SUPPORTING STATEMENT

U.S. Department of Commerce

National Institute of Standards and Technology

Analysis of Exoskeleton-Use for Enhancing Human Performance to Complete Industrial Tasks

OMB Control No. 0693-0083

SUPPORTING STATEMENT PART A

Abstract

Exoskeletons—sometimes called wearable robots—are a very rapidly expanding domain with a range of applications and a broad diversity of designs. NIST's Engineering Laboratory will be developing methods to evaluate performance of exoskeletons in two key areas (1) The fit and motion of the exoskeleton device with respect to the users' body and (2) The impact that using an exoskeleton has on the performance of users executing tasks that are representative of activities in industrial settings and emergency response applications. The results of these experiments will inform future test method development at NIST, other organizations, and under the purview of the American Society for Testing Materials (ASTM) Committee F48 on Exoskeletons and Exosuits.

For the first research topic, NIST will be measuring the difference in performance of a person wearing an exoskeleton versus the person's baseline without the exoskeleton while positioning loads and tools. The NIST Position and Load Test Apparatus for Exoskelons (PoLoTAE), which presents abstractions of industrial task challenges, will be used in this research. NIST researchers will also develop standard test methods to represent real world applications for emergency responders such as mobility tasks; climbing over, around and thru obstacles.

For the second research topic, NIST will evaluate a method for measuring the alignment of an exoskeleton to human joint (knee) and any relative movement between the exoskeleton and user. Measurement methods prototyped by NIST for evaluating exoskeleton on mannequin position and motion will be applied to human subjects to verify the usefulness of optical tracking system and designed artifacts worn by users as measurement methods.

Justification

1. Explain the circumstances that make the collection of information necessary. Identify any legal or administrative requirements that necessitate the collection. Attach a copy of the appropriate section of each statute and regulation mandating or authorizing the collection of information.

As stated in the Abstract, NIST's Engineering Laboratory will be developing methods to evaluate performance of exoskeletons in two key areas (1) The fit and motion of the exoskeleton device with respect to the users' body and (2) The impact that using an exoskeleton has on the performance of users executing tasks that are representative of activities in industrial settings and emergency response applications. The results of these experiments will inform future test method development at NIST, other

organizations, and under the purview of the American Society for Testing Materials (ASTM) Committee F48 on Exoskeletons and Exosuits.

NIST intends to publish information on the analysis and results of the data collected. Because of the diversity of the subject pool and the test methods being evaluated, the survey will be used to fill-in details (e.g., previous injuries, sore spots from an exercise routine, etc.) that correlate with the recorded data. The survey also allows the subject to provide any other potentially useful information that may help in the data analysis. For example, the participant may inform researchers of any mechanical issues of the exoskeleton or awkwardness of fit. An example of this would be indicating if the exoskeleton was awkward to use for the task causing a change in typical task completion.

2. Indicate how, by whom, and for what purpose the information is to be used. Except for a new collection, indicate the actual use the agency has made of the information received from the current collection.

NIST estimates that 30 participants will complete up to Eight (8) tasks. The survey will be administered to the participants after each completed task. Some participants may not complete each task, however for the purposes of calculating burden, NIST will assume a 100% participation rate at 30 participants * 8 responses each which equals 240 responses * _10 minutes per response = _2,400 / 60 (minutes in an hour) = 40 burden hours. Some or all of the survey data may be publicly disclosed. The consent form addresses this point and provides a choice to the subject whether or not they wish to publicly disclose any information about their test.

Data previously collected prior to the renewal of this collection has been banked and will be added to new data collected. The onset of Covid and the limitations it has caused has hampered data collection in general.

3. Describe whether, and to what extent, the collection of information involves the use of automated, electronic, mechanical, or other technological collection techniques or other forms of information technology, e.g., permitting electronic submission of responses, and the basis for the decision for adopting this means of collection. Also describe any consideration of using information technology to reduce burden.

The survey form is in paper format and is completed by the participant. The research team collects the surveys for each and all subjects and locks them in a file drawer in the Primary Investigator's (PI) office.

4. Describe efforts to identify duplication. Show specifically why any similar information already available cannot be used or modified for use for the purposes described in Item 2 above.

This study is unique to the technology created by NIST and therefore is not duplicative.

5. If the collection of information impacts small businesses or other small entities, describe any methods used to minimize burden.

Small businesses are not involved in this information collection.

6. Describe the consequence to Federal program or policy activities if the collection is not conducted or is conducted less frequently, as well as any technical or legal obstacles to reducing burden.

There are no consequences to any Federal program or policy activities if this collection is not conducted.

7. Explain any special circumstances that would cause an information collection to be conducted in a manner: requiring respondents to report information to the agency more often than quarterly; requiring respondents to prepare a written response to a collection of information in fewer than 30 days after receipt of it; requiring respondents to submit more than an original and two copies of any document; requiring respondents to retain records, other than health, medical, government contract; grant-in-aid, or tax records, for more than three years; in connection with a statistical survey, that is not designed to produce valid and reliable results that can be generalized to the universe of study; requiring the use of a statistical data classification that has not been reviewed and approved by OMB; that includes a pledge of confidentiality that is not supported by authority established in statute or regulation, that is not supported by disclosure and data security policies that are consistent with the pledge, or which unnecessarily impedes sharing of data with other agencies for compatible confidential use; or requiring respondents to submit proprietary trade secrets, or other confidential information unless the agency can demonstrate that it has instituted procedures to protect the information's confidentiality to the extent permitted by law.

