

# Design and Fabrication Beach Cleaning Machine

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## ABSTRACT

Beach pollution caused by plastic waste, bottles, seaweed, and other debris has become a serious environmental problem affecting marine ecosystems and tourism. Traditional manual cleaning methods are time-consuming, labor-intensive, and inefficient for removing waste mixed with sand. To address this issue, the present project focuses on the design and fabrication of a beach cleaning machine that can efficiently separate waste materials from sand. The machine operates using a conveyor-based mechanism combined with a perforated sieve that allows sand to fall back while collecting waste in a hopper. The system is powered by an electric motor and utilizes a chain and sprocket mechanism for power transmission. The proposed machine is designed to be simple, cost-effective, and easy to operate, making it suitable for small and medium-scale beach cleaning applications. Structural components such as the frame, shaft, bearings, and drive system are carefully selected to ensure durability and reliability under working conditions. The fabricated model was tested under practical conditions and demonstrated effective waste separation and improved cleaning efficiency compared to manual methods. This machine provides a sustainable solution for maintaining beach cleanliness, reducing human effort, and supporting environmental conservation.

## 1. INTRODUCTION

The coastal area beaches are main attraction for tourism, so in attracting tourist the beach must be kept clean. For the purpose of cleaning the beach, some cleaning machine must be used so we have manufactured a cleaning machine which is helpful in cleaning the beaches. The motor is responsible for driving mechanism of conveyor. The strainer attached to the conveyor will collect the wastages from the

surroundings and transferred to storage bucket through conveying belt As today's era is moving towards being digitalized and automated with a great speed, the youth want everything very easily and smart. Not only the youth but the people of all generation are finding it very easy to be smart effort and more and more being healthy and are getting attracted or joined towards latest technology of being "smart work". Anywhere you go, you get this technology available. So we thought of using this technology and adding more to it for our final year project. Nobody likes to suffer and wait for our long waiting hours just to get good surrounding or so. To avoid this and to save time of our management of waste we are creating a application called "Smart cleaning system". For that we are using system by which beach cleaner can do his work smartly using communication through application. Smart Cleaning System proposed to overcome the real time problems. With the continued expansion of industries, the problem of sewage water must be urgently resolved due to the increasing sewage problems from industries of the surrounding environment. The wastes produced from the industries are very harmful to human beings and to the environment. Second Important thing is waste management system by which worker can maintain all his health and work good through application maintain that reporting worker don't need to wait and get in to drainage. One more very useful and important advantage of our system is that the worker to replace the manual work in beach cleaning by semi mechanical beach cleaner. And can access them very easily

## 2. LITERATURE REVIEW

Beach pollution has become a critical environmental issue due to the accumulation of plastic waste, organic debris, and microplastics along coastal regions. Traditional manual cleaning methods are inefficient,

labor-intensive, and time-consuming, especially when waste is buried beneath sand layers. This has led to increasing research interest in the design and fabrication of automated and semi-automated beach cleaning machines that improve efficiency, reduce human effort, and support environmental sustainability.

Early research primarily focused on mechanical beach cleaning machines utilizing conveyor belts, sieves, and chain drive mechanisms. Dhole et al. [1] developed a manually operated machine where forward motion drives a conveyor system that lifts debris and separates it from sand. However, such systems were limited in handling fine particles and required continuous human effort. Balasuthagar et al. [2] highlighted that manual and semi-mechanical cleaning methods are inefficient due to buried waste and harsh environmental conditions, emphasizing the need for mechanized solutions. Sai Charan et al. [3] focused on affordability and ease of operation while reducing labor requirements. Their system demonstrated that mechanized cleaning significantly lowers operational cost and improves cleaning coverage. Likewise, Mahendra Kumar et al. [4] emphasized that beach cleaning is resource-intensive and requires automated solutions to handle large-scale pollution effectively. Ravi et al. [5] proposed a machine where a motor-driven conveyor collects waste and transfers it into a storage container, reducing manual handling. Their work also highlighted challenges such as detecting buried waste and operating under extreme coastal conditions. These systems demonstrate improved efficiency but still face limitations in separating fine particles like microplastics.

Further advancements involve multi-functional and adaptable machines capable of handling diverse beach conditions. Sankhe et al. [6] developed a compact beach garbage cleaning machine suitable for both high-traffic and remote areas. Their design emphasizes minimal environmental disturbance while effectively collecting plastics, seaweed, and other debris. Gorane et al. [7] designed a beach sand cleaner that filters sand and collects debris using a mesh-based system, focusing on affordability and ease of maintenance. A major recent trend is the development of automated and robotic beach cleaning systems. Nambiar et al. [8] introduced a robotic beach cleaner equipped with a conveyor blade system and a density-based separation mechanism. The system uses a dual-hopper arrangement to segregate waste into biodegradable and non-biodegradable categories, significantly improving

