Joint International IMEKO TC1+ TC7+ TC13 Symposium
August 31st – September 2nd, 2011, Jena, Germany
urn:nbn:de:gbv:ilm1-2011imeko:2

THE NECESSITY FOR MEASURING A SPECTACLE FRAME BY IMAGE PROCESSING

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Abstract – In this paper the need is described of a vision aid for a lot of humans. They can only see well with it and if their defective vision is checked out. But not only the eye-sight has to be measured also the spectacle frame has to be measured. This is for a stable purchase of the eyeglasses in the spectacle frame. All available frame tracers base upon a tactile measurement principle. Nowadays this principle is limited more and more due to the contact measuring force. Therefore the investigation of a new principle based on image processing has to be the next step. For this a customer survey was done and the results are given here. The problematic categories are figured out for measuring with tactile frame tracers. Also the enhancement requires of the optician are named for measuring a spectacle frame by image processing.

Keywords: optical measuring, spectacle frame, image processing

1. THE SPECTACLE FRAME IN GERMANY

Humans take up nearly 90 % of all sensation with the eyes. More than 60 % of all adults carry spectacle frames in Germany today [1]. But they can only see well with an optical aid. In Germany this is normally a spectacle frame as shown in Fig. 1. Over 11 million pieces of spectacle frames have been sold there in 2010. In a lot of cases the customer wants to use its spectacle frame again. That is the reason why the disposal of eyeglasses is about 34 million [2].

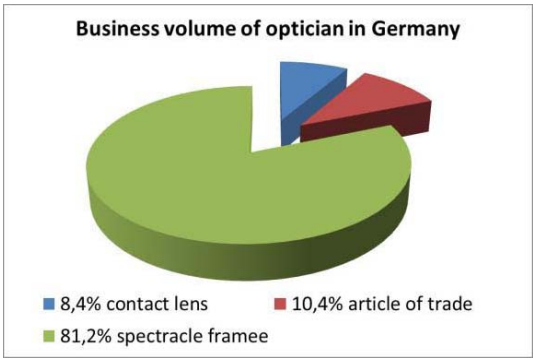

Fig. 1. Optician conversion in Germany [2]

Spectacle frames are made of different materials. The most common is the metal frame with a proportion of 71.7 %, afterwards are the plastic frames and rimless mount frames. The rimless mount frames are subdivided in thread and drill frames, as seen in table I. Thread frames do not have a closed frame out of one material. The gap between the two ends of the frame is closed with a thread, typically out of nylon. At drill frames the bridge and the side are direct fastened at the eyeglasses [3]. The spreading of material and foci of the eyeglasses are in table II.

The material has got a huge influence on an image processing measuring setup. The measuring objects covered different material classes from metal with high reflexion character or a huge roughness and also plastic in different colours and surfaces or even transparent plastics. The transparent objects represent a special challenge for optical measurement system. Because the detected measuring points can be desired as a part of the ground of the groove but in addition they could also occur through material inclusions, reflexions on a particle or dust or at the backside of the groove [4].

TABLE I. Materials of frames [2]

Material	Proportion
metal frame	71.7%
plastic frame	17.1%
thread frame	7.4%
drill frame	3.8%

TABLE II. Groups of eyeglasses [2]

Eyeglass	Proportion
organic	88%
mineral	12%
one-focal	66.6%
multi-focal	33.4%

2. DRAWBACKS OF THE TACTILE MEASUREMENT OF SPECTACLE FRAMES

After the costumer has chosen his spectacle frame and his defective vision is checked out it is necessary for the optician to measure the groove of the spectacle frame with a so called frame tracer. In the next step the optician could grind the eyeglasses for the

costumer. The measurement of the spectacle frame is needed, because of the huge range of the different designs and their manufacturing inaccuracies. There are almost no regulations to the design and especially to the groove. Furthermore spectacle frames are very elastics but also easily to warp.

Each tactile measurement depends on a contact force and this force is able to warp the spectacle frame.

