

Utilization and Benefits of Smart Textiles on Security Challenges in Niger State

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Abstract

The study investigated the utilization and benefits of Smart Textiles on security challenges in Niger State. There is a significant knowledge gap in the utilization of smart textiles on security in the Nigerian context. Three research questions were raised to; investigate the benefits of smart-textiles used by service men in Niger state, assess the utilization of smart textiles used by service men in Niger state and examine security challenges in Niger state. The research adopted descriptive survey research design. Purposive sampling techniques was used to collect data from: Army, Police, Air force, Civil Defense, Man O War (Two selected local Government) with the total population of 301. Data collected were statistically analyzed using descriptive statistics such as: frequency counts, percentage, mean, and standard deviation. The results from the findings shows that the benefits of smart textile as perceived by the respondents include: improvement in Security system, comfortability, temperature control, safety and protection, and monitoring of vital signs with grand mean score 4.0. Smart textiles are used for Health Monitoring, Life jacket, Smart bra, in Military safety and as for Sportswear with grand mean score 3.80. The security challenges include the following; Insurgency, Banditry, Kidnapping, and Boko Haram with grand mean score 4.20. This study concluded that benefits of smart textile to servicemen in Niger State include: improvement in Security system, comfortability, temperature control, safety and protection, and monitoring of vital signs of insecurity. The recommendation are to create more awareness on benefits of smart textile. Training and workshop should be organized on the usage of smart textiles. Service men should be encouraged to use them for their protections and that of the citizen.

Keywords: Smart Textiles, Security, Stimuli-Responsive, Thermal Management, Flexibility

Introduction

Textiles are essential part of human life for thousands of years. In the earlier ages, humans used textiles majorly as clothing for protection, but the use of textile has steadily expanded. Humans now wear clothes at all times and are surrounded by textiles of various kinds in virtually all our environments. The incorporation of multifunctional values in such a common material has become an important field of interest in recent years. Fabrics, fibers yarns and many other

materials which have added functionalities have been developed for a range of applications. Textile materials and their manufacturing techniques has become an important avenue for high-tech innovations in which smart fabrics emerged. Smart Textiles are fabrics that have woven electronics and interconnections, resulting in physical flexibility that is not achievable with other known electronic manufacturing techniques.

Smart Fabrics have their sources in different research disciplines such as chemistry, computer science and engineering, textile design and technology, material science, physics. Smart Textiles refers to a wide field of studies and products that displays the functionality and usefulness of regular fabrics. According to Junior, Neves, Monticeli and Dall- Aqno (2022) stated that textile products are able to interact with the environment and are made from fibers and filaments which the yarns are spun together, can be knitted, woven or non-woven structures

Niu, Qi, Shuaib and Yuan, (2022), asserts the concept of intelligent or smart materials respond to environmental changes at the most optimum conditions and manifest their own functions according to the changes. Floris, Adam, Calderon, and Sales, (2021), also added that the growing advances in science allow for more sophisticated technologies to be developed and inserted in even more complex systems in different discipline such as cloth manufacturing.

Terms have been used for similar textile products, such as smart textiles, smart fabrics, smart clothing, smart garments, as well as functional textiles, functional clothing, intelligent textiles, interactive textiles. Smart textiles or functional textiles are demarcated as textile constituents that are capable of changing their characteristic behavior with response to the inspiration of peripheral features or technical stimuli from the surrounding environment (Tadesse, Loghin, & Dulger 2021). Meena, Choi, Jung and Kim (2022) explained that smart textiles are fabrics derived from intelligent or responsive materials that sense stimuli and enable information transmission. However, most authors agreed that smart textiles can sense the environment (sensing function), act upon it (actuating function), and adapt their behavior

accordingly (adaptive function) (Niu, Qi, Shuaib, & Yuan, 2022, Meena, Choi, Jung & Kim, 2022, Tadesse, Loghin, & Dulger 2021) and that these have evolved from simpler to more complex over the three generations as stated: The first generation of smart textiles are referred to as passive smart textiles, with a sensing function only – their materials perceive external stimuli; The second generation is called active smart textiles, with an actuating function – they sense a stimulus from the environment and respond to it and the third generation is called advanced, very smart, or ultra-smart textiles – they perceive, respond, and adapt to changes in the environment.

Smart textiles enable specific functions and applications, such as in clothing and/or technical textiles (thermal insulation, barrier properties, signal sensing, monitoring, displaying, energy generation, energy storage, responsive actuating, leak detection, self-repairing, self-cleaning, treatment), security (identification, monitoring, data processing, localization), and decoration (changes in color, luminance, transparency, morphology, shape; light emission).

