

Design of a Mechanical Litter bin with Underground Waste Container

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ABSTRACT

“Underground Waste Bin”, has the gravity enough to describe itself. The bin under the ground, to dispose waste not manually rather mechanically to eradicate the risk of environmental pollution as well as human diseases and infections, is Underground Waste Bin. In near about 70% of the cities in underdeveloped or developing countries, roadside open air dust bins are cast-off to control wastes. [1] People like Garbage collectors, drivers of waste collector vehicles, street children along with the health care worker, patients and the whole community either directly dealt with waste or not is in high risk. The environmental pollution including water, air and land are also in an alarming stage due to wastes. For safe and better management of waste, an underground waste collector instrument can be introduced. The main operation of this type of container is to hold wastes and can be controlled by a Hydraulic Suspension System. When the lever is pressed, the whole body of the bin can be brought above ground and burdened onto the garbage-collection vehicles by rotating it up to 90 degree. One third of this container would be above the ground to receive the waste with addition to a lid on it. This lid would automatically open with a load up to 5kg and the garbage thrown on it would be clear out into the compartment. This Mechanical Waste Bin was designed in CAD software. By implementation of this mechanism, there will be no need of using hand to collect waste thus this process will be more hygienic. This would reduce risk on human health and also diminish human effort.

Keywords: Pollution, Health hazard, Automation, Mechanical Waste container.

1. Introduction

Waste may create a serious health hazard to human beings; if it is not appropriately dispose. With the increasing global population and the rising demand for food and other essentials, there has been a significant amount of waste being generated every day. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further disposition into the landfills and dumps. [7]

Wastes contain hazardous chemical such as mercury, PBDEs (flame retardant chemicals), SO₂ etc. and these toxic products are combined with a surplus of other chemicals, which eventually react and produce odor. [2] Some symptoms that odor producing chemicals may cause are dizziness, headache, watery, itchy & burning eyes and nose, depression, stress etc. Folks living near the accumulated piles of waste are at a risk of infectious diseases. [3] As the accumulated wastes produce an unpleasant odor and the decomposing waste is highly contagious in nature. An estimated 300 million people worldwide suffer from “Asthma”, with 250,000 annual deaths. Among of them 11% of “Asthma” cases worldwide is responsible for workplace condition, such as exposure to dust. Also approximately 50 million people worldwide being infected every year by “Coughing” and 294,000 dying. Across the world 6% people are suffered from lung diseases because of pollution owing to waste.[4] Moreover, unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease.

Generally, the harmful effects of pollution are not felt immediately, but occur after a length of time. **Diseases** that can be produced by waste are-

1. Skin and blood infections like allergy, fungal contaminations due to direct contact with waste.
2. Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations.
3. Various diseases like dengue, malaria etc. which are caused due to the bites of animals feeding on the accumulated waste.
5. Lung Cancer.
6. Developmental defects.
7. Reproduction problems.
8. Liver and kidney failure. [7-9]

Accidents can be happened during direct handling of waste materials like-

1. Bone and muscle disorders resulting from the handling of heavy containers.
2. Infecting wounds resulting from contact with sharp objects.
3. Poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste.
4. Burns and other injuries resulting from occupational accidents at waste disposal sites or from methane gas explosion at landfill sites. [5, 7-10]

It is very important to ensure a safe and healthy technique for collecting and dumping waste. For an example, let's take Bangladesh as a developing country- by analyzing the data according to the World Bank, Population growth (annual %) in Bangladesh is **1.19**.

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With this increase, there has also been an increase in the amount of wastes being produced especially in the cities.

In Bangladesh Per capita waste generation is **4.3** pounds. At this rate in a city of about **10** lakh people around **43** lakh pounds and a country of about **154.7** Million people around **70.5** corers pounds of wastes is being produced every day! [11] This huge amount of rubbish produced per day is not properly handled to dispose. In the absence of proper solid waste management, this waste lies littered on our streets, road corners and improperly disposed of in vacant land. If they are not going to accumulate in a proper way serious disaster can be occurred relating to health issues and environmental pollution.

