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A Mechanical Automatic Urinal-Toilet Flusher for Swach Bharat Mission

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Abstract

A flush urinal-toilet disposes human waste by using water through a drainpipe to another location. A series of urinal-toilets are fitted in offices, malls, multiplexes, educational institutions, bus railway stations, airports, commercial complexes, stadia and other public places. Most have manual flushing systems like push button, trigger, pull chain, etc. however, use of such manually operated flush can spread germs and bacteria when contacted and thus users avoids to flush or lead to wastage of water if used. Now a day's laser or infrared sensor operated flushes is also used in the places of high commercial value and importance but are expensive and required continuous O&M. Therefore, the sanitary facility may remain un-flushed leading to unhygienic conditions and foul smell. Thus need for a low cost automatic flushing apparatus which can flush the right-controlled amount of water and avoid direct contact thus conserving water as well as maintaining personal hygiene and sanitation. The present invention relates to a specially designed mechanical automatic urinal-toilet flusher and a mechanism thereof, which utilizes the weight load/pressure of the person using the urinal-toilet for automatic flushing the urinal-toilet with the specified or measured quantity of water to prevent odors, soil drain and scale buildup. It ensures the compulsory, regular and un-intentional flushing of the urinal-toilet without any direct hand contact of the user to the flush and also conserve water at the same time is simple and cheap, which can be fitted-retrofitted to new as well as existing water pipe line of the urinal-toilets.

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1. Introduction

A flush urinal-toilet disposes human waste by using water through a drain pipe to another location. A series of

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urinal-toilets are fitted in offices, malls, multiplexes, educational institutions, bus stands, railway stations, airports, commercial complexes, stadia and other public places. Most have manually operated flushing systems such as push button, trigger, pull chain, etc. however, use of such manually operated flush can spread germs and bacteria when contacted and thus users avoids to flush-on or flush-off, which may lead to dirty toilets or wastage of water if used. Now a day's laser or infrared sensor operated flushes are also used in the places of high commercial value and importance but are expensive and required continuous O&M, which may not be affordable to all. Therefore, the toiletries-sanitary facilities may remain un-flushed leading to dirty, unhygienic environment and foul smell, due to which people refrain from using it, and may leads to open defecation even in places with toilets, which may leads to various diseases.

Public awareness of personal hygiene and water conservation issues over the last several years has caused manufacturers of sanitary facility and hygiene devices to develop automatic actuators for sanitary facilities such as toilets and urinals. One purpose of such devices is to automatically control the amount of flush water used to eliminate waste and in the process eliminate human contact with the surfaces that may contain disease spreading bacteria.

Most of the present day toilets and urinal flush devices for sanitary facilities are operated by a water control valve which includes a manually operable flush handle adapted to be gripped and moved by a user. However, those manually operated valve actuation devices have many problems for e.g. use of such manually operated flush can lead to diseases thus users avoid to touch / use the flush button. Therefore, the sanitary facility may remain un-flushed which increases the unsanitary conditions, and fouling the atmosphere in the facility. Also, a large volume of water is wasted every time a user flushes a standard toilet.

Thus there is a great need for a low cost automatic flushing apparatus which can flush the essential-controlled amount of water and avoid direct hand contact, thus conserving water as well as maintaining personal hygiene and sanitation. The present invention discloses an automatic flusher with dual-valve pipe mechanism actuated by a mechanical platform

1.1 Reasons of Unflushed- Dirty Urinals-Toilets: Technicalchallengesto be overcome

In general, public places do stink, and un-clean urinals-toilets are the common observations which make the user of these urinals-toilets to avoid its uses, or to use it reluctantly in case of urgency. The reasons of not flushing the urinals-toilets and its limitations may be many which includes both *Technical* as well as *Non-Technical (Behavioural and Psychological)*, such as:

A. Limitation of Resources

- Un-availability of water.
- Higher water usage: Conventional water flush urinals use approximately 4 liters (approx. 1 gallon) of water for flushing, which goes up to 10-15 liters (approx. 3-4 gallons) when a toilet pan with flush is used for urinating. (Source: <http://web.iitd.ac.in/~chariarv/WLUResourceBookFinal.pdf>)
- Un-availability of flushing system itself
- Non-operational flush/ flushing system

