

SMART REUSABLE PRESSURE-TEMPERATURE-MOISTURE MONITOR FOR PRESSURE ULCERS

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ABSTRACT

Pressure ulcers remain a significant health issue for individuals with limited mobility. Early detection and proactive management are crucial in preventing complications with patients and promoting better health outcomes. The current monitoring devices are not easily accessible to patients in home settings who rely on frequent repositioning. These preventive measures lowered the overall number of pressure ulcers being treated but have yet to make a significant impact on pressure ulcers worldwide. This project is to design-build-test a conceptual prototype. It consists of a wearable multisensor device attached onto a lightweight and biocompatible 3D-printed Thermoplastic Polyurethane (TPU) sensor housing that attaches onto a foam bandage to measure the sensor parameters. A homemade membrane capacitance pressure sensor detects pressure distribution across key contact points, while a temperature and humidity sensor monitor environmental conditions that contribute to skin breakdown. All sensors were interfaced with a microcontroller programmed to collect and transmit data when pressure, temperature, and moisture exceed safe levels. The combined bandage and sensor prototypes would potentially measure and relay data in real-time within clinically relevant thresholds. Online simulations and hands-on tests have shown that each sensor can measure their respective parameters to identify optimal conditions for pressure ulcer formation. The development of a 3D-printed foam bandage with attached, detachable, and reusable multisensor device marks a significant advancement in pressure ulcer prevention and monitoring. The goal of this project is to provide users with timely alerts, promoting proactive care and improving the overall quality of life.

Keywords: Pressure Ulcer, Pressure, Temperature, Moisture, Med IoT, Reusable Multisensor.

INTRODUCTION

Pressure ulcers, commonly known as bedsores or pressure injuries, are localized wounds that develop on the skin and underlying tissue due to prolonged pressure, friction, or shear. They typically form over bony areas such as the hips, heels, tailbone, and elbows, where sustained pressure restricts blood flow, leading to tissue damage and necrosis. Risk factors include immobility, poor nutrition, moisture, and medical conditions that affect blood circulation. If left untreated, pressure ulcers can lead to severe infections, delayed wound healing, and reduced quality of life [1]. Pressure ulcers, commonly affecting individuals with limited mobility, remain a major health concern globally. Treating pressure ulcers is expensive, with an average hospital stay costing $37,800 [2]. Additionally, a Healthgrades study analyzing data from approximately 5,000 hospitals between 2003 and 2005 identified pressure ulcers as one of the most common patient safety issues [2]. Early detection and timely management are essential to prevent complications, improve patient outcomes, and reduce the burden on healthcare systems. Peer-reviewed studies show that current preventive strategies involve caregivers repositioning patients every two to three hours to alleviate pressure on vulnerable areas. While this approach has contributed to a decline in pressure ulcer cases, its global impact remains limited, especially for patients in home care settings who lack access to advanced monitoring technologies [1].