

## **IARPA RFI 15-01: Future Applications of Sensing Technologies for Fidelitous Wearable Devices (FAST FWD)**

The Intelligence Advanced Research Projects Activity (IARPA) is seeking information on the future capabilities of wearable devices for direct and persistent sensing of an individual and their local social and physical environment. Of specific interest are potential advancements in sensing capabilities that enable accurate, continuous measurement with devices that are relatively imperceptible to the user and seamlessly integrated with their daily activities. This request for information (RFI) is issued solely for information gathering and planning purposes; this RFI does not constitute a formal solicitation for proposals and may be used in planning a workshop, if deemed appropriate. The following sections of this RFI define the overall scope of the technical domain of interest, along with instructions for the preparation and submission of responses.

### **Background & Scope**

The growing capabilities of consumer electronics have enabled wearable devices<sup>i</sup> that provide new opportunities for understanding and predicting human health, performance, and behavior. Exemplified by communities like the “quantified self” movement,<sup>ii</sup> this expanded consumer market has led to an increased appreciation for the potential value in using wearable devices to enable direct and persistent sensing of individuals and their social and physical environment. Accordingly, the most popular applications today are fitness and other lifestyle trackers<sup>iii</sup> with other wearable devices being used in, or being developed for, the workplace, entertainment, education, public safety, as well as the healthcare and medical sectors. Further, these trends in both market growth and diversification are projected to continue as wearable devices advance technologically and become more integrated within our lives.<sup>iv</sup>

Recent trends in the development of sensing capabilities for commercial wearables has been largely evolutionary with many new devices incorporating added features and new design, but still relying on accelerometers, gyroscopes, and GPS to infer activity based on movement. Despite this relatively narrow focus, ongoing research suggests there are many more signals and features to be captured and extracted by sensors that can be easily and comfortably worn throughout the day.<sup>v</sup> However, in all cases there are concerns about the accuracy of existing sensors and the actions and behaviors they purport to measure,<sup>vi</sup> which only serve to highlight the relatively small - but growing - body of research and researchers actively examining signal fidelity across a range of activities and conditions. By developing these pockets of promising research and development into valid, accurate sensing capabilities, the benefits of novel wearable devices are potentially far-reaching for a variety of personal, professional, and scientific uses. Rapid development of this pipeline may yield innovative, and potentially disruptive, sensing capabilities for future wearable devices.

Accordingly, IARPA is soliciting responses to this RFI to better characterize sensing capabilities of wearable devices that go beyond current prototypes in development and extend up to 10 years in the future as computing, power, materials, processing, communications and design advance and converge to enable devices capable of persistent sensing with high fidelity. **This RFI seeks information regarding the future form of wearable devices and innovative ideas about significant advances in sensing capabilities that can be used to leverage the wearer of such devices – the human - as a sensor of their own biology and behavior, of those around them, and of their real world environment.** IARPA is not seeking technology development concepts, but rather what sensing capabilities will be possible with future wearable devices embedded within our daily lives.

Responses to this RFI should discuss the five following aspects of future wearable sensors and their local or remote set of applications. Responses should address all five points.

1. **What is the form and fit of the proposed wearable sensor(s)?** Respondents should assume that computing, communication, and battery technology will advance at historical rates, enabling a device with the following characteristics:
  - a. Persistent battery life, processing power, and transmitter functionality and speed that enables continuous sampling and near real-time feedback to the user;
  - b. Comfortable enough to be imperceptible to the wearer throughout waking hours and during sleep;
  - c. Ergonomic design and size that does not obstruct normal movement, circulation, respiration, ingestion, digestion, neural function, social dynamics, or other activities and processes;
  - d. Space for single or multiple sensors; and,
  - e. Durability and robust to some environmental conditions (e.g., temperature, moisture) and large impacts or forces.

\*\*Respondents that believe some or all of these assumptions will not hold true should specify theoretical, empirical, and practical reasons why they will not hold and provide a response that is consistent with their alternative assumptions.

2. **What signatures will the sensor(s) measure?** Responses should describe the function of the proposed new or advanced sensor(s), to include what signals and specific features will be measured, how these will be captured, and other specifications, as necessary.
3. **What is the purpose of measuring the proposed signatures?** This should include the broad areas of application, as well as specific behaviors or states of the individual wearer, others that might be in their social and physical environment, as well as the actual environment around them. Also, what is the benefit of using a wearable sensor that is not afforded by more standard or traditional methods used to measure the proposed signatures for the general and specific applications proposed?
4. **How would testing and validation be conducted?** Consider the methods, environments, control conditions or “gold standard” techniques necessary to establish the accuracy of the proposed sensing capability for the specific application described in the response.
5. **What are the theoretical and/or practical limitations?** Responses may discuss limitations in the context of what sensors can be worn, the signatures they are designed to measure, specific applications, and/or testing and validation.

