Wearable LED Illumination for Skin Sensitivity Calibration

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A patch-test is a medical procedure in which UV light is administered onto a small patch of skin to calibrate skin sensitivity. Current patch testing methods involve covering the patient's entire body, exposing only the patch of skin to be tested; the patient would then be placed under UV light tubes for the test. To develop a convenient and energy saving patch testing method, we devised a Light Emitting Diode strap that can be worn over a specific patch of skin which requires testing. Our device greatly simplifies the test process, reduces energy consumption and frees up the treatment room in hospitals for other uses. In our prototype, glass beads were used to homogenize light incident on the skin because the patch test requires a uniform light intensity profile that commercial LEDs do not have. We drew inspiration for this from a cluster of water droplets on a window which causes the view outside to appear blurred. Compared to current homogenizing devices such as integrating sphere and lenslet arrays, glass beads are readily available, cheaper, and allow flexibility in design. Simulations were conducted on ZEMAX, a ray tracing software, to identify the design specifications which maximize light homogeneity. Optical and physical properties of the beads, and how the arrangement of the optical components would affect homogeneity of light, were studied. The optimal configuration was then tested using a 3D printed prototype. We measured the intensity across the diameter of its light patch and showed that there was a significant improvement in light homogeneity (64% decrease in CV) with the use of glass beads. Additionally, our patch testing method consumes 99% less power and is much cheaper and convenient for the patient than the existing patch testing method.

Awards Won: