

ButtonTips: Design Web Buttons with Suggestions

Supplementary Material

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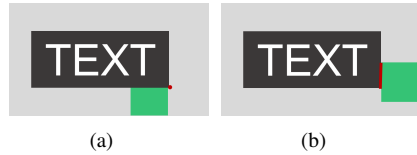


Figure 1: Example of boolean function \sqcap . (a): The right edge of the seed (green) is "snapped" to the bottom-right vertex (red) of the text element. (b): The left edge of the seed is "snapped" to the right edge of the text element (red is the intersection). Either case will return *True* to the function caller.

S0. Seed expansion method.

For each component in a sub-region of a webpage, we first define four seed rectangles. To make the generated candidate regions cover different neighboring spaces of the component, we represent the seeds as fixed-size squares that are attached to the corners of the component along different edges, as shown in Figure 3. Next, the candidate regions are obtained by expanding each of the seed rectangles iteratively. Figure 3 illustrates the expansion process for one seed rectangle. For each seed, to start its expansion, we construct a queue \mathcal{Q} and a list \mathcal{L} . We initialize \mathcal{Q} to be the seed rectangle and \mathcal{L} to be empty. At each iteration, we pop out a rectangle from \mathcal{Q} , and expand the rectangle to generate more rectangles. The expansion is performed by translating one edge of the rectangle to snap to the corner or edge of other components. After the current iteration of the expansion process ends, we check each newly generated rectangle s against the list \mathcal{L} , and add the rectangles that are not in \mathcal{L} to both \mathcal{Q} and \mathcal{L} . This process will be repeated until \mathcal{Q} is empty, which results in a set of candidate regions in \mathcal{L} . For each seed, we run the expansion above and combine the candidate regions from each seed to get a set of candidate regions.

S1. Defining Horizontal and Vertical Expansion of Seed Rectangle

In this section, we describe the functions to expand a seed rectangle horizontally and vertically, attempting to be as concise as possible. We begin by defining the symbols that are used in our algorithm.

1. \sqcap is the boolean function indicating whether an edge is "snapped to" an edge or a vertex of other elements. (see Fig 1)
2. $E(j).x$ and $E(j).y$ are the x- and y-coordinates of $E(j)$ (see Section 4.1). In our current implementation, the origin of the coordinate system is the upper-left corner of the webpage. Hence, $E(l).x \leftarrow E(l).x - 1$ translates the left edge of E to the left by 1 pixel. Similarly, $E(t).y \leftarrow E(t).y - 1$ translates the top edge of S up by 1 pixel.

Algorithm 1 Horizontal expansion of the seed.

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1: procedure HORIZONTAL_EXPAND( $S^{new}$ )
2:    $S^l, S^r \leftarrow S^{new}$ 
3:    $flag \leftarrow false; rs \leftarrow []$ 
4:    $e^l \leftarrow \{E_i(l) \cup E_j(r)\}, \forall \{E_i(l).x < S^l(l).x, E_j(r).x < S^l(l).x\}$ 
5:    $e^r \leftarrow \{E_i(l) \cup E_j(r)\}, \forall \{E_i(l).x > S^r(r).x, E_j(r).x > S^r(l).x\}$ 
6:   while do  $flag = false$ 
7:      $flag \leftarrow true$ 
8:     while  $S^l(l) \sqcap \{e^l\} = \emptyset$  do
9:        $S^l(l).x \leftarrow S^l(l).x - 1; flag \leftarrow false;$ 
10:    while  $S^r(r) \sqcap \{e^r\} = \emptyset$  do
11:       $S^r(r).x \leftarrow S^r(r).x + 1; flag \leftarrow false;$ 
12:     $rs \leftarrow rs \cup \{S^l, S^r\}$ 
13:  return  $rs$ 

```

▷ Horizontal Expansion results of $Seed_i$

Algorithm 2 Vertical expansion of the seed.

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1: procedure VERTICAL_EXPAND( $S^{new}$ )
2:    $S^t, S^b \leftarrow S^{new}$ 
3:    $flag \leftarrow false; rs \leftarrow []$ 
4:    $e^t \leftarrow \{E_i(b) \cup E_j(t)\}, \forall \{E_i(b).y < S^t(t).y, E_j(t).y < S^t(t).y\}$ 
5:    $e^b \leftarrow \{E_i(b) \cup E_j(t)\}, \forall \{E_i(b).y > S^b(b).y, E_j(t).y > S^b(b).y\}$ 
6:   while do  $flag = false$ 
7:      $flag \leftarrow true$ 
8:     while  $S^t(t) \sqcap \{e^t\} = \emptyset$  do
9:        $S^t(t).y \leftarrow S^t(t).y - 1; flag \leftarrow false;$ 
10:    while  $S^b(b) \sqcap \{e^b\} = \emptyset$  do
11:       $S^b(b).y \leftarrow S^b(b).y + 1; flag \leftarrow false;$ 
12:     $rs \leftarrow rs \cup \{S^b, S^t\}$ 
13:  return  $rs$ 

