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Literature Review, Problem Statement for Development of Electric Garbage Vehicle with Differential

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Abstract- An Literature Review is conducted to investigate recent research and current state of practice related to design developments of Electric Garbage Vehicle with differential. India generates 62 million tonnes of waste each year. About 43 million tonnes (70%) are collected by different municipal corporation and civic bodies through contract labor The garbage rickshaws, garbage trucks , hand driven garbage carts etc are in use. Although majority of the collection is still done using hand push carts which have limitation on carrying capacity and speed of travel. On the other hand with the increasingly severe environmental problems around the world, exploitation of clean and renewable energy has been a crucial topic As indispensable transportation in modern society, vehicles are ubiquitous but also one of the main sources of pollutants. Because of their status, it is almost impossible to decrease the volume of vehicles. One solution to lowering emissions is the electric vehicle, Overall, the electric vehicle is more energy efficient, environmentally friendly, and cleaner than the vehicle that relies on fossil fuels especially when smart grids have become omnipresent , considering this electric vehicle will be used increasingly in the times to come. The differential is an important part of the automobile transaxle . The purpose of the differential is to distribute power to the two rear wheels and provide differential speed to the vehicle wheels when the vehicle takes a turn. The project work aims at design development of differential system for an electric vehicle for garbage with carrying capacity of 200 kg driven by single operator or garbage collector. The electric vehicle will have a travel speed of 6 to 10 kmph along with an compact electrical jack for dumping. The objective is to expedite the garbage collection with minimal effort to the labor.

Keywords- Electric Garbage Vehicle, Differential, Design Developments, Transaxle, Reduced Labour.

I. INTRODUCTION

Solid waste management (SWM) is a major problem for many urban local bodies (ULBs) in India, where urbanization, industrialization and economic growth have resulted in increased municipal solid waste (MSW) generation per person [1]. Effective SWM is a major challenge in cities with high population density.

Achieving sustainable development within a country experiencing rapid population growth and improvements in living standards is made more difficult in India because it is a diverse country with many different religious groups, cultures and traditions. Despite development in social, economic and environmental areas, SWM systems in India have remained relatively unchanged.

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The informal sector has a key role in extracting value from waste, with approximately 90% of residual waste currently dumped rather than properly land filled [2].

There is an urgent need to move to more sustainable SWM, which requires new management systems and waste management facilities. Current SWM systems are inefficient, with waste having a negative impact on public health, the environment and the economy [3].

The Waste Management and Handling Rules in India were introduced by the Ministry of Environment and Forests (MoEF) [4], yet, compliance is variable and limited.

India generates 62 million tonnes of waste each year. **About 43 million tonnes** (70%) are collected by different Municipal Corporation and civic bodies through contract labor. The garbage rickshaws, garbage trucks, hand driven garbage carts etc are in use. Although majority of the collection is still done using hand push carts which have limitation on carrying capacity and speed of travel.

In most cities, the municipal service for the collection and transportation of urban solid wastes comprises three separate functions as follows

- Sweeping, curb-side and domestic waste collection from garbage bins
- Transportation by handcarts to large or road collection points, which may be open dumps.
- Transportation by vehicles to the disposal sites

II. LITERATURE REVIEW

Weimin Liu et al (1) (2012) Based on the analysis of characteristics and Application requirements, one type of micro-pure electric garbage transfer vehicle was designed. The power layout program, chassis layout and hydraulic lifting mechanism were researched to meet the driving safety need and automobile ride.

The McPherson independent front suspension and the coil spring integral rear suspension were selected as the suspension program. The type of motor front and front drive was the arrangement of power system. The ladder frame chassis was selected for its high strength and low cost and the finite element analysis of frame was executed to verify the strength. The lifting mechanism was the key of the vehicle, one integrated hydraulic lifting mechanism was selected and the lifting time and angle and cylinder diameter were calculated. The tests confirm the sample vehicle being of reliable design and good performance.

Ricardo Ewert et al (2) (2021) Electrification is a potential solution for transport de-carbonization and already widely available for individual and public transport. However, the availability of electrified commercial vehicles like waste collection vehicles is still limited, despite their significant contribution to urban emissions. Moreover, there is a lack of clarity whether electric waste collection vehicles can persist in real world conditions and which system design is required. Therefore, we introduce a multi-agent based simulation methodology to investigate the technical feasibility and evaluate environmental and economic sustainability of an electrified urban waste collection.

Souvik Bhattacharjya et al (3) (2018) India's ambition towards an electric mobility economy by 2030 was announced in 2016. Further, in a recent communication by the Ministry of Road Transport and Highways (MoRTH) and NITI Aayog, the government announced its aim of increasing share of electric vehicle (EV) from its current share of less than 1 percent to nearly 30 percent by 2030. This implies that by 2030, the total estimated number of electric two wheelers on Indian roads will be more than 200 million, while for cars and buses, the electric vehicles have been estimated at 34 million and 2.5 million (TERI Estimates). Very soon, the government is expected to announce India's policy on Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles II, at the Global Mobility summit in Delhi towards the latter half of 2018.

Wentao Jing et al (4) (2016) Electric vehicles are believed to be an effective solution for reducing greenhouse gas emissions. Despite extensive study on the attributes and characteristics of electric vehicles and their charging infrastructure design, the development and network modelling of electric vehicles are still evolving and limited. This article provides a comprehensive review of electric vehicle studies and identifies existing research gaps in the aspects of theories, modelling approaches, solution algorithms and applications. This article first describes the electric vehicles' concepts, market share, characteristics and charging infrastructures.

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Then, the studies on traffic assignment problem with electric vehicles in the network and limited charging facilities are particularly discussed. We conclude that it is of great importance to take into account electric vehicles' special characteristics (e.g. range limit) in predicting their routing behaviour and charging infrastructure design networks.