B. Technical and Economic Reasons

- *Extra Time and efforts needed:* Tap fitted and manually operated urinal-toilets are sometimes too high or awkwardly mounted and are often dirty. It may lead to dirty urinals-toilets, if not flushed; or wastage of water, if flushed. As person using doesn't bother to take of extra time and efforts to open or close the tap/ knob fitted on the wall.
- *Absence of regular maintenance:* Faulty taps used for flushing may leads to continuous wastage of water and is commonly observe all over. Also there is a chance of spillage of urinal water on the person during its usage.

- *Non-functioning of flushers* both in case of manual and high tech laser/infrared operated flushers.
- *Expensive and high operational & maintenance expenses* (Automatic high-tech infrared/ laser) High-tech flushing system using infrared/ laser sensing devices is expensive, and require regular and high maintenance & operational expenses (as required continuous source of electricity- batteries) which cannot be affordable in all cases. And may be stolen or damaged in public toilets, where no supervision is available.

C. Social-Behavioral-Hygienic Reasons

- *Ignorance and lethargy* for flushing urinal-toilets on the user parts, even in case of push button or trigger type flushes.
- *Hygiene and contamination point*: It is a known fact that the public urinal-toilets are unhygienic and replete with germs, and so are flush handles. The germs get transferred to the person who touches the flush handle and may even leads to transmission of communicable diseases. In addition many people who use a public urinals-toilets flush do not wash their hands prior to leaving, which results in spreading the germs to doorknobs and other objects, such as the paper dispensers, soap dispensers, etc. Due to which generally users refrain from touching the flusher fitted for flushing, leading to dirty urinals-toilets.

1.2 Implications of Poor Sanitation

- Polluted and Stinky Environment
- Results in Open Urination- Defecation
- Wastage and Loss of Precious Natural Resource-WATER.
- More importantly High risk to Public Health & Life

Therefore it is desirable and expected by the user of urinal-toilets, to have *automatic-regular-compulsory and un-intentional* flushing *without* his/her any *direct hand contact*.

2. Design and Development

Keeping these challenges and drawbacks/limitations of the existing systems a novel device is developed. And understanding this limitation and reasons for not-flushing or dirty toilets, a “**Low Cost Mechanical Automatic Urinal-Toilet Flusher**” is designed and developed(Wath et al., 2013 194/DEL/2013A) as shown in figure 1, which overcomes the basic challenges and requires:

- Minimum maintenance, and can be used for flushing the urinal-toilet, automatically, regularly and unintentionally every time the person uses it.
- And can be fitted with new as well as existing urinals-toilets leading to its acceptance in existing as well as in new constructions in comparison to the already existing technologies and systems.

The mechanical platform compresses under the weight of a person when a person stands on it. This movement of the platform activates the spring mechanism. The downward motion of the platform pulls the cable creating a tension in the cable spring and thereby displacing the valves from their normal positions. The downward motion causes the inlet valve to open and outlet valve to close simultaneously. When the inlet valve opens, the water fills in the bulging reservoir of the pipe. After the person leaves the platform, the spring decompresses and the platform rises back to its normal state. During the upward rise of the platform the tension in the spring cable releases due to which the inlet valve closes and outlet valve opens i.e. the valves regain their normal position. This opening of outlet valve flushes the water to the urinal.



Fig. 1: Low Cost Mechanical Automatic Urinal-Toilet Flusher

2.1 Comparative placement of the innovation in the specific area (national / international)

Table 1 shows the detailed comparison amongst the between the various available technologies and products available in the market for flushing the urinals –toilets and the invented low cost mechanical automatic urinal-toilet flusher.