The contact force can also shift the spectacle frame in its holder. By the movement through the groove of the spectacle frame there will always be stick-slip-effects between the stylus and the different possible materials of the spectacle frame. All this leads to incorrect measurements of the three dimensional curve. The last disadvantage due the contact force is represented in the abrasion of the stylus. There is a call for a stylus change after several measuring times. This will coast time and money for the optician, when the machine is standing still and the part has to be replaced [5].

But there is also a general problem by tracing spectacle frames and not just due to the tactile measuring method. The stylus is held in the groove of the spectacle frame only through the contact force in the direction of the ground of the groove. Therefore the stylus is able to follow the groove over a wide range and it is possible to get a three dimensional curve.

Nowadays it is commend to have corrective eyeglasses even in sport spectacle frames. They are strongly curved to protect the patient against wind for example. It will happen if these sport spectacle frames are measured with a normal tactile frame tracer that the stylus will fall out of the groove. So there is no direct way to measure these sport spectacle frames [5].

3. CUSTOMER SURVEY OF USER OF TACTILE FRAME TRACERS

A customer survey was made of users of the tactile frame tracers to finding further room of improvement. The asked users were opticians from optician specialist shops established in Germany. They were asked about the pros and cons of tactile frame tracers.

First of all thes were asked, wihich terracing device they have. The spreading of frame tracers on the market shows the Nidek LT-900 as the market leader device, see Fig 2.

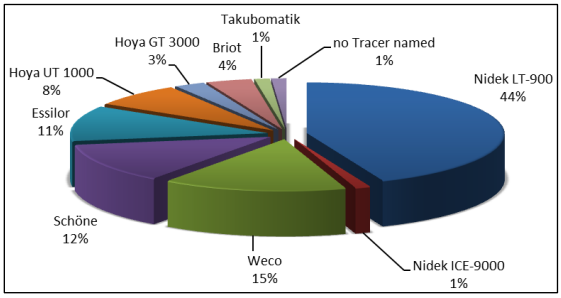

Fig. 2. The spreading of frame tracers on the market

But almost every user of tactile frame tracers does have problems with his device in Germany, see Fig 3.

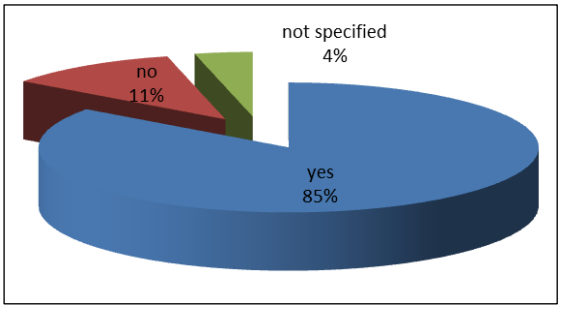

Fig. 3. Proportion of users of tactile frame tracers with problems with their device

For the improvement of the problems with the tactile frame tracer, they were listed in problematic categories. An overview is given in Fig. 4.

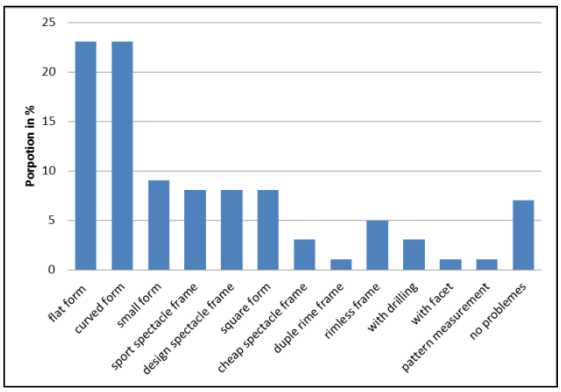

Fig. 4. Proportion of problematic categories for measuring with tactile frame tracers

A flat form is for the optician, if the spectacle frame has a small deflection. The market leader Nidek LT-900 is expressed the deflection as a Curve in a modified numerical value from 0 to 10. Flat forms have a Curve between 0 and 2. Curved forms have a clear deflection and the Curve is greater than 6. Sport spectacle frames are more curved. Their Curve is in the range of 8 and higher.

