A Review of Experimental study of home automation by bicycle pedal power

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Abstract- With respect to human performance and power efficiency, the gear system in typical multi-speed bicycles is often biased and redundant. A preliminary user survey in this study reveals that the average utilization of each shift for a multi-speed gear system is less than 40%.

This study attempts to measure the optimal pedaling rates for given power output levels as well as design the optimal number of gears and the corresponding gear ratios. Heart rate, ratings of perceived exertion and electromyogram of quadriceps femoral for male subjects are measured at three different power output levels (40, 80 and 120 W) and four different pedaling rate levels (40, 60, 80 and 100 rpm). Various riding conditions including slope gradient and cruising velocity are also converted to the equivalent power output level.

Key Word- Gear ratio; Bicycle riding; Ergonomic design;

1 -Introduction-
A preliminary user survey revealed that the average utilization of multi-speed gear system is less than 40%. Fig. 1 displays the nominal gear values in commercialized multi-speed gear system and their actual gear ratios. Thus, with respect to human performance and power efficiency, current design of gear system is inefficient and hard to use because of the many number of unnecessary shifts. This study not only measures the optimal pedaling rates for given power output levels, but also designs the optimal number of gears and corresponding gear ratios.

2- Pedal power-
Pedal power is the transfer of energy from a human source through the use of a foot pedal and crank system. This technology is most commonly used for transportation and has been used to propel bicycles for over a hundred years. Less commonly pedal power is used to power agricultural and hand tools and even to generate electricity.

Some applications include pedal powered laptops, pedal powered grinders and pedal powered water wells. Some third world development projects currently transform used bicycles into pedal powered tools for sustainable development. The articles on this page are about the many wonderful applications for pedal power technology[1].
Sprocket - A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which are radial projections that engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

**Chain Construction**

Chains have a surprising number of parts. The roller turns freely on the bushing, which is attached on each end to the inner plate. A pin passes through the bushing, and is attached at each end to the outer plate. Bicycle chains omit the bushing, instead using the circular ridge formed around the pin hole of the inner plate.
Chain types are identified by number; ie. a number 40 chain. The rightmost digit is 0 for chain of the standard dimensions; 1 for lightweight chain; and 5 for rollerless bushing chain. The digits to the left indicate the pitch of the chain in eighths of an inch. For example, a number 40 chain would have a pitch of four-eighths of an inch, or 1/2", and would be of the standard dimensions in width, roller diameter, etc.

The roller diameter is "nearest binary fraction" (32nd of an inch) to 5/8ths of the pitch; pin diameter is half of roller diameter. The width of the chain, for "standard" (0 series) chain, is the nearest binary fraction to 5/8ths of the pitch; for narrow chains (1 series) width is 41% of the pitch. Sprocket thickness is approximately 85-90% of the roller width.

Plate thickness is 1/8th of the pitch, except "extra-heavy" chain, which is designated by the suffix H, and is 1/32" thicker.

Gearing

![Figure2.3 - different gear](image-url)
Bicycles usually have a system for selecting different gear ratios. There are two main types: derailleur gears and hub gears. The derailleur type is the most common, and the most visible, using sprocket gears. Typically there are several gears available on the rear sprocket assembly, attached to the rear wheel. A few more sprockets are usually added to the front assembly as well. Multiplying the number of sprocket gears in front by the number to the rear gives the number of gear ratios, often called "speeds".

Hub gears use epicyclic gearing and are enclosed within the axle of the rear wheel. Because of the small space, they typically offer fewer different speeds, although at least one has reached 14 gear ratios and Fallbrook Technologies manufactures a transmission with technically infinite ratios.

Causes for failure of bicycle gearing include: worn teeth, damage caused by a faulty chain, damage due to thermal expansion, broken teeth due to excessive pedaling force, interference by foreign objects, and loss of lubrication due to negligence.

3- Literature- By research paper, In accordance with the growth of bicycle market, multi-speed gear systems have become increasingly popular. In Korea, more than 60% of the bicycles sold in 1995 had a multi-speed gear system (Korea Bicycle Industry Institute, 1995). Power output during bicycle riding can be expressed as the product of pedaling force and pedaling rate. Under the same power level, a human can either pedal fast with a small amount of force (high-speed gear), or pedal slowly with a large amount of force (low-speed gear). Thus, the main function of multi-speed gear system can be considered to provide the shifting mechanism that a human can select his/her own combination of pedaling force and rate under certain degree of power output (Kyle, 1988; Whitt and Wilson, 1982).

Boff (2006) divided, in his review article, the development of human factors and ergonomics (HFE) into four generations, from adaptation to equipment with human limitations to improvement of equipment design for biological enhancement of physical or cognitive capabilities. The transformations of HFE are inducing more and more rearrangements of existing tools and equipments. The bike power saver (BPS, Chic Sheng Industrial Co., Ltd, Taiwan, China) is one of them, which aims to reduce energy-consumption during human cycling by changing traditional cycling pattern. Saving cycling energy is an important and active consideration for both professional and leisure cyclists. The famous yearly competition Tour de France is essentially a competition of human power combined with energy-saving strategies. Bicycles that optimize pedaling techniques, thus saving cycling energy, are certainly beneficial to athletes[7].

In 1989, ENEA started an R&D activity in co-operation with the Italian De Nora company for the development of proton exchange membrane fuel cells in the year 2000, De Nora Fuel Cells merged with EPYX to form Nuvera Inc. A NUVERA 300 Wstack has been used by ENEA for the construction of an easy-to-use, robust, safe power generating system installed on a commercial electric bicycle. The generator acts as a range extender of the electric bicycle. Only commercially available components were chosen for the system, whenever possible; an ad hoc single cell voltage detection device was developed[8].
We explicitly avoid a repetition of the lengthy discussion in the 1999 article about the choice of bikeway vs. roadway cycling facilities and the many other factors affecting cycling volumes and safety. Given the broad scope of our overview, it is not possible to analyze in any detail, let alone with rigorous multivariate methods, the impacts of specific types of infrastructure or programs on cycling levels. We do, however, cite the key literature related to the specific points we examine, with a focus on articles published since 2000. For a comprehensive review of the cycling literature, readers may consult four recent international surveys (Heinen et al., 2010; Krizek et al., 2009; Pucher et al., 2010a; Reynolds et al., 2009).

Our purpose in this article is twofold: (1) to portray national trends in cycling levels, safety, and funding over the past two decades and (2) to examine cycling trends, safety, and policies in large American and Canadian cities that have been especially innovative and successful at increasing cycling. As explained in this article, the cities we have chosen for detailed analysis have increased cycling far more than their countries as a whole, suggesting that their experience may provide valuable lessons for other cities seeking to promote cycling. Based on the results of our aggregate, national analysis and the city case studies, we assess to what extent the past decade has brought North America closer to a true bicycling renaissance[9].

Reference –