Table 1: Comparison of Various available Technologies and Products

	Mechanical Flusher	High-Tech Sensor Flusher	Waterless Urinal	Invented Flusher
Water Use/flush(L)	4-13	2.8-10	Not regularly but after fixed duration	Pre-specified Customised Vol.
• Standing Urinal	4			• Urinal < 1 Ltr.
• Toilet Pan with flush	10-13			• Toilet < 4 Ltr. (as per EP Std.)
• Highly Efficient flush				
○ Full Vol. Flush	6-7			
○ Half Vol. Flush	3-4			
• Water Efficient Urinal		2.8		
O & M	Moderate	High	High	Low
Consumables Requirement	Low	High (Batteries, etc.)	High (Cartridges, membranes, Bioblocks, Sealant, etc)	Low
Power	No	Yes	No	No
Price	Low-High	High	Moderate-High	Low
Assured-Automatic- Unintentional Flushing	No	Yes	No Need	Yes
Common Problems	<ul style="list-style-type: none"> • Water Wastage • Contamination • Unclean Toilet 	<ul style="list-style-type: none"> • Theft/damage • Need High Supervision 	<ul style="list-style-type: none"> • Odour Problem • Scaling • Pipeline Corrosion • Not Suitable for • Public Toilets 	Yet Not

Source: Compiled from 1) Development of EU Ecolabel and GPP criteria for flushing Toilets and Urinals- Technical Report, 20132) Rating System for Water Efficient Fixtures: A Way to Sustainable Water Management in India CSE Report 2010 New Delhi3) Self Observation

2.3 Advantages

- No need for manual knob/trigger pushing or electronic/electrical operation.
- Low cost and cheaper.
- Simple and easy to construct and can also be retrofitted to existing urinals- toilets with some modification.
- Easy and Low Maintenance.
- Maintenance cost is negligible.
- Operation is automatic and without any intention/efforts.
- No wastage of water.
- Leads to regular and compulsory flushing and cleaning of toilets/urinals.
- Assured regular flushing.

2.4 Areas of application

- Commercial Complexes such as Markets, Malls, Theaters, Air Ports, Sport Complexes, Stadia, Railway Stations, Bus Stands, etc.
- Public-Municipalities Toiletries, remote areas with urinals-toilets
- Government, Private, Public, Municipalities, Administrative Buildings and Offices
- Academic Institutions such School, Colleges, Coaching Classes, Universities.
- Social and Religious Gathering Places Tourist Places

This innovation certainly has the potential to bring the paradigm shift in the operation and functioning mechanism of the Urinal-Toilet Flushers. As till date almost all of the Urinal-Toilet flushers are mainly manually intentionally operated by hand, with an exception to infrared/ laser sensor operated flushers, the limitations of which are already discussed. The present innovation will certainly shift the focus of the toiletries and sanitary equipment manufacturing companies from hand operated flushers towards the more convenient paddle or leg operated flushers. Moreover it will be helpful in providing the better sanitation and improving the health-hygiene of the society at the low and affordable cost. More importantly by avoiding the water wastage during flushing, it will surely help in environmental protection by conserving the precious natural resource like water and contributing the country towards the goal of sustainable development.

3. Envisaged impact of the Innovation

3.1 Economic Impact

This low cost flusher will certainly grab the attention of the different stakeholder due to saving in economy in terms of the capital investments and operation & maintenance, with addition of saving in the water usage, sewer charges, etc. Most of the flush urinals-toilets use average 4 litres to 12 litres. (1 to 3 gallons) of water per use, depending on the type, model and make, Whereas the minimum water required for flushing the urinal-toilets as per the European Union Ecolabel standard is 1 litre/flush. If being replaced by the developed flusher that can flush the exact minimum quantity of water needed in 2 different scenarios. Table 2 shows the saving in direct fresh water usage cost per year approximately.

Table 2: Saving in Water Usage and Economy per Year

	Small Office Scenario	Large Office Scenario
Number of Staff	25	1000
Number of Urinal Uses/Person/Day (8 h office time)	4	4
Number of Days of Urinal Use/Year	300	300
Number of Urinal Uses/Year	30,000	12,00,000

	Small Office Scenario	Large Office Scenario
Liters of water per use conserved (i.e. per flush saved)	3*	3*
Liters of water saved/year	90,000	36,00,000
Assuming Cost of Fresh water per Cu meter (in Rs.)**	60	60
Estimated Water Cost savings/year (in Rs.) **	5,400	2,16,000

* Assuming the minimum water usage of 4 litres per flush. Although in case of the maximum usage saving will be much more.

