Universitätsklinikum Ulm

Study

Readability of information on dynamic public information systems with LED- und LCD-Technology for persons with and without optical impairments and disabilities

Care of the Study by Prof. Dr. Gerhard K. Lang and Prof. Dr. W. Spraul

Study of the University Ophthalmic Hospital and Polyclinic in Ulm

Readability of information on dynamic public information systems with LED- und LCD-Technology for persons with and without optical impairments and disabilities

Content:

Foreword:

Millions of people worldwide use public transport every day. Either to reach their workplace or to reach any kind of target. Especially elderly people and many people with optical impairments and disabilities are reliant on public transport.

To inform passengers and to make public transport more attractive, there are all kinds of dynamic information systems on display throughout the public transport system.
The passengers want to be informed at the right time. This means they want to know the right time and the direction where the next public transport will go. As well as they want to know at the right time about any kinds of delays

There are all kinds of different technologies used to give to passengers information. Nowadays the main technology for information systems are Magnetic dots (FlipDot), LEDs (**L**ight **E**mitting **D**iodes) and LCDs (**L**iquid **C**rystal **D**isplay).
For quite a few years now the main technology for dynamic information boards is LED and LCD technology. In the following study of the University Ophthalmic hospital and polyclinic in Ulm was examined the readability of LED and LCD boards for all passengers.

Information which are indicated in the public transport must be readable for all the users. Therefore the test persons for this study were chosen to represent the whole population. This means the persons were chosen with different age and gender, as well as also with and without optical impairments and disabilities.

Subject:

Readability of information on dynamic public information systems with LED- und LCD-Technology for persons with and without optical impairments and disabilities.

Aim:

The Aim of this study was to find out which information medium and which passenger information board is most appropriate (readable) for people with and without optical impairments and/or disabilities as well as from the front as also from the side.
Therefore a comparison between two standard technologies (LCD and LED) for information media has been made. We compared two standard or low disruptive information boards with 16 dots. Additional we examined if the resolution of a dynamic information board is an important criteria for the readability. Therefore we used an additional information board higher disruptive with 26 dots.

Implementation:

The study “Readability of information on dynamic public information systems with LED- und LCD-Technology for persons with and without optical impairments and disabilities” has carried out at the University Ophthalmic Hospital and Polyclinic in Ulm between the dates of 7 July 2004 and 21 August 2004.

Care of the study was undertaken by Prof. Dr. G. K. Lang and by Prof. Dr. W. Spraul.

150 test persons of different ages, gender and optical impairments (binocular visus) were interviewed.

Experimental Set-up:

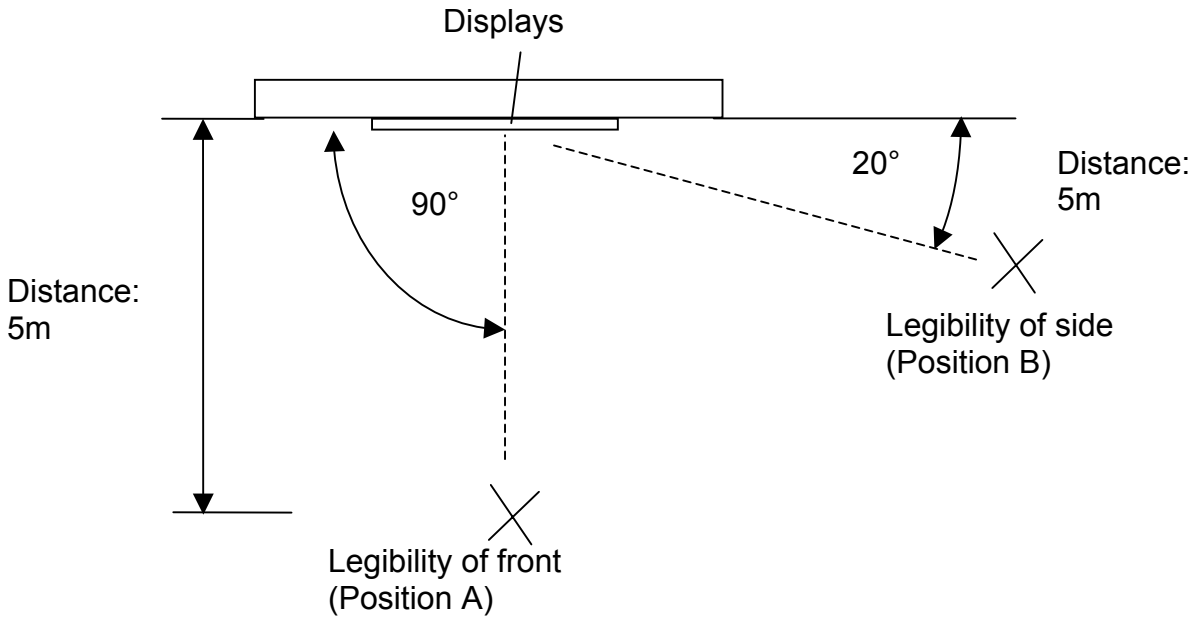
Three standard dynamic information displays with similar dimensions, which are usual in the trade, were hung up next to each other and viewed.
The test persons had to look from a distance of 5 m at the information boards and evaluate the front (Position A) and the side (Position B) legibility.
The information which was shown on the three displays was all the same. The visible area of the boards were approx. 150x1000 [mm] and the character height of a capital letter was approx. 70mm

