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Illumbrella - An Umbrella that Shines the Lives by Lighting, Charging, Protecting and Empowering Communities

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Abstract: ***Umbrella that shines the lives i.e. Illumbrella is a multipurpose smart umbrella that transforms a familiar, everyday object into an affordable utility platform for lighting, cooling, charging, hygienic sheltering, public communication and source of income. It was conceived in 2019 after observing the realities of village life during monsoons when rains coincide with power cuts and people are left in darkness without a free hand to hold a torch. The Illumbrella integrates LED lighting on the canopy ribs, a compact DC fan for heat protection, and a solar-to-USB charging module built around the IC 7805 regulator. A detachable tarpaulin sheet expands the protective footprint to cover the stall or walking area, improving hygiene and blocking sideways rain. In addition, the canopy surface doubles as advertising real estate for social messaging or sponsor branding, enabling donation-based distribution models. This paper documents the narrative arc from problem observation to proof-of-concept, presents design details and discusses performance, field use-cases, safety, and scalability for rural and urban contexts. The work exemplifies grassroots, frugal innovation and demonstrates how small, human-centered improvements can unlock outsized social value.***

Keywords: Illumbrella, Smart umbrella, umbrella with light, umbrella with mobile charging, umbrella for street vendors, hygiene tarp, frugal innovation, rural resilience, grassroots innovation, public advertising, solar for mobile charging.

1. Introduction

In India's villages, the arrival of monsoon rains often means sudden darkness. Power supply can be unreliable, and when electricity fails at night, daily life pauses, food vendors cannot keep stalls open, walkers cannot navigate muddy lanes, students cannot study, and families cannot continue household chores. A torch, if available, remains inconvenient because both hands are already committed, one to holding the umbrella and another to managing bags, goods, or children. The simple umbrella ubiquitous, portable, and affordable presents a compelling foundation for solving this cluster of problems. Illumbrella emerged from this context as a human-centered response. By integrating illumination into the umbrella itself, it restores mobility and dignity during rainy nights without asking the user to juggle extra gadgets. By harvesting solar energy during the day and storing or regulating it to 5V USB, it enables off-grid charging of mobiles and low-power household lamps without dependence on the grid. By adding a small DC fan, it supports safe outdoor work during peak summer, reducing heat stress. And by attaching a hygiene-focused tarpaulin skirt around the canopy, it extends the protective envelope over a vendor's table or a caregiver's space, blocking horizontal rain and improving cleanliness. Finally, the canopy doubles as an advertising surface, allowing sponsors and governments to underwrite costs while broadcasting public-interest messages directly to communities. In addition, the Illumbrella offers street vendors an extra source of income by providing space for advertising to these sponsors.

2. Problem Statement

The core challenges addressed by Illumbrella are:

- Night-time darkness during rain and power cuts, leading to unsafe mobility and interrupted livelihoods.
- Lack of hands-free lighting, even when torches exist, users cannot dedicate a hand to hold them while also using an umbrella.
- Absence of convenient charging options for mobile phones in off-grid or outage conditions.
- Exposure to extreme heat in summer during outdoor work.
- Poor hygiene at street stalls due to sideways rain, splashes and dust.
- High cost of reaching grassroots audiences with public-interest messaging and local advertising.
- A lack of reliable passive income opportunities for street vendors remains a persistent challenge.

3. Objectives

Illumbrella aims to transform a conventional umbrella into a multifunctional, low-cost platform that:

- Provides hand-free lighting for safe, dignified night-time mobility during rain and outages.
- Ensures uninterrupted access to power for households, supporting education and livelihoods during outages.
- Harvests solar energy to power 5V USB charging for mobiles and small LED lamps, including emergency household lighting.
- Mitigates heat exposure with an integrated DC fan.
- Enhances stall hygiene and weather protection through a detachable tarpaulin skirt.
- Creates an advertising surface for social messaging and sponsor branding to enable donation-led distribution.
- Empowers street vendors with an ongoing stream of passive income by leveraging the umbrella's multifunctional features and advertising space.

4. Design and Implementation

Illumbrella's design philosophy is frugal, uses widely available components, keep assembly intuitive, and maintain reparability in local markets. The base model integrates LED lighting on the ribs, a compact DC motor with fan blades centrally mounted, a solar panel feeding an IC 7805 regulator for 5V USB output and a detachable tarpaulin skirt with quick ties along the canopy's hem. Wiring harnesses are tucked along ribs and the shaft, with toggle switches positioned for gloved/wet-hands operation. The battery source follows the original concept notes (9V batteries), while acknowledging options for rechargeable packs in future revisions. The following table outlines the components and costs, demonstrating the cost-effectiveness of this innovative modification.