**Please note that IARPA is not seeking responses that provide new or alternative power sources, novel chip design, processing and storage improvements, or advances in transmitters or communication capabilities.**

#### **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) regarding what such approaches might require in terms of funding and other resources for one or more years. This announcement contains all of the information required to submit a response. No additional forms, kits, or other materials are needed.

IARPA appreciates responses from all capable and qualified sources from within and outside of the US. Because IARPA is interested in an integrated approach, responses from teams with complementary areas of expertise are encouraged.

Responses have 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 and fax numbers, and email addresses of all co-authors, and clearly indicating its association with RFI-15-01;
2. A substantive, focused, one-half page executive summary;
3. Responses to the five questions (limited to 6 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);
4. A list of citations (any significant claims or reports of success must be accompanied by citations, and reference material MUST be attached);
5. Optionally, a single overview briefing chart graphically depicting the key ideas.

### **Submission Instructions to Respondents**

Responses to this RFI are due no later than 4:00pm, Local Time, College Park, MD on Friday, January 16, 2015. All submissions must be electronically submitted to [dni-iarpa-rfi-15-01@iarpa.gov](mailto:dni-iarpa-rfi-15-01@iarpa.gov) as a PDF document. Inquiries to this RFI must be submitted to [dni-iarpa-rfi-15-01@iarpa.gov](mailto:dni-iarpa-rfi-15-01@iarpa.gov). 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 of the information received, or provide feedback to respondents with respect to any information submitted under this RFI.

The responses to this RFI may be used to help in the identification of promising areas for investment through vehicles such as programs or small studies, as well as in the planning of an agenda and participant list for a potential workshop on future capabilities for wearable devices in sensing the self, the social, or physical environment. If appropriate, a separate workshop announcement may be posted at a later date with additional details.

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. Neither proprietary nor classified concepts or information should be included in the submittal. 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.

### **For information contact:**

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<sup>i</sup> **Wearable** – being worn for an extended period of time, with the user experience significantly enhanced as a result (IHS Electronics and Media, 2013)

<sup>ii</sup> <http://quantifiedself.com>; [http://archive.wired.com/medtech/health/magazine/17-07/lbnp\\_knowthyself?currentPage=all](http://archive.wired.com/medtech/health/magazine/17-07/lbnp_knowthyself?currentPage=all); <http://www.armedforcesjournal.com/the-quantified-warrior/>

<sup>iii</sup> <http://www.vandrico.com/database>

<sup>iv</sup> <https://www.abiresearch.com/analyst-insider/archive/56/>; <http://www.idc.com/getdoc.jsp?containerId=247318>;

IHS Electronics and Media, 2013; <http://dl.acm.org/citation.cfm?id=1886195>

<sup>v</sup> <http://www.technologyreview.com/news/530011/an-air-quality-monitor-you-take-with-you/>;

[http://www.darpa.mil/Our\\_Work/BTO/Programs/Systems-Based\\_Neurotechnology\\_for\\_Emerging\\_Therapies\\_SUBNETS.aspx](http://www.darpa.mil/Our_Work/BTO/Programs/Systems-Based_Neurotechnology_for_Emerging_Therapies_SUBNETS.aspx);

<http://www.bostonglobe.com/sports/2014/05/24/sports-wearables-are-wave-future/4gwNDNBxPCEkD4h9yYf8K/story.html>; <http://www.newscientist.com/article/mg22229634.300-clothes-with-hidden-sensors-act-as-an-alwayson-doctor.html>; <http://www.technologyreview.com/news/530166/a-new-chip-could-add-motion-sensing-to-clothing/>; <http://www.nano-tera.ch/projects/369.php>;

<http://www.cnn.com/2014/04/16/opinion/saffo-google-glass/>; <http://www.proteus.com/proteus-digital-health-announces-fda-clearance-of-ingestible-sensor/>

<sup>vi</sup> <http://www.ncbi.nlm.nih.gov/pubmed/21971963>; <http://www.ncbi.nlm.nih.gov/pubmed/22157772>;

[http://www.huffingtonpost.com/dr-christopher-winter/sleep-tips\\_b\\_4792760.html](http://www.huffingtonpost.com/dr-christopher-winter/sleep-tips_b_4792760.html);

<http://www.insideactivitytracking.com/tracking-accurately-how-is-it-done-why-is-it-difficult/>