View results

Respondent

9 Nishant Garg

43:35
Time to complete

ACKNOWLEDGMENT

1

Please read and acknowledge the following:

- SSC funding can take ****1 MONTH OR LONGER**** to receive after the SSC has voted to approve a project because it includes several steps:
  - the authorization of an award letter by SSC, iSEE, Division of Student Affairs, the project's advisor *(student-led projects only)*, and the project lead;
  - the creation of the CFOP by the project team's departmental financial contact in conjunction with the project team;
  - the transfer of funds from SSC to the project's CFOP.
- If you are a project lead for a new project that is approved by the SSC, be sure to check your email regularly for the prompt to sign the award letter to help facilitate the efficiency of the process.
- Project teams for funded SSC projects do NOT receive funds directly. After a project's SSC funds have been transferred to the project's CFOP, the project team must work with the sponsoring department to purchase the approved budgeted items on behalf of the project team.
- This application will be shared publicly on our SSC Illinois Climate Action Plan (iCAP) portal so that others can learn from your project.
- Funded projects have grant reporting requirements. See our website for more information.

*

◉ I acknowledge that I have read this information.

APPLICATION INSTRUCTIONS

Prior to starting your application, make sure you have the following information available:

- Project personnel including project lead, confirmed faculty/staff advisor ***(student-led projects only)***, departmental financial contact, other team members
- Working Group attendance information
- Project title and abstract
- Project description including timelines, deliverables, detailed description about the project, project feasibility information
- Intended student impacts
- Intended sustainability impacts
- Optional supporting documentation (e.g., Working Group presentation, letters of support)
- Detailed project budget information
- Information about changes to the Step 2 application submitted compared to the Step 1 application submitted

See our website for a sample application:
https://studentengagement.illinois.edu/studentsustainability/illinoisgreenfund/funding

2

Today's Date *

11/5/2025

3

Please tell us how you heard about the availability of SSC's funding for your sustainability project. *

- [x] I Have Received SSC Funding Previously.
- [ ] Instagram
- [ ] MassMail
- [ ] SSC's Newsletter
- [ ] Departmental Newsletter
- [ ] Digital Signage
- [ ] LinkedIn
- [ ] SSC Website
- [ ] SSC Board Member or Other Member of the Committee
- [ ] Other Project Teams that Received Funding
- [ ] Illinois Faculty or Staff
- [ ] At a Tabling Event
- [ ] General Word of Mouth
- [ ] Other

4

A follow up project presentation at a SSC Working Group meeting is *occasionally* requested of a project team prior to submitting their Step 2 application. Did someone from the project team present updates to their originally proposed Step 1 project at a SSC Working Group meeting this semester?

*

- ( ) YES
- (•) NO

5

Select the Working Group meeting you attended. *

- ( ) Energy + Transportation & Infrastructure Working Group Meeting
- (•) Food & Waste + Land, Air, & Water Working Group Meeting
- ( ) Education & Justice Working Group Meeting

6

Date of the Working Group meeting you attended. *

9/30/2025

7

What is the name of your project? *

Automated Waste Sorting via Computer Vision & Robotics: A Feasibility Study

8

Amount of funding requested from the SSC for this project *

The amount entered here must match the amount reflected in your detailed primary budget spreadsheet that you will be prompted to submit with this application.

$181,000

PROJECT DESCRIPTION

9

Project Category *

- ○ Education & Justice
- ○ Energy
- ◉ Food & Waste
- ○ Land, Air & Water
- ○ Transportation & Infrastructure

10

Project Abstract *

In approximately 100 words, describe your project.

Campus waste facilities process nearly 7,850 tons of material each year but achieve low diversion rates (19% in 2025), falling short of the Illinois Climate Action Plan (iCAP) Zero Waste goals. To address this challenge, our team installed cameras at the Waste Transfer Station and developed an initial AI model for real-time waste classification. While the prototype delivered promising results, it was trained on a limited dataset and constrained by single-camera coverage. Building on this foundation, the proposed project will expand the dataset (~2,000 to >10,000 labeled images) and integrate multiple cameras and weight sensors for real-time accuracy. In parallel, a robotics feasibility study will establish the foundation for future automation in waste sorting, contributing towards achieving iCAP goals.

11

What key changes are reflected in your Step 2 application compared to your Step 1 application, if any, and why? *

Compared to Step 1, this application provides technical detail and includes a visual presentation illustrating the concept and workflow.

12

Describe your proposed project in detail. Ensure the SSC has sufficient details to be able to evaluate the merits and feasibility of this project. *

Be sure to address the following:
-What are your project's goals and how do you intend to accomplish them?
-What are your project's deliverables?

The primary goal of this project is to improve waste diversion on campus by advancing automated waste classification and laying the groundwork for robotic sorting at the Waste Transfer Station. Each year, the University generates nearly 7,850 tons of waste, but only about 30% is diverted (19% in 2025), which is well below the Illinois Climate Action Plan (iCAP) Zero Waste goal of 80% by 2035. To address this gap, our team has demonstrated a proof of concept by installing cameras and developing an initial AI model capable of real-time waste detection, classification, and counting. Early results confirmed the potential of this AI-based approach but also revealed limitations such as a small training dataset and single-camera coverage, which constrain both detection accuracy and generalization.
Building on this foundation, the proposed project will expand and diversify the dataset of waste images, capturing data across different collection periods and lighting conditions to enhance model robustness. Multiple RGB cameras will be installed along the conveyor belt at the Waste Transfer Station to capture waste streams from different viewpoints, ensuring comprehensive video coverage. In addition, weight sensors will be integrated to generate real-time weight data, linking visual classification with quantitative measurements of diversion. All visual and weight data will be collected continuously, annotated using Roboflow for high-quality labeling, and stored in a secure cloud environment. The refined dataset will then be used to retrain the AI model using the YOLOv12 (you only look once, version 12) architecture, optimized for real-time object detection and classification. Moreover, data from the upgraded system will also feed into a campus-facing dashboard visualizing waste composition, diversion trends, and overall environmental impact.
In parallel, the project will include a feasibility study on robotic integration, focusing on the potential deployment of a robotic arm for automated waste sorting. This study will assess the technical requirements for motion control, object recognition, and material handling, as well as the compatibility of robotic systems with the conveyor setup at the Waste Transfer Station. It will also establish performance benchmarks such as sorting speed, accuracy, and safety, while evaluating cost, scalability, and maintenance considerations. The findings will provide a roadmap outlining the equipment recommendations and plans for a pilot robotic sorting setup.
The deliverables from this project will include an expanded and annotated dataset of waste images, an upgraded AI classification system enhanced with multimodal inputs, installed hardware upgrades (cameras and weight sensors), and a campus-facing dashboard to visualize waste diversion data. In addition, the project will deliver a feasibility report on robotics that outlines technical requirements and cost analyses. Together, these outcomes will accelerate progress toward achieving the iCAP Zero Waste goal of 80% diversion by 2035, while also demonstrating how technology-driven solutions can reduce landfill dependency and support sustainable waste management practices.

13

List your proposed project's timeline and major milestones. *

NOTE: SSC funding agreements remain active for two years. Thus, your timeline should reflect your activities over a two year period or less.

Over two years, the project will progress through sequential phases with clear objectives. In Q1 2026, a literature review will be conducted to align the project with current advances in AI-based waste management and robotic sorting. During this phase, the team will also finalize technical specifications for cameras, sensors, and data storage.
From Q1 to Q2 2026, the project will focus on installing and calibrating multiple RGB cameras and industrial weight sensors at the Waste Transfer Station, establishing the foundation for continuous data collection. Beginning in Q2 2026, image and weight data will be collected, processed, and annotated through a standardized labeling workflow to create a comprehensive dataset of over 10,000 images. The enriched dataset will then be used to retrain the YOLO model, with performance validation continuing through Q3 and Q4 2026 to ensure robust classification performance under operational conditions.
From Q1 through Q3 2027, a robotics feasibility study will be carried out, including a review of existing technologies, system requirements, and cost considerations. Finally, in Q3 to Q4 2027, the project will conclude with a comprehensive final report that summarizes all outcomes, including the validated AI models, expanded dataset, installed hardware, and recommendations for robotic integration.

14

Have you spoken with anyone in UIUC's Facilities & Services (F&S) department regarding the feasibility of your project? *

NOTE: While this step is optional for many projects, all projects involving infrastructure (e.g., internal or external physical infrastructure of university buildings, etc.) or grounds (e.g., plantings, installing structures on campus grounds, etc.) must have F&S approval prior to receiving SSC funding. If you need assistance evaluating the feasibility of your proposed project, please reach out to SSC-Advisor@illinois.edu PRIOR to submitting your application.

- (●) YES
- ( ) NOT YET
- ( ) N/A

15

With whom in the Facilities & Services department did you speak and when did you speak with them? *

Daphne Hulse, Zero Waste Coordinator

STUDENT IMPACTS

16

How many students will be directly impacted by this project? *

Six, (2 graduate and 4 undergraduate students)

17

How many students will be indirectly impacted by this project? *

~60000

18

What is the intended student impact? *

Be sure to address the following:
-How will this project benefit students?
-How will students be involved with this project?
-What educational components are in your project?

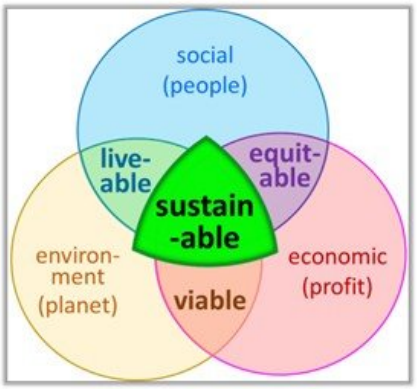
This project will provide students with direct opportunities to engage in real-world sustainability challenges. Students will actively participate in collecting and annotating images of waste, training and refining AI models, and assisting with the installation and monitoring of cameras and weight sensors at the Waste Transfer Station. Through these hands-on activities, they will gain practical experience in computer vision, data analysis, and systems testing, while also building transferable skills in teamwork, project management, and problem-solving. The project will also produce a campus-facing dashboard that displays real-time waste diversion data, creating a valuable resource for coursework, research projects, and campus engagement. By making waste data transparent, the dashboard will raise awareness across the student body, encourage responsible recycling practices, and promote sustainable behavior.
The project will also encourage student participation in outreach activities such as Zero Waste awareness events, giving them opportunities to lead outreach initiatives, present results, and engage the broader campus community. Through these efforts, students will strengthen their leadership skills, deepen their understanding of sustainability, and make tangible contributions to UIUC's iCAP Zero Waste goals.

SUSTAINABILITY IMPACTS

19

Authentic sustainability consists of the overlapping area of 3 spheres: Environment, Society, and Economy.

Describe how your project addresses sustainability. *



This project advances sustainability by integrating environmental, social, and economic benefits.
Environmentally, it reduces landfill dependency by improving the accuracy of waste diversion, helping the University progress toward the Illinois Climate Action Plan (iCAP) Zero Waste target of 80% diversion by 2035. Enhanced recovery of recyclables will lower greenhouse gas emissions by preventing methane generation from landfills and reducing the need for energy-intensive extraction of raw materials. Recycling materials such as aluminum, paper, and plastics conserves both energy and water while reducing the University's overall carbon footprint. The use of AI-based monitoring further enables continuous measurement and verification of progress, promoting data-informed sustainability practices.
Socially, the project builds transparency and engagement through a campus-facing dashboard that visualizes real-time waste diversion performance. This resource will not only inform students, faculty, and staff but also foster a culture of shared responsibility by making the impact of individual actions visible. In addition, the system reduces manual sorting requirements at the Waste Transfer Station, improving worker safety and operational efficiency.
Economically, higher diversion rates reduce landfill tipping fees and transportation costs while improving recycling efficiency. Over time, the scalable automation framework established through this project can lead to significant cost savings for Facilities & Services (F&S) by optimizing waste processing operations. Together, these outcomes will drive UIUC toward a more sustainable, data-driven, zero-waste future while inspiring similar initiatives at other campuses.

20

How does your project promote and increase environmental stewardship at UIUC? *

If applicable, also address what the carbon, water, waste, and/or energy savings is associated with your project.

This project promotes environmental stewardship at UIUC by making waste management transparent and data-driven. The integration of AI-based image classification, weight sensors, and real-time monitoring will create a continuous feedback system at the Waste Transfer Station, allowing the University to track waste composition and diversion progress with greater accuracy. The results will be visualized through a publicly accessible dashboard, fostering awareness and accountability among students, faculty, and staff.
Environmentally, improved sorting and diversion will reduce landfill dependency, lower methane emissions from decomposing waste, and significantly cut the campus's carbon footprint. Recycling also conserves resources; for example, aluminum recycling uses ~95% less energy and water, and paper recycling reduces emissions by ~40%. By recovering a greater share of recyclable materials and minimizing waste sent to landfills, the project will not only reduce emissions and conserve energy and water but also foster a stronger culture of sustainability on campus.

21

Does your project aim to advance one or more of the Illinois Climate Action Plan's (iCAP) objectives? If so, indicate which and describe how. If not, enter N/A.

A full list can be found here: https://icap.sustainability.illinois.edu/objectives

This project directly advances multiple Illinois Climate Action Plan (iCAP) objectives within the areas of Zero Waste and Education. It supports Objective 5.2 (Reduce Landfilled Waste) by improving waste classification accuracy with AI-enabled cameras, an expanded dataset of waste images, and integrated weight sensors. These upgrades will decrease landfill dependency and contribute to achieving the University's 80% diversion target by 2035. The project also advances Objective 5.2.1 (Install Appropriate Infrastructure) by deploying cameras and sensors at the Waste Transfer Station to strengthen real-time monitoring and data-driven decision-making. Additionally, it aligns with Objective 5.3.1 (Zero Waste Messaging Campaign) by developing a campus-facing dashboard that visualizes waste diversion performance, engages the campus community, and encourages responsible recycling behaviors. Finally, it supports Objective 6.1 (Broaden Sustainability Education) by making transparent waste and diversion data available to students, faculty, and staff, fostering greater awareness, accountability, and participation in UIUC's sustainability initiatives.

PROJECT LEAD

22

Project Lead's Full Name *

Nishant Garg

23

Project Lead's Department *

Civil and Environmental Engineering

24

Project Lead's University Email Address *

nishantg@illinois.edu

25

The Project Lead must be a UIUC faculty, staff, or currently enrolled student. Which category describes the Project Lead's primary role at the university? *

- ( ) Currently enrolled UIUC student
- (•) UIUC faculty
- ( ) UIUC staff

PROJECT'S FINANCIAL CONTACT

The project's Financial Contact must be a full-time Illinois employee who has the authority to make university purchases, manage the project's financials, and generate financial reports on behalf of the project.

26

Financial Contact's Full Name *

Griffin Knight

27

Financial Contact's Department *

Civil and Environmental Engineering

28

Financial Contact's University Email Address *

gknight@uillinois.edu

29

Are there additional members of your project team? *

- (•) YES
- ( ) NO

ADDITIONAL TEAM MEMBER

30

Team Member's Full Name:

Muhammad Ayyan Iqbal

31

Team Member's Department/Campus Affiliation:

Civil and Environmental Engineering/Graduate Student

32

Team Member's University Email Address:

maiqbal2@illinois.edu

33

Do you have additional team members? *

- (●) YES
- ( ) NO

ADDITIONAL TEAM MEMBER

34

Team Member's Full Name *

Daphne Hulse

35

Team Member's Department/Campus Affiliation *

Facilities & Services/Zero Waste Coordinator

36

Team Member's University Email Address *

dlhulse2@illinois.edu

37

Do you have additional team members? *

- (●) YES
- ( ) NO

ADDITIONAL TEAM MEMBER

38

Team Member's Full Name: *

Saurabh Gupta

39

Team Member's Department/Campus Affiliation: *

Electrical & Computer Engineering/Associate Professor

40

Team Member's University Email Address: *

saurabhg@illinois.edu

SUPPORTING DOCUMENTATION

41

OPTIONAL: Attach any letters of commitment or support here along with any supplemental media that will support your application (presentations, photos, etc.).

Letter of Support F&S_DH_signed_Nishant Garg.pdf

AI_SSC_Pitch_Step 2_Nishant Garg.pptx

PROJECT FINANCES

42

Describe in detail how SSC funds will be used in your project.

NOTE: Only address the use of SSC funds, specifically, even if the project will be funded by multiple sources.

To achieve the proposed objectives, the SSC funds will be used to support both project infrastructure and student involvement. $25,000 will cover the material testing, procurement of essential equipment, including cameras, weight sensors, and components for the robotic feasibility study. To ensure student engagement, $120,000 will fund two graduate students for two years, and $24,000 will support four undergraduate students over the same period for work on data collection, annotation, AI model training, and outreach. In addition, $5,000 is allocated for publications and presentations to share project findings, while $7,000 will fund hourly F&S staff at the Waste Transfer Station to assist with equipment setup.

43

If you receive SSC funding, will your project require additional sources of funding to achieve your project's overall goals? *

NOTE: SSC cannot guarantee financial support beyond that provided in an approved funding agreement.

- ○ YES
- ◉ NO

44

Has your project team or department previously been awarded funding from the SSC for the same or a similar project? *

- ◉ YES
- ○ NO

45

What is the total amount of SSC funding received to date for the same or a similar project by the project team/department submitting this application? *

$96600

46

Download, complete, and submit the **SSC-Budget-Timeline_NEW APPLICATION_template** file linked below. Please be very detailed so that the SSC can fully evaluate the merits of your funding request. **We STRONGLY recommend providing alternate budgets in addition to your main budget in case SSC cannot fully fund your project. There are alternate budget tabs in the template.**

https://studentengagement.illinois.edu/sites/default/files/2024-09/SSC-Budget-Timeline-NEW-APPLICATION-template.xlsx
*

SSC-Budget-Timeline-NEW-APPLICATION-template_Nishant Garg.xlsx