Table 1: Components and Cost

Component	Quantity	Unit Price (INR)	Total (INR)
Umbrella (base canopy & frame)	1	200	200
LED lights	4	5	20
Battery source (9V)	3	15	45
DC motor (miniature)	1	10	10
Fan wings	1	5	5
Switches (toggle/push type)	2	5	10
Wire (approx. meters)	4	5	20
Electrical tape / heat-shrink	1	10	10
Subtotal (without solar & hygiene sheet)	-	-	320
Solar charging circuit (Solar panel + IC 7805 + USB jack) Without Charge controller.	1	100	100
Tarpaulin Sheet for hygiene and protection	1	100	100
Total (with charger & hygiene sheet)	-	-	520

5. Electrical Schematics

The following conceptual schematics illustrate the lighting, cooling fan, and solar-to-USB charging subsystems. They are intentionally simplified for clarity. If rechargeable batteries are introduced, a compatible charge controller (e.g., for Li-ion or NiMH) must be added to protect cells and ensure longevity.

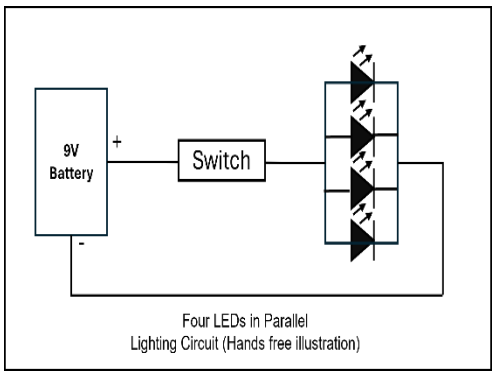

Figure 1: Lighting circuit: 9V battery - switch - four LED branches - ground.

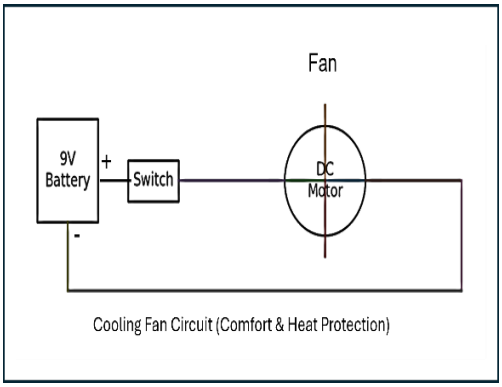

Figure 2: Fan circuit: 9V battery - switch - DC motor (Fan) - Return path to battery negative.

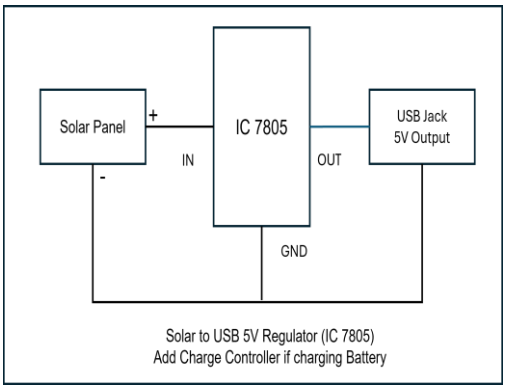

Figure 3: Solar to 5V USB regulator: Solar panel - diode (reverse-flow protection) -IC 7805 with input/output capacitors - USB 5V output; common ground.

6. Field Narratives & Use-Cases

- **Villager during Monsoon Night:** Power fails; rain intensifies. The Illumbrella's rib LEDs cast a stable cone of light, freeing one hand for safe walking while carrying supplies.
- **Household Outage:** The solar-charged battery supplies 5V to a small LED bulb or charges a mobile, keeping communication and minimal lighting available. Student uses for study purposes, improve lighting during outages.
- **Street Vendor:** The tarpaulin skirt covers the stall perimeter, blocking horizontal rain and maintaining hygiene; onboard lighting improves visibility for customers and fan provides the cooling in daytime. On to space utilized for advertising generate additional income. A step towards self-reliant.
- **Daily Wage Worker / Walker:** During the day, the USB port charges a mobile en-route between worksites; during summer, the fan reduces heat stress during rest breaks.
- **Sponsored Distribution:** An NGO or local government sponsors Illumbrellas with public health messages printed on the canopy, distributing them to at-risk groups. Championing a social cause transforms intention into impactful action.

7. Performance, Safety, and Maintenance

Lighting performance depends on LED selection and resistor values; parallel branches offer graceful degradation if a single LED fails. The DC fan provides airflow adequate for personal cooling at low power draw. The 7805-based regulator

supplies a stable 5V output within its thermal and current limits adequate heat dissipation and correct capacitor values are recommended. Safety practices include waterproofing switch interfaces, strain-relieving wires along the ribs, insulating joints with heat-shrink or tape, and ensuring that metallic frames are isolated from conductors. Periodic checks for moisture ingress and connector corrosion extend service life.

