Optimizing webpage layout for smartwatches - avoiding sticky menus

Tanja Krunić, Petar Vasiljević
The Higher Education Technical School of Professional Studies in Novi Sad
Serbia, Novi Sad
krunic@vtsns.edu.rs, vasiljevic@vtsns.edu.rs

Abstract — **This paper is devoted to a problem that occurs in a novel discipline – web design for smartwatches. Smartwatches are devices with small screens, and therefore, designing a webpage for them is a challenge. In the process of adapting the page layout for smartwatches, many issues are the same as in mobile web design, since smartphones have small screens, too. But smartwatches have even smaller screen dimensions, so additional problems may occur in this case. Herein, we will consider one of such problems – the display of sticky navigation menus on smartwatches.**

Keywords - smartwatch; responsive web design; sticky navigation menu

I. Introduction

In the last decade, there is a growing market of wearable technologies including hearables, smartwatches, wrist-bands, smart glasses, etc. According to [1], the global shipment of such devices in 2020 reached 444.7 million units. The same source claims an approximately 28% year-over-year growth in this market. Especially, starting from 2015, smartwatches became a very popular device worldwide. Similar, a 27% year-over-year growth on the smartwatch market is reported by [2]. Among other benefits of smartwatches, working at home due to the global pandemic of Covid-19 is mentioned as one of the factors for the growing popularity of these devices, [3].

The most popular features of smartwatches are alerts and notifications, time related features such as stopwatches and alarm clocks, health features with included pedometers, blood pressure, heart rate and sleep monitors, as well as physical activity monitors, and call/messages features, [4]. However, the latest versions of smartwatches have a web browsing ability, too. The first smartwatches with web browsing ability had limitations like small screens and poor hardware. But the latest smartwatches created by companies such as Apple, Samsung, and Mobvoi are equipped with better screen resolution, more powerful processors and much more memory, so even it is not an ideal experience, browsing the internet becomes more comfortable than before, [5]. Fig. 1 shows exploring a website on a round shaped smartwatch using a web browser for Wear operating system, [6].

Figure 1. Surfing the web with a smartwatch [6]

According to [7], [8] responsive—web design for smartwatches will be a new challenge for web designers in the future. This was a motivation for us to investigate issues in adapting webpage content to be viewed on smartwatches. Particularly, we are interested in the impact of sticky navigation menus on browsing a webpage on smartwatches.

This paper is organized as follows. In section two we provide facts about smartwatch web design, such as smartwatch screen dimensions and responsive design breakpoints for smartwatches (a precise definition is given in section 2. B) and the similarity between smartwatch and mobile web design. Section three is devoted to the explanation of a current trend in web design – sticky navigation menus. However, in section four, the use of sticky navigation menus is shown to be an additional problem that can occur in smartwatch web design. Namely, as will be shown, this trend may work fine on smartphones, but not on smartwatches. All examples used in this paper are created using the *21st International Symposium INFOTEH-JAHORINA* website, [9] since it has a sticky navigation menu.

II. Smartwatch web design

Web design for smartwatches is a novel discipline, so there are only a few sources on this topic available by now. Since both smartwatches and smartphones are devices with small screen dimensions, there is a relationship between smartwatch and mobile web design. But smartwatches have even smaller screens than smartphones, so it is clear that most of the issues of mobile design should be followed in smartwatch web design, too. Let us mention the most common ones, [10]-[15]:

- Simple page layouts (content should be displayed in one column, horizontal scroll should be avoided, displaying too much content at once is not desired, promotion popups should be avoided);
- Optimized navigation (using hamburger menus rather than horizontal navigation menus, using markable call to actions on the center of the page, visually separating navigation and content using margins, enabling a search bar on the top of the page, keeping the user in a single browser window);
- Optimizing text (using larger fonts and line-heights, respecting text and background contrasts in order to make text readable on small screens);
- Reducing the need for user input (keeping forms as short as possible, enabling form autocomplete, using date pickers instead of letting the user type the desired date, using choice buttons instead of input fields whenever suitable);
- Optimizing page load speed (avoiding the usage of large videos, high resolution images and unnecessary scripts).