Terrorism, insurgency, kidnapping, militancy, cattle rustling, pastoralist-farmers conflicts are security challenges characteristic of the Nigeria's return to democratic governance in 1999 and have continue to threaten the corporate existence of the country. The management of these challenges over the years have not yielded adequate positive results regardless of the huge resources annually allocated to defense and security. It is surprising that immediately the country got transited to civilian or democratic rule in 1999, it is widely observed that the political space got more broadened, giving room for various violent agitations, putting more pressure on the Nigerian military. In the South-South region, there

are militants' agitations and ritual killings; in South East, there exists Biafran agitations for secession and call for a sovereign state, North East, there is armed banditry, Boko Haram terrorism in the North East and kidnapping has remained a "huge and lucrative business" in all parts of the country (Abiodun, Oploki, Adeyemi & Obi 2020).

As these security issues persist, it becomes increasingly important to explore innovative solutions. The integration of smart textiles into the realm of security holds great potential to mitigate some of these challenges. It is on this premise that the study is based on.

Statement of the Problem

One of the basic needs of man is safety and security unfortunately, Niger State faces numerous security challenges, including but not limited to insurgency, banditry and communal conflicts. Various security measures engaged to curb this challenge the problem still persists. The security situation in Niger State poses a matter of great concern, despite various efforts to address these challenges the utilization of smart textiles in the security domain remains largely unexplored, and there is a lack of knowledge regarding their potential impact.

Objectives of the Study

The main objective of this research is to examine the effects of smart textiles on security challenges among service men in selected Local Government Area of Niger State. To achieve this research, the specific objectives are to:

1. Investigate the kinds of smart textiles used by service men in Niger State
2. Examine the security challenges faced by the service men in Niger State.

3. Assess the benefits of smart-textiles used by service men in Niger State

Methodology

Research Design

The research design adopted for this study was descriptive survey research Design. The study is to assess smart textiles on security challenges in Niger State; thus, Survey method was considered as most appropriate for the study.

Area of Study

This study was carried out in Niger State, located in Nigeria. Large-scale farming and animal husbandry have been acknowledged to be the main economic activities in the Northwest, with trading as an alternative source of income. Most farmers cultivate yams in Niger state, beans, millet, tomatoes, and rice are also common food products (Council on Foreign Relations, 2020).

Population of Study

The Population given from offices of the service men was three hundred and fourth-nine (349) in Borgu and Mokwa Local Government Area, consisting the following Categories of service men and their Populations respectively in Borgu Local Government Area. Army (80), Police (100), Air force (20), Civil Defense Corps (39), Man O' War (40), while Mokwa Local Government Area consist of the Police (60), Civil Defense Corps (10). All the 349 questionnaires were administered to service men but 301 was retrieved.

Sample and Sampling Techniques

Random sampling method was used. The Sample size of the service men includes; Army 78 (25.9%), Police 119 (39.5%), Civil Defense 48 (15.9%), Air Force 20 (6.6%) and Man O' war 36 (11.9%)

Data Analysis Techniques

Data collected was statistically analyzed using descriptive statistics such as mean and ranking.

Results

Table 1 shows mean score and ranking of respondent's kinds of smart textile utilized. Here, the "Mean" values offer insights into which uses resonated most with the participants. The table revealed that "Smart textiles are used for Health Monitoring" takes the top spot with the highest mean (4.15), signifying its

perceived importance. Following closely are applications crucial for potentially dangerous situations "Life jacket" ($\bar{x} = 4.13$) and "Military" (4.12). These findings showcase a clear focus on safeguarding health and ensuring safety. The table reveals further applications which are sportswear with a mean of 3.99, indicates that smart textiles are being integrated into athletic wear to potentially enhance performance. Fashion had a mean of 3.85 for "Smart textiles are used for Fashion."

Table 1: Mean Scores and Ranking of Respondent's Kinds of Smart Textiles Utilized

SN	Statement	$\bar{x}$	Rank
1	Health Monitoring	4.15	1 st
2	Life jacket	4.13	2 nd
3	Military safety	4.12	3 rd
4	Sportswear	3.99	4 th
5	Defense	3.95	5 th
6	Fashion	3.85	6 th
7	Life belt	3.75	7 th
8	Smart bra	3.65	8 th
9	Diagnostics Segment	3.56	9 th
10	Interactivity	3.55	10 th
11	Personal wears	3.53	11 th
12	Integrators	3.48	12 th
13	Entertainers	3.49	13 th
14	Sensory baby vest	3.45	14 th
	Grand mean score	3.80	

Table 2 shows mean scores and the ranking of the security challenges confronted by the respondents. Kidnapping with the highest mean (4.47) emerges as the most frequent security challenge according to the service men. Following closely behind is "Banditry" ($\bar{x} = 4.43$), highlighting its prevalence as

a security threat. Insurgency (4.41) also ranks high, indicating it's a major security concern for service men. The table reveals other significant security challenges faced by service men, though with slightly lower mean scores: Boko Haram (4.42): Gun Men Attacks (4.35): and Armed Robbery (4.36).

