts that could be generalized in terms of reusable graphical elements. After technical discussions with developers and observations on how drivers interact through current automotive UI solutions [2], we've defined a concept that should adapt to the targeted domain and can be easily integrated into the automotive version of the multimodal dialogue platform SiAM-dp [3].

REALIZATION AND BENEFITS

The needs expressed by the developers and interaction designers led us to structure autoUI-ML on a fine-granular level in order to leverage following benefits:

- A generic language for GUI output and control structure built on the UI model of SiAM-dp for an integration into the multimodal dialogue platform.
- Benefits for tier vendor and integrators: the application can be designed by other teams and integrated into OEM solutions.
- Semantic behind autoUI-ML is clear and generic (e.g. *<header/>,<screen/>,<navigation/>,<radio/>)*
- Encapsulation of common data such as speed, engine data, geolocalization of the car, via a tag-based definition (e.g.*<clock/>,<engineTemperature/>, <geoloc/>*): the designer uses these tags and the effective values will be computed by the SiAM-dp.
- Shorter prototyping cycles: designers can entirely focus on enriching the user's experience, without being affected by internal modifications realized on the platform side.

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- Event handling of several input sources (e,g, knob, touchscreen) is more flexible as realized over the multimodal dialogue platform.
- Personalization possibilities: the graphical output produced by the processing of autoUI-ML can be skinned and adapted to brands, without losing or having to change the complete internal interaction knowledge.
- Freedom of choosing the most adapted rendering technology (e.g. Flash, AIR, HTML5, Web-Apps) for the graphical output.

INTEGRATION

autoUI-ML is designed on the basic GUI-Model of SiAM-dp. The rendering engine of the client is consuming outgoing autoUI-ML messages by connecting to the dialog application as output GUI-rendering device. Once retrieved, the autoUI-ML document is interpreted and rendered by the client. Design and personalization aspects such as skinning are taken in account and integrated into the generated graphical output. Figure 1 shows the workflow and the usage of autoUI-ML within a dialogue application.

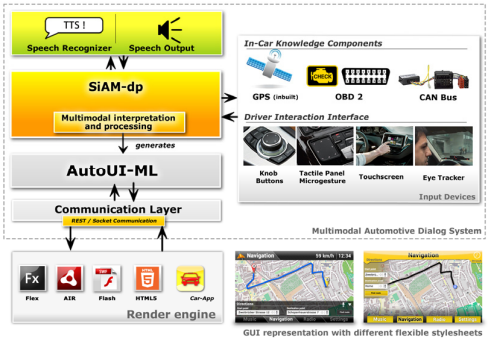

Figure 1: Integration of autoUI-ML within a typical automotive dialogue system

USAGE

As a first step in the development of the automotive UI with autoUI-ML, a structured document must be specified and can be enhanced via encapsulated functions (clock, speed etc...). Figure 2 shows the internal structure of a typical autoUI-ML document within an infotainment system

```
<autoUIML>
    <header>
        <title touchEnabled="true">Navigation</title>
        <clock/><speedIndicator/>
    </header>
    <screen>
        <navigation>
            <map gpsEnabled="true" speechOutputLanguage="EN">
                <markers>
                    <marker lon="49.230378" latitude="7.009535">
                        <name>Your position</name>
                        <icon src="car.png" />
                    </marker>
                    <marker lon="49.244248" latitude="7.013479">
                        <name>Home</name>
                        <icon src="home.png" />
                    </marker>
                </markers>
            </map>
            <option collapsable="true">
              <startPointTextInput inputModality="voice|knob"/>
<destinationPointTextInput inputModality="voice|knob"/>
<confirmButton inputModality="voice|knob" touchEnabled="true" />
            </option>
        </navigation>
    </screen>
    <footer>
        <menu>
            <menuItem touchEnabled="true">Music</menuItem>
            <menuItem touchEnabled="true"
selected="true”>Navigation</menuItem>
            <menuItem touchEnabled="true">Radio</menuItem>
            <menuItem touchEnabled="true">Settings</menuItem>
        </menu>
    </footer>
</autoUIML>
```

Figure 2: Definition of a Navigation Panel using autoUI-ML

After the interpretation is done, the rendering technology (in our example HTML 5 in combination with AJAX and CSS 3) will produce a skinned user interface as depicted on Figure 3.

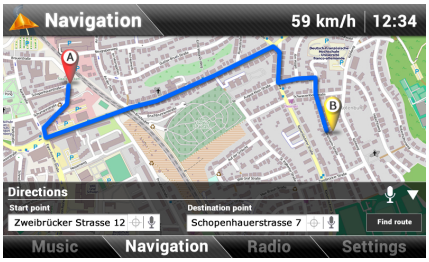

Figure 3: Visual output (HTML 5 interface) of an autoUI-ML based navigation panel as defined in Figure 2

CONCLUSION

Through the usage of a clear and semantically annotated markup language we have presented a solution on how to solve key issues while developing graphical user interfaces in combination with multimodal dialogue systems in the automotive field. This approach also closes the gap between designers, interaction designers and dialogue application developers by offering a modular graphical user interface conception approach. To support the work of designers, we are planning to realize a graphical editor that will enable designers and UI-creators to easily generate their in-car user interfaces.

The upcoming trend of "In-Car Apps" for mobile devices like iPhone or Android phones could fully take benefit of autoUI-ML and its generic approach. The future of this format could also pass through a standardization with the expectation of turning autoUI-ML into a W3C approved UI format.

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