Since smartwatches have smaller screens than smartphones, in [8], [16], [17] one can find additional advices such as: use rounded rectangle shape to indicate button interactivity, use large tap targets to decrease the possibility that users click on the wrong target and use micro-interactions (icon animations, button animations and similar interactive elements).

As we can conclude, in the lack of smartwatch design literature one could follow mobile design instructions in smartwatch design. However, since smartwatches have smaller screen dimensions than smartphones, additional issues can arise. Since the literature on this topic is still poor, sticky navigation menus are not yet recorded to be a problem in smartwatch design. But, as will be shown in section four, the use of sticky navigation menus may work fine on smartphone layout, but interrupts effective page browsing on smartwatches. Therefore, it should be avoided in smartwatch design.

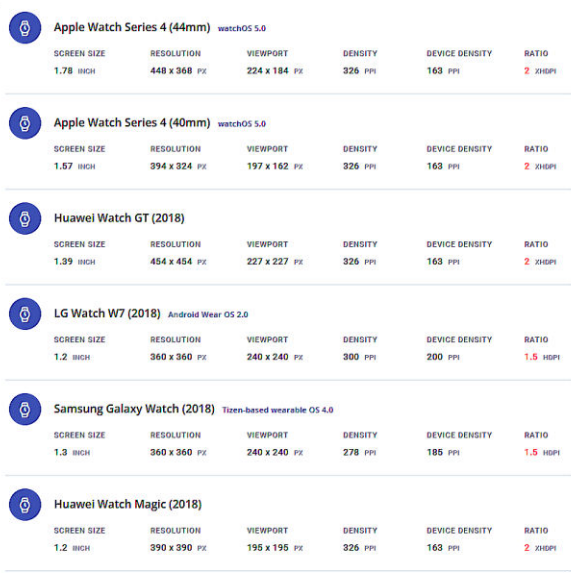
A. *The use of the Mobile first principle for websites that should be adapted for smartwatch layout*

As one can see from global statistics, 68% web visitors in 2020 were mobile users, whereas 29% were desktop users, [18]. This is a valid argument to use Mobile first web design (writing CSS for mobile viewport sizes first and use media queries to adapt the layout for devices with wider screens afterwards) rather than the Desktop first principle (writing a style for devices with wide screens first, and then adapting the page layout for devices with smaller screens, e.g. smartphones). According to a survey conducted in [19], 33.3% of web designers use the Mobile first principle, and 21.9% use the Desktop first principle.

In our opinion, another argument for using the Mobile first principle is the fact that the webpage layout for smartwatches is similar as for smartphones, since they both have small screens. However, in that case, there is still a need to write a media query using a smartwatch breakpoint, in order to give a few additional changes in the style needed to correct specific layout problems that arise in the case of such small screens. But this way is easier than using the Desktop first principle, in which case we must repeat the same style changes for mobile and smartwatch breakpoints, by adding a few changes for smartwatches. So, the better option is to create a Mobile first style, add a media query for smartwatches with only a few lines of code, and then a special media query for wide screens.

B. *Smartwatch breakpoints and media queries*

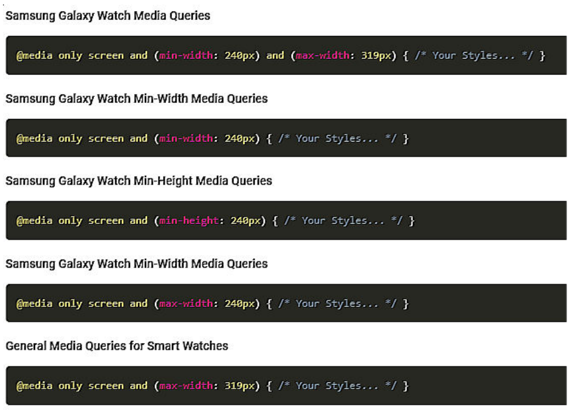
As mentioned before, smartwatches are devices with small screen dimensions. In order to have an insight in how small these dimensions are, a part of a table (which can be found in [20]) with smartwatch screen dimensions and viewports (the user's visible area which varies according to the dimensions of the device, [21]) is shown in Fig. 2.



