A REVIEW PAPER ON DI WHEEL AUTOMOTIVE VEHICAL

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Abstract

The paper presents systematic and detail study of a Di wheel concept of automobile. A brief review of various works, research and earlier studies are summarized and analyzed for design features advantages and limitations research has carried out and economic relevance. Case study of E.D.W.A.R.D.is mentioned in the review. It has the mechanical and electronic integrated system which basically focus on yaw control and slosh control. It is first of its kind di wheel project which can be use as commercial and it's also has the software integration which can be used for the safety and controlling of the di wheel basically the project has get over some innovation which can be a future of automobile industry .but it's still have some kind of limitation which should be research by next generation innovators in future.

Keywords: *Di wheel, vehicle, design, future of automobiles, latest automobile*

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1. INTRODUCTION

The Di-wheel's distinctive design makes it a novel alternative form of transport. "One of the first recorded designs was by Mr. Otto in 1870" [2, 3]. However, the Di-wheel concept since then has yet to achieve wide acclaim and much attention outside of hobby circles. The aim of project, then is to bring the Di-wheel concept into the 21st century vehicle through the design and construction of a fully functioning, energy efficient electric Di-wheel. A Di-wheel allows the driver to sit in a frame which is rigidly connected to an inner ring and surrounded by two large wheels. These two wheels cause the entire system to move when rotated.

The Di-wheel is comprised of many typical subsystems. These subsystems must be integrated to provide an energy efficient system and all mechanical systems need to comply with relevant safety expectations. Typical subsystems of a Di wheel include large outer wheels covered with a tyre surface, an inner ring, idlers wheels, a drive system, brakes and a method for steering an energy efficient drive system is one that has minimal losses due to heat production and noise.

The extension goal of being able to drive upside down within the Di-wheel is an unusual operating condition. There are many difficulties associated with the goal that must be addressed. Although this extension goal presents many challenges, if it is achieved the project, as far as the authors are aware, will be first of its kind

2. PREVIOUS DESIGN

Modern designs of Di- wheels and mono- wheels have been used only on a small noncommercial scale as projects and attractions. Perhaps the closest use of the Di-wheel principle in commercial applications is the prototype of Andre Costa [4], winner of the 3rd Peugeot Design Competition. Details of the system's design have not been made publicly available. However the concept design is described in a Peugeot press release. This highly stylized version of the Di-wheel is not a true Di-wheel in nature, as it is stabilized by two spheres which act as front wheels. Other relevant constructions include the Rocket Roaster by Kerry Mclean [5] and the Di-wheel by Jonas Bjork holtz [6], as well as other monocycle, and Mono-wheel constructions. Patent archives contain many old Mono-wheel and Di-wheel designs with details of their intended mechanical realization. Detailed description of a Di-wheel concept and its working subsystems are presented in the 1947 Belgian Patent: "Two-wheeled Vehicle supportive of each other". This Di-wheel was said to have been constructed and designed by Ernest Fraquelli [7]. Correspondence with Dave South Hall from the UK, who has made a petrol powered Mono-wheel and is currently completing an electric Di-wheel, was personally initiated by him and has been useful for ascertaining detailed knowledge of some of the problems he has encountered with construction of his Di-wheel.

Fig 1 Rocket Roaster by Kerry[1]

Fig 2 Trinity DI Wheel[2]

2.1 Basic Parts of DI Wheel

- Outer wheel
  The traction between the road surface and outside tire means there should be minimal slip.

- Inner ring
  The suspension in the inner ring provides support for the main frame. This is tested by driving over a ruff surface road and comparing the results with the gyro-sensor.

- Main frame
  The main frame will achieve its function by supporting the weight of a passenger.

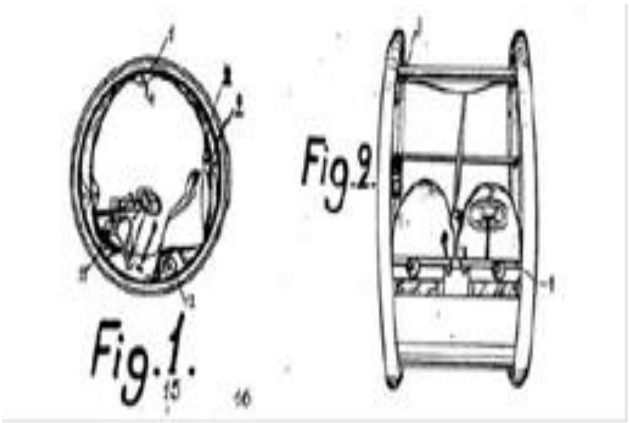

Fig 3 Basic Diagram of DI Wheel[3]

3. WORKING

A Di-wheel allows the driver to sit in a frame which is rigidly connected to an inner ring and surrounded by two large wheels. These two wheels cause the entire system to move when rotated. This allows the Di-wheel to rotate on the spot but restrains lateral movement.