waste management efficiency. These intelligent systems mark a transition toward automation and smart waste segregation. Arun et al. [9] developed a solar-powered beach cleaning machine using a photovoltaic system and battery storage to drive mechanical components. This approach reduces reliance on fossil fuels and supports eco-friendly operations, particularly in remote coastal areas. Shelly et al. [10] explored solar-powered remote-operated robots equipped with sensors and filtering systems, enabling efficient waste collection while minimizing environmental impact. Meshram et al. [11] developed a robotic beach cleaner equipped with a rotating conveyor mechanism and rechargeable battery system, enabling efficient waste collection from sandy surfaces. The study demonstrated that such systems reduce labor dependency while maintaining cost-effectiveness and eco-friendly operation. Similarly, Baru and Tomazic [12] proposed an automated beach cleaning robot integrating machine learning and sensor-based navigation. Their system uses a robotic arm, ultrasonic sensors, and microcontrollers to detect and collect waste autonomously, highlighting the increasing role of artificial intelligence in environmental cleanup. Devi et al. [13] emphasized the use of machine learning and computer vision in autonomous marine cleaning robots, enabling real-time waste detection and optimized cleaning paths. Additionally, recent studies have demonstrated the effectiveness of deep learning models such as YOLO and RT-DETR in detecting beach litter with high accuracy, supporting the integration of smart sensing technologies in cleaning machines. Emerging research has also addressed the challenge of microplastic detection and removal, which is a critical limitation of traditional machines. Recent robotic systems incorporate advanced sensors and spectroscopic techniques to detect microplastics on beach surfaces with high precision. A study introduced an autonomous robotic platform capable of detecting and analyzing microplastics using near-infrared sensing, demonstrating a shift toward precision cleaning technologies [14]

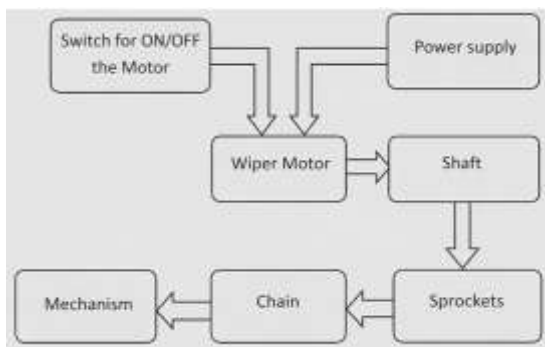
### **Beach cleaning machine:-**

The Beach Cleaners are suitable for private beach owners, contractors, public bodies and life guard's cooperatives. It manages to operate in the worst conditions of the beaches: it loads large materials without damage. It is excellent for winter interventions. Equipped with large mesh grids, it is used even on agricultural land. There mark ably robust

structure and components, the high grating surface and the large capacity box make it a very important machine. Depending on your needs, we supply it with a vibrating screen divided into two or three sectors. The right combination is with an 80-100 HP open field or tracked tractor.

### Working Principal:-

The device is placed across a beach and sea so that only beach sand can get through the lower basement. Floating waste like bottles, plastic cans, covers any kind of waste, etc. is lifted by lifters which are connected to the chain. The chain revolves with the sprocket wheel which is driven by the motor. The energy provided to the motor is electrical energy. When the motor runs, the chain starts to circulate, making the lifter to lift up. The waste material is lifted by lifter teeth and stored in the collecting box. Once the collecting box is full, the waste materials are removed from the box. There is a 45 to 50° bend plate which is assembled at the bottom of the box. It is mainly used to level the beach surface. The material which we are going to use is M/S Mid-Grade, which is easily available in the market with less cost compared to others. The two rollers are connected apart from each other through belt drive on which perforated buckets are mounted through riveting joints. As the system is allowed into drainage, the roller starts rotating, the buckets will move inside the drainage, which will go up to material inside the drainage block. The bucket will pick up the waste material and floating material from the drain block. The bucket allows water to flow out as it is perforated, and only the waste part will be collected into the storage collector behind the belt drive.



### FUTURE SCOPE

In future developments, the beach cleaning machine can be enhanced by incorporating advanced automation and smart control systems to improve operational efficiency. The integration of programmable logic controllers (PLC) or microcontroller-based systems can enable automatic

speed control of the conveyor and motor depending on the load conditions. GPS tracking and data logging features can be added for monitoring cleaning coverage and performance analysis. The machine can also be modified to include a vibration-assisted screening mechanism to improve separation efficiency in wet sand conditions. Additionally, designing interchangeable sieve plates with varying hole sizes will allow the machine to collect different categories of waste, including smaller plastic particles. Further improvements may include the development of a hybrid or fully electric vehicle-mounted version suitable for large-scale beach cleaning operations. The use of corrosion-resistant materials such as stainless steel or coated alloys can enhance durability in saline environments. Incorporating a compact waste compaction system inside the hopper can increase storage capacity and reduce disposal frequency. Research can also be conducted to optimize energy consumption and improve the overall mechanical efficiency of the system. With these advancements, the beach cleaning machine can evolve into a more sustainable, high-capacity, and commercially viable solution for environmental conservation.

