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Smart curtains using 4D printing technology to protect people with Special needs due to temperature differences

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Abstract:

Climate change directly threatens the right to health of people with disabilities due to rising ambient temperatures and increased exposure to extreme weather events that include heat waves, floods, hurricanes, and forest fires. Extreme temperatures are associated with higher numbers of emergency room visits, hospitalizations, and deaths in individuals with mental health, cardiorespiratory, and other disabilities; Pre-existing psychosocial disabilities triple the risk of death during heatwaves. High ambient temperatures also negatively affect the health of individuals whose disabilities are affected by temperature sensitivity or thermoregulation.Hence the need to use 4D printing technology for shape memory polymers (SMPs). Printed structures are programmed to make shape changes in response to environmental factors to create intelligent, adaptable objects that can change their shape in response to environmental stimuli, such as heat. The development of reversible (two-way) 4D printing using strong materials to manufacture smart curtains that adjust their position in response to sunlight, allowing a new era of innovation and customization to suit the needs of end users, especially those with special needs.

Research problem: Thus, the research problem is summarized as follows: - Failure to adequately control the negative impact of high ambient temperatures on the health of individuals whose disabilities are affected by temperature sensitivity or thermoregulation. - Is it possible to find interactive solutions to protect people with special needs from sun damage in light of 4D printing technology?

Objectives: -Printing dynamic structures (smart curtains) with shapes, characteristics or functions that are adjustable to suit the health needs of people with disabilities due to high ambient temperatures. -Using 4D prints to achieve specific functions useful to humans, depending on their degree of adaptation to the surrounding environmental conditions (temperature, light...). -Finding innovative solutions that suit the requirements of people with special needs without the need for human intervention. -Completely eliminating the need for human intervention, which led to ease of use.

Importance: Helping people with special needs whose health is affected by any difference in temperature; Especially those with psychosocial disabilities, as the risk of death during heat waves triples compared to normal temperatures.

- The optimal use of smart materials to print products with mechanical properties suitable for their use, as this is considered an important indicator of the effectiveness of 4D printing in the functional performance assigned to it, which achieves better efficiency and greater suitability to meet the needs of consumers in society, which helps them in various areas of life.

Methodology:

The study follows the descriptive and analytical approach to the types of smart materials in general and 4D printing methods and how to use them positively in serving people with special needs whose health conditions are affected by the temperature differences surrounding them. The practical focus of the research follows a descriptive and analytical study of a group of proposed designs for the implementation and mechanical stages of the process of closing and opening the smart curtain by employing the use of smart materials with shape memory.

Results:

Some potential applications for 4D printed curtains include: 1. Curtains open and close automatically depending on temperature or light levels. 2. Curtains that change shape or pattern in response to heat. 3. Curtains can be easily compressed for storage and then expanded to their full size when needed. 4. The ability to program the curtain to change independently over time without the need for external mechanical parts, and the ability to compress the curtain to a much smaller size for storage or shipping. 5. The use of smart materials leads to simplification of movement, manufacturing, and exploitation of renewable energy. 6. The behavior of shape memory alloys (SMAs) can be utilized in applications in the field of renewable energy. 7. Taking advantage of 4D printing technology to serve people with special needs and help improve their health. 8. The mechanical strength of 4D printed materials and the speed of response to stimuli vary depending on the type of smart material used.

Keywords:

4D printing , smart materials, smart curtains , people with special needs

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