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UCTC No. 476

The University of California
Transportation Center
University of California
Berkeley, CA 94720
The University of California Transportation Center

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Improving Transit Access for the Blind and Vision Impaired

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The University of California Transportation Center
University of California at Berkeley
Our research identifies and evaluates a new technology to allow safe and easy access for the blind and vision impaired.

Signs, both written and iconic, guide us through unknown environments. We use them to identify street intersections, buildings, transit stops, different transit vehicles, and amenities such as telephones, fare, and information booths. People who can't read signs — the dyslexic, the illiterate, the developmentally disabled, people with brain trauma — experience difficulty traveling through unknown territory. The 8.9 million blind and visually impaired people in the United States face greater problems. They do not get the information embedded in signs, and receive few other cues to the environment around them. They are denied cues about pathways and traffic flows, both vehicle and pedestrian. They can't see buses or other transit vehicles, can't find doors, elevators, and other building amenities. This lack of easy and safe access to urban travel and public transit is certainly one reason why only 26 percent of working-age people who can't read newspaper are employed.

How can we improve access for these groups? The Americans with Disability Act of 1990 mandated equal access for all to transit and public buildings. Ramps, curb cuts, and lifts have replaced structural barriers, such as stairs and curbs, for those in wheelchairs. But print-handicapped and vision-impaired people still face functional barriers to equal access. How do blind people find their way, facing these problems of mobility, wayfinding, and exploration? Long canes and guide dogs help a person avoid objects and danger within a few feet, but give no cues to the more distant environment. If a person can't find a bus stop, identify a transit vehicle, or find a building or its entrance, they are denied equal access to transit and public buildings.

Our research identifies and evaluates a new technology to allow safe and easy access for the blind and vision impaired. Remote Infrared Signage Systems (RISS), or Talking Signs®. Each of these signs consists of an infrared transmitter that continuously beams a signal. A hand-held receiver picks up the beam and converts it into a spoken message that can be heard when the receiver is pointed at the transmitter. This gives the user a directional beam to the sign, as well as the sign's content or name.

**Test 1-A**

We conducted two tests, using 10 blind subjects and 10 blindfolded sighted subjects. The first involved walking around a simple geometric path, either a 60' x 60' (18m x 18m) square or a 60' x 30' (18m x 9m) rectangle. A 36' (1m) high stanchion marked each corner of the shape. Subjects were led around the path three times using sighted guide techniques. Subjects swung a long cane ahead as they walked in order to help find the stanchion. Subjects identified the shape as they walked, and then were asked to walk the path on their own. They were pointed at the first stanchion, but received no further information during each attempt. People in the baseline condition made two attempts to recreate the path in a forward direction and one attempt in the reverse direction. If the stanchion was not found within 60 seconds, subjects were told to stop and search for the next stanchion. Response times, angle, and distance errors were recorded for all stanchions.

The blindfolded sighted subjects found 14 stanchions out of a possible 120 (10 subjects x 4 stanchions x 3 attempts). The blind subjects found 35 out of a possible 120 stanchions. Most successes occurred on the first leg, after the subjects had been pointed toward the first stanchion. We examined the response time, distance and angle error, means, and variance between the blindfolded sighted and the blind, and found no significant differences, although the means for the blind were often less than the means for the sighted.

**Test 1-B**

We next tested our 20 subjects using a Remote Infrared Signage System (Talking Signs®). After five minutes of hands-on training, the subjects were led around a different geometric shape one time and identified the shape. They were then given the receiver and retraced their path on their own. After one forward path retrace, they retraced the path in the reverse direction. The results were very significant: all 20 subjects found every stanchion.
was therefore no angle or distance error. Average
response times for retracing the rectangle were 205
seconds without Talking Signs® and fell to 71 sec-
onds with them, a difference of 134 seconds or 65%
less time to walk the same path. The results were
significant at the 0.0001 level.

**Bus Test**

The next day, our subjects were blindfolded and
taken to the university’s bus circle. This busy bus
terminal is served by over 5000 riders per day and
is located by nine different bus lines, so there are
often several buses waiting at the circle. Three RISS
transmitters were set up to guide subjects around
the test path, halfway around the circular sidewalk.
All subjects were walked around the half circle two
times for practice. This task was made more diffi-
cult because there were no straight lines, and a
planter and tree were in the middle of the path.
The subjects also had to cross two access drives.

