“FABRICATION OF SMART BICYCLE”

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Introduction:

Folding Bicycles

A folding bicycle is a bicycle designed to fold into a compact form, facilitating transport and storage. When folded, the bikes can be more easily carried into buildings and workplaces or on public transportation (facilitating mixed-mode commuting and bicycle commuting), and more easily stored in compact living quarters or aboard a car, boat or plane.

Folding mechanisms vary, with each offering a distinct combination of folding speed, folding ease, compactness, ride, weight, durability and price. Distinguished by the complexities of their folding mechanism, more demanding structural requirements, greater number of parts, and more specialized market appeal, folding bikes may be more expensive than comparable non-folding models. The choice of model, apart from cost considerations, is a matter of resolving the various practical requirements: a quick easy fold, compact folded size, or a faster but less compact model.

There are also bicycles that provide similar advantages by separating into pieces rather than folding.

Electric Bicycles

An electric bicycle, also known as an e-bike, is a bicycle with an integrated electric motor which can be used for propulsion. There are a great variety of different types of e-bikes
available worldwide, from e-bikes that only have a small motor to assist the rider's pedal-power (i.e. pedelecs) to somewhat more powerful e-bikes which tend closer to moped-style functionality: all however retain the ability to be pedalled by the rider and are therefore not electric motorcycles. E-bikes use rechargeable batteries and the lighter varieties can travel up to 25 to 32 km/h (16 to 20 mph), depending on the laws of the country in which they are sold, while the more high-powered varieties can often do in excess of 45 km/h (28 mph). In some markets, such as Germany, they are gaining in popularity and taking some market share away from conventional bicycles while in others, such as China, they are replacing fossil fuel-powered mopeds and small motorcycles.

Depending on local laws, many e-bikes (e.g. pedelecs) are legally classified as bicycles rather than mopeds or motorcycles, so they are not subject to the more stringent laws regarding their certification and operation, unlike the more powerful two-wheelers which are often classed as electric motorcycles. E-bikes can also be defined separately and treated as a specific vehicle type in many areas of legal jurisdiction.

A pedelec (from pedal electric cycle) is a bicycle where the rider's pedalling is assisted by a small electric motor; thus they are a type of low-powered e-bike. However, unlike some other types of e-bikes, pedelecs are classified as conventional bicycles in many countries by road authorities rather than classified as a type of electric moped. Pedelecs include an electronic controller which stops the motor producing power when the rider is not pedalling or when a certain speed – usually 25 km/h – has been reached. Pedelecs are very useful for people who have to ride in hilly areas or where there are often strong headwinds. A pedelec can be any type of bicycle, but a pedelec city bike is very common. Ordinary conventional bicycles can be converted to pedelecs with the addition of the necessary parts, i.e. motor, battery etc.

The most influential definition which defines which e-bikes are pedelecs and which are not, comes from the EU and as such is valid across the whole of Europe. From the EU directive (EN15194 standard) for motor vehicles, a bicycle is considered a pedelec if:

1. the pedal-assist, i.e. the motorised assistance that only engages when the rider is pedalling, cuts out once 25 km/h is reached, and
2. when the motor produces maximum continuous rated power of not more than 250 watts (n.b. the motor can produce more power for short periods, such as when the rider is struggling to get up a steep hill).
An e-bike conforming to these conditions is considered to be a pedelec and is legally classed as a bicycle.

**Objectives:**

- In human transportation as a personalized vehicle.
- For inter departmental transportation in huge campuses.
- In industries for different level personnel to move around to inspect the work progress.
- In hospitals, Airports, Shopping malls, IT campuses, Hotels & resorts, Power stations, manufacturing units, etc...
- Light weight & easy to control, makes convenient for use by anyone.
- Controlled speed ensures rider’s safety.
- Can be used by old aged demography.
- On site charging facility. No need to visit fuel station

**Methodology:**

- Firstly the Hub motor was fit on to the rim using spokes.
- The fabrication was carried out keeping in mind the maximum load the motor will be able to withstand.
- Various fabrication processes were carried out.
- Tube cutting for the construction of chassis.
- Edge grinding to provide smoother surface finishing.
- Welding to join the tubes to form a stable chassis.
- All the fabricated parts were assembled.
- The controller is powered by batteries which are placed in the control box.
- Controller connects the main electrical components: the throttle and electric brake assembly and also the Hub motor. The throttle sends signal to the controller and based on these signals the controller sends output to the hub motor.
## List Of Components Required

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hub motor (24V, 7 Amps)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Batteries (12V, 24AH)</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Brakes (External brakes, circuit breaker)</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Rear Shaft Assembly</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Controller</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Fork (mild steel)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Rod (mild steel)</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Handle (steel)</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Charger</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Throttle</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Battery box</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Chassis (mild steel tubes)</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Rim (Mild Steel)</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Tires (Front and Rear)</td>
<td>1FW+1RW</td>
</tr>
</tbody>
</table>
Results & Conclusions:

Health Benefits

E-bikes can be a useful part of cardiac rehabilitation programmes, since health professionals will often recommend a stationary bike be used in the early stages of these. Exercise-based cardiac rehabilitation programmes can reduce deaths in people with coronary heart disease by around 27%; and a patient may feel safer progressing from stationary bikes to e-bikes. They require less cardiac exertion for those who have experienced heart problems.

