Group Name - PSYDUCK

1. Aaradhya Rohi - 230011
2. Anjali Patra - 230148
3. Lipi Khandelwal - 230603
4. Marisha Thorat - 230637
5. Vaibhav Arya - 231112
6. Yuvraj Kumar - 231204

EARTHSHOT PRIZE

Clean Our Air

SolarClean: An Affordable, Sustainable Air Purifier

1.Problem Identification: Air Pollution in India

Environmental Issue

Air pollution is something which has plagued the world alike and posed many public health challenges, especially in India. Some of the world's most populated cities can be found in India, including Delhi. In 2017, Kanpur reported an annual mean PM2.5 concentration of 207 $\mu g/m^3$. This highlights the severe air pollution issue this region faces and underscore the urgent need for strategies to mitigate air pollution and safeguard public health.

Indoor air pollution is also severe, especially in rural and low-income urban areas, because of the use of biomass fuels like cow dung and wood for cooking, which create a plethora of smoke.. Poor ventilation and outdoor pollutants seeping into houses makes this issue even worse.

Relevance and Urgency

Health Impacts: Air pollution is one of the leading causes of deaths in India, being a reason for over 1.67 million deaths every year according to Lancet, 2020. It is a primary cause of several serious health problems like asthma, pulmonary disease, lung cancer, etc. Young children and the elderly are most susceptible to this issue, along with people already suffering from health conditions.

Economic Burden: Air pollution costs India around $95 billion a year according to the World Bank in 2022 due to healthcare expenses and lost productivity. Bad air quality lowers work efficiency and makes more people absent from work due to bad health and thus slows down the economic growth of our country.

.**Environmental Degradation:** Air pollution exacerbates the climate change in our world by adding greenhouse gases to the atmosphere, which then leads to snow and ice caps melting and many more devastating changes like damaging ecosystems and crop yields and lowering biodiversity.

Social Inequity: Economically challenged groups in our society are hit the hardest by air pollution because they don't have the money or the means to afford expensive solutions to air pollutioon and they are resigned to live in crowed and highly polutated areas. Women and children are at more at risk of indoor air pollution.

India-Specific Challenges

Outdoor Pollution Sources: Emissions from vehicles, smoke from industries, construction dust and crop burning are the primary contributors to outdoor air pollution. Cities like Delhi, Mumbai and Kolkata consistenly are ranked the most polluted in the world.

Indoor Pollution Sources: Most of the rural and some urban households still rely on buring solid fuels like wood, cow dung etc for cooking. This leads to high levels of indoor air pollution. Poor ventilation in crowded slums and rural houses only makes this worse.

Geographical and Climatic Factors: Crop burning by farmes in Punjab and Haryana and low wind speeds in winter leads to the formation of deadly smong in northern India, especially Delhi. Dust storms are also a major cause.

Policy and Implementation Gaps: While India has launched initiatives like the National Clean Air Programme (NCAP), implementation remains slow due to inadequate funding, lack of public awareness, and insufficient enforcement of regulations.

Why a DIY Air Purifier is Relevant for India

Affordability: Commercial air purifiers are very expensive, costing between ₹10,000 to ₹30,000. This is not something an average middle class family in India can afford. To solve this issue, a DIY air purifier can be built for very cheap and with easily available local material.

Energy Efficiency: Most areas in India still face frequent power cuts, hence a solar powered air purifer can be an effective solution to this.

Scalability: The simplicity and cost efficiency of the design makes mass implentation easy, especially in rural and low-income urban areas and can be promoted by NGOs and workshops.

Immediate Impact: With air pollution levels often becoming many times over the WHO's safe limits, especially during winter, a low-cost, effective solution is urgently needed to protect public health.

