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Energy Harvesting using Bio Mechanical Knee

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Abstract: ***We recently developed a biomechanical energy harvester that generated substantial electricity during walking while requiring little extra effort. It took advantage of the fact that much of the displacement during walking occurs at body joints and harvested energy from knee motion. It selectively engaged power generation to assist the body in performing negative work, analogous to regenerative braking in hybrid cars.***

I. INTRODUTION

A. Aluminum

1) *Weight:* One of the best known properties of aluminium is that it is light, with a density one third that of steel, 2,700 kg/m3. The low density of aluminium accounts for it being lightweight but this does not affect its strength.

2) *Strength:* Aluminium alloys commonly have tensile strengths of between 70 and 700 MPa. The range for alloys used in extrusion is 150 – 300 MPa.

B. Gear

A gear also known as "gear wheel" is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque.

1) *Spur Gear:* Parallel and co-planer shafts connected by gears are called spur gears. The arrangement is called spur gearing. Spur gears have straight teeth and are parallel to the axis of the wheel. Spur gears are the most common type of gears.

2) *Benefits of Spur Gear*

a) Spur gears have high power transmission efficiency.

b) They are compact and easy to install.

c) They offer constant velocity ratio.

3) *Disadvantages of Spur Gear*

a) Spur gear drives are costly when compared to belt drives.

b) They have a limited center distance.

4) *Applications of Spur Gear*

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a) Metal cutting machines
b) Power plants
c) Marine engines
d) Mechanical clocks and watches
e) Fuel pumps

C. Diode

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other.

D. LED

Light emitting diodes (LEDs) were first developed in the 1960s, but only in the past decade have LEDs had sufficient intensity for use in more than a handfulof lighting applications and specifiers are confronted with an increasing number of lighting products that incorporate LEDs for certain applications. Primarily, these applications have taken advantage of the characteristics of LEDs that have made them most suitable for indication, not illumination.

1) Advantages of using LEDs

a) LEDs produce more light per watt than do incandescent bulbs; this is useful in battery powered or energy saving devices.
b) LEDs can emit light of an intended color without the use of color filters that traditional lighting methods require. This is more efficient and can lower initial costs.
c) The solid package of the LED can be designed to focus its light. Incandescent and fluorescent sources often require an external reflector to collect light and direct it in a usable manner.
d) LEDs, being solid state components, are difficult to damage with external shock. Fluorescent and incandescent bulbs are easily broken if subjected to external shock.
e) LEDs can be very small and are easily populated onto printed circuit boards.
f) LEDs do not contain mercury, unlike compact fluorescent lamps.

E. DC motor

DC motors are rarely utilized in normal applications as a result of all electricalsupply firms furnish electrical energy but, for special applications like in steel mills, mines and electric traction, it's advantageous to convert AC into DC so as to use DCmotors.
The rationale is that speed/torque characteristics of DC motors are much more superior thereto of AC motors.

II. MECHANISM

The biomechanics of walking presented four main challenges for designing a device to harvest energy from the motion of the knee joint. The first challenge was to determine an effective mechanism for converting biomechanical power into electrical power. At any given point in the walking cycle, there is only a certain amount of mechanical power available for harvesting from the knee—attempting to harvest too much power will cause the user to limp or stop walking while harvesting too little results in less electrical power generated.

A. LCD

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other

B. DC motor

A DC motor in simple words is a device that converts electrical energy into mechanical energy. It is of vital importance for the industry today, and is equally important for engineers to look into the working principle of DC motor in details that has been discussed in this article.
The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes. The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above.

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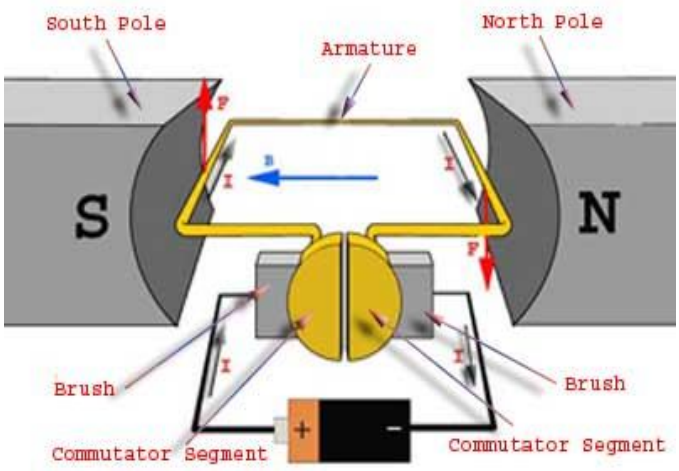
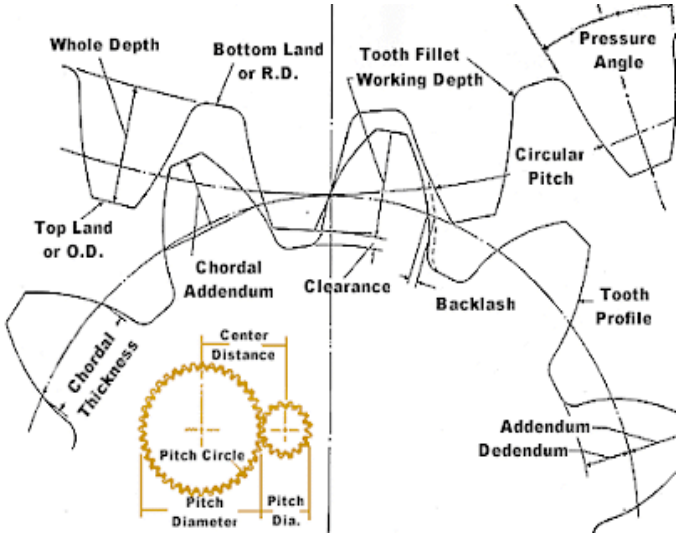