Information board 1 (LCD; Resolution 26x192 dots)

Information board 2 (LCD; Resolution 16x112 dots)

Information board 3 (LED; Resolution 16x120 dots)

Experimental Set-up (drafted):



Questionnaire:

In this study we questioned which information board people with and without optical impairments and disabilities found the easiest to read.

These are the questions we asked the test persons:

Question 1: Visual impairments (visus) within a distance of (5m): ……..

Question 2: Gender: male / female

Question 3: How old are you?

- Up to 10 years
- 11 – 20 years
- 21 – 40 years
- 41 – 60 years
- 61 – 70 years
- Over 70 years

Question 4: Out of those three information boards, on which board can you read the information shown **as the best (position A front)** ?

- Display 1
- Display 2
- Display 3

Question 5: Out of those three information boards, on which board can you read the information shown **as the best (position B side)** ?

- Display 1
- Display 2
- Display 3

Question 6: Which criteria led to the choice of this display (multiple selections possible)?

- Font-type
- Contrast
- Side legibility from position A and B
- Resolution
- Appearance

- ……..

Question 7: Out of those three information boards, on which board can you read the information shown **as the worst (position A front)** ?

- Display 1
- Display 2
- Display 3

Question 8: Out of those three information boards, on which board can you read the information shown **as the worst (position B side)** ?

- Display 1
- Display 2
- Display 3

Question 9: Which criteria led to the choice of this display (multiple selections possible)?

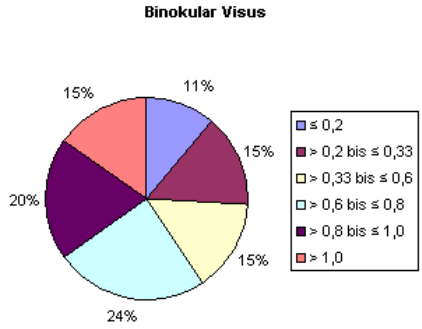
- Side legibility from position A and B
- Outshining of the display
- Uncomfortable feeling while looking at the display
- Blurry text
- Contrast
- ……..