2. Research & Context Analysis

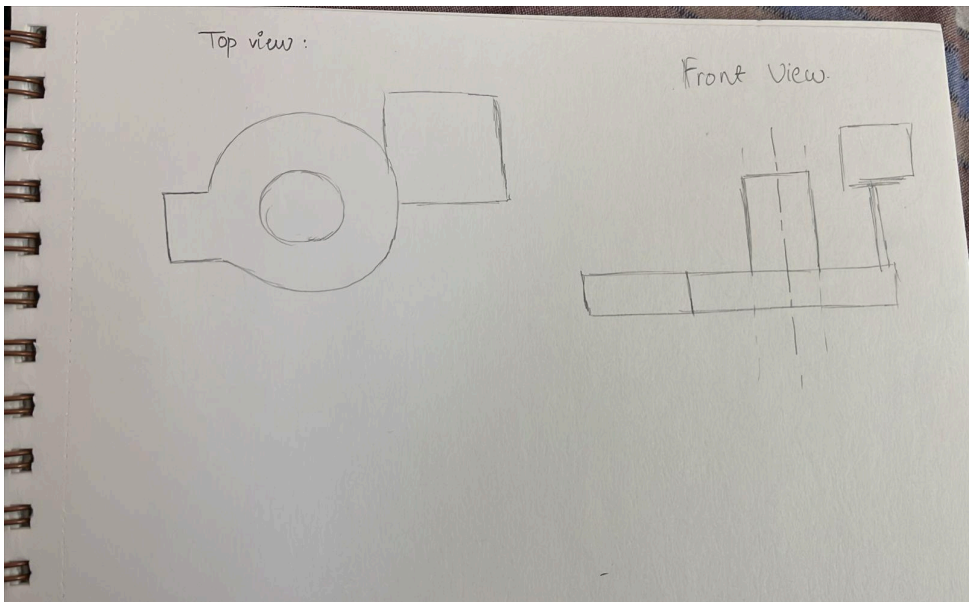
Current air cleaning technologies broadly fall into two categories: high-end commercial products and low-cost options. Although commercial products provide sophisticated filters and intelligent controls, they are grid-dependent and not affordable, which renders them unsuitable for low-income or rural communities. However, most low-cost schemes posted online hardly use renewable energy, which leaves a huge gap for an ultra-low-cost option.

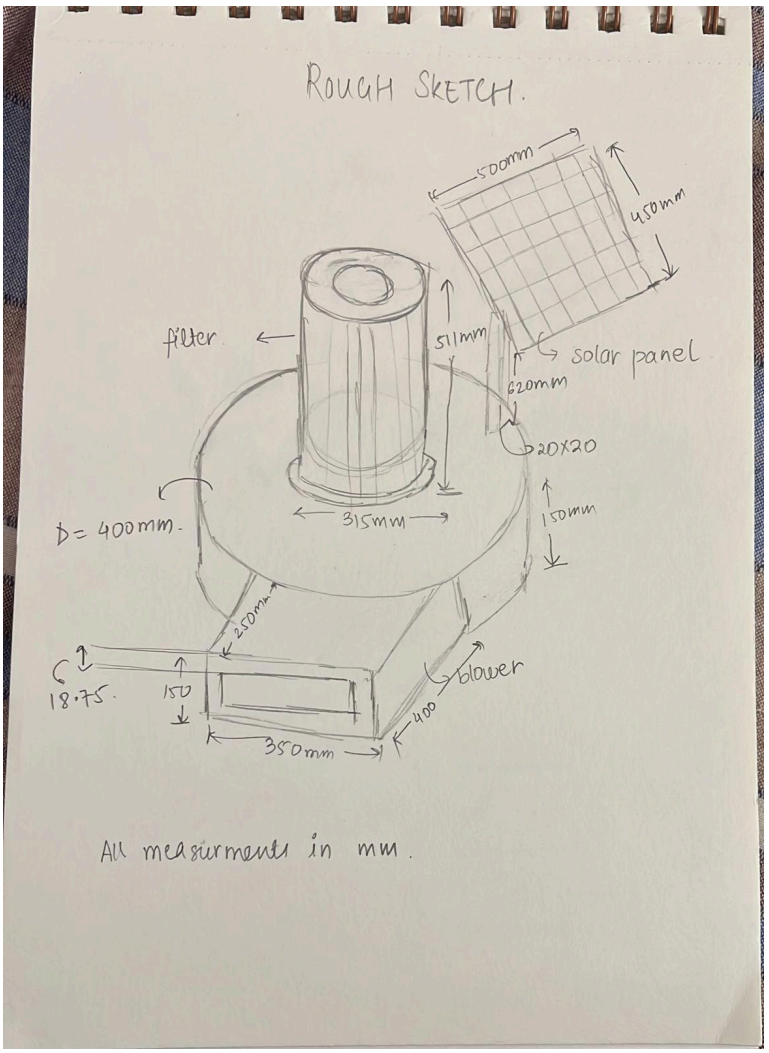
This provides a one-of-a-kind chance to create an independent grid-based solar-powered air purifier for an affordable price. By keeping cost-effectiveness, simplicity, and local scalability in mind—adopting materials and components found locally—the device can be made easy to maintain and mass-scale for individual use in homes and community centers. The outcome is a strong, energy-independent solution that enhances indoor air quality for under-resourced communities without placing a financial burden.

