IFA
Institut für Arbeitsschutz der
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Focus on IFA's work

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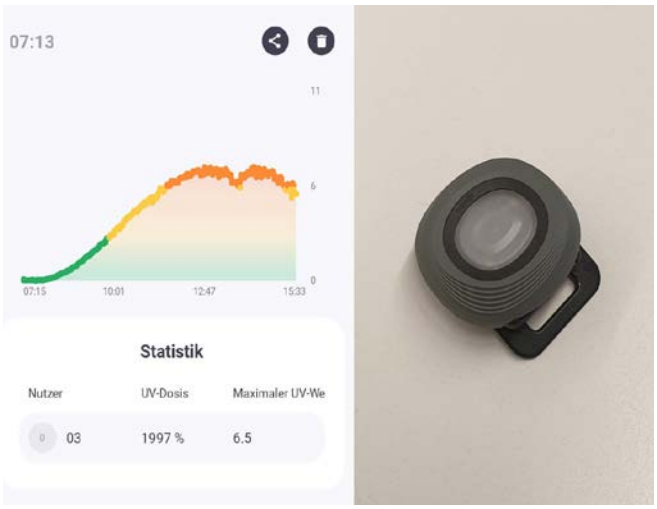
Wearable UV sensors for use during work performed outdoors

Problem

Persons working outdoors are exposed constantly to solar UV radiation. The effects of this radiation include sunburn and skin cancer. However, it is often difficult for workers to judge when their skin and eyes are being harmed by excessive UV radiation levels. Wearable UV sensors available on the consumer market can help to make this easier. These sensors are small devices, worn for example on the wrist or upper arm, which measure the incident UV radiation. They are connected to a smartphone, on which they output the measured values using an app. The personal skin type can also be set in the app. This yields a personal minimal erythema dose (MED) for each user, above which sunburn (erythema) can occur. The app issues a warning shortly before the MED is reached, enabling the person at risk to withdraw indoors or at least to a shady area if necessary. In the course of a project commissioned by the German Social Accident Insurance Institution for the building trade (BG BAU), one of these commercially available systems was tested for its suitability, in terms of measuring accuracy and reliability, for use in an occupational environment.



Left: Screenshot from the app showing measurement over the course of a day (in German). The UV dose is shown below the measurement curve, expressed as a percentage of the personal MED. (The skin type can be set in the app.)
Right: Wearable UV sensor tested

Activities

As part of the measurement project, a commercially available waerable UV sensor for private use was compared with a professional electronic dosimeter. The latter had already proved effective, including in IFA research projects. A solar tracking system was used to test the devices at different angles of radiation incidence. This enabled the incident solar radiation angles to be maintained constant for each day of measurement. This was important for testing of the devices' angular response. Ideally, this should take the form of a cosine curve; measurements conducted in the past with use of other dosimeter models have shown that this is not always the case, however. Measurement was performed at different angles, ranging from perpendicular incidence of the sun's rays to grazing incidence, on a total of seven measurement days. The sky was at times clear and at times cloudy during the measurements.

Results and use

The wearable UV sensors output the measured UV radiation in units of the UV index. The measured radiation indicated can be used to calculate the erythema-weighted

radiation (i.e. the radiation causing sunburn) in the usual unit of J/m², thereby permitting comparison with the other dosimeters used.

The individual dosimeters tested yielded very similar measurement results. Deviations from the values yielded by the IFA's own dosimeters were also only minor, in the order of up to 15 %. Deviation of this magnitude is perfectly adequate for the intended purpose of warning against excessive UV radiation.

However, the warning systems exhibited major reliability issues. The wearable UV sensors often failed to perform measurement, or problems arose with communication with the smartphone. Overall, it was not possible in over 50 % of cases to operate the devices properly and obtain a measurement.

Consequently, at the time of the project, the use of wearable UV sensors for the purposes of prevention in occupational scenarios could not be recommended. However, since the problems arising are probably primarily caused by the software, it is conceivable that the deficits described will be eliminated by modifications to the latter. Should this prove possible, wearable UV sensors could well constitute a significant means of raising awareness of the potential hazards of solar UV radiation in an occupational context.

User group

Accident insurance institutions, companies in which activities are performed outdoors

Technical enquiries

- IFA, Department "Ergonomics – Physical Environmental Factors "

Literature enquiries

- IFA, Department "Interdisciplinary Services"

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