These safety standards will be tested with the extension goal of driving upside down in the Di-wheel. The large outer wheels provide the motion of the Di-wheel and are usually made of bent metal tube. Since the wheels are quite large they require high torques to start moving. The inner ring and frame seats the driver and supports the drive system. Idler wheels are commonly employed to constrain the outer wheels to the inner ring, and typically require good wear properties. The drive system provides the motion for the Di-wheel and is commonly powered by a petrol motor which provides the torque required to move the Di-wheel.

Once in motion the Di-wheel must be stopped by a brake, which can be implemented electronically using the motors and mechanically using any common mechanical brake. To control the steering of the Di-wheel a differential drive is typically used.

4. TYPES OF DI-WHEELS

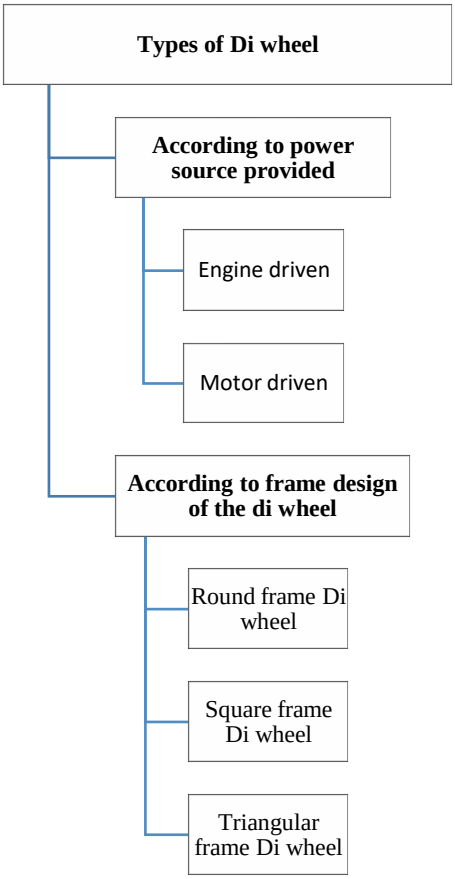

Chart 1 Type of DI Wheel

- **According to power source provided**
  1. Engine driven di wheel [7]
     Petrol engine is fitted as power source
  2. Motor driven di wheel [7]
     Electric motor of high torque is fitted instead of petrol engine

- **According to frame design of the di wheel**
  1. Round frame Di wheel
     Example – Trinity Di wheel
  2. Square frame Di wheel
  3. Triangular frame Di wheel
     Example – E.D.W.A.R.D [10]

5. ELECTRIC DI WHEEL WITH AUTOMATIC ROTATION DAMPING (E.D.W.A.R.D)

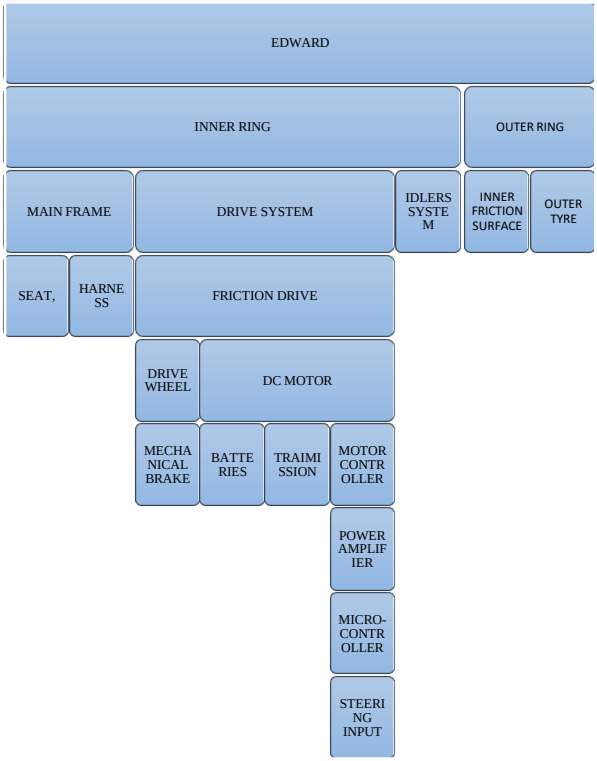

Chart 2. System Hierarchy

6. SYSTEM OVERVIEW

Fig 4 MODEL OF E.D.W.A.R.D[4]