The collection will be conducted in a manner consistent with OMB guidelines.

8. If applicable, provide a copy and identify the date and page number of publication in the Federal Register of the agency's notice, required by 5 CFR 1320.8(d), soliciting comments on the information collection prior to submission to OMB. Summarize public comments received in response to that notice and describe actions taken by the agency in response to these comments. Consultation with representatives of those from whom information is to be obtained or those who must compile records should occur at least once every 3 years - even if the collection of information activity is the same as in prior periods. There may be circumstances that may preclude consultation in a specific situation. These circumstances should be explained.

A 60-day Federal Register Notice (FRN) soliciting public comments was published on Tuesday, September 14, 2021 (Vol. 86, No. 175, pages 51122-51123). No comments were received.

A 30-day Federal Register Notice (FRN) soliciting comments was published on Tuesday, November 23, 2021 (Vol. 86, No. 223 pages 66535-66536).

Data previously collected in reference to the quality and comfort of the exosuit is considered consultation in moving forward with additional data, as NIST has taken these comments into consideration moving forward.

9. Explain any decision to provide any payment or gift to respondents, other than remuneration of contractors or grantees.

No payments or gifts are offered to participants. The consent form and the recruitment flyer both state: "There will be no compensation for participation in this study and results of this study are expected to be made public."

10. Describe any assurance of confidentiality provided to respondents and the basis for the assurance in statute, regulation, or agency policy. If the collection requires a systems of records notice (SORN) or privacy impact assessment (PIA), those should be cited and described here.

Some or all of the survey data may be publicly disclosed. Video and photos of the subject performing the task and knee tests may be released with only the subject number. The participant's name will not be released. The consent form addresses this point and provides a choice to the subject whether or not they wish to publicly disclose any information about their test. Should the subject choose to not disclose their information, no personally identifiable information will be disclosed. Although the participant's name may be collected, the storage of information is not in a Privacy Act System of Records which retrieves information based on a personal identifier. This collection does not require a Privacy Act Statement or SORN.

11. Provide additional justification for any questions of a sensitive nature, such as sexual behavior and attitudes, religious beliefs, and other matters that are commonly considered private. This justification should include the reasons why the agency considers the questions necessary, the specific uses to be made of the information, the explanation to be given to persons from whom the information is requested, and any steps to be taken to obtain their consent.

No questions of a sensitive nature will be asked of the participants.

12. Provide estimates of the hour burden of the collection of information.

The survey regarding the participant's experience using the exoskeleton suit takes approximately 10 minutes to fill out. 30 Subjects may participate in up to 8 separate tasks. The survey will be given after each task to record the experience of using the exoskeleton. There are up to eight task tests for a total of 240 participants at 10 minutes per response equaling 40 hours burden.

13. Provide an estimate for the total annual cost burden to respondents or record keepers resulting from the collection of information. (Do not include the cost of any hour burden already reflected on the burden worksheet).

There is no cost to the respondent.

14. Provide estimates of annualized costs to the Federal government. Also, provide a description of the method used to estimate cost, which should include quantification of hours, operational expenses (such as equipment, overhead, printing, and support staff), and any other expense that would not have been incurred without this collection of information. Agencies may also aggregate cost estimates from Items 12, 13, and 14 in a single table.

Professional cost: 30 hours x $158 per hour with overhead = $4800.

15. Explain the reasons for any program changes or adjustments reported on the burden worksheet.

NIST anticipates the use of two additional tasks for testing the exosuit, therefore there is a slight increase in burden hours as this corresponds with administering the survey post task.

Two questions have been added to the pretest section:
(A) What is your age, height, handedness, job title, and hobbies/sports?
(B) On a scale from 0 (low) - 5 (high), what is your daily activity level?

Question 4 was split into two questions (now Questions 4 and 5):
Q4: When NOT wearing the exoskeleton and while performing the test, did you have any pain, soreness or discomfort? Please mark accordingly.
Q5: When wearing the exoskeleton and while performing the test, did you have any pain, soreness or discomfort? Please mark accordingly.

Two questions have been added to the survey:
Q9: Which part of the test did the exoskeleton provide the most benefit? 0 N/A, 1 floor, 2 low wall, 3 high wall, 4 ceiling
Q10: Which part of the test did the exoskeleton provide the least benefit? 0 N/A, 1 floor, 2 low wall, 3 high wall, 4 ceiling

Remaining questions are unchanged except to be renumbered due to the above additions.

16. For collections of information whose results will be published, outline plans for tabulation and publication. Address any complex analytical techniques that will be used. Provide the time schedule for the entire project, including beginning and ending dates of the collection of information, completion of report, publication dates, and other actions.

Once data is analyzed, publication of results by subjects who allow public disclosure of their information may occur in written reports, conference papers, journal papers, books and presentations at standards development organization meetings. The data collected will not be reused, other than for the purposes stated above. The data will not be used by NIST in the future beyond the current study analysis and compilation. NIST also plans to publish the collected

publicly disclosed data in accordance with NIST guidelines and procedures to allow the research community to develop measurement science beyond allowable NIST resources.

17. If seeking approval to not display the expiration date for OMB approval of the information collection, explain the reasons that display would be inappropriate.

The OMB approval information will be displayed.

18. Explain each exception to the topics of the certification statement identified in "Certification or Paperwork Reduction Act Submissions."

There are no exceptions.