8. Hygiene Tarpaulin & Advertising for Livelihoods

A detachable tarpaulin skirt fastens along the canopy hem using toggles or Velcro ties, forming a protective curtain around the stall footprint. This minimizes splash, dust, and sideways rain, improving food hygiene and product cleanliness, critical for vendor trust and regulatory compliance in urban markets. The canopy fabric itself is a prime surface for high-visibility messaging. Sponsor branding and government advisories reach exactly where they matter: streets, markets, bus stands, and rural haats. This creates a viable CSR-backed model in which advertisers subsidize or donate Illumbrellas to end users at low or zero cost. Figure 4 below is a placeholder for the user-provided painting that illustrates the street vendor application with advertising and the hygiene tarpaulin sheet.

Figure 4: Illumbrella street vendor setup - advertising + hygiene tarp [Painting by Mr. Amit Gaonkr, SVHS]

9. Advertising as an Additional Source of Income

Beyond its functional benefits, Illumbrella offers a unique livelihood opportunity for street vendors. The canopy serves as a visible advertising medium, enabling local businesses, NGOs, and government agencies to display promotional content. This model not only offsets the manufacturing cost through sponsorships but also provides vendors with an additional income stream. By hosting advertisements, vendors can earn support while sponsors reach grassroots audiences directly in markets, streets, and fairs. The illustration above (user-provided) demonstrates how Illumbrellas double as protective stalls with hygiene tarpaulins and as mobile advertising billboards, ensuring both comfort and income.

10. Recognition and Origin

Illumbrella was conceived and built in August 2019 by author at the age ~7 years while in the 2nd standard. The prototype earned wide publicity and secured the first prize at a Science Exhibition in December 2023. Bolstered by national recognition and crucial grant support, the project stands poised for transformative growth. This recognition underscored the power of youth-led, need-driven innovation and encouraged broader conversations about practical assistive technologies for villages and informal urban economies. In March 2024, the Department of Science and Technology (DST), Government of India, recognized the innovation through the Inspire-Manek award and support its development.


सकाळ

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विधायक

छोट्या शास्त्रज्ञाची कल्पकता : सोशल मिडियावर

Figure 5: Illumbrella news in Daily Sakal, August-2019

Figure 6: Illumbrella presented in Science Exhibition at Mumbai in December 2023

Figure 7: Illumbrella presented in Science Exhibition at Mumbai in January 2024

11. Limitations and Future Work

Several enhancements are planned to migrate from primary 9V cells to rechargeable packs with appropriate charge controllers, adding weather-sealed connectors, modular fan and lighting kits for easy replacement, higher-efficiency buck converters in place of linear regulation for improved runtime, reflective edging for road safety, and standardized mounting points for accessories such as small sirens or GPS trackers for vendor safety. Field trials spanning multiple districts will rigorously assess Illumbrella's durability, charging efficiency, and hygiene impact across varying monsoon conditions.

12. Conclusion

Illumbrella reframes an age-old object as a platform for safety, dignity, and livelihood. By fusing lighting, cooling, solar charging, hygiene protection, and public messaging into a single frugal device, it addresses a tightly coupled set of problems faced by villagers, street vendors, and outdoor workers. This evolution from a simple sheltering device to an innovation that illuminates and uplifts livelihoods demonstrates the transformative power of observation, empathy, and persistent tinkering. By uniting corporate sponsorship with grassroots needs, Illumbrella stands as proof that practical solutions can scale sustainably, empowering communities and creating lasting impact. National recognition, including the DST Inspire–Manek award, further underscores its relevance and scalability for broader adoption.

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Author Profile

Arjit Amol More is a student of Swami Vivekanand English High School, Mumbai studying in standard VIII. He is widely recognized as a young science speaker, motivator, grassroots innovator, and a keen physicist of his age. His flagship innovation Illumbrella (2019) published herein above, won the first prize in science exhibition (2023) and a DST Inspire–Manek Award (2025). In 2024, he secured the Gold Medal in the prestigious Homi Bhabha Balvaidnyanik Competition, and he has also won several gold medals in Olympiads. Beyond Illumbrella, Arjit has developed innovations such as hair accessories from orange peel bioplastic, an automatic shoe shiner, and a physiotherapy device. Through his YouTube channel, Littlentist, he inspires children to explore science and technology. He has been interviewed by All India Radio for his contributions as a young innovator. His vision is to establish a Science and Innovation Centre in the country, empowering rural inventors and fostering interdisciplinary research. Passionate about blending science, empathy, and entrepreneurship, Arjit aspires to build sustainable solutions that improve lives and strengthen communities.