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Flexible Emergency Decontamination Shower For Laboratories (FLEX-ED)

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1. Product Description

FLEX-ED is an innovation designed to enhance the functionality and effectiveness of existing emergency shower and eyewash stations. Unlike conventional designs, FLEX-ED integrates advanced technological features and accessibility enhancements, ensuring greater usability for all individuals, including those with physical limitations. As depicted in Figure 1, the heightadjustable eyewash allow users to easily adjust the height of the device according to individual needs, within the range of 30 inches to 42 inches. This system is complemented by a flexible nozzle, which enables adjustment of the water flow distance to match the spacing between the user's eyes. In addition, the device incorporates an automatic sensor-activated water flow, which detects the user's presence and activates the water flow instantly without requiring physical contact. The system is further enhanced with an emergency shower station that integrates the easy-access valve innovation. designed with a large rotary valve positioned at an ergonomic height on the pipe pole, it ensures effortless operation and quick access for all users.

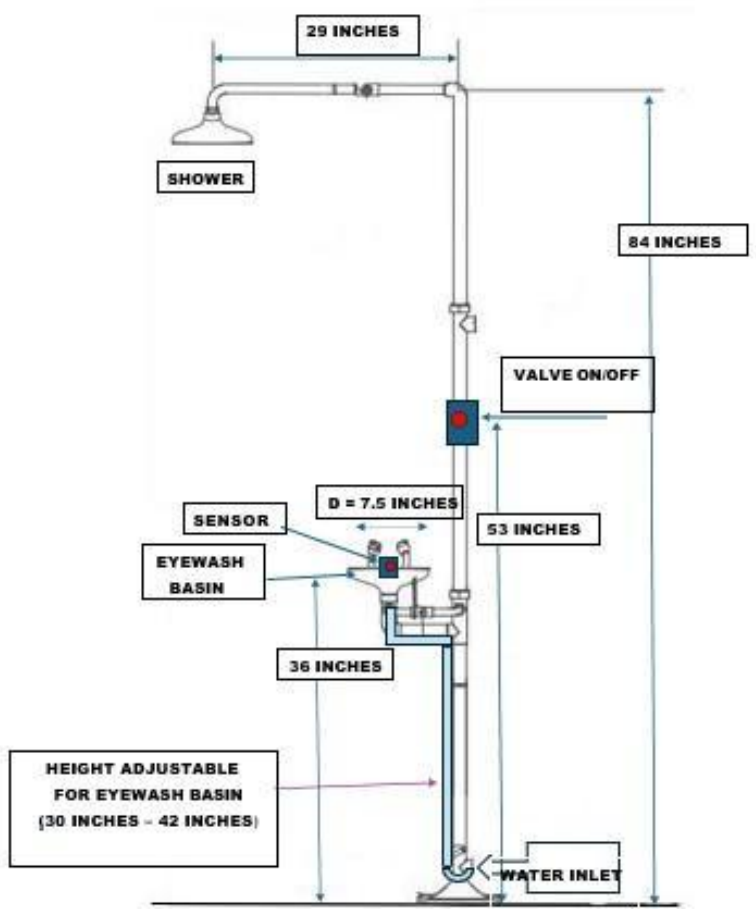

Figure 1: Schematic diagram of FLEX-ED

2. Innovation Objectives
   - To minimize the physical effort required for operation by incorporating adjustable height settings and sensor-based automatic activation.
   - To improve the efficiency of the tools by reducing response time, thus providing immediate support to laboratory users in emergency situations.

3. Problem Statement

Conventional emergency shower and eyewash station still rely heavily on manual operation and lack accessibility features, particularly for users with physical limitations or disabilities. Furthermore, existing designs have not adequately addressed energy efficiency or adaptability to diverse laboratory settings. This lack of inclusivity, combined with limited adaptability and poor energy efficiency, reduces their overall effectiveness. Additionally, research and development efforts aimed at enhancing the accessibility and functionality of these systems remain insufficient.

4. Authenticity / Novelty

The novelty of this research lies in the development of FLEX-ED, an adjustable, sensorassisted emergency shower and eyewash station that overcomes the limitations of conventional systems. In contrast to conventional designs that rely solely on manual operation, FLEX-ED integrates an adjustable height mechanism to accommodate users of varied heights, including individuals with disabilities or mobility challenges. Its sensor-based automatic activation, enables hands-free operation that ensures a faster and more efficient response during emergencies. In addition, the system also incorporates energy-efficient components to optimize water usage and reduce energy consumption. These combined features make the innovation safer, more inclusive, and environmentally conscious, distinguishing it from existing laboratory safety equipment. Thus, making FLEX-ED suitable for laboratories, factories, technical schools, and industrial sites.

5. Implementation Level

a) The limitations of conventional emergency shower and eyewash stations were examined, with particular emphasis on user-friendliness and accessibility for individuals with disabilities.

b) A more user-friendly design was created, consisting of two main components.

- The emergency shower valve was repositioned to an ergonomic height to improve accessibility and ease of operation.
- The eyewash station was equipped with a sensor system using a relay, IR sensor, pump, and power supply to allow automatic activation. In addition, an adjustable-height eyewash unit was developed with flexible nozzles to provide ergonomic alignment and greater comfort for diverse users.

c) The applied design modifications were thoroughly evaluated to verify their effectiveness, reliability, and user-friendliness.

d) Once the design proved successful, the system was made fully operational and prepared for deployment. In cases where the design did not meet the required functionality, further modifications were implemented and re-evaluated until satisfactory performance was achieved.