	SCREEN SIZE	RESOLUTION	VIEWPORT	DENSITY	DEVICE DENSITY	RATIO
Apple Watch Series 4 (44mm) watchOS 5.0	1.78 INCH	448 x 368 PX	224 x 184 PX	326 PPI	163 PPI	2 XHDPI
Apple Watch Series 4 (40mm) watchOS 5.0	1.57 INCH	394 x 324 PX	197 x 162 PX	326 PPI	163 PPI	2 XHDPI
Huawei Watch GT (2018)	1.39 INCH	454 x 454 PX	227 x 227 PX	326 PPI	163 PPI	2 XHDPI
LG Watch W7 (2018) Android Wear OS 2.0	1.2 INCH	360 x 360 PX	240 x 240 PX	300 PPI	200 PPI	1.5 HDPI
Samsung Galaxy Watch (2018) Tizen-based wearable OS 4.0	1.3 INCH	360 x 360 PX	240 x 240 PX	278 PPI	185 PPI	1.5 HDPI
Huawei Watch Magic (2018)	1.2 INCH	390 x 390 PX	195 x 195 PX	326 PPI	163 PPI	2 XHDPI

Figure 2. Smartwatch screen sizes and viewports [20]

CSS breakpoints are the points to be added in the code of the webpage style. The webpage layout responds to them depending on the device screen dimensions. Breakpoints are actually used in CSS media queries which allow us to write different styles for different breakpoints. The goal is to obtain user friendly layouts for users visiting the website with various devices (TV, PC, tablet, smartphone, smartwatch), [22].



Samsung Galaxy Watch Media Queries

```
@media only screen and (min-width: 240px) and (max-width: 319px) { /* Your Styles... */ }
```

Samsung Galaxy Watch Min-Width Media Queries

```
@media only screen and (min-width: 240px) { /* Your Styles... */ }
```

Samsung Galaxy Watch Min-Height Media Queries

```
@media only screen and (min-height: 240px) { /* Your Styles... */ }
```

Samsung Galaxy Watch Min-Width Media Queries

```
@media only screen and (max-width: 240px) { /* Your Styles... */ }
```

General Media Queries for Smart Watches

```
@media only screen and (max-width: 319px) { /* Your Styles... */ }
```

Figure 3. Media queries with smartwatch breakpoints [23]

Fig. 3 shows the most common breakpoints for smartwatches. As one can see, those are commonly 240px or 319px of screen width, [23]. Similar, according to [24], web designers should use a breakpoint for screen widths less than 290px.

III. Sticky Navigation Menus

Sticky navigation menus are a trend in modern web design. They may be found on many popular appealing designed websites, [25]. Those menus stay just in place when scrolling down the page. The *21st International Symposium INFOTEH-JAHORINA* webpage has a sticky navigation menu, so it is used for the purpose of our investigation. Fig. 4 and Fig. 5 show two different scrolling positions on that webpage. We realize that the menu is always available, regardless of the scrolling position. It is just attached on the top of the page.

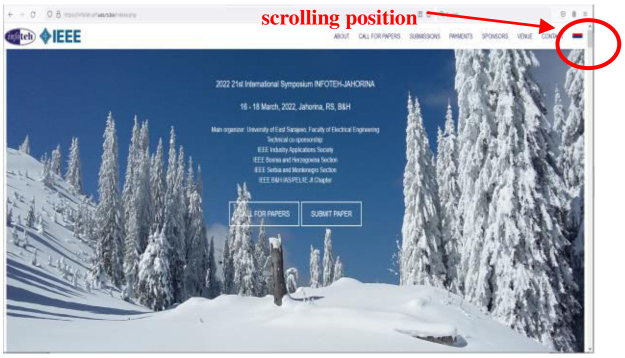

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Figure 4. Sticky navigation menu – scrolling position 1