The maximal expansion of small forms is less than 25 mm. In this case a tactile frame tracer could not measure the spectacle frame, because the stylus is to big to get in the frame.

After the categorization of the problems on the spectacle frames in the following step the optician had to appraise the incidence of the problems, see Fig 5. Therefore they had to choose the categories from often, frequently to always. The correct measurement of extreme forms is the main problem for the optician with a quantity of 37. There is increased demand for reliable correct measurement on the spectacle frame.

But it is remarkable that the category, always, was selected only rarely. This reveals that that the opticians have found different strategies to work against their common problems, like measuring a high curved sport spectacle frame. On the one hand they do

not have problematic spectacle frames in their assortment. On the other hand they have external service provider for measuring the spectacle frames.

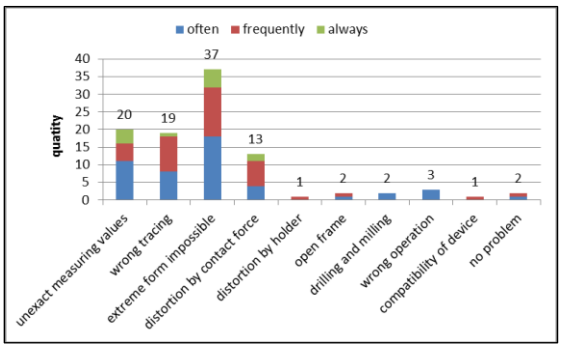

Fig. 5. Appraised incidence of problematic categories for measuring with tactile frame tracers

In the next step the optician were asked for their enhancement requires. A priority for the enhancement requires was given with the three steps very important, important and useful. This can be seen in Fig 6.

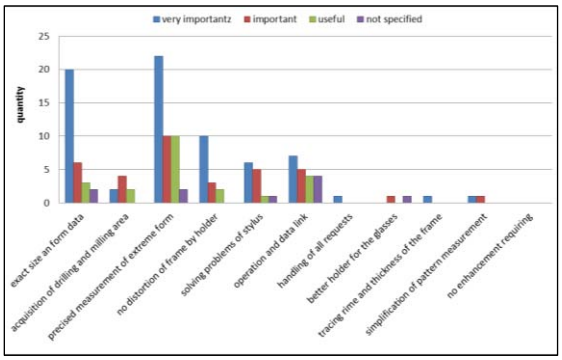

Fig. 6. Enhancement requires of the optician for measuring a spectacle frame

There were developed 10 categories of enhancement requires, which almost equal to the categories of measuring problems. The category no enhancement requiring was never chosen, because every user of tactile frame tracers does have problems with his device.

All dies facts should be the information basis for the development of a measuring system for a spectacle frame by image processing. This can be done on different ways, as presented in [5] and [6].

4. CONCLUSION

It is necessary to trace every groove of a spectacle frame for well grinding results. Nowadays this happens with tactile frame tracers. But this technique has got several disadvantages displayed in this paper. It is possible to trace the spectacle frames by optical measuring machines, if some boundaries are kept [5].

In summary there are a set of problematic categories of spectacle frames and weak spots of the tactile frame tracers. The problematic spectacle frames are:

- flat forms
- curved forms
- small forms
- sport spectacle frames
- design spectacle frames

The weak spots of the tactile frame tracers are:

- precised measurement of extreme form
- exact size an form data
- no distortion of frame by holder
- operation and data link
- abrasion and service of the tactile frame tracer

With the development of a new measuring procedure for spectacle frame tracing not only the developed demands and enhancement requires should be considered. Also the state of the art has to be reached with the new procedure.

Then the optical measuring will be an alternative to tactile tracers.

ACKNOWLEDGEMENT

This work is funded by the Federal Ministry of Economics and Technology within the framework of the InnoNET program.

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