C. Spur Gear

Spur gears are simple, easily manufactured gears and are usually the first choice when exploring gear options. Transmitting power between parallel axes, the teeth project radially on the disc.



Spur gears are regularly used for speed reduction or increase, torque multiplication, resolution and accuracy enhancement for positioning systems. The teeth run parallel to the gear axis and can only transfer motion between parallel-axis gear sets. Spur gears mate only one tooth at a time, resulting in high stress on the mating teeth and noisy operation.

Gears mate via teeth with very specific geometry. Pitch is a measure of tooth spacing and is expressed in several ways.

D. Diametric Pitch

The ratio of the number of teeth to the pitch diameter of a gear; a higher DP therefore indicates finer tooth spacing. It is easily calculated by the formula **DP= (N+2) ÷ OD**, where N is the number of teeth, and OD represents the circumferential measurement.

E. Circular Pitch

A direct measurement of the distance from one tooth center to the adjacent tooth center. It can be measured by the formula **CP=Π÷DP**.

F. Module

A typical gear discipline and is a measurement of the size and teeth number of the gear. Gears measured in inches earn 'English module' distinction to prevent confusion. **M=OD÷N**

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G. Pressure angle

The angle of tooth drive action, or the angle between the line of force between meshing teeth and the tangent to the pitch circle at the point of mesh. Typical pressure angles are 14.5° or 20°.

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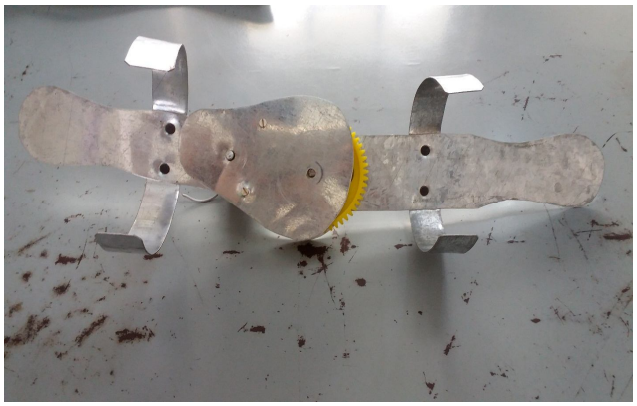
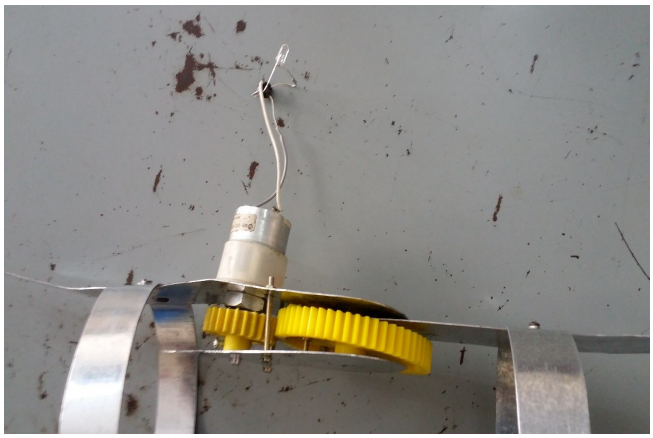
IMAGES





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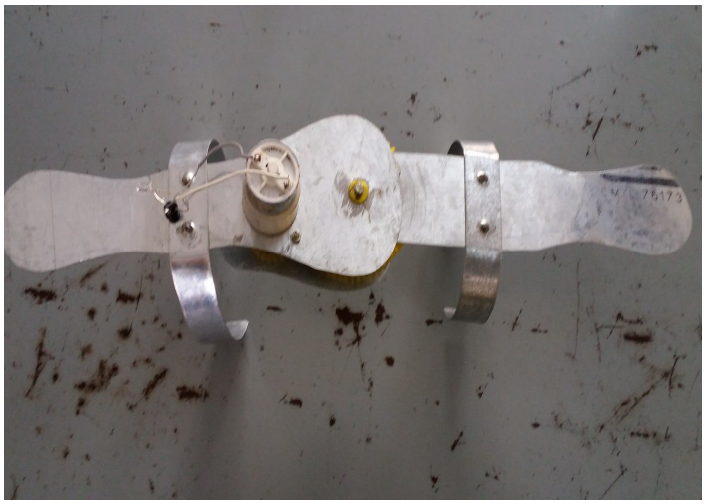

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