Table 2: Mean Ranking of Respondent's Security Challenges

Sn	Items	$\bar{x}$	Rank
1	Kidnapping	4.47	1 st
2	Banditry	4.43	2 nd
3	Boko Haram	4.42	3 rd
4	Terrorism	4.42	3 rd
5	Insurgency	4.41	5 th
6	Armed robbery	4.36	6 th
7	Gun Men attack	4.35	7 th
8	Tracking Yahoo boys	4.20	8 th
9	Communal conflicts	4.17	9 th
10	Clashes between herders and farmer	4.17	9 th
11	Tribal conflict	4.07	11 th
12	Ritualist	4.04	12 th
13	Jihadism	3.91	13 th
14	Hired assassins	3.80	14 th
Grand mean score		4.20	

The data presented in table 3 presents the mean scores and ranking on the benefits of smart textiles to Service men. "Improved Security System" tops the list with the highest mean (4.36) and ranked (1), highlighting its importance for service men. Following closely behind is "Safety and Protection" (ranked 2 with a mean of 4.29). These findings suggest that smart textiles that enhance security and safeguard service men are seen as highly beneficial. Beyond security, staying

comfortable is crucial. "Use of smart textiles makes service men Comfortable" (mean 4.16, Ranked 5) showcases this. Similarly, "Use of smart textiles helps to Control temperature" (mean 4.17, Ranked 4) emphasizes the value of regulating temperature for service men in various environments. The table reveals other potential benefits, though ranked slightly lower. Keeping an eye on vital signs with "Use of smart textiles has the ability to monitor vital signs (mean 4.18, ranked 3).

Table 3: Mean Score and Ranking of Respondents on Benefits of Smart Textiles Used By Service Men

Sn	Statement	$\bar{x}$	Rank
1	Textiles Improves the Security system of service men	4.36	1 st
2	Aids Safety and protection	4.29	2 nd
3	Has the ability to monitor vital signs	4.18	3 rd
4	Use of smart textiles helps to Control temperature	4.17	4 th
5	Comfortable	4.16	5 th
6	Digital transformation	4.10	6 th
7	Helps in Health monitoring	4.10	6 th
8	Mental wellbeing of the wearer	4.09	8 th
9	Fashion in Digital economy	3.98	10 th
10	Therapeutic application	3.79	11 th
11	Aids beauty	3.74	12 th
12	Resist Water	3.54	13 th
13	Dangerous to health	3.32	14 th
Grand mean score		4.00	

Discussion

This study revealed that the benefits of smart textile as perceived by servicemen in Niger State include: improvement in Security system, comfortability, temperature control, safety and protection, and monitoring of vital signs. This finding agreed with the finding of (Niu, Qi, Shuaib & Yuan 2022) that says Smart textiles are redefining the health and wellness sectors. These enhanced fabrics, designed to do more than meet the eye, are opening new avenues for monitoring, therapy, protection, and mental well-being. This study unveiled that the security challenges associated with service men encompass Insurgency, Banditry, Kidnapping, and the presence of Boko Haram. These findings are in line with the conclusions drawn by Muhammed (2020) which says Farmers have been kidnapped for ransom, while bandits in Shiroro LGA have demanded payments of up to \$1,100 before farmers can access their farmlands. Also, Orjinmo, (2020), affirms that Bandits have warned farmers to stay away from their farms and about 26 farmers who ignored this order were killed in Batsari Local Government Area of Katsina state. The wave, dynamics and sophistication of security crisis have led to very serious social consequences particularly on the economy, similarly, commercial activities have become skeletal and paralyzed in the areas worst hit by these security challenges (Obarisiagbon, et al., 2019).

This study established that smart textiles are applied in Health Monitoring, Life jacket, as Smart bra, in Military and as for Sportswear. This finding corroborates the finding of Niu, *et al* (2022) that says major sectors of smart textiles applications include military and security, aerospace, environmental engineering, industrial protective clothing, biomedical and healthcare, cosmetics, sports and fitness, vehicle

safety and comfort, fashion and entertainment, computing and electronics, buildings and interiors, and others Giglio *et al.*, (2022) added that another example of this is textile fabrics that release medication or moisturizer into the skin. Product applications also extend from the field of life clothing to the medical and health, ecology and environmental protection, military, and aerospace fields.

Conclusion and Recommendation

This study concludes that service men are facing a lot of security challenges in Niger State. The service men are not expose to the kinds of smart textiles which affect the utilization and their knowledge of it benefits such as smart textile to servicemen in Niger State which include: improvement in Security system, comfortability, temperature control, safety and protection, and monitoring of vital signs. Smart textiles are applied in Health Monitoring, Life jacket, as Smart bra, in Military safety and as for Sportswear. Servicemen face security challenges which include Insurgency, Banditry, Kidnapping, and Boko Haram.

Based on the findings from this study, the study recommended that:

1. More awareness on the benefits and utilizations of smart textiles should be encouraged by the Government for their protections and that of the citizens.
2. Government should make smart textiles available for the service men and they should be trained on the utilization
3. Nigeria government should sustain the military efforts in prosecuting the war against banditry as well as equip the security forces with both types of modern equipment like smart textiles and necessary incentives to enable them carry out their duty without hindrances

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