Global EV Outlook 2021Accelerating ambitions despite the pandemic (5) (2021) The Global EV Outlook is an annual publication that identifies and discusses recent developments in electric mobility across the globe. It is developed with the support of the members of the Electric Vehicles Initiative (EVI). Combining historical analysis with projections to 2030, the report examines key areas of interest such as electric vehicle (EV) and charging infrastructure deployment, energy use, CO2 emissions and battery demand.

The report includes policy recommendations that incorporate learning from frontrunner markets to inform policy makers and stakeholders that consider policy frameworks and market systems for electric vehicle adoption.

S.G. Ghugal et al (6) (2019) As the garbage collection is one of the most hazardous jobs in our country and to avoid direct contact between the worker and harmful trash. So this paper concentrates on designing of automated garbage collecting vehicle. It also discuss in detail about the every component of this garbage collecting vehicle. Automation is nothing but a work without manual effort so this paper; contain the design and analysis of each and every parameter of automatic garbage collecting vehicle. As this automatic garbage collecting vehicle is battery operated so the pollution by this vehicle is negligible

Zubov V.V.et al (7) (2015) Around the world the issue related to municipal solid waste (MSW) management ranks second in urban economy system. For the most part the actual researches deal with the improvement of MSW recycling, neutralization, utilization and burying processes .The garbage trucks are initial unit in a processing chain of MSW utilization. As to the garbage trucks operation management issues the researches are carried out on the enhancement of designs, maintenance and repair system, models and methods of work route schedules development.

Sunil Kumar et al (8) (2017) India faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal. Current systems in India cannot cope with the volumes of waste generated by an increasing urban population, and these impacts on the environment and public health. The challenges and barriers are significant, but so are the opportunities.

This paper reports on an international seminar on 'Sustainable solid waste management for cities: opportunities in South Asian Association for Regional Cooperation (SAARC) countries' organized by the Council of Scientific and Industrial Research-National Environmental Engineering Research Institute and the Royal Society.

Akhilesh Kumar et al (9) (2020) In recent years, the exponential population growth, high density of urban areas, diverse culture, changing food habits ,and lifestyles have seen an unresolved problem in terms of Municipal Solid Waste Management (MSWM) in India. Consequently, the municipalities have been facing many other issues related to the collection, treatment, and management of solid waste. The present study is a comprehensive review summarizing the present SWM status identifying the associated challenges and deriving potential solutions for the MSWM in the Indian context. The unsorted solid waste at source, social taboo, citizen's attitude, poor assessment, inadequate potential strategies un-organized informal sector of waste, unplanned fiscal, and poor implementation government policies.

Xuan Zhao et al (10) (2018) We propose an electronic differential system (EDS) based on a wavelet controller for electric vehicle with dual-wheeled motor front drive. According to an analysis of current electronic differential strategies and vehicle driving dynamics, a new electronic differential strategy model of equal power allocation is proposed, and based on an analysis of the mathematical model of an interior permanent magnet synchronous motor; a new current controller based on the discrete wavelet transform is proposed using vector control.

Leonardo Israel et al (11) (2019) Considering the growing interest in substituting internal combustion engine vehicles with highly efficient electric vehicles

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around the world, this paper aims to contribute with a literature review about the current state and future improvement trends for optimization of critical tribological components used in passenger electric vehicles. The review gives an understanding of the most recent achievements in terms of tribological solutions applied to the critical components and the identification of research gaps for further developments and efficiency improvements for EVs through novel component designs, materials and lubricant technologies

Arthur D Little (12) (2019) Battery electric vehicles (BEVs) do not consume gasoline or produce tailpipe carbon emissions, placing the promise of an environmentally sustainable driving experience within reach of the average consumer. However, the question remains: "Do BEVs truly offer an environmental advantage with respect to global warming potential and secondary environmental impacts – and if so, at what cost?"

Ilyès Miri et al (13) (2020) Electric vehicles (EVs) have a limited driving range compared to conventional vehicles. Accurate estimation of EV's range is therefore a significant need to eliminate "range anxiety" that refers to drivers' fear of running out of energy while driving. However, the range estimators used in the currently available EVs are not sufficiently accurate. To overcome this issue, more accurate range estimation techniques are investigated.

Saleem Merkt et al (14) (2009) The NCSU FH.09 vehicle utilized a series electric hybrid system to create an electronic differential with no mechanical components connecting the two rear wheels. Research and analysis was conducted to govern the movement of the rear wheels to allow maximum traction while allowing instant driver adjustment based on his/her preference.

Eaton E-Locker (15) (2018) The Eaton ELocker™ differential is a driver-controlled, electronically activated locking differential that can easily replace a traditional differential to gain much more traction and off-road capability. During everyday use or on-road driving, the Eaton ELocker™ differential operates as an "open" differential. This enables easy maneuverability in tight parking lots and good road manners while cornering. However, when the terrain gets tough, or ultimate traction is needed, a switch allows the driver to fully lock the differential. A locked differential provides 100% of the drive torque to both wheels at any given moment, enabling difficult obstacles to be easily overcome.

III. PROBLEM STATEMENT

Fig 1. Garbage collection process in India.

Picture speaks a hundred words. The picture above clearly shows that the garbage collection in India is still a labor intensive activity and involves considerable amount of labor, time and effort.

Other vehicle used in garbage collection is the garbage rickshaws and garbage trucks that are driven using petrol or diesel engines.

Fig 2. Garbage collection process in India.

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IV. CONCLUSION

After careful review of research in waste management in India it is clear that garbage handling is done manually including a lot of labor, time and cost and thus need of electric garbage vehicle. The garbage vehicle development will necessarily need adding f the differential and so various differential systems are also studied.

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