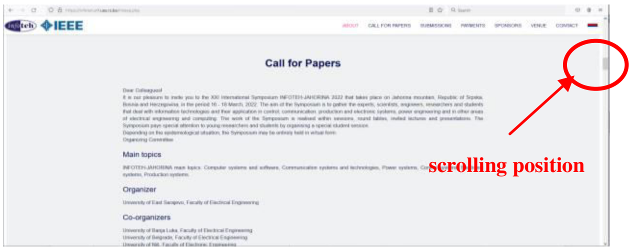

Figure 5. Sticky navigation menu – scrolling position 2

The main advantage of using sticky navigation menus in [25]-[27] is mentioned to be the ease of access of all pages regardless of how far the user has scrolled down the page. There is no need for the user to scroll back in order to change the page or take some other action offered in the sticky menu. This definitely helps faster browsing and saves time. One can conclude that sticky menus are a very good solution for long pages. On the other hand, one of the main disadvantages of using sticky menus is mentioned to be a waste of space, especially on small screen devices, such as mobile phones. Also, if the website consists of short pages, there is no need to use sticky navigation menus, since there is not much vertical scrolling. The creation of sticky navigation menus is not complicated. It can be achieved by adding the CSS rule *position: fixed*, [28] on standard navigation menus.

IV. The Impact of Sticky Navigation Menus on Smartwatch Web Browsing

As mentioned in the previous section, the main disadvantage, known in literature, of using sticky navigation menus on layouts for small screen devices such as smartphones, is that sticky menus waste space. This remains true for smartwatches. But there is an additional, more serious problem with sticky navigation menus that can occur on smartwatches. In order to figure out the problem, we use several responsive design tools in this section. First we use the *Inspect element web browser tool* that allows us to inspect the HTML and CSS code of all webpage elements. This tool enables us to change the code and to preview the obtained effects in the web browser. Of course, all changes are just virtual, [29]. This tool has a *Responsive design mode* which provides us the preview of the webpage for desired screen dimensions, [30].

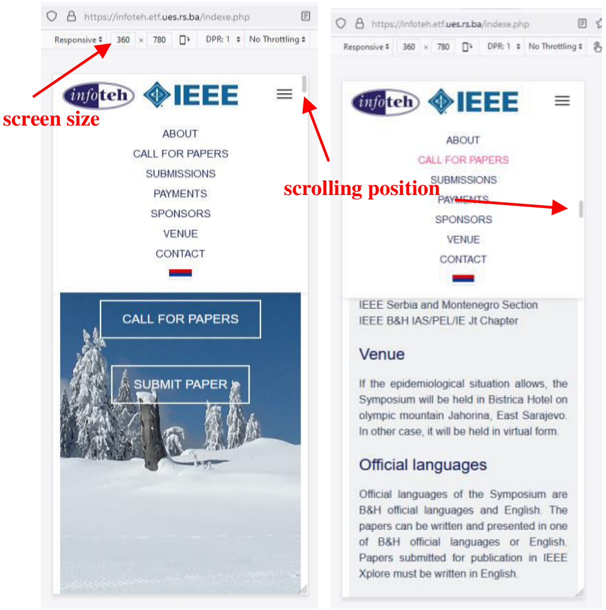

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Figure 6. Opened sticky menu on a smartphone with 360x780px screen size viewed in the Responsive design mode of Inspect element tool

Fig. 6 is obtained using *Responsive design mode* for a 360x780px screen size (see [22] for suggested smartphone breakpoints). The figure shows two different scrolling positions on a smartphone while the hamburger menu (navigation menu for the mobile version of the webpage, [31]) is opened. As one can see, the opened menu takes much space, but scrolling and page browsing is still possible.

Unfortunately, this is not the case with smartwatches. Fig. 7 shows the same website with the opened sticky menu in the *Responsive design mode* for a 240x240px screen size characteristic for smartwatches (the suggested dimensions and breakpoints for smartwatches are presented in section two). The figure shows two scrolling positions. As we can see, if the user forgets to click on the hamburger icon in order to close the menu, scrolling down the page is disabled.

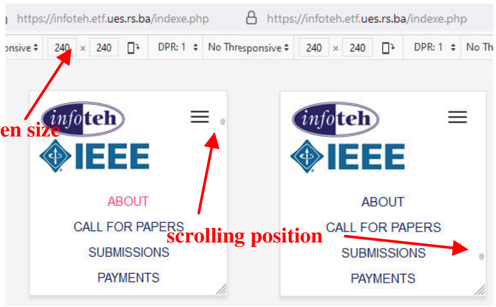


Figure 7. Opened sticky menu viewed in Responsive design mode of Inspect element tool with a 240x240px screen size characteristic for smartwatches

Such result can also be obtained by viewing the same webpage using another similar tool, such as the *Responsive test tool,* [32]. As we can see on Fig. 8, the same problem occurs again.

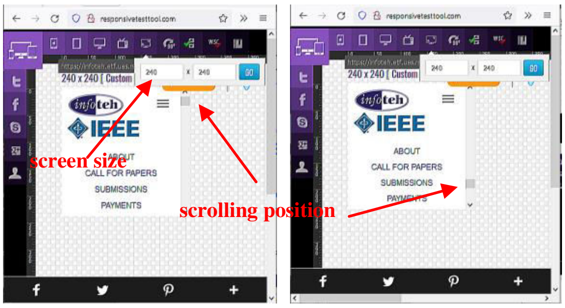
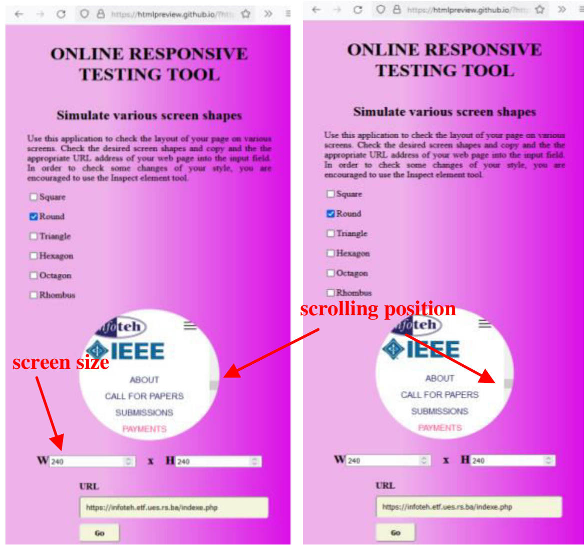


Figure 8. Opened sticky menu viewed in Responsive test tool, [29] with a 240x240px screen size characteristic for smartwatches

Furthermore, since smartwatch screens are either rectangular or round shaped, we check the same webpage and its layout using our responsive testing tool for round shaped screens described in [32]-[34]. As we can see on Fig. 9, the same problem occurs on smartwatches with round screens.


ONLINE RESPONSIVE TESTING TOOL

Simulate various screen shapes

Use this application to check the layout of your page on various screens. Check the desired screen shapes and copy and the the appropriate URL address of your web page into the input field. In order to check some changes of your style, you are encouraged to use the Inspect element tool.

- □ Square
- ☑ Round
- □ Triangle
- □ Hexagon
- □ Octagon
- □ Rhombus

W 240 x H 240

URL https://infoteh.etf.ues.rs.ba/indexe.php

Figure 9. Opened sticky menu viewed in Responsive testing tool, [30]-[32] on a round shaped screen with dimensions 240x240px

At last, we test the page layout in the *Responsive design mode* of *Inspect element tool* of the webpage for a quite larger smartwatch screen size (319x319px), suggested in [22] as a smartwatch breakpoint (see Fig. 4). Again, we get the same result, Fig. 10.

