Dear Ilakkuvaselvi,

Here is the copy of the Project Pitch with reference number : **00064247** submitted to the **Advanced Materials (AM)** on **7/8/2023**.

1. Submitter Name

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   `N/A`

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

   `Advanced Materials (AM)`

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 ?

   `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?

The technical innovation that would be the focus of a Phase I project: In a Phase I project focused on the research and development of spin qubits and quantum dots, the primary technical innovation would be to explore and develop novel materials and fabrication methods for spin qubits and quantum dots. This innovation would aim to enhance the performance, scalability, and sustainability of spin qubit-based technologies for various applications such as quantum computing, quantum simulation, quantum communication, quantum sensing and metrology, and quantum error correction. The project would involve investigating new materials that exhibit favorable spin properties, such as long coherence times and robustness against decoherence. This could include exploring advanced semiconductor materials, topological insulators, or other promising candidates with desirable spin characteristics. The goal would be to identify materials that can effectively trap and manipulate individual spins to serve as reliable qubits. Furthermore, the project would focus on developing fabrication methods that enable precise control and manipulation of spin qubits and quantum dots. This could involve novel lithography techniques, growth methods, or nanofabrication processes to create well-defined structures and interfaces at the atomic scale. The objective would be to achieve high-fidelity qubit initialization, manipulation, and readout, as well as long qubit coherence times, which are crucial for quantum information processing. Another crucial aspect of the Phase I project would involve exploring various qubit architectures. This would entail investigating different physical implementations of spin qubits, such as single-electron spins in quantum dots, nitrogen-vacancy centers in diamond, or other suitable systems. By examining different architectures, researchers can identify the most promising platforms for achieving scalability, error correction, and fault-tolerant quantum computation. Additionally, the Phase I project would focus on researching and developing new qubit control techniques. This could involve exploring innovative control schemes, pulse sequences, or protocols for precise qubit operations, entanglement generation, and error mitigation. Advanced control techniques are essential for achieving high-fidelity quantum gates and reducing the impact of noise and errors in quantum systems. Overall, the technical innovation in the Phase I project would revolve around advancing the field of spin qubits and quantum dots by investigating novel materials, developing fabrication methods, exploring various qubit architectures, and researching new qubit control techniques. These advancements are crucial for realizing practical and scalable quantum technologies for quantum computing, quantum simulation, quantum communication, quantum sensing, metrology, error correction, and other applications. Challenges faced by spin qubits and the importance of researching new materials: Coherence and Decoherence: Coherence refers to the stability and preservation of the quantum state of a qubit. Decoherence occurs when the qubit's state becomes entangled with its surrounding environment, leading to the loss of quantum information. Spin qubits are susceptible to various sources of decoherence, such as electromagnetic noise, temperature fluctuations, and interactions with host materials. Enhancing coherence times and mitigating decoherence effects are crucial for reliable quantum computation. Readout and Initialization: Accurate measurement of the quantum state of a qubit, known as readout, is essential for obtaining meaningful results from quantum computations. Similarly, initializing the qubit into a known state is necessary for performing calculations. Achieving high-fidelity readout and efficient initialization of spin qubits are active areas of research, as they are vital for reliable quantum operations. Qubit Connectivity: Building large-scale quantum computers requires the ability to connect and entangle multiple qubits. For spin qubits, establishing robust and controllable interactions between qubits is challenging. Developing methods to mediate interactions between distant qubits and implementing high-fidelity two-qubit gates are ongoing research objectives. Material Compatibility and Fabrication: Spin qubits typically rely on semiconductor materials, such as silicon or gallium arsenide. The challenge lies in integrating these materials into existing semiconductor fabrication processes while maintaining the desired qubit properties. Compatibility