America's Seed Fund powered by the National Science Foundation

Small Business Innovation Research (SBIR)/
Small Business Technology Transfer (STTR) program
seedfund.nsf.gov

SOLICITATION TOPICS & SUBTOPICS

America's Seed Fund powered by NSF encourages proposals in nearly all technology and market sectors (with the exception of clinical trials and Schedule I controlled substances.) NSF routinely moves Project Pitches and proposals to the topic area that better describes the underlying technical innovation to ensure the best qualified program director manages the review process or project. An exact fit into one of these topics or subtopics is not required on submission.

Robotics (R)

The Robotics topic covers robot intelligence and experiential learning, particularly in the areas of high-performance processors or hardware that provides situational awareness and improved artificial intelligence. Innovations in voice, obstacle and image recognition, emotional response and hand-eye coordination are encouraged. We encourage proposals describing projects that borrow features from other animal nervous systems and include biologists, neuroscientists and psychologists on their team to exploit new knowledge in the study of the brain and behavior.

NSF also seeks proposals that address next-generation automation; the flexible and rapid reconfiguration of assembly lines allowing mass customization; the use of advanced control, scheduling, modularization, and decentralization with agile, mobile robotic systems that can enable the cost-effective manufacture of small lot-size products; and on-demand parts manufacturing.

Proposals to support the physical and educational needs of individuals with disabilities (e.g., vision, hearing, cognitive, motor related) are sought. Robotic applications in healthcare, smart drones and drone networks are appropriate. Medical devices focused on providing new capabilities to doctors including surgery; robotic exoskeletons to enhance human strength; personal robots with an emphasis on human-centered end use and interaction, personal caregiving and increased autonomy; future of work; flying taxis; reverse engineering the human brain; robot sense, motion, thought, and emotion; human-robot art; and robots of augmentation are welcome.

R1. Human Assistive Technologies and Bio-related Robotics

R2. Human-Machine Interfaces and Control/Architecture

R3. Robotic Applications

R4. Robotics in Agile Manufacturing, and Co-Robots

R5. Underground or Underwater Robotics for Low-Visibility, Poor-Connectivity or Hidden Topography

R6. Other Robotics Technologies

Dear Jerry,
Here is the copy of the Project Pitch with reference number : **00067835** submitted to the **Robotics (R)** on **9/20/2023**.

1. Submitter Name

    `Jerry Sommerville`

2. Submitter Email

    `jnsville@yahoo.com`

3. Submitter Phone

    `9092277159`

4. Company Name

    `Sommerville, Jerry`

5. State

    `CA`

6. Zip Code

    `91737`

7. Corporate Website

    `https://laserpositioningsystem.com`

8. SBIR/STTR topic that best fits your projects technology area

    `Robotics (R)`

9. Is this Project Pitch for a technology or project concept that was previously submitted as a full proposal by your company to the NSF SBIR/STTR Phase I Program – and was not awarded ?

    `Yes`

9a. Please provide the Proposal Number of the previously submitted full NSF SBIR/STTR Phase I proposal ?

    `2026388`

9b. Have you contacted the associated NSF SBIR/STTR Program Officer, via email or phone, to discuss this prior full proposal submission?