Question 10: What is important for you when you look at an information display (multiple selections possible)

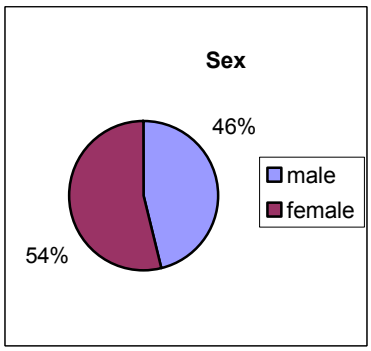
- Information has to be clearly illustrated
- Information has to be readable from a distance
- Information has to be clear at day, night and solar irradiation

Results of the study:

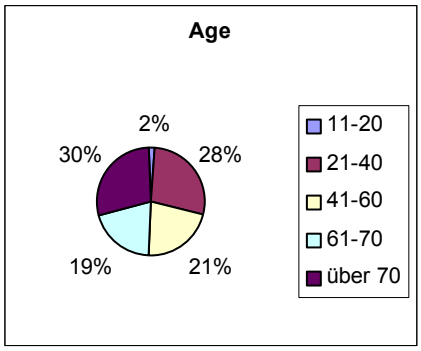
Question 1:



Question 2:



Question 3



Question 4,5,7 and 8

Information board 1 (LCD with 26x192 pixel resolution) was favoured in readability by 92,7 % of the test persons from position A (front legibility) as well as from position B (side legibility).

93,5 % of all test persons have chosen the information board 3 (LED with 16x120 pixel resolution) as the one which had the worst legible from both positions.

Information board 3 (LED with 16x120 pixel resolution) has been favoured by 0.7% of the test persons in both positions (A front legibility and B side legibility).
All those test persons had a very bad visus and weren't able to read the display but preferred the "amber colour" of this display.

2.7% test persons favoured the information board 2 (LCD with 16x112 pixel resolution) from both positions.

Four test persons (2,6 %) indicated different preferences depending from the angle of vision:

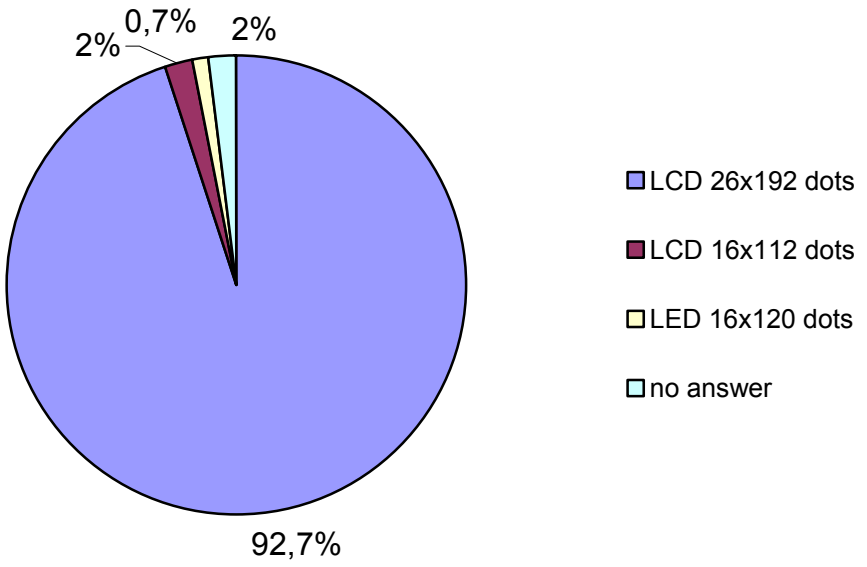
Test person	Pos. A (front legibility)	Pos. B. (side legibility)
1	LCD 16x112 Pixel	LCD 26x192 Pixel
2	LED 16x120 Pixel	LCD 16x112 Pixel
3	LED 16x120 Pixel	LCD 26x192 Pixel
4	LCD 26x192 Pixel	LED 16x120 Pixel

2 % of the test persons did not come to a clear decision.