** Is the minimum cost presumed, which may vary w.r.t location and duration in different cities.

*** If the Sewer charges is also added the estimated saving amount will be much more.

3.2 Societal Impact

Half of India's 1.25 billion people have no toilet at home, but more people own a mobile phone. Only 46.9% of the 246.6 million households have lavatories while 49.8% defecate in the open. 3.2% use public toilets. Despite the Indian government spending Rs.1, 250 billion on water and sanitation projects in the last 20 years. Obviously, all that money is going down the drain. About 77% of homes in the eastern state of Jharkhand have NO TOILET facilities, while the figure is 76.6% for Orissa and 75.8% in Bihar. All three are among India's poorest states with huge populations which live on less than a dollar a day (Source: Millennium India Education Foundation, 2012). Tables 3 and 4 shows the condition of sanitation in rural and urban India and associated health risk globally due to poor sanitation respectively.

Table 3: Assessment to Sanitation Facility in Urban and Rural Areas in India (%)

Year	Improved Sanitation		No Sanitation	
	Urban	Rural	Urban	Rural
1990	51	7	28	91
1995	53	10	25	86
2000	55	14	22	79
2005	56	19	18	73
2010	58	23	14	67

Source: WHO/UNICEF (2012b)

Moreover, Public toilets that are badly designed, badly maintained, and poorly located generate a *sense of neglect, attracting vandalism, anti-social behaviour and social disorder*. Poor quality of construction and inappropriate designs of urinals lead to improper use of facilities in most cases. As a result, most urinals suffer from the vicious cycle of bad use and improper construction or maintenance leading poor sanitation and hygiene.

These are some of the serious health implications which the society faced due to poor sanitation. The present invention may lead to improve this condition up to certain extent and also may help in

- Improvement in the health hygiene and sanitation field related to urinal-toilets.
- Touch-contact free flusher eliminates the exposure to disease-causing bacteria that can occur when users operate manual flush fixtures.

Table 4: Associated Health Risk Due to Poor Sanitation Globally

Disease	Mortality (death / year)	Comments
Diarrhoea	18,00,000	99.8% of deaths occur in developing countries; 90% are children
Typhoid	6,00,000	Estimate: 16 million cases/year
Ascariasis	3,000	Estimate: 1.45 billion infections, of which 350 million suffer adverse health effects
Hookworm disease	3,000	Estimate: 1.3 billion infections of which 150 million suffer adverse health effects
Schisto-somiasis	15,000	Found in 74 countries, 200 million estimated infected, 20 mi with severe consequences
Hepatitis A	no data	Estimate: 1.4 million cases/yr

Source: WHO, 2006

3.3 Environmental benefits

Water saving

The highest environmental benefit, which can be achieved for flushing toilets and urinals, is related to water saving, as out of the total water usage in household maximum 45- 50% is used for flushing the urinals-toilets (*source: EPA*). Beyond resource saving, water saving would also result in less environmental impacts related to water supply and wastewater treatment (energy saving and lower related air emissions, lower water pollution) and in economic savings for the users with direct cost savings (lower water bills).

- Conserve electricity used for pumping water & treating wastewater
- Reduce emission of greenhouse gases and pollution of water bodies
- Foster regional competitiveness amongst the sanitary equipment manufacturers for low cost, better quality and environmental friendly product.
- Expenditure spends on the health –illness arising out of the poor sanitation by the individual in society will be directly saved.

4. Conclusion

Thus the present innovation provides the low cost alternative for the automatic –compussary regular and unintentional and handsfree flushing of urinal-toilets Which not only results in the development and facilitation of the low cost clean and hygeinic but also results in saving of presious natural resources like water and energy. More importantly in view of the recently launched “*SWACH BHARAT MISSION*”, by *Honourable Prime Minister of India* with a special focus on sanitation and hygiene in rural as well as urban areas, especially for the economically backward population of India, this innvoation has a great societal importance and potential for replication within India.

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