E.D.W.A.R.D. is a complex system that is comprised of many components interacting with each other. Which is basic System Hierarchy diagram of the Di-wheel system and its components. These components combine together to achieve the project goals. To achieve these goals each subsystem has a functional requirement that must be achieved. To confirm the requirements have been met there must be a way to assess each component.

7. COMPONENTS OF E.D.W.A.R.D

Components use in E E.D.W.A.R.D. are as below with their functional use

7.1 Mechanical Components

O Outer wheel
- provide balancing to the frame of vehicle and motion Provide traction between surface and wheels Tyre surface (Component)

O Inner ring
- Provide suspension for the main frame (Function)
- Keep the main frame aligned with the outer wheels Idler wheels (Component)

O Main frame
- Provide seating for the driver Seat (Component)
- Support electronic components

O Drive system
- Read X, Y-axis data Joystick (Component) Processor (Component)
- Provide power to system Battery (component)
- Supply power to components Power distribution board (Component)
- Apply power to tors

O Mechanical Braking system
- Brake drive-wheel Foot pedal (Component) Disk brake, caliper, cables (Component)
- Signal processor when mechanical brake is engaged Limit switch (Component)

7.2 Electronic Components [13]

- H-bridge motor controller (Component)
- Signal distribution board (Component)
- Convert power to rotational velocity
- Motor (Component)
- Convert motor's rotational velocity to motion
- Transmission (Component)
- Drive wheel (Component)
- Outer wheel (Component)
- Provide speed measurement
- Encoder (Component)
- Processor (Component)

O Yaw control [14]
- Determine desired yaw rate
  - Joystick (Component)
  - Processor (Component)
- Determine actual yaw rate Encoder (Component)
- Determine error in yaw rate Processor (Component)
- Produce output voltage Processor (Component), Control circuit (Component) H-bridge

O Dynamic braking [13]
- Determine when to activate Limit switch (Component) Battery (Component)
- Active dynamic braking Dynamic braking circuit (Component)
  H-bridge (Component)

O Slosh control
- Reduce slosh angular rate Gyro sensor (Component) Accelerometer (Component) Processor (Component)
- Control slosh Processor (Component) Slosh controller (Component)

By conducting an extensive literature review on topics directly related to previous mechanical solutions, several mechanical concept designs were established. These designs were examined and components of successful solutions formed the basis for the design of E.D.W.A.R.D. The complete design has been modelled and gives a distinct visual impression of how the parts are integrated together. Some of these parts still need to be built and assembled in order to achieve the project's goals.

The problems anticipated with this include being able to maintain this unstable equilibrium whilst driving. The complexity of the problem have been attempted at a cursory level by calculating the dynamics of the system. However, these dynamics are highly non-linear, and have yet to be analyzed in full. They will form the basis of several controllers used in subsequent control systems. Review of literature has provided encouraging results in terms of the number of controllers; but few if any have attempted this feat for such a large under actuated system

8. SUMMARY OF PAPER

The di wheel concept is presented in various design initiated by andra costa design, the concept has been tried with many structural and electronic modification like use of engines, use of sensors and electric power source. A case study of E.D.W.A.R.D complex system, synchronization of mechanical and electrical component to satisfy many functional & safety goal. Review of literature has provided encouraging result in terms of the numbers of controllers but few if any he attempted this feat for such a large under actuated system. The di wheel vehicle has a good future in 21ST century. It has to still overcome some structural stability difficulty.

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Courtesy

[15] FIGURE 1 ROCKET ROASTER BY KERRY
[16] FIGURE:2TRINITY DI WHEEL
[17] http://www.redmaxmonowheel.co.uk/diwheel.html
[18] FIGURE 3 BASIC DIAGRAM OF DI WHEEL
[19] FIGURE 4MODEL OF E.D.W.A.R.D