    `no`

10. Has your company received a prior NSF SBIR or STTR award?

    `No`

11. Does your company currently have a full Phase I SBIR or STTR proposal under review at NSF?

    `No`

12. Briefly Describe the Technology Innovation?

There is a significant shortage of competent candidates to fill jobs requiring highly technical skills. Raytheon has recently urged its employees to play an active role in shaping college curricula to foster critical skills needed for the aerospace industry. This initiative aims to create a pool of talented individuals who can fill the gaps in the industry and help tackle the scarcity of skilled workers. The Carnegie Foundation suggests that industry and academia collaborate to form networked improvement communities.Commercially available 3D laser scanners and jointed arm robots have not yet been combined in a cost-effective and accessible package that can be modularized for different industries. Lego Mindstorms products have been discontinued because the skills they help develop are not readily portable to industry.VRSolutions proposes the development of two products to teach multi-disciplinary skills and methods critical to highly technical industries such as aerospace and medical devices. These technical skills have applications in many other industries. Adopting a modular approach to developing components enables technology transfer to other sectors. The two proposed products have many potential applications because they represent key features of human limbs and the human eye. Both can be used independently, but considerable advances can be made if used together.The Mixed Reality (MR) Robot is a prime example of hand-eye coordination in action. It showcases how medical robotics and manufacturing can be transformed by simulating hands and eyes. In this approach, a virtual robot operates an actual robot, enabling human and AI control.The 3D Laser Distance Meter (3DLDM) allows for mapping physical space into virtual space, enabling a manipulator to interact with its environment, using either human or AI input.Most industrial robots operate in batch mode, where computer code controls the manipulator's movements. Others are programmed by moving a robot manipulator around while in teach mode. The robot's movements are recorded in a computer's memory; then, the robot's motion is replayed to manipulate something in an assembly line.VRSolutions designed its MR Robot to revolutionize local and remote robot operations. It provides a simplified human–machine interface (HMI) that drastically reduces operator data input requirements to orchestrate robot movements. Labor reduction is possible because no programming or teaching is needed. Robot motions occur by pointing with mouse on screen or with laser to desired location. Virtual Robot is moved to pointed location using inverse kinematics. The actual robot then follows the virtual robot.MR Robot and 3DLDM derivatives will proliferate in real-time robot systems, synthetic-aperture radar systems, and 3D surface mapping systems in many sectors of society, including space exploration. Surface or terrain mapping methods for real-time operations will be developed. Virtual robot control methods will be advanced by academic institutions and industry

13. Briefly Describe the Technical Objectives and Challenges?

The following explanation of the technical objectives and challenges is extracted from US Patent 9044857. A COTS 3D laser distance meter (LDM) measures a single dimension with USB output is mounted in the middle of a U-Bracket with pivot points on both sides and on the bottom. The U-Bracket bottom pivot pans U-bracket around and side pivots tilts LDM up and down. The pan and tilt angles are measured with high resolution incremental encoders, thus a three- dimensional position (or 3D point) can be measured using spherical coordinates by including the measured radial distance of the commercial LDM. The 3DLDM HMI robot uses the 3D point to move a virtual robot (VR) in virtual space then it sends commands to move an actual robot (AR) in real space. The sequence of events needed to move the AR using the 3DLDM HMI is as follows. The user points the 3DLDM laser beam to a targeted location in 3D space. The COTS LDM's radial position must be combined with the measured angles of the incremental encoders to obtain a 3D point in spherical coordinates. An Encoder Counter Unit (ECU) circuit board (CB) has quadrature decoders that count incremental encoder pulses and stores them. The ECU reads the radial distance from the (LDM) and the pan and tilt angles counts from the quadrature decoders to obtain spherical coordinates of targeted location. The ECU provides the pan and tilt counts and radial distance when requested by VR SW as a virtual 3D point. The VR SW converts the spherical coordinates of the virtual 3D point to Cartesian coordinates and relates the 3DLDM reference frame to the VR coordinate frame. The VR SW uses inverse kinematics to determine the VR joint angles necessary to reach the virtual 3D point. The error between the AR angles and the VR angles is calculated by the computer software. The error signal is sent to a PID servo controller to move the AR angles to match the VR arm angles by reducing the joint angle errors. The mouse HMI robot operates similarly except the user controls the VR by pointing to a targeted 2D location on the GUI with the mouse cursor. The VR uses the 2D target location and inverse kinematics SW to figure out the joint angles needed to move the VR end point to targeted location in the GUI. The error between the AR angles and the VR angles is calculated. A PID servo controller moves the AR by minimizing its joint angle errors. Here are some technical challenges: sizing the quadrature decoders for sufficient position resolution, designing fabricating the ECU CB, designing the U-bracket, developing 3DLDM software, streaming 3D data points, designing & fabricating the 2DOF robot, developing the virtual reality robot software and GUI, AR/VR angle calibration, integrating the COTS servo controller, integrating & tuning 3DLDM SW/HW, VR software, COTS PID controller, and AR to obtain a nearly repeatable AR endpoint position.

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14. Briefly Describe the Market Opportunity?