### RESULTS

The fabricated beach cleaning machine was successfully tested under practical operating conditions on sandy surfaces. During testing, the machine effectively lifted sand mixed with waste materials and separated debris using the conveyor and sieve mechanism. The separation efficiency was observed to be approximately 75–85% for dry sand conditions, with effective removal of plastic waste, paper, seaweed, and other visible debris. The structural components, including the frame and shaft, showed no signs of excessive deformation or vibration, confirming the adequacy of the design calculations and material selection. The motor operated smoothly without overheating, and the chain and sprocket system ensured reliable power transmission. The overall performance demonstrated that the machine reduces manual effort, saves time, and provides a cost-effective solution for beach cleaning operations. Thus, the project objectives were successfully achieved with satisfactory operational results. The rotating sieve worked efficiently in separating the waste from sand, and the collected waste was stored in the waste collection bin. The machine operated smoothly with proper functioning of the motor, chain drive, and other mechanical components. The results show that the

machine significantly reduces manual labor and saves time compared to traditional beach cleaning methods. It also improves the efficiency of waste collection and helps maintain cleanliness of beaches. The developed system is simple in design, economical, and easy to operate. Therefore, the beach cleaning machine can be considered a useful solution for beach maintenance and environmental protection.



## CONCLUSION

The design and fabrication of the beach cleaning machine successfully demonstrate an efficient and economical solution for removing solid waste from sandy coastal areas. The machine operates on a conveyor-based separation mechanism that utilizes mechanical conveying and gravity-based screening to separate debris from sand. Proper design calculations, material selection, and structural analysis ensured that all components such as the frame, shaft, motor, chain drive, and hopper function reliably under operational loads. The system offers improved cleaning efficiency compared to manual methods while reducing labor effort and operational time. Overall, the developed machine is simple in construction, cost-effective, and suitable for small- to medium-scale beach cleaning applications. It promotes environmental protection by helping maintain cleaner coastal regions and reducing marine pollution. With further technological improvements and automation, the machine has strong potential for large-scale implementation. The project successfully integrates mechanical design principles with practical fabrication techniques, making it a sustainable and valuable solution for beach waste management.

## References:

1. Dhole, V., Doke, O., Kakade, A., Teradale, S., & Patil, R. (2019). Design and fabrication of beach cleaning machine. *International Research Journal of Engineering and Technology*, 6(4).
2. Balasuthagar, C., Shanmugam, D., & Vigneshwaran, K. (2020). Design and fabrication of beach cleaning machine. *IOP Conference Series: Materials Science and Engineering*, 912(2), 022048.
3. Sai Charan, B., Vijaya Kumar, K., Nitish Kumar, B., et al. (2023). Design and fabrication of beach cleaning vehicle. *International Journal of Research Publication and Reviews*, 4(4), 1573–1578.
4. Mahendra Kumar, C., Venkat, C., Meghana, K. B., Amir, M., & Gowda, N. (2023). Design and fabrication of beach cleaning equipment. *International Journal of Innovative Research in Science, Engineering and Technology*, 12(5).
5. Ravi, B., Krishna Saket, T. V. S., & Nemani, S. S. (2023). Design of beach cleaning machine. *International Journal of Science and Engineering Technology*, 11(4).
6. Sankhe, P., Vijay, Y. S., Pitroda, D. M., & Thakur, A. (2024). Beach garbage cleaning machine. *VIVA Institute of Technology Journal*.
7. Gorane, P. S., Roundal, V. B., Fegade, R. S., Lone, A. A., Asawale, P. T., Deshmukh, D. P., & Kadam, N. D. (2024). Design and fabrication of beach sand cleaner. *IJSREM*.
8. Nambiar, S., Kumar, V., Kumar, V., Azzha, M. A. K., Kumar, P., & Junaid, A. C. H. (2024). Design and fabrication of beach cleaning robot. *Journal of Mechanical Robotics*, 9(2).
9. Arun, A., Nagasankar, P., Amirthalingam, P., Barath Kumar, E., Janarthanan, G., & Magesh, A. S. (2018). Design and fabrication of garbage collector on the beach using solar power. *International Journal of Engineering and Technology*, 7(3.34), 394–396. <https://doi.org/10.14419/ijet.v7i3.34.19331>
10. Shelly, A. S., Bershini, D., & Narmadha, R. (2025). Comprehensive review of solar remote-operated beach cleaning robot. *International Journal of Mechanical Engineering and Technology*, 16(1), 58–76.
11. Meshram, V. A., Bankar, M., Bansode, S., Barge, V., Bari, P., & Basarkar, A. (2025). Design and development of a robotic beach cleaner for coastal waste management. *International Journal of Engineering and Techniques*, 11(6).
12. Baru, S., & Tomazic, K. (2025). Automated beach cleaning robot. *Journal of Science &*

Engineering, *I*(3),

68.<https://j.snerds.org/index.php/jse/article/view/32>

13. Devi, A. M., Mundru, Y., & Yogi, M. K. (2025). A systematic study of AI-powered robotics for ocean cleanup of plastics. *Journal of Advancements in Robotics*, *12*(2), 1–10.

14. Iqbal, H., Rex, K., Shirley, J., Baiz, C., & Claudel, C. (2025). A novel autonomous microplastics surveying robot for beach environments. *arXiv preprint arXiv:2508.02952*.