with fabrication techniques is crucial for scaling up quantum processors and realizing practical quantum computers. The need to research and develop new materials for spin qubits arises from the following reasons: Improved Coherence and Control: Exploring new materials can potentially offer better control over qubits and enhance coherence times. For example, materials with reduced sensitivity to environmental noise or lower spin-orbit coupling effects may improve the stability and controllability of spin qubits. Novel Quantum Phenomena: Investigating new materials can uncover unique quantum phenomena that may be exploited for more efficient qubit operations. For instance, materials with topological properties hold promise for protecting qubits from certain types of errors, thereby improving fault tolerance. Alternative Qubit Architectures: New materials enable the exploration of alternative qubit architectures beyond the current electron spin-based approaches. Examples include using nuclear spins, defects in diamond, or rare-earth ions in crystals. These alternative architectures may offer advantages in terms of coherence, interaction strength, or scalability. Overcoming Limitations: Current spin qubit materials have certain limitations, such as limited coherence times or challenges in achieving high-fidelity operations. Researching new materials provides an avenue to overcome these limitations and unlock improved qubit performance. In summary, the development of spin qubits faces challenges related to coherence, control, scalability, and material compatibility. Researching new materials not only addresses these challenges but also opens up opportunities for improved qubit performance, the discovery of novel quantum phenomena, and the exploration of alternative qubit architectures. When considering materials for spin qubits, Silicon is a top choice due to its favorable properties and compatibility with existing semiconductor technology. Silicon-based spin qubits offer several advantages, such as long coherence times, scalability, and the potential for integration with classical electronics. Silicon quantum dots have emerged as promising candidates for spin qubits in recent years. Silicon, being an abundant and well-studied material, benefits from a mature fabrication infrastructure and extensive knowledge of its electronic properties. This enables the use of well-established semiconductor processing techniques, making it easier to achieve reproducible and high-quality quantum dot devices. One of the key advantages of Silicon spin qubits is their potential for long coherence times, which is crucial for performing accurate quantum operations. Silicon benefits from its isotopic purity, particularly in the form of enriched ^{28}Si, which has a low natural abundance of nuclear spins. This feature reduces the noise arising from nuclear spins and enhances the coherence times of electron spins confined within silicon quantum dots. Moreover, Silicon's strong spin-orbit coupling allows for efficient electrical control of the spin qubits. This makes it possible to manipulate and read out the spin states using electric fields, which simplifies the qubit control architecture compared to other systems that rely on magnetic fields. In terms of scalability, Silicon spin qubits offer promise. They can be integrated with traditional silicon-based complementary metal-oxide-semiconductor (CMOS) technology, allowing for the potential integration of spin qubits with classical electronics on the same chip. Leveraging the existing semiconductor industry infrastructure and manufacturing processes opens up avenues for large-scale fabrication and commercialization of quantum devices. Additionally, Silicon quantum dots have demonstrated the ability to achieve single-spin readout and strong spin-qubit coupling, which are crucial for performing quantum operations and achieving entanglement. This progress has been driven by advancements in device design, fabrication techniques, and understanding of quantum dot physics in Silicon. While Silicon spin qubits show great potential, there are still technical challenges to address. For example, improving the qubit coherence times, mitigating charge noise, and achieving high-fidelity two-qubit gates are ongoing research areas. However, the advantages of Silicon's compatibility with existing semiconductor technology and the potential for long coherence times make it a top choice for material selection in the development of spin qubits, particularly Silicon quantum dots, for quantum computing and other applications. Top choices for quantum dot spin qubits, along with their advantages and challenges: Silicon (Si) Quantum Dots:Advantages: Long coherence times, scalability, compatibility with existing semiconductor technology, potential for integration with classical electronics.Challenges: Mitigating charge noise, improving qubit coherence times, achieving high -fidelity two-qubit gates.III-V Semiconductors (e.g., GaAs):Advantages:

Excellent electron mobility, efficient spin manipulation and control, mature growth techniques, high-quality quantum dot structures.Challenges: Addressing charge noise, enhancing qubit coherence times, improving gate fidelity.Indium Arsenide (InAs) Nanowires:Advantages: High crystal quality, strong spin-orbit coupling, long coherence times, potential for scalable integration.Challenges: Achieving uniform and reproducible quantum dot properties, reducing the impact of environmental noise, enhancing qubit control.Carbon Nanotubes:Advantages: Unique electronic properties, compatibility with existing fabrication methods, long coherence times.Challenges: Controlling and tuning the charge environment, reducing the influence of spin-orbit coupling, achieving high-fidelity gates.Quantum Dots in Graphene:Advantages: High electron mobility, potential for tunable properties, compatibility with graphene-based devices.Challenges: Enhancing the coherence times, reducing charge noise, achieving scalable fabrication.Zinc Oxide (ZnO) Quantum Dots:Advantages: Large exciton binding energy, compatibility with optoelectronic applications, potential for spin qubits based on defects.Challenges: Reducing defects and impurities, achieving long qubit coherence times, improving control and readout techniques.Germanium (Ge) Quantum Dots:Advantages: Compatibility with Si-based technology, long coherence times, potential for efficient electrical control.Challenges: Enhancing the scalability, mitigating environmental noise, achieving high-fidelity gates.Lead Sulfide (PbS) Quantum Dots:Advantages: Narrowband emission, potential for compatibility with telecommunications applications, tunable properties.Challenges: Reducing surface defects, achieving long coherence times, improving qubit manipulation techniques.Hybrid Systems (Combining Different Materials):Advantages: Leveraging the strengths of multiple materials, exploring new functionalities and interactions.Challenges: Overcoming interface issues, achieving coherent coupling between different quantum dot systems, ensuring compatibility and scalability. It's important to note that each material has its own unique set of advantages and challenges, and ongoing research is focused on addressing these challenges to further improve the performance and scalability of quantum dot spin qubits in various applications.   The origins of the innovation: The innovation in spin qubits stems from the desire to harness quantum mechanics for computing, communication, sensing, and metrology. Researchers recognized the potential of spin qubits and embarked on extensive research and development efforts. The field of quantum information science emerged when physicists like Richard Feynman and Paul Benioff proposed leveraging quantum mechanics for computing and information processing. Spin qubits, utilizing the spin properties of particles, emerged as promising platforms due to their long coherence times and controllability. The innovation in spin qubits involves exploring novel materials, such as Silicon and III-V semiconductors, and different qubit architectures like single-electron spins in quantum dots. Additionally, advanced control techniques have been developed to achieve high-fidelity qubit operations. The development of less toxic and sustainable quantum dots arises from concerns about traditional materials' toxicity and environmental impact. Researchers actively seek alternative materials and fabrication methods, driven by interdisciplinary collaborations and the demand for greener technologies. Quantum dot-based sensors and lasers are a focus of application-driven innovation. Quantum dots offer tunable emission spectra, high quantum efficiency, and sensitivity to environmental changes, making them promising for various applications. Overall, the origins of these innovations lie in the pursuit of leveraging quantum mechanics, exploring novel materials and architectures, and addressing environmental concerns. The research and development efforts aim to advance spin qubits and develop safer, more sustainable quantum dots for transformative technologies. Why it meets the program’s mandate to focus on supporting R & D of unproven, high-impact innovations: The project described aligns well with the program's mandate to focus on supporting research and development (R&D) of unproven, high-impact innovations. There are several reasons why this project meets this mandate: Unproven Innovations: The project aims to explore and develop novel materials, fabrication methods, qubit architectures, and control techniques for spin qubits and quantum dots. These areas of research are still in their early stages and have not yet reached the level of maturity required for widespread adoption. By focusing on unproven innovations, the project seeks to push the boundaries of what is currently possible in the field of quantum information processing. High-Impact Potential: Spin qubits and quantum dots have tremendous potential for various applications in quantum computing, quantum simulation, quantum communication, quantum sensing and metrology, and quantum error correction. These technologies can revolutionize industries such as computing, telecommunications, healthcare diagnostics, environmental monitoring, and more. By investing in the R&D of these technologies, the project aims to unlock their high-impact potential and pave the way for transformative advancements. Sustainable and Less Toxic Quantum Dots: The project also emphasizes the research and development of quantum dots that are less toxic and more sustainable. This aspect is crucial in addressing the environmental concerns associated with traditional quantum dots, which often contain heavy metals. By focusing on developing environmentally friendly quantum dots, the project aligns with the goal of promoting sustainable and responsible innovation, addressing potential risks, and ensuring long-term viability of the technology. Multidisciplinary Approach: The project encompasses various disciplines, including materials science, physics, chemistry, and engineering. This multidisciplinary approach fosters collaboration and knowledge exchange among experts from different fields, leading to innovative solutions and breakthroughs. By supporting R&D efforts that span multiple disciplines, the program enables synergistic advancements and encourages the exploration of new ideas from diverse perspectives. Overall, the project's focus on unproven, high-impact innovations, its potential to revolutionize multiple industries, its emphasis on sustainability, and its multidisciplinary nature make it a strong candidate for the program's support in advancing cutting-edge research and development efforts.