Interest in STEM education is growing exponentially, while there is a desperate need for qualified educators with experience in key areas. By partnering with VRSolutions, educators will be able to meet the demand for technical skills. US-based SMB Virtual Reality Solutions (VRSolutions) will operate a D2C business model, marketing to career training institutions, such as universities and trade schools.VRSolutions’ customers can be segmented by their use cases. Education and training institutions have a well-documented need to cultivate students with industry experience (Carnegie Foundation, 2015). The serviceable market will initially focus on universities, trade schools, and technical high schools.VRSolutions addresses educators' need to cultivate a learning mindset in students by bringing key technology and industry practices to the classroom. Using VRSolutions’ products will expose students to systems engineering practices by introducing critical technology as a multi-disciplinary holistic system, not as separated siloes[Ed3] . Students will learn cross-functional and soft skills crucial to the technical industries.Assuming a production quantity of 1K per batch and a 60% gross profit margin, the 3DLDM will be sold at $1.1K per unit. The MR Robot will be sold at $3.2K per unit. US addressable market: $193MUS serviceable market: $96M Global addressable market: $774Global serviceable market: $375MGlobal CAGR: 22% 2018-23(RATATAZ, 2021; NCSES, 2021)

15. Briefly Describe the Company and Team?

VRSolutions will be pre-sales until commercial versions of its VR products are available.Solar Solutions sells renewable energy products for industry and education in the US. Its renewable energy kits help introduce renewable energy concepts and entrepreneurship to students. Likewise, VRSolutions introduces state-of-the-art industry-specific technology to schools to cultivate entrepreneurship and innovation. Jerry Sommerville will be the Principal Investigator. Jerry has an MA in control systems. The software algorithms used in creating the virtual robots are from a project he did to obtain his master's degree in 1989[. He has over 30 years of experience working with servo controls at industry leading companies such as Northrup Grumman, JPL, Honeywell, and Raytheon. He has taught college level courses for over five years. The proposed innovations are based on his patent 9044857. Mike Martin Vegue, Mechanical Engineering Consultant: Mike owns MVI Engineering in Ontario. He designed and fabricated the prototype 3DLDM and a low inertia robot concept.Alan Paine, Electronics Engineer: Alan owns Force Switch Corporation. He has over 25 years of experience fabricating electronic circuits and sensors for the aerospace, medical, and oil industries.

16. How did you first hear about our program?

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I first heard about the SBIR program from Veronica Santos in 2019, a
UCLA robotics professor who was involved in 3D Gaze Tracking research.
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NSF SBIR/STTR Phase I Eligibility Information:

In addition to receiving an invitation to submit a full proposal from the NSF SBIR/STTR Phase I Program based upon the review of their submitted Project Pitch,potential proposers to the program must also qualify as a small business concern to participate in the program (see SBIR/STTR Eligibility Guidefor more information).

The firm must be in compliance with the SBIR/STTR Policy Directive(s) and the Code of Federal Regulations (13 CFR 121).

- Your company must be a small business (fewer than 500 employees) located in the United States. Please note that the size limit of 500 employees includes affiliates.
- At least 50% of your company’s equity must be owned by U.S. citizens or permanent residents, and all funded work needs to take place in the United States (including work done by consultants and contractors).
- Primary employment is defined as at least 51 percent employed by the small business. NSF normally considers a full-time work week to be 40 hours and considers employment elsewhere of greater than 19.6 hours per week to be in conflict with this requirement.
- The Principal Investigator needs to commit to at least one month (173 hours) of effort to the funded project, per six months of project duration.

For more detailed information, please refer to the SBIR/STTR Eligibility Guide by using https://www.sbir.gov/sites/default/files/elig_size_compliance_guide.pdf. Please note that these requirements need to be satisfied at the time an SBIR/STTR award is made, and not necessarily when the proposal is submitted.

Re: Project Pitch 00067835

From: Elizabeth Mirowski (emirowsk@salesforce.nsf.gov)

To: jnsville@yahoo.com

Date: Thursday, September 21, 2023 at 08:52 AM PDT

Project Pitch: 00067835
Topic Area: SBIR/STTR: Robotics (R)
Invite Date: 9/21/2023
Expiration Date: 9/21/2024

Dear Jerry,

Upon reviewing your submitted Project Pitch, I am pleased **to invite you to submit a full Phase I proposal** to the National Science Foundation's (NSF) Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) program. This invitation to submit a full proposal (based on the project proposed in the associated Project Pitch) is **valid for one year** and can only be used once for one full proposal submission (i.e. cannot be used for multiple full proposal submissions).