3. Concept Development

Our innovative idea is to create a self-sustaining air purifying system comprising a blower, a HEPA filter, and a solar panel. In our design, we use a standard blower and remove the front grill such that there is a flat surface where we can attach a high-efficiency HEPA filter firmly with forceful straps or adhesive tape in such a way that there is no air leakage. The blower pressure pushes air constantly through the HEPA filter, which captures dust, allergens, and other particles. In order to have the system operate independently of power and be more environmentally friendly, we include a tiny solar panel that recharges the battery, and it drives the blower even on low light days. This technique not only preserves consistent, efficient air cleaning but also preserves minimal overall expense, thereby making it a practicable solution for improving indoor air quality in low-resource settings.

Our initial sketches can be seen here :





4. Feasibility & Impact

Practicality in Practical Use

1. **Power Source & Reliability**
   Solar power drives the purifier, making it electric grid-independent.
   Excess energy is stored by a rechargeable battery, providing 24/7 use through periods of low sunlight.
   Its compact and portable construction guarantees that placing the system is simply accomplished within domestic, office, and school settings.
2. **Material & Cost Considerations**
   Uses inexpensive and widely available material like polycarbonate casing, HEPA filter, and blower.
   Utilization of small-sized solar panels (5W-10W) keeps production cost low while efficiency is preserved.

Modular build allows for easy solar element and filter replacement, ensuring durability.

3. **Ease of Use & Maintenance**

   Low maintenance—clean every few months/replace filters or blower, no other maintenance required.

   Low operation noise, perfect for home and office settings.

4. **Social Benefits**

   It reduces AQI , making air breathable . It also reduces any risk of asthma or any other respiratory disease.

5. **Economic Benefits**

   It is useful for the areas where there is no electricity as it runs on solar panel, also making it economically sustainable as it cuts down electricity costs.

6. **Environment Benefits**

   It reduces carbon emissions making our environment cleaner.

   It's component can be recyclable causing minimum e-waste.

5. Implementation Strategy

Our implementation strategy for the solar-powered air purifier begins with a focused development phase where all key components—the blower, HEPA filter, and solar panel—are integrated into a cohesive design. During this stage, we have created CAD model and sketches. The blower will be carefully paired with the HEPA filter to optimize airflow.

Following the initial development, the prototype will undergo rigorous testing. Functionality testing will evaluate airflow and filter efficiency in varying situations, and solar charging tests will measure the panel's performance at varying light intensity and angle. Reliability and safety testing, such as long cycle and environmental exposure testing, will reveal any weaknesses and ensure all electrical components are in compliance with safety standards.

As we move along in scaling, the design will be made modularity-optimized. Not only does this ensure easy replacement of components, but it also ensures easier assembly, which is ideal for mass production. We plan to reduce the bill of materials by working with suppliers to purchase in bulk, thereby cutting costs without compromising on quality.

A challenge is creating air-tight seals around filters to prevent air leakage that could compromise efficiency. Another is accessing high-quality HEPA filters at a moderate price for bulk use. To aid in addressing these challenges, we will use solid adhesive tape or straps to secure filters firmly and prevent leakage. Moreover, buying filters in bulk will save money and make the design for bulk manufacture easier.

6. Presentation & Communication

As I entered into the IITK campus, I had many expectations about hostel life, as this was the first time I would stay away from my parents. While most of my expectations have been fulfiled like midnight Maggi, endless gossip and fun with friends, sprinkled with the

occasional panic about quizzes and exams and assignments, one problem has stood first and foremost and that is my next door neighbour. Aditi(name changed) next door—smokes like her life depends on it, and it probably does but for the worse. Every night, our room filled up with so much smoke, I half expect an apocalypse. Waking up feels like crawling out of a smoggy Delhi winter—throats sore, noses stuffed, and lungs absolutely hating us.

The obvious fix? An air purifier. The problem? I am broke. So, we did what all desperate, resourceful students do—we built our own. After deep-diving into wikipedia and the like and watching way too many YouTube videoes, we managed to put together a solar-powered air purifier.No cost other than the material, no extra electricity bill, just clean air free from Aditi's smoke.

Here's the thing—if we solved it for ourselves, why not for others? Frustration sparked innovation, proving the best ideas come not from eureka moments, but from sheer persistence.