13. Briefly Describe the Technical Objectives and Challenges?

The R&D or technical work to be done in a Phase I project: In a Phase I project, the focus would be on conducting initial research and development (R&D) activities to lay the foundation for the advancement of spin qubits and sustainable quantum dots. The technical work would involve the following key aspects: Material Exploration and Fabrication Methods:Conducting a systematic study of novel materials with potential for spin qubits and quantum dots, including Silicon, III-V semiconductors, carbon nanotubes, and other suitable candidates.Developing innovative fabrication methods and techniques to create well-defined quantum dot structures, ensuring precise control over their size, shape, and composition.Optimizing the growth and synthesis processes to enhance the quality and reproducibility of quantum dot materials. Qubit Architecture Exploration:Exploring various qubit architectures, such as single-electron spins in quantum dots, nitrogen-vacancy centers in diamond, or other emerging platforms, to assess their suitability for specific applications.Investigating the scalability and error correction capabilities of different qubit architectures, evaluating their potential for large-scale quantum systems. Qubit Control Techniques:Developing and refining qubit control techniques, including pulse sequences, gate operations, and readout methods, to achieve high-fidelity qubit operations and enhance the coherence times of spin qubits.Investigating advanced control schemes and protocols for entanglement generation, error correction, and improving the robustness of quantum operations. Sustainable Quantum Dot Development:Conducting research to identify alternative materials for quantum dots that are less toxic and more environmentally sustainable, while maintaining desirable optical and electronic properties.Exploring innovative synthesis approaches and surface functionalization techniques to produce quantum dots with reduced environmental impact and improved biocompatibility. Feasibility Studies and Performance Evaluation:Conducting feasibility studies and performance evaluations of spin qubits and quantum dots in different application domains, such as quantum computing, simulation, communication, sensing, and metrology.Assessing the performance metrics, such as coherence times, gate fidelity, scalability, and quantum dot properties, to benchmark the progress and guide further development. Overall, the Phase I project would involve comprehensive research and development activities, including material exploration, fabrication method development, qubit architecture exploration, qubit control technique development, and sustainable quantum dot research. These activities would set the foundation for subsequent phases to advance the state of the art in spin qubits and sustainable quantum dots for a wide range of applications. How and why the proposed work will help prove that the product or service is technically feasible and/or will significantly reduce technical risk: The proposed work in advancing spin qubits and sustainable quantum dots aims to demonstrate the technical feasibility and mitigate technical risks associated with these technologies. Here's how and why the proposed work will achieve this: Novel Materials and Fabrication Methods:By conducting research and development on novel materials for spin qubits and quantum dots, the project seeks to identify materials that exhibit long coherence times, strong spin-qubit coupling, and compatibility with existing semiconductor technology.Developing innovative fabrication methods and techniques will enable the creation of well-defined quantum dot structures with precise control over their properties, ensuring reproducibility and scalability.These efforts will significantly reduce technical risks by establishing the feasibility of utilizing alternative materials and advanced fabrication techniques for spin qubits and quantum dots. Exploration of Qubit Architectures:Investigating various qubit architectures, such as 2D arrays and linear arrays, helps optimize qubit density, interconnectivity, and scalability. This exploration will assess the feasibility of scaling up quantum systems, which is crucial for practical implementation.By understanding the performance and limitations of different architectures, the project will identify the most promising approaches, reducing technical risks associated with scalability and system integration. New Qubit Control Techniques:The research and development of new qubit control techniques, such as advanced pulse sequences and gate operations, aim to achieve high-fidelity qubit operations and enhance coherence times.These techniques will reduce technical risks by improving the robustness and reliability of quantum operations, mitigating errors, and optimizing control mechanisms. Less Toxic and Sustainable Quantum Dots:The project's focus on developing quantum dots that are less toxic and more sustainable will significantly reduce technical risks associated with environmental and health concerns.By identifying alternative materials with similar optical and electronic properties, the project aims to demonstrate the technical feasibility of using safer and environmentally friendly quantum dots. By addressing these key aspects, the proposed work will provide experimental evidence, theoretical insights, and technological advancements that prove the technical feasibility of spin qubits and sustainable quantum dots. It will help validate the viability of these technologies, reduce technical risks, and pave the way for their successful integration into quantum computing, simulation, communication, sensing, metrology, and other applications. How, ultimately, this work could contribute to making the new product, service, or process commercially viable and impactful: The research and development outlined in the project can significantly contribute to making new products, services, or processes commercially viable and impactful in several ways: Advancing Quantum Computing: The development of spin qubits and exploration of various qubit architectures can enhance the performance and scalability of quantum computers. By improving qubit density and interconnectivity, researchers can lay the groundwork for building larger and more powerful quantum computers. This can enable complex calculations and simulations that are currently infeasible with classical computers. Commercializing such advancements in quantum computing could revolutionize industries such as drug discovery, optimization, cryptography, and machine learning. Quantum Simulation and Metrology: Spin qubits can be utilized for quantum simulation, enabling the study of complex quantum systems that are difficult to model using classical approaches. This capability can facilitate breakthroughs in materials science, physics, and chemistry, leading to the discovery of new materials, optimized chemical reactions, and the development of innovative technologies. Additionally, spin qubits can be employed in quantum metrology applications, enabling highly accurate measurements and precise sensing capabilities. Commercialization of these advancements can drive improvements in fields like precision manufacturing, navigation, and imaging. Quantum Communication: Spin qubits offer the potential for secure and efficient quantum communication protocols. By leveraging the principles of quantum entanglement and superposition, quantum communication can provide secure encryption methods and faster data transmission compared to classical systems. Research and development in this area can lead to the creation of commercial quantum communication networks, enabling secure communication channels for sensitive information, such as financial transactions, government communications, and data privacy. Quantum Sensing and Quantum Dot Applications: The development of sustainable and less toxic quantum dots can have a significant impact on a range of applications. Quantum dot-based sensors can revolutionize environmental monitoring, healthcare diagnostics, and food safety by providing highly sensitive and accurate detection capabilities. Furthermore, quantum dot lasers can find applications in telecommunications, data storage, and optical sensing, leading to faster and more efficient data transmission and storage solutions. Commercializing these quantum dot-based technologies can transform industries such as healthcare, telecommunications, and environmental monitoring. Quantum Error Correction: Research and development in quantum error correction techniques are crucial for mitigating the impact of errors and improving the reliability of quantum systems. By developing effective error correction codes and error detection methods, researchers can significantly enhance the stability and performance of quantum technologies. This can enable the creation of more robust and commercially viable quantum systems, making them reliable for practical applications and attracting investment and adoption.Overall, the project's focus on advancing spin qubits, developing novel materials and fabrication methods, exploring new qubit architectures, and enhancing qubit control techniques sets the stage for significant advancements in quantum technologies. The commercial viability and impact of these developments lie in their potential to revolutionize industries, enable new applications and services, enhance computing power and precision, and drive economic growth in various sectors.   The proposed work meets the definition of R&D, rather than straightforward engineering or incremental product development tasks: The proposed project clearly falls within the domain of research and development (R&D) rather than straightforward engineering or incremental product development tasks. Several aspects of the project highlight its alignment with the definition of R&D: Exploration of Novel Concepts: The project involves the research and development of spin qubits and quantum dots for various applications. This includes investigating new materials, fabrication methods, qubit architectures, and control techniques. The exploration of these novel concepts implies that the project seeks to push the boundaries of existing knowledge and technologies, which is a fundamental characteristic of R&D. Pursuit of Advancements: The project aims to advance spin qubits and quantum dots in terms of their performance, scalability, and sustainability. It emphasizes the development of new materials, fabrication methods, and control techniques, indicating an intent to achieve significant improvements beyond incremental enhancements. This pursuit of advancements aligns with the purpose of R&D, which aims to achieve breakthroughs and innovation. Addressing Technological Challenges: The project's focus on quantum computing, simulation, communication, sensing, metrology, and error correction demonstrates an intention to tackle complex technological challenges. These areas represent cutting-edge domains with ongoing scientific and technical uncertainties. By addressing these challenges through the development of novel materials, architectures, and control techniques, the project exhibits a high degree of technological risk and experimentation, characteristic of R&D endeavors. Potential for Commercial Impact: The project's objectives encompass a wide range of applications with commercial potential, such as quantum computing, quantum communication, sensing technologies, and quantum dot-based sensors and lasers. While the ultimate commercialization of these technologies may require additional steps beyond the research phase, the project's focus on developing the foundational elements necessary for commercial viability indicates an intention to create novel products, services, or processes that can have a significant economic impact. In summary, the proposed work involves the exploration of novel concepts, pursuit of advancements, addressing technological challenges, and potential for commercial impact. These characteristics clearly align with the definition of research and development (R&D), distinguishing the project from straightforward engineering or incremental product development tasks.

14. Briefly Describe the Market Opportunity?

The near-term commercial focus related to this technical project lies in addressing the market opportunities and customer pain points in various applications related to spin qubits and quantum dots. Here, we will discuss the customer profiles and pain points for three key areas of application: Quantum Computing: The customer profile for quantum computing applications includes industries and organizations that require high-performance computing capabilities for complex calculations and simulations. This includes sectors such as pharmaceuticals, finance, logistics, and materials science. The pain point in this domain is the inability of classical computers to efficiently solve certain problems due to their limited processing power. Quantum computing holds the promise of exponentially faster computations, and the commercial focus is to develop spin qubits, novel materials, and fabrication methods that can enhance the performance and scalability of quantum computers, ultimately addressing the pain point of limited computational capabilities. Quantum Sensing and Metrology: The customer profile for quantum sensing applications encompasses industries such as environmental monitoring, healthcare, and food safety. These customers require highly sensitive and accurate sensing technologies to detect and analyze various parameters. The pain point in this area is the need for improved precision, sensitivity, and reliability in sensing devices. By developing sustainable and less toxic quantum dots, and leveraging their properties for quantum dot-based sensors, the commercial focus is to address the pain point of suboptimal sensing capabilities and provide enhanced solutions for environmental monitoring, healthcare diagnostics, and food safety. Quantum Communication: The customer profile for quantum communication applications includes organizations and industries dealing with sensitive information and requiring secure communication channels. This includes government agencies, financial institutions, and data centers. The pain point in this domain is the vulnerability of traditional encryption methods to hacking and interception. Quantum communication offers the potential for secure transmission through quantum key distribution. The commercial focus is to develop spin qubits, explore qubit architectures, and advance control techniques to enable secure quantum communication protocols. This addresses the pain point of data vulnerability and the need for more robust and secure communication solutions. By addressing these customer pain points and developing innovative solutions through the research and development of spin qubits, novel materials, fabrication methods, qubit architectures, and control techniques, the project aims to seize the market opportunities in quantum computing, quantum sensing, and quantum communication. The commercial focus is to offer customers enhanced computational power, improved sensing capabilities, and secure communication channels, ultimately providing solutions that meet their specific needs and requirements.

15. Briefly Describe the Company and Team?

The team consists of only the solo founder - Ilakkuvaselvi Manoharan Ilakkuvaselvi (Ilak) Manoharan is a highly skilled and experienced professional based in Aurora, IL. With a diverse background in entrepreneurship, product management, research, and engineering, Ilak brings a unique set of skills and expertise to various industries. Ilak is currently the Founder, CEO, Scientist, Researcher, and Engineer at Curious & Connected NPO, an organization focused on research exploration, innovation, and product development. In this role, Ilak actively engages in scientific research, drives product development initiatives, and oversees the overall operations of the organization. Additionally, Ilak is involved in startup development and fundraising activities, demonstrating a strong entrepreneurial spirit. Furthermore, Ilak is the Founder, CEO, Scientist, Engineer, and Product Manager at Bubbles & Cafe, a venture that has applied for a utility patent for AIOS IoT Smart Restaurant. Ilak leads the innovation and product development efforts of Bubbles & Cafe, working towards revolutionizing the restaurant industry through the application of advanced technologies. As a strategic thinker and experienced product manager, Ilak combines scientific knowledge with business acumen to drive the success of the venture. Ilak's expertise extends to mobile app development, with a focus on iOS and Android platforms. With a portfolio of successful apps available on both the App Store and PlayStore, Ilak has demonstrated proficiency in Swift, Flutter, and other related technologies. Ilak's background also encompasses data engineering, data science, and backend development using technologies such as Java, Spring, Hibernate, RDBMS, NoSQL, and Python. Throughout Ilak's career, leadership, creativity, adaptability, and problem-solving skills have been key attributes that have contributed to success in various roles. Ilak has experience working in renowned companies such as JPMorgan Chase, Accenture, McDonald's, and Caterpillar, where they have held positions ranging from lead application developer to solution architect. Ilak holds a Master's degree in Electrical Engineering with a minor in Software Engineering from Texas A&M Kingsville, as well as a Bachelor's degree in Electronics and Instrumentation Engineering from the University of Madras. She have also acquired additional certifications in software development. Overall, Ilakkuvaselvi (Ilak) Manoharan is a multifaceted professional with a passion for entrepreneurship, innovation, and leveraging technology to drive positive change. Through her diverse skill set and experiences, Ilak is poised to make significant contributions in various domains, particularly in research, product development, and the advancement of the AIOS IoT Smart Restaurant concept.

16. How did you first hear about our program?

NSF email, webinar, or event

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.