Please submit your proposal to the **Robotics (R)** topic as soon as you are ready. Some points to consider as you develop your proposal include;
"Please submit your proposal to the Robotics (R) topic when you are ready. Since this is a resubmission, you will need to significantly revise the proposal and address the weaknesses noted in the panel summary and individual reviews. You can submit a one page resubmission change letter in the supplementary documents section that includes prior review weaknesses and statements on how/where in the proposal you made revisions to address the weakness. Be sure to include sufficient technical details in the experimental plan along with specific milestones and quantitative success metrics. Some points to consider as you develop your proposal include:
Technical:
1. What are the key technology risks/problems?
2. What is the proposed innovation to solving the problems? If there has been work done on the innovation, what are the new scientific/engineering elements to be developed that will address the technical risks? What are plans should certain aspects of the approach not work?

3. Provide a project plan that clearly describes the research objectives and tasks to achieve the objectives. What set of quantitative metrics will you use to assess the outcome of the innovation research described in the plan? What are the range of values [or specific values] for target specifications that will establish proof of concept in Phase I?
4. What skills, capabilities and resources will be needed to successfully build the prototype?
5. If the skills are not present, how will they be acquired?
6. How will the PI know that Phase-I goals have been met?
7. What intellectual property does the company currently have? Future IP development? What license terms (if any) exist?

Broader Impacts:
1. How does this technology provide beneficial societal impacts. This is different from commercial impacts...consider the non-commercial aspects of what the technology brings. This should not be a list of all possible broader impacts, but rather specific broader impacts that you intend on tracking over time and how might you measure the impact.

Commercial:
1. What is the background of the team, why is this the right team to execute the commercialization of the proposed innovation?
2. What is the size and scope of the market opportunity? You must identify how you plan to make a scalable, sustainable business from this effort.
3. Who is the customer for the innovation? What is the value proposition for your customer?
4. What does the competitive landscape look like? What is your competitive advantage? (Please search NSF awards database for prior similar technology awards)
5. Which group of customers want the product/technology being proposed?
6. What customer(s) needs or requirements will be satisfied by the proposed product? Is this a need to have or a nice to have?
7. How are the needs and requirement(s) being satisfied now?
8. Why will the customer choose the proposed product over existing solutions?
9. Please explain how this technology is high-risk/high-reward and why NSF funding is needed as catalytic funding to bring the project forward."""

To prepare your full Phase I proposal, please follow the NSF SBIR/STTR guidelines and instructions as outlined in the Phase I solicitation. You may use this invitation to submit either an SBIR or an STTR proposal, but not both.

> [NSF SBIR/STTR Phase I Solicitation](#)
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> SBIR - No partnership requirement; partnerships are allowed. The small business must perform a minimum of two-thirds of the research, as measured by the budget.
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> STTR - Requires a partnership with an eligible research institution. A small business must perform a minimum of 40% of the research, as

measured by the budget, and a minimum of 30% must be performed by the partner research institution.

To receive an award, you must meet the **eligibility criteria** as a small business (see section IV of the solicitation document and the SBIR/STTR Eligibility Guide for details). Proposals that do not comply with the guidelines or do not meet the listed eligibility requirements outlined in the solicitation may be returned without review.

Please save this email. This email invitation must be uploaded as part of your Phase I proposal submission in the "Additional Single Copy Documents" **section of the Research.gov System.**

Please also make sure to select the following topic area from the drop-down menu when completing the NSF SBIR Phase I Cover Page for your proposal: Robotics (R). For a list of sub-topic areas, please review our most recent solicitation topic and subtopic document.

I recommend starting the required governmental and NSF registrations immediately (See more information about the registrations on the full proposal page**)**. The System for Award Management (SAM) registration process is free but can take up to a month to complete. You MUST have an active SAM.gov registration number to register with NSF and submit an invited full proposal through Research.gov. Sam.gov registration must be renewed annually.

Please refer to the NSF's website for more information about proposal preparation and we invite you to join us at an upcoming webinar Office Hours: SBIR/STTR Proposal Prep via Zoom: Events

We look forward to receiving your Phase I proposal. Please let me know if you have questions.

Thank you,
Elizabeth Mirowski
NSF SBIR/STTR Program Director
America's Seed Fund powered by NSF
National Science Foundation
Alexandria, VA 22314
emirowsk@salesforce.nsf.gov