```

▷ Vertical Expansion results of $Seed_i$

S2. More results

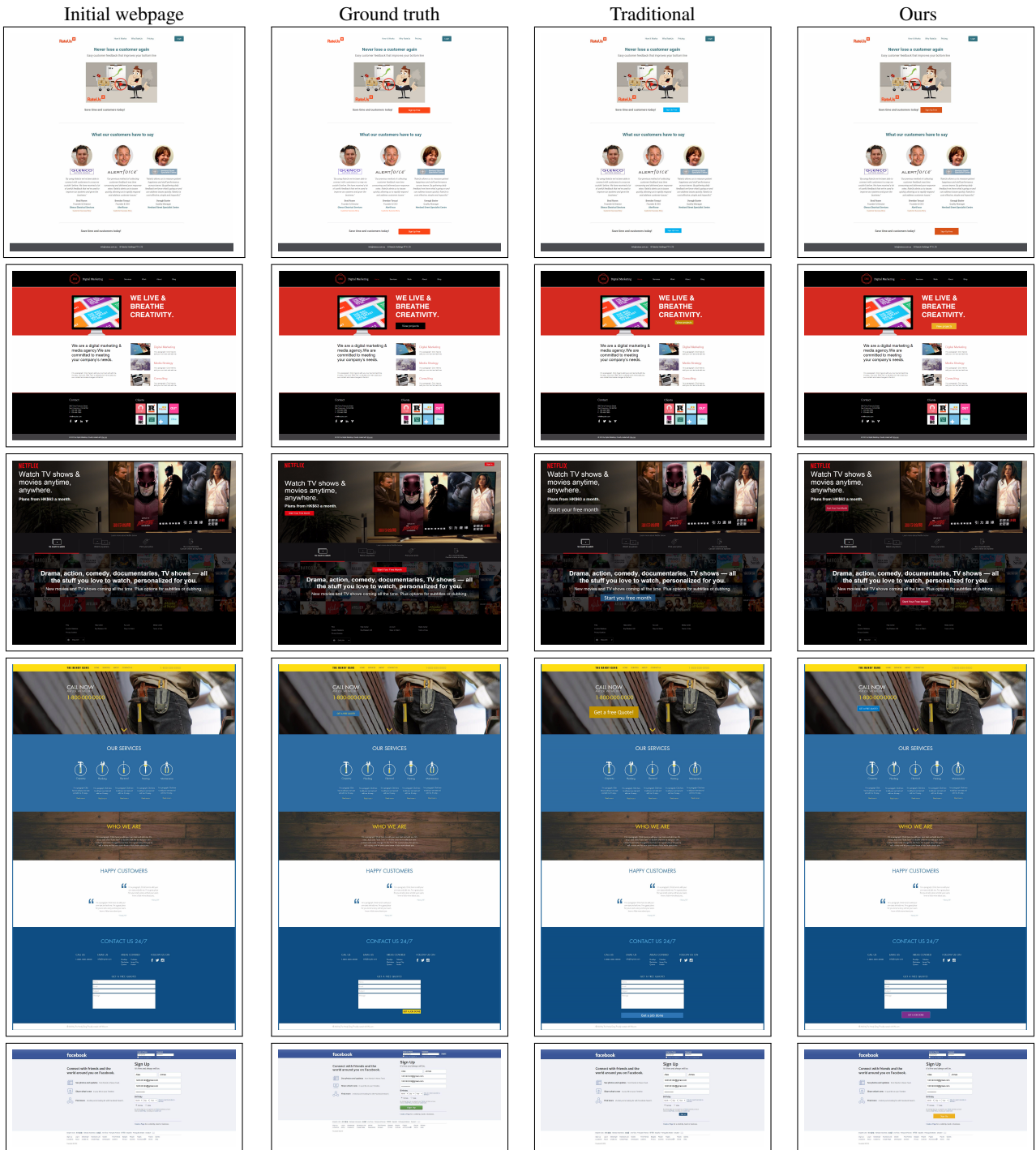


Figure 2: Comparison results on four webpages. The first column shows the initial webpages. The second column shows the ground-truth (original) buttons. The third column shows the results using the traditional UI, while the fourth column shows the results using our UI.