Environmental Effects

E-Bikes are zero-emissions vehicles, as they emit no combustion by-products. However, the environmental effects of electricity generation and power distribution and of manufacturing and disposing of (limited life) high storage density batteries must be taken into account. Even with these issues considered, e-bikes will have significantly lower environmental impact than conventional automobiles, and are generally seen as environmentally desirable in an urban environment.

The environmental effects involved in recharging the batteries can of course be minimised. The small size of the battery pack on an e-bike, relative to the larger pack used in an electric car, makes them very good candidates for charging via solar power or other renewable energy resources. Sanyo capitalized on this benefit when it set up "solar parking lots," in which e-bike riders can charge their vehicles while parked under photovoltaic panels.

A recent study on the environment impact of e-bikes vs other forms of transportation\(^1\) found that e-bikes are about:

- 18 times more energy efficient than an SUV
- 13 times more energy efficient than a sedan
- 6 times more energy efficient than rail transit
- and, of about equal impact to the environment as a conventional bicycle.

One major concern is disposal of used lead batteries, which can cause environmental contamination if not recycled.

Road Traffic Safety: China's experience, as the leading e-bike world market, has raised concerns about road traffic safety and several cities have considered banning them from bicycle lanes. As the number of e-bikes increased and more powerful motors are used,
capable of reaching up to 30 miles per hour (48 km/h), the number of traffic accidents have risen significantly in China. E-bike riders are more likely than a car driver to be killed or injured in a collision, and because e-bikers use conventional bicycle lanes they mix with slower-moving bicycles and pedestrians, increasing the risk of traffic collisions.

**Performance Evaluation:** The combined center of mass of a bicycle and its rider must lean into a turn to successfully navigate it. This lean is induced by a method known as **counter steering**, which can be performed by the rider turning the handlebars directly with the hands or indirectly by leaning the bicycle.

**Speed:**
- Average speed: 12 mi/h 19 km/h
- Maximum speed**: 20 mi/h 32 km/h
- Travel range: 10–50 mi 16–80 km

**Batteries**
- Charging time: 2–8h
- Cycles of charge/discharge: Upto 400

**Power**
- Power consumption: 100–500 Wh
- On-board power supply: 12–36 V

**Torque**
- Hill climbing ability up to 6% slope

**Weight**
- Electric bicycle kit: 10–50 lbs 4.6–22.8 kg
Conclusions

Task

A detailed study of literature was initially carried out and the limitations of the existing E BIKE were observed. Deliberate efforts are made to resolve the existing problems. Various fabrication processes were carried out.

Also a detailed cost estimation of components that includes material, labour, fabrication and other overheads was made to make the SMART BICYCLE more economical and affordable to a common man.

The various problems associated with building a portable vehicle was studied so that the most common problems could be eliminated beforehand. Also the vehicle is made suitable for different people and the height of the handle bar can be adjusted so that any person can adjust the handle bar as per his requirements.

The main task of this project was to replace the complex electrical circuits with simple mechanical components so that it is more economical and convenient to use.

Achievement

Some of the improved features in the newly fabricated SMART BICYCLE are given below.

- **Low cost:**
  
  Compared to the cost of MOTOR BIKES and other mobility devices SMART BICYCLE is very economical as it uses simple mechanical components which are available easily. Also it can be afforded by the middle class segment.

- **Accessibility to different places:**
  
  The new vehicle is compact in size and lighter in weight and is accessible to remote places. The design efforts on a new SMART BICYCLE are successful and produce highly-portable product. The SMART BICYCLE is the mobility vehicle in the near future.

  SMART BICYCLE is an Electric vehicle with all necessary requirements. A Personal Transportation device finds great applications due to the convenience of its utilization.
- **Handling:**
  The new model is fully balanced with no handle effort. The entire model rests on three wheels which makes it completely stable under all conditions.

- **Portable:**
  The Trans-3 model can be detached and can be transported anywhere with very minimum space for storage and Transportation.

**Final Inference**

- The unique Hub motor which is used reduces friction to a great extent when compared to a standard chain belt drive.

- The basic problems associated with mobility vehicles were studied and most of the problems were eliminated such as maneuverability, size, power etc.

- The vehicle can run for longer distances (upto 20 kms) on a full charge.

- The SMART BICYCLE is a suitable vehicle for all types of people and some modifications can be made based on requirements.

- SMART BICYCLE is considered as the replacement for MOTORBIKE. High complex circuits are replaced by a secondary wheel which drives the vehicle. Single hub motor is used instead of two brushless hub motor as in Segway.

- Also the gyroscopes used in MOTOR BIKE are more complex compared to simple mechanical components which are used in SMART BICYCLE.

- The main purpose of this vehicle is to accommodate short distance travelling and transportation of small goods from one place to other.
Scope for Future Improvements

Solar docking stations

- Solar panels can be used for charging of batteries. Fully-powered Personal Transporter can go approximately 18kms on a charge, but in contrast, a solar powered Personal Transporter can go 20 to 30 kms.

- Solar docking stations can be used for the vehicles to get charged which can be installed conveniently in the campuses and large companies which save lot of power.

- Another wheel can be attached to the SMART BICYCLE so that handicapped people and old aged people will be able to use it.

- A trolley can be attached to the rear so that it can carry loads and can be used in industries by accommodating a high powered motor.

- It can be made more portable by using clamps so that it can be folded easily.