Dustbin is the ultimate solution of this problem. But the main problem is that most of the times in developing or under developed countries, dustbins do not contain any lid. So bad odor, infectious viruses & bacteria find space to flow and mix with environment. Again, it attracts flies, rats, and other animals that in turn blow out infections. Rotting waste also provide a fertile breeding ground for flies, mosquitoes etc. Another disadvantage of normal dustbin is that, the waste scatters around it, can only be collected by direct handling. This can be very perilous to the persons who are working on this field. To avoid these problem normal dustbins can be upgraded by some modifications. Here a **Mechanical Litter bin with Underground Waste Container** can be introduced. It is mainly a mechanical system by which waste can be collected mechanically. It has a lever system to pull the bin and dump the waste to the waste collecting vehicle. It also contains a mechanical lid to block the infectious materials to blowout. Most importantly, it is user friendly and does not cost more than normal dustbins!

2. Physiology

Dustbins have only been around since the last 150 years or so. Before that waste were just disposed by burning or dumping in empty lands. But with increasing population and waste produced by them became a main concern. In **1842**, Sir Edwin Chadwick first influenced for the matter of waste clearance and disposal. [9] In **1875** the **Public Health Act** made it compulsory for each household to keep a dustbin. Normally, a large rectangular or cylindrical container is used for reserving refuse which is known as dustbin or litterbin. Early dustbins were simple in design. The temporary storage of rubbish can be traced to the 1800s; it took until the 1960s for the standardized dustbin. During this time the form of the dustbin changed significantly. Medium sized galvanized metal bins were introduced in the 1950s, and larger plastic bins were in the 1960s. [10-12] But nowadays various kinds of dustbins are introduced for different purposes which are unlike in size shape and function. Some examples are-

The Wheelie Bin which is moveable, the recycling bin where waste that can be recycled are dumped for reuse, the color coded bins that are specified by color code for specific waste and so on. But for developing countries where waste management system is insufficient there the **“Mechanical Underground Litter Bin with Waste Container”** can be introduced. It can be described in four parts. They are -

1. Automatic Lid with micro controlling system.
2. Waste reservoir for collecting waste.
3. Hydraulic Suspension system for lifting the container.
4. Rotation system for dumping the waste.

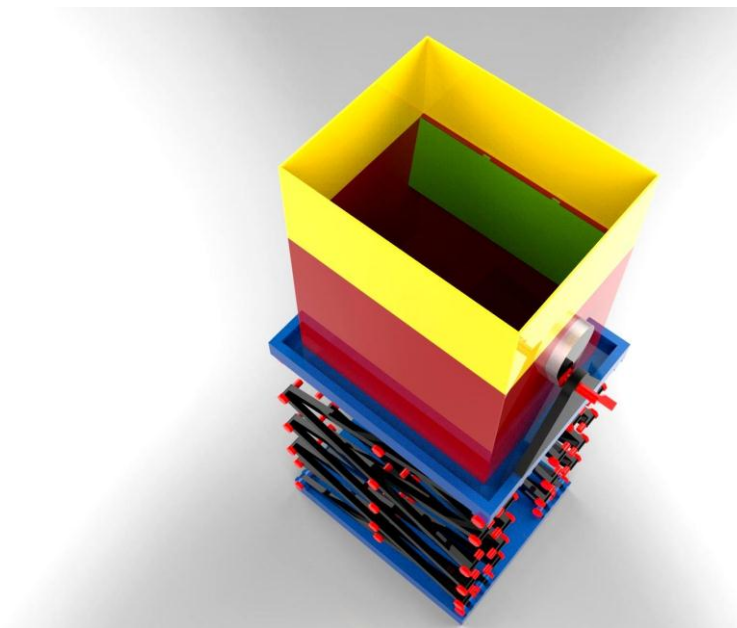


Fig.1 Mechanical Litter Bin with Underground waste Container.

3. Design Structure

Design structure of a “Mechanical Litter bin with Underground Waste Container.” is given below-

3.1 Dimension

It is a rectangular box type construction.

Length	5 feet
Width	4 feet
Height (above ground)	2 feet
Height (below ground)	4 feet

3.2 Material

Any ferrous material can be used. But light alloy is more preferable to avoid corrosion and also it will be suitable for lifting.

3.3 Systems

Mainly three systems are used in this design.

They are -

- 1) Micro controlling system.
- 2) Hydraulic Suspension system.
- 3) Belt pulley system.