Two buses on the Number 9 line were equipped
with RISS transmitters, which were installed on the
front and side window, directly to the rear of the
doors. Subjects were told where on the bus the two
receivers were located, but were not given any prac-
tice in locating the door. In the first trial, subjects
waited at the start position, and as each bus was
heard coming into the circle they pointed the re-
ciever at the sound. When their receiver picked up
the message from the Number 9 bus, they began
walking toward the transmitters that guided them
along the sidewalk. The verbal message broadcast
by those signs said “Sidewalk to Bus Stop.” When
the subjects got to the bus stop area, they began to
scan for the transmitter on the side of the bus. The
task ended when they reached the proper bus and
put their cane inside the doorway. Response times
from first identifying the bus to reaching the doo-
way were recorded.

In the second bus trial, subjects used their normal
techniques, which meant asking a passerby (the re-
searcher) which bus was coming. Subjects then
walked from the start position to the bus stop. Here
they had to find the door and then ask the driver
which bus it was. If it was the proper bus, the trial
stopped. If it was the wrong bus, they walked to the
next bus in line and asked again for confirmation.
(This is what happens in real life at busy bus stops.
A blind person must approach each bus and ask the
driver which bus it is.)

The third bus trial was identical to the first. Table
1-A shows the number of people that found the
proper bus. The success rate when using the Remote
Infrared Signage System is clearly evident. A nomi-
nal logistic model (Table 1-B) comparing success rate

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**Table 1-A**

<table>
<thead>
<tr>
<th></th>
<th>Blind</th>
<th>Blindfolded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1 (RISS)</td>
<td>10/10</td>
<td>5/9</td>
</tr>
<tr>
<td>Trial 2 (No RISS)</td>
<td>8/10</td>
<td>2/9</td>
</tr>
<tr>
<td>Trial 3 (RISS)</td>
<td>10/10</td>
<td>7/9</td>
</tr>
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</table>

**Table 1-B**

<table>
<thead>
<tr>
<th></th>
<th>Both</th>
<th>Vision</th>
<th>Aid</th>
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</thead>
<tbody>
<tr>
<td>DF</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chi Q</td>
<td>22.24</td>
<td>10.08</td>
<td>6.80</td>
</tr>
<tr>
<td>Sig</td>
<td>&lt;0.0001</td>
<td>&lt;0.0015</td>
<td>&lt;0.0091</td>
</tr>
</tbody>
</table>

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Continued on page 11

**Left** Bus test—Talking
Signs® transmitters were
installed on front and side of
buses on the #9 line at
UCSB. Blind or blindfolded
subjects used receivers to
find the correct bus.

Above Prof. Golley and
PATH researcher Robert Tam
demonstrate Talking Signs®
system.
to vision (B/S) and aid (RISS/No RISS) was highly significant. This model shows the significance of the success rate compared to the person's sight, the use of the Talking Signs® aid, and the combination of both of these variables.

Most of our blind subjects had been blind most or all of their lives and were very experienced and independent travelers, with their own tested mobility procedures. The blindfolded sighted subjects were more like newly or untrained blind people. The mean response time for the blindfolded sighted without the aid was 243 seconds and 172 seconds using the RISS.

The quantitative portion of the experiment showed that there is a significant difference in response times and performance when using a Remote Infrared Signage System. The last part of our experiment was to collect qualitative data from post-test interviews. We first asked general questions about how subjects felt about using the Talking Signs® RISS. Using a five-point scale for agreement or disagreement, we asked if the system relieved stress or reduced cognitive load; if the signs were helpful when navigating known and unknown spaces, identifying street corners, and finding bus stops and buildings, and finally, if the subjects would use such a system if installed. Ninety-five percent (95%) indicated agreement. Next we asked about the ease of understanding and finding the signs, if the subjects would use them at bus stops, and if finding unfamiliar bus stops was easier than by the subjects' usual method. We also asked if the bus auditory messages were easy to pick up, if the messages made it easy to find the right bus, if the subjects would use them on buses, and if it was easier to find the right bus than by using their usual method. On a five point scale from "strongly agree" to "strongly disagree," no subjects indicated disagreement on any of these points.

We also asked open-ended questions. The first was "Where would you like to see Talking Signs® used?" One subject, an Orientation & Mobility (travel techniques for the blind) instructor, summed it up by saying, "Wherever visual signs are used." All subjects made many suggestions, including all forms of transit, intersections, and many kinds of buildings. We then asked, "What was your opinion of Talking Signs®?" The results were extremely positive. Subjects called the signs great, superb, the best thing yet for the blind, and so on. Many people mentioned how they gained confidence and independence using them.

Our last question was "How does using Talking Signs® differ from your regular method of mobility?" Responses to this question were also very positive, many people said how much easier the system was, that they felt less stress, and mostly they mentioned how much more independent they felt, not having to ask others for help.

Our quantitative results show strong significant results when using a RISS. User feedback was overwhelmingly positive. We conclude that Remote Infrared Signage Systems should be adopted to erase the functional barriers that the blind, dyslexic, developmentally disabled, illiterate and others face daily when trying to access the built environment.