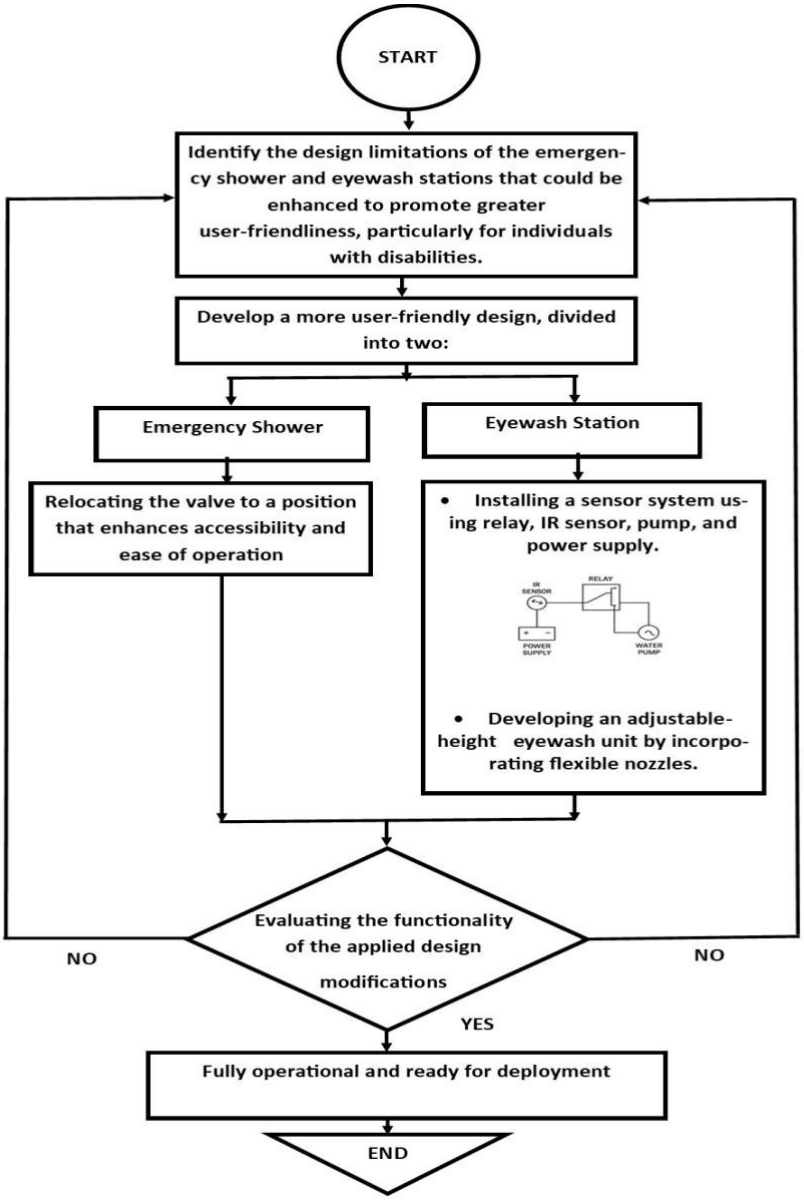

Figure 2: Implementation framework for FLEX-ED

6. Uses and Applications

The use of FLEX-ED is activated when emergency occurs, such as accidental chemical splashes to the eyes or body. In such a situation, the user immediately approaches the FLEXED station, which has been strategically positioned in the laboratory for easy access. For eyerelated emergencies, the eyewash basin is automatically activated through a sensor system that detects the user's presence. Water begins to flow instantly without requiring physical contact, minimizing delays and preventing the risk of contamination. Users can conveniently adjust the height of the eyewash basin (between 30 - 42 inches) and reposition the flexible nozzle to align

with their eye level, ensuring comfortable, effective and ergonomic rinsing process. As for body-related emergencies, the user can immediately activate the emergency shower by pulling down the easy-access rotary valve or lever located at an ergonomic height on the supporting pipe. This releases a strong water flow from the showerhead positioned above, allowing rapid and thorough decontamination of hazardous substances from the body. The decontamination process continues until the user is in a safe condition or medical assistance is provided. Once the user steps away or the valve is closed, the system automatically stops the water flow conserving resources while maintaining safety. Ultimately, FLEX-ED enhances workplace safety by providing fast, efficient, and accessible protection, effectively reducing the severity of injuries during critical incidents.

7. Innovation Product/Project Impact

FLEX-ED aligns closely with the United Nations Sustainable Development Goals (SDGs) by addressing critical aspects of health, sustainability, and innovation. In line with SDG 3 (Good Health and Well-Being), FLEX-ED prioritizes the protection of laboratory users by providing a reliable, rapid-response emergency system that minimizes risks of chemical exposure and ensures immediate decontamination during accidents. This proactive safety measure significantly enhances the well-being of individuals working in high-risk environments. Under SDG 9 (Industry, Innovation, and Infrastructure), FLEX-ED introduces a modernized, adaptable, and inclusive safety infrastructure designed to meet the diverse needs of laboratory users, including those with physical limitations. Its integration of innovative technologies, ergonomic features, and sensor-based automation represents a forward-looking approach that elevates laboratory safety standards while fostering a culture of continuous improvement and sustainable innovation. Through these efforts, FLEX-ED demonstrates its potential not only as an emergency safety solution but also as a model of responsible innovation that supports global sustainability agendas.

8. Achievements

The development of FLEX-ED has successfully achieved several key milestones that emphasize its novelty, functionality, and impact. Firstly, accessibility enhancements are designed into FLEX-ED with universal access in mind, making the device suitable for all users, including those with physical limitations or injuries. Secondly, technological advancement for the device incorporates advanced features such as height adjustability, flexible nozzle positioning, and automatic sensor activation, ensuring a faster, safer, and more ergonomic emergency response. Finally, in terms of product development, it is proven that FLEX-ED is a fully functional system, demonstrating the system's reliability, user-friendliness, and effectiveness in real laboratory settings.