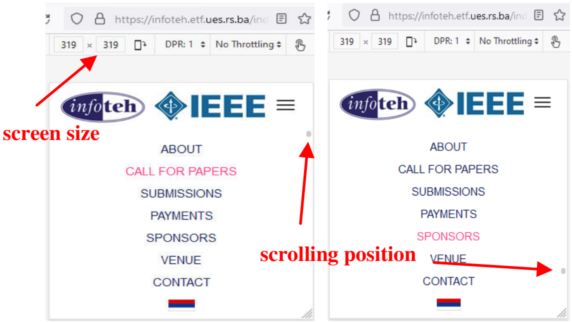
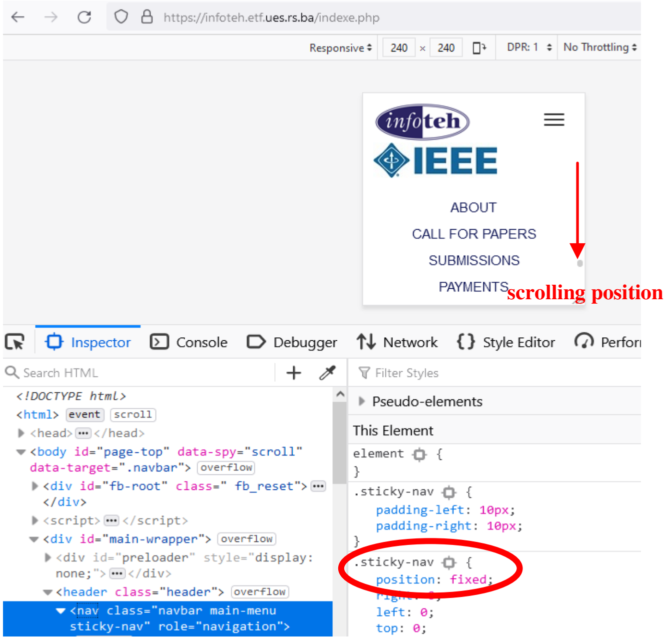


Figure 10. Opened sticky menu viewed in the Responsive design mode of Inspect element tool with a 319x319px screen size characteristic for smartwatches

As one can conclude, sticky menus should be avoided in the smartwatch layout of webpages. But, since sticky menus are popular and have advantages on websites designed for desktop devices, their usage should not be excluded in general. They can be used on a desktop width layout, but excluded for smartwatches. If one uses the Desktop first principle in web design, this can be achieved by using an appropriate media query for a smartwatch breakpoint.

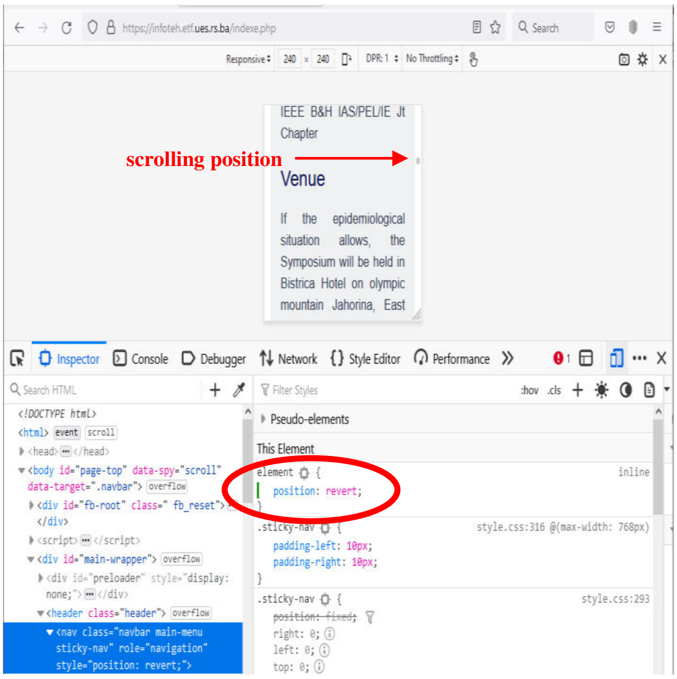


```
<!DOCTYPE html>
<html> event scroll
  <head> ••• </head>
  <body id="page-top" data-spy="scroll"
  data-target=".navbar"> overflow
    <div id="fb-root" class=" fb_reset"> •••
    </div>
    <script> ••• </script>
    <div id="main-wrapper"> overflow
      <div id="preloader" style="display:
      none;"> ••• </div>
      <header class="header"> overflow
        <nav class="navbar main-menu
        sticky-nav" role="navigation">
```

```
element {
}
.sticky-nav {
   padding-left: 10px;
   padding-right: 10px;
}
.sticky-nav {
   position: fixed;
   right: 0;
   left: 0;
   top: 0;
```

Figure 11. A sticky menu has the CSS rule *position:fixed*

As we have mentioned in section three, sticky menus commonly have the CSS rule *position: fixed.* We use the *Inspect element browser tool* to verify this, Fig. 11. As we can see, the navigation menu has a class named *sticky-nav* containing the aforementioned CSS rule. So, among other CSS rules within the media query, we need to include a rule that unsticks the fixed menu. The CSS value *revert* can be used to reset a property back to its inherited value, [36]. Fig. 12 shows resetting the position value of the sticky navigation menu within the *Inspect element tool*.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Pseudo-elements
This Element

```
<!DOCTYPE html>
<html> event scroll
<head> ••• </head>
<body id="page-top" data-spy="scroll"
data-target=".navbar"> overflow
  <div id="fb-root" class=" fb_reset">
  </div>
  <script> ••• </script>
  <div id="main-wrapper"> overflow
    <div id="preloader" style="display:
    none;"> ••• </div>
    <header class="header"> overflow
      <nav class="navbar main-menu
      sticky-nav" role="navigation"
      style="position: revert;">
```

```
element {                                  inline
  position: revert;
}
.sticky-nav {    style.css:316 @(max-width: 768px)
  padding-left: 10px;
  padding-right: 10px;
}
.sticky-nav {                         style.css:293
  ~~position: fixed;~~
  right: 0;
  left: 0;
  top: 0;
```

Figure 12. The CSS rule *position:revert* can be used to unstick the menu

This means that we should add the following media query for a smartwatch:

@media only screen and (max-width: 240px){

…………

.sticky-nav{position:revert;

…………

}

}.

As we can see on Fig. 13, after unsticking the menu, scrolling down the page while the menu is opened is enabled again.

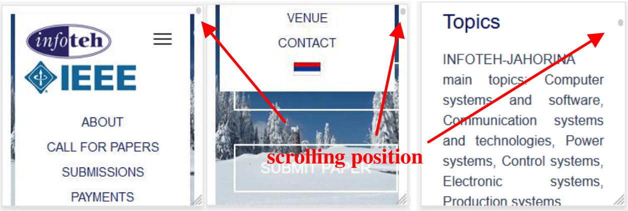
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Figure 13. Various scrolling positions with the opened menu after reverting its position (unsticking)

It remains for the designer to decide if the sticky menu is to be excluded from the version for smartphones or not. On the other hand, if the designer uses the Mobile first principle, the *position: fixed* rule is to be initially omitted from the *sticky-nav* class, and then added to the media query for devices with wider screens, e.g.

@media only screen and (min-width: 992px){

…………

.sticky-nav{position:fixed;

…………

}

}.

V. Conclusion

The rapid development of devices with internet access causes new challenges in web design. One of such challenges is smartwatch responsive design. As discussed in this paper, sticky menus display correctly on smartphones and devices with wider screens such as tablets, laptops or desktop computers. But smartwatch screens are too small to display them correctly and they cause problems in navigation or reduce the visibility of other important page elements. Thus avoiding sticky elements can help smartwatch user experience.

Smartwatch web design is a novel discipline, so it presents a new research field. We expect new layout issues for smartwatches to be discussed among web designers in the forthcoming time.

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