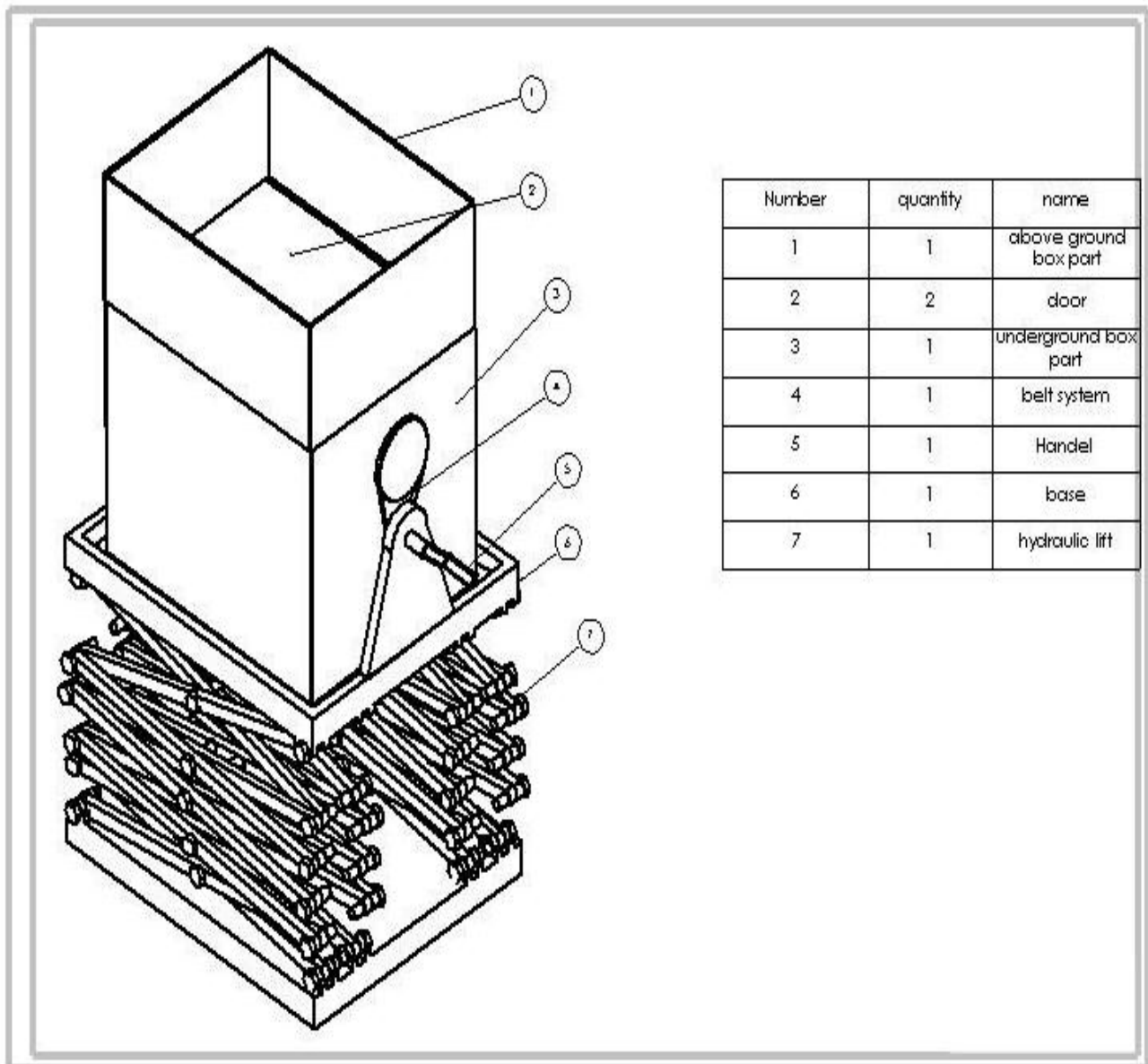


Fig.2 Dimension of Mechanical Litter Bin.

4. Design Description

It can be described part by part gradually as – It is a rectangular box in shape. It's larger portion means 4 feet is beneath ground and smaller portion means 2 feet is above ground. The portion which is lying under ground is work as **waste container**.



Fig. 3: Mechanical litter bin.

