

(U) Request for Information for
Smart Electrically Powered and Networked Textile Systems
(SMART e-PANTS)

Request for Information: Smart Electrically Powered and Networked Textile Systems (SMART e-PANTS)

RFI Number: IARPA-RFI-22-03

Agency: Office of the Director of National Intelligence

Office: Intelligence Advanced Research Projects Activity

IARPA-RFI-22-03

Synopsis:

The Intelligence Advanced Research Projects Activity (IARPA) seeks information regarding innovative approaches to enhance the performance of Advanced Smart Textile (AST) systems with an emphasis on individual component integration.

The military, first responders (police/firefighters/emergency medical technicians (EMTs)) and professional athletes alike desire electronics that can help keep people safe by sensing, processing and communicating information on individuals' location and physical surroundings (audio and video recording). Integration of these capabilities into textiles for greater capability, comfort and convenience has long been envisioned, free of uncomfortable, bulky, rigid devices strapped to their bodies. However, consumers perceive little advantage in integrated textile-based systems over the smartphones or other rigid wearable electronics they already carry.

Active smart textile (ASTs) research is a burgeoning new field where fabrics are designed to adapt and change their functionality in response to changes in their external environment or user input. Unlike passive smart textiles (PST) such as Gore-Tex™ which rely on their physical structure to function, ASTs employ energy to power built-in sensors and/or actuators that sense, store, interpret or react to information from their environment.¹

Background & Scope:

New enabling research to transfer many of the capabilities of rigid wearable electronics into ASTs has surfaced, including weavable, conductive polymer “wires”,² energy harvesters powered by the body,³ computers and other electronic components that are printable on cloth and that run on nanoamps of power,^{4,5} microphones that behave like threads⁶ and “scrunchable” batteries

that can function after multiple deformations.⁷ To transfer this research into AST products however, revolutionary new materials and manufacturing techniques are needed to develop textile-friendly system components that resemble garments rather than rigid structures.

This RFI seeks innovative approaches to improve the effective performance limits of AST integrated systems and their components. In order to be considered responsive, the proposed technologies must perform the intended purpose of the component or system described by the list below, and must also be flexible and stretchable enough to incorporate into garments with no significant change in comfort, style or performance of the clothing article (i.e., no visually evident rigid components). ASTs capable of performing one or more of the listed component requirements that do not use electricity are also of interest.

AST Components of Interest

1. **Sensors:** Audio, video, and geolocation. (State of health and molecular sensors are not considered responsive);
2. **Power Sources:** Possible technologies include, but are not limited to, batteries, supercapacitors, and thermal, kinetic or chemical energy harvesters that use their surroundings (such as body heat or excretion) as an energy source;
3. **Computation and Data Storage:** Microprocessors, I/O buses and data storage devices;
4. **Data Transfer:** Systems capable of transferring data from an AST to a storage or computation device. Data transfer systems do not need to be bendable or stretchable, so long as they are not meant to be physically incorporated into the AST;
5. **Wires and Interconnects:** Electrically conductive materials that enable connection between AST components in a system; and
6. **Haptics:** On/off or intensity regulation devices (i.e. switches or dials) that indicate device status to the wearer by changing shape, size, vibration, or producing some other discernable user response.

Responses are of particular interest where the components described have been successfully incorporated into textiles, where components have been integrated into an entire AST system (i.e. includes one or more sensors connected to data computation and an energy source required for operation), and/or is proven to be flexible, stretchable or washable by some independent testing criteria. Technologies capable of function for any time period are of interest, but longer periods are preferred. Desired operating times range from ten minutes to eight hours.

Preparation Instructions to Respondents:

IARPA requests that respondents submit ideas related to this topic for use by the Government in formulating a potential program. IARPA requests that submittals briefly and clearly describe the potential approach or concept, outline critical technical issues/obstacles, describe how the approach may address those issues/obstacles and comment on the expected performance and robustness of the proposed approach. If appropriate, respondents may also choose to provide a non-proprietary rough order of magnitude (ROM) estimate regarding what such approaches might require in terms of funding and other resources for one to four years. This announcement contains all of the information required to submit a response. No additional forms, kits, or other materials are needed. IARPA welcomes responses from all capable and qualified sources from within and outside of the U.S.

Because IARPA is interested in an integrated approach, responses from teams with complementary areas of expertise are encouraged.