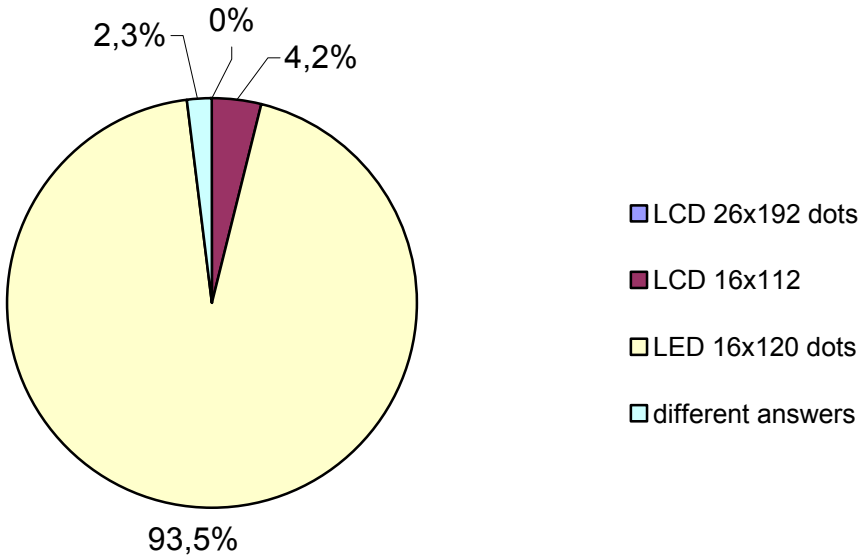
None of the test persons indicated information board 1 (LCD with 26x192 pixel resolution) as the one which is the worst legible. Neither from position A (front legibility) nor from position B (side legibility).

Graphical Analysis of the questions 4,5,7 and 8:

Favoured information board from position A (front legibility) as well as position B (side legibility):



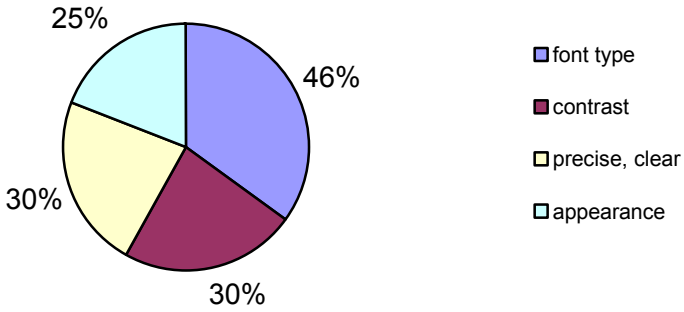
Worst information board from position A (front legibility) as well as position B (side legibility):



Question 6:

Reasons why the display LCD 26x192 pixel resolution was the most favoured (multiple selections possible):

- Type face 46%
- Contrast 30%
- Resolution 30%
- Appearance 25%



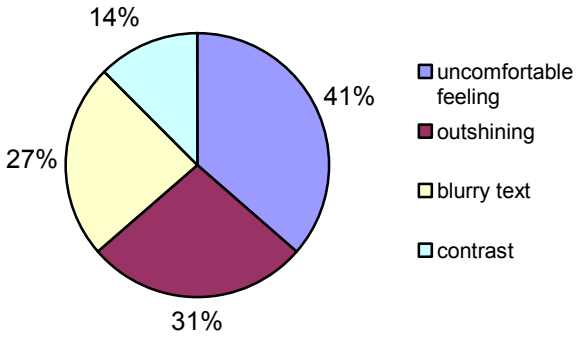
In addition the test persons gave us their own opinions e.g.:

- Colour ("colour green is calming, red isn't", "yellow colour of the type face is good"…)
- Using upper and lower case characters are better to read
- Real descenders are good for good readability

Question 9:

Reasons why the display LED 16x120 pixel resolution was the least favoured (multiple selections possible):

- Uncomfortable feeling While looking at the display 41%
- Outshining of the display 31%
- Blurry text 27%
- Contrast 14%



In addition the test persons gave us their own opinions e.g.:

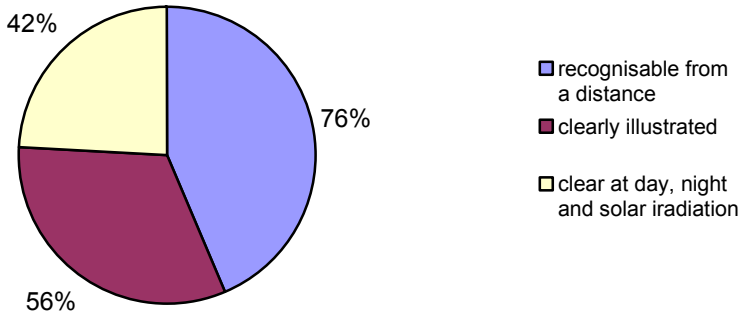
- Colour amber ("awkward", "colour has been chosen unfavourable"…)
- "Too bright", "blinding"
- "Flickers when looking at it", "punctual type face", "like LEGO bricks", "hurts when you look at it"
- Not clear appearance

Question 10:

What is important for you when you look at passenger information displays (multiple selections possible)

The test persons answered:

- Information has to be readable from a distance 76%
- Information has to be clearly illustrated 56%
- Information has to be clear at day, night and solar irradiation 42%



Result of the study especially for people
<u>with</u> optical impairments and disabilities (binocular visus ≤ 0,5)

97% of the test persons with optical impairments and disabilities have judged that the readability of the LCD boards from the front is very good.
99% have chosen that the readability also from the side as very good.

90% of the test persons with optical impairments and disabilities have judged that the readability of the LED display is exceptionally bad. Out of the 90% of the test persons 43% said the LED display is unpleasant to look at, 21% could read the LED display only blurred, 31% found the LED displays was to bright to look at and 5% were not able to read anything on the LED display.

93% have judged that the readability of the LED display from the side as exceptionally bad.

Result of the study especially for people
<u>without</u> optical impairments and disabilities (binocular visus >1)

92% of the test persons without optical impairments and disabilities have judged that the readability of the LCD boards from the front is very good.
90% have chosen that the readability also from the side as very good.

93% of the test persons without optical impairments and disabilities have judged that the readability of the LED display is exceptionally bad. Out of the 93% of the test persons 34% said the LED display is unpleasant to look at, 32% could read the LED display only blurred, 26% found the LED displays was to bright to look at and 8% could read the LED display extremely bad.

81% have judged that the readability of the LED display from the side as exceptionally bad.

Result of the study especially for elderly people (age > 60 years)

94% of the test persons over 60 years have judged that the readability of the LCD boards from the front is very good.
93% have chosen that the readability also from the side as very good.

90% of the test persons over 60 years have judged that the readability of the LED display is exceptionally bad. Out of the 90% of the test persons 40% said the LED display is unpleasant to look at, 32% could read the LED display only blurred, 28% found the LED displays was to bright to look at.

83% have judged that the readability of the LED display from the side as exceptionally bad.

Result / Summary

The result of this study concludes that the majority of people with or without optical impairments and disabilities prefer passenger information with LCD displays in cause of readability and the appearance and they decline the LED boards. This result is independent from age, visus ranges and gender.

The test persons gave strong arguments for the LCD displays like a clear type face (not single dots), with capital and small letters, real descenders, a good contrast and a clear appearance.
For the LED displays the test persons gave arguments like unclear and blurred appearance and in general bad to read.

Take a look at the results of the study especially for test persons with optical impairments and disabilities, they favoured the LCD displays as the displays which they can read.
In the same way judged the people above the age of 60 years.

In addition the side legibility has to be considered as most passengers look at the display from a side position. At the side readability almost all test persons voted that the LCD displays are the displays on which they were able to read everything from the side. The LED display was also like from the front bad readable from the side.

Another point which was figured out was that the readability depends on the resolution. The test persons favoured the LCD display with 26 dots as the display which was the best to read.
The higher the number of dots on a character and the higher the resolution, the better the legibility of the font type becomes. Also the closer you are to the printed font type, the better the legibility.

People who have no optical impairments but especially people with optical impairments and disabilities are often reliant on public transport and need information systems for their navigation. Therefore all information systems must have maximum readability for everyone. Therefore, this study should be seriously considered before renewing or purchasing a new passenger information system and if possible it should be avoided to use LED boards in the public transport.