There is a **lid** in between the upper portion and the lower portion. When the amount of garbage exceeds up to 5 kg the lid will open with a **micro controlling mechanism**. Mechanisms and equipment used in this lid are – a weight sensor, an OPAMP 741(Operational Amplifier) [17] and a motor. A weight sensor is used here so that when rubbish are dumped on the upper portion, if its weight become more than 5 kg then the lid will open up as (fig:4). Because the sensor will send signal to the OPAMP to enlarge the signal and then the OPAMP send the signal to the motor so it turns on and so the lid opens. As a result the pile of waste dumped directly into the lower part or the waste container. After dumping waste there will be no weight to sense, so the sensor will stop giving signal to the OPAMP and subsequently no signal is sensed by the motor. So, the lid will close automatically (fig: 5). The lid can be opened up manually during collection of waste. Its function is to seal up the waste container to get rid of from the unpleasant stinks. Unpleasant odor created because of hazardous chemical reaction among household wastes and other wastes collected from different places. Another function of this lid is to keep the creatures such as rats, flies, mosquitoes etc. far

from the bin and thus to prevent the infectious diseases and viruses to spread. If this “**Mechanical Litter bin with Underground Waste Container**” can be introduced seemly efficient waste management and quality environment can be ensured.

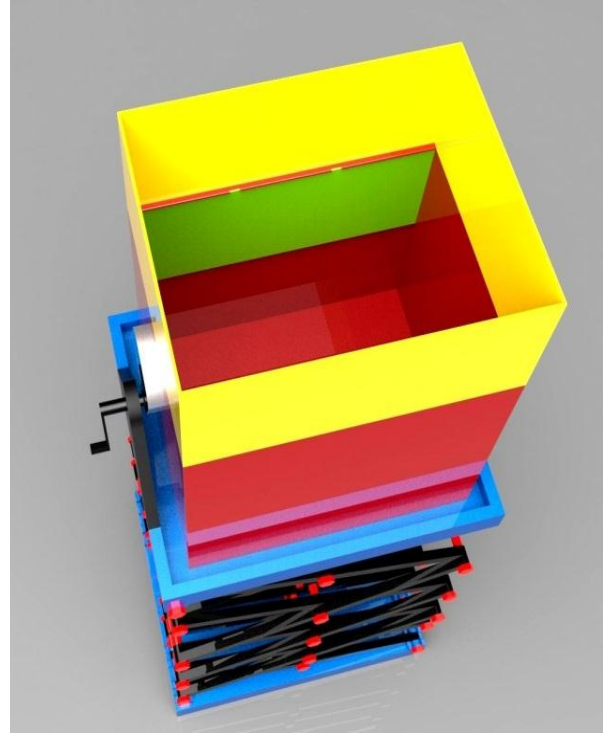


Fig. 4: Lid opens up due to weight sensor.

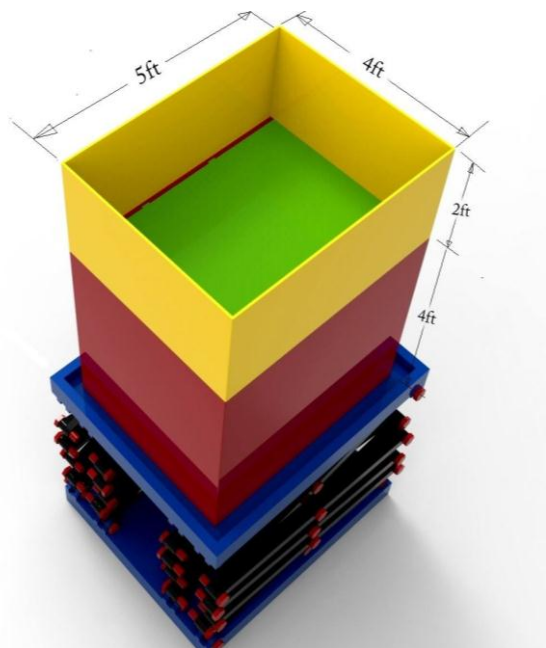


Fig. 5: Lid closed after dumping waste.

After block up the container, it can be brought up from the ground by using **Hydraulic Suspension** system (fig: 6). A hydraulic suspension system is very versatile because it puts the controller in control of the body's height via a fluid pressure system. Fluid suspension action is usually considered faster, depending on the power used to create the pressure of the hydraulics. This suspension system can be driven by using motor which can be controlled by a switch. [15-16]

Finally the total litter bin can be rotated up to 90 degree to dump the waste to the waste collecting van. To rotate the body **Belt pulley** mechanism is used (fig: 7). As the litter bin is not fixed to the platform, so by rotating the handle attached to the belt system, the total body can be rotated on its axis.

After that the litter bin can be again placed to its position. This whole process can be done without making direct contact with waste.

5. Discussion

Unmanaged waste becomes a serious environmental, economic, health and aesthetic problem around the world. As the production of waste cannot be stopped so a proper way of collecting and disposal should be introduced. In developed countries, there are many private and government institutes that collect and recycle renewable waste that comes from households, industries, restaurants, medical centers etc. But waste collection by direct handling in developing and under developed countries, causes an adverse effect on people related to this job. A “**Mechanical Litter Bin with Underground Waste Container**” can be used to serve the purpose. This is designed to collect waste without direct handling. It reduces the threat on health of the concerned people. Again at the time of collecting waste, there is a high risk of getting injured and infected by objects such as broken glass, syringes, metallic and other jagged objects. This risk can be minimized by using mechanical bin. Also because of the lid there will be no unpleasant odor. Thus environment pollution can be reduced.

6. Conclusion

After all this discussion about health hazards due to uncontrolled wastage, it can be summed up that a Mechanical Litter Bin with Underground Waste container is an ultimate option to get rid of these problems. It is suitable for reducing environment pollution, infectious diseases and human effort.

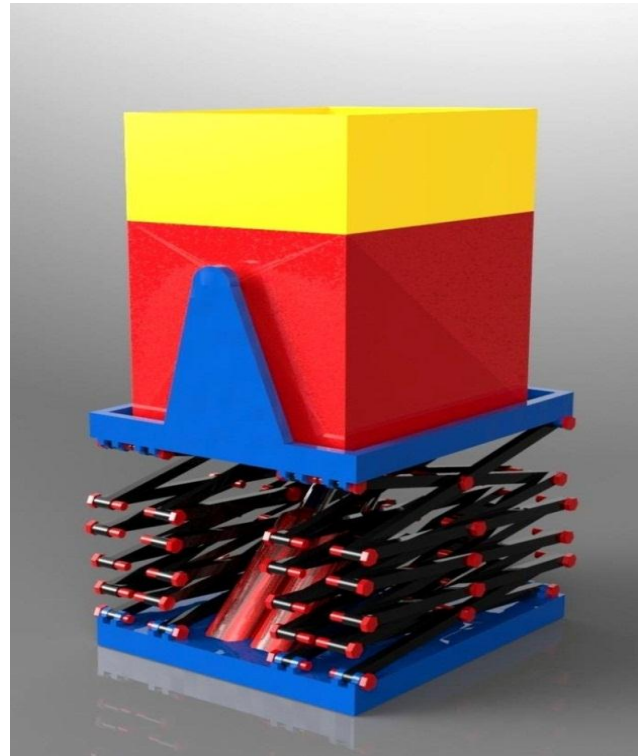


Fig. 6 Hydraulic Suspension System.

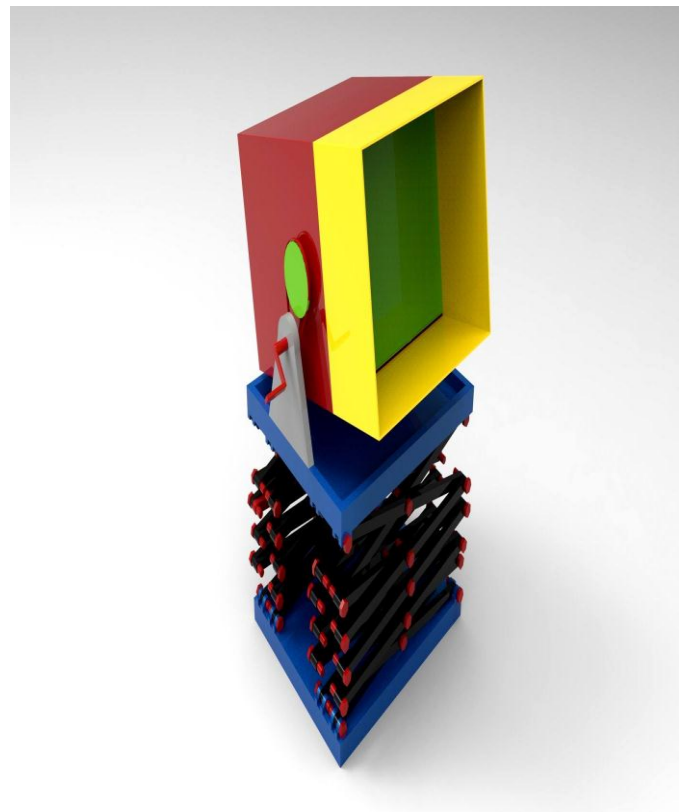


Fig.7 Rotation of Mechanical Litter Bin.

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