Responses must meet the following formatting requirements:

1. A one page cover sheet that identifies the title, organization(s), respondent's technical and administrative points of contact - including names, addresses, phone numbers, informational websites (if available) and email addresses of all co-authors, and clearly indicating its association with RFI-22-03;
2. A substantive, focused, one-half page executive summary specifying the AST components of interest described within;
3. A description (limited to 5 pages in minimum 12 point Times New Roman font, appropriate for single-sided, single-spaced 8.5 by 11 inch paper, with 1-inch margins) of the technical challenges and suggested approach(es);
4. A list of citations (any significant claims or reports of success must be accompanied by citations);
5. A single quad-chart depicting the approach, key ideas, and impact.

Submission Instructions to Respondents:

Responses to this RFI are due no later than **5:00 p.m., Eastern Time, 31 January 2022**. There is no limit to the number of submissions from individual respondents, although each response should describe its specified technology as a standalone document. All submissions must be electronically submitted to dni-iarpa-rfi-22-03@iarpa.gov as a PDF document. Inquiries to this RFI must be submitted to dni-iarpa-rfi-22-03@iarpa.gov no later than 5:00 p.m., Eastern Time, 31 January 2022. Do not send questions with proprietary content. No telephone inquiries will be accepted.

Disclaimers and Important Notes:

This is an RFI issued solely for information and planning purposes and does not constitute a solicitation. Respondents are advised that IARPA is under no obligation to acknowledge receipt or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. Respondents are solely responsible for all expenses associated with responding to this RFI. IARPA will not provide reimbursement for costs incurred in responding to this RFI. It is the respondent's responsibility to ensure that the submitted material has been approved for public release by the information owner. The Government does not intend to award a contract on the basis of this RFI or to otherwise pay for the information solicited, nor is the Government obligated to issue a solicitation based on responses received. **No proprietary and no classified concepts or information shall be included in the submittal.** However, should a respondent wish to submit classified concepts or information, prior coordination **must** be made with IARPA Security. Email the Primary Point of Contact with a request for coordination with IARPA Security. Input on technical aspects of the responses may be solicited by IARPA from non-Government consultants/experts who are bound by appropriate non-disclosure requirements.

Contracting Office Address:

Office of the Director of National Intelligence, Intelligence Advanced Research Projects Activity, Washington, District of Columbia 20511, United States

Primary Point of Contact:

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¹ The definition employed for active versus passive smart textiles may be found on the Loomia website: <https://www.loomia.com/blog/passive-vs-active-smart-textiles> (accessed July 17, 2021).

² Loke, G.; Yan, W.; Khudiyev, T.; Noel, G.; Fink, Y. Recent Progress and Perspectives of Thermally Drawn Multimaterial Fiber Electronics. *Adv. Mater.* 2020, 32 (1), 1904911. <https://doi.org/10.1002/adma.201904911>.

³ Myers, A.; Hodges, R.; Jur, J. S. Human and Environment Influences on Thermoelectric Energy Harvesting Toward Self-Powered Textile-Integrated Wearable Devices. *MRS Adv.* 2016, 1 (38), 2665–2670. <https://doi.org/10.1557/adv.2016.316>.

⁴ Misra, V.; Bozkurt, A.; Calhoun, B. H.; Datta, S.; Dickey, M.; Kiani, M.; Lach, J.; Lee, B.; Jur, J.; Oralkan, O.; Ozturk, M.; Rajagopalan, R.; Roundy, S.; Strohmaier, J.; Trolier-McKinstry, S.; Vashaee, D.; Wentzloff, D.; Werner, D. Optimizing the Energy Balance to Achieve Autonomous Self-Powering for Vigilant Health and IoT Applications. *J. Phys. Conf. Ser.* 2019, 1407, 012001. <https://doi.org/10.1088/1742-6596/1407/1/012001>.

⁵ Loke, G.; Alain, J.; Yan, W.; Khudiyev, T.; Noel, G.; Yuan, R.; Missakian, A.; Fink, Y. Computing Fabrics. *Matter* 2020, 2 (4), 786–788. <https://doi.org/10.1016/j.matt.2020.03.007>.

⁶ Chocat, N.; Lestoquoy, G.; Wang, Z.; Rodgers, D. M.; Joannopoulos, J. D.; Fink, Y. Piezoelectric Fibers for Conformal Acoustics. *Adv. Mater.* 2012, 24 (39), 5327–5332. <https://doi.org/10.1002/adma.201201355>.

⁷ Fu, W.; Turcheniuk, K.; Naumov, O.; Mysyk, R.; Wang, F.; Liu, M.; Kim, D.; Ren, X.; Magasinski, A.; Yu, M.; Feng, X.; Wang, Z. L.; Yushin, G. Materials and Technologies for Multifunctional, Flexible or Integrated Supercapacitors and Batteries. *Mater. Today* 2021. <https://doi.org/10.1016/j.mattod.2021.01.026>.