Initial webpage

Ground truth

Traditional

Ours

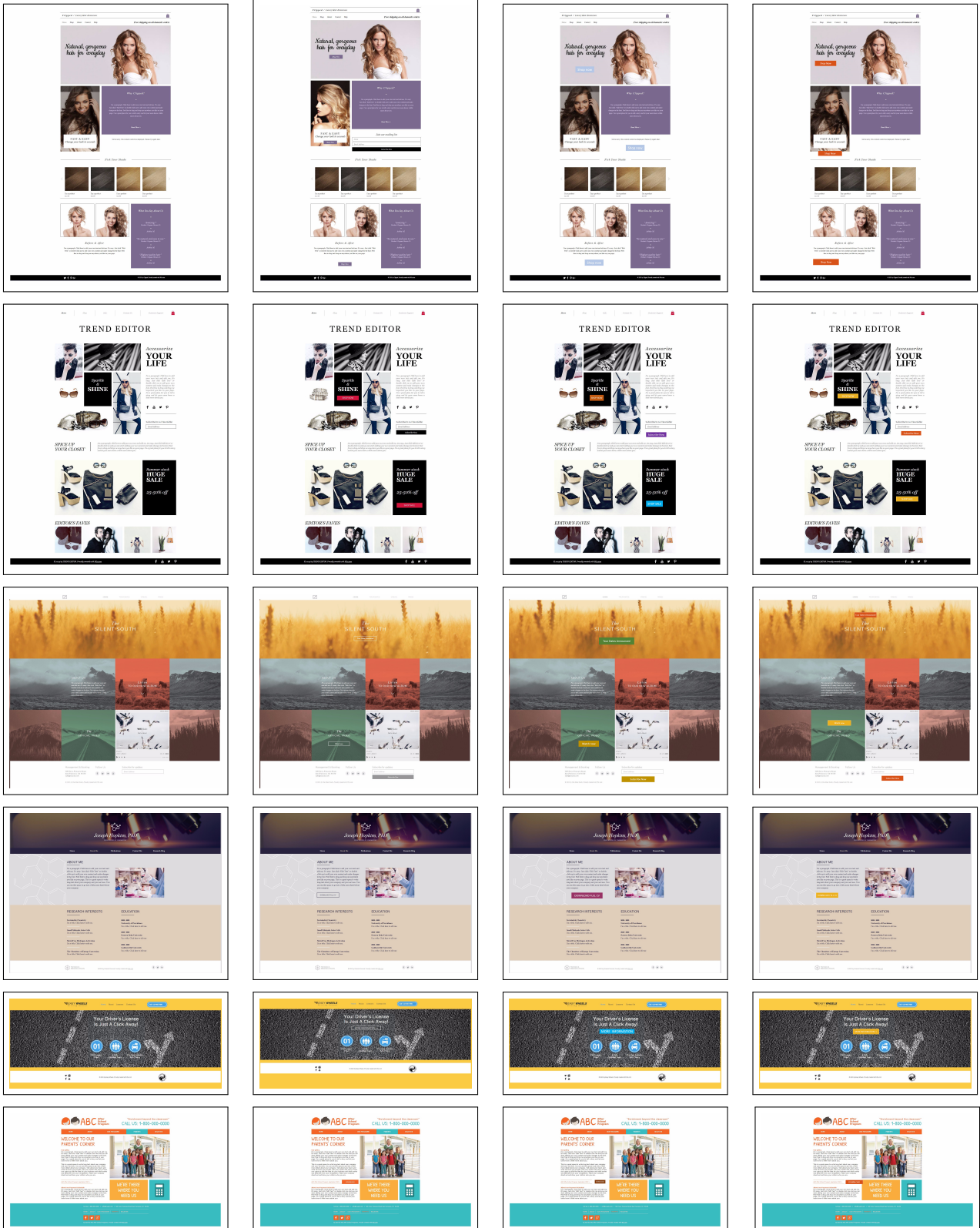


Figure 3: Comparison results on four webpages. The first column shows the initial webpages. The second column shows the ground-truth (original) buttons. The third column shows the results using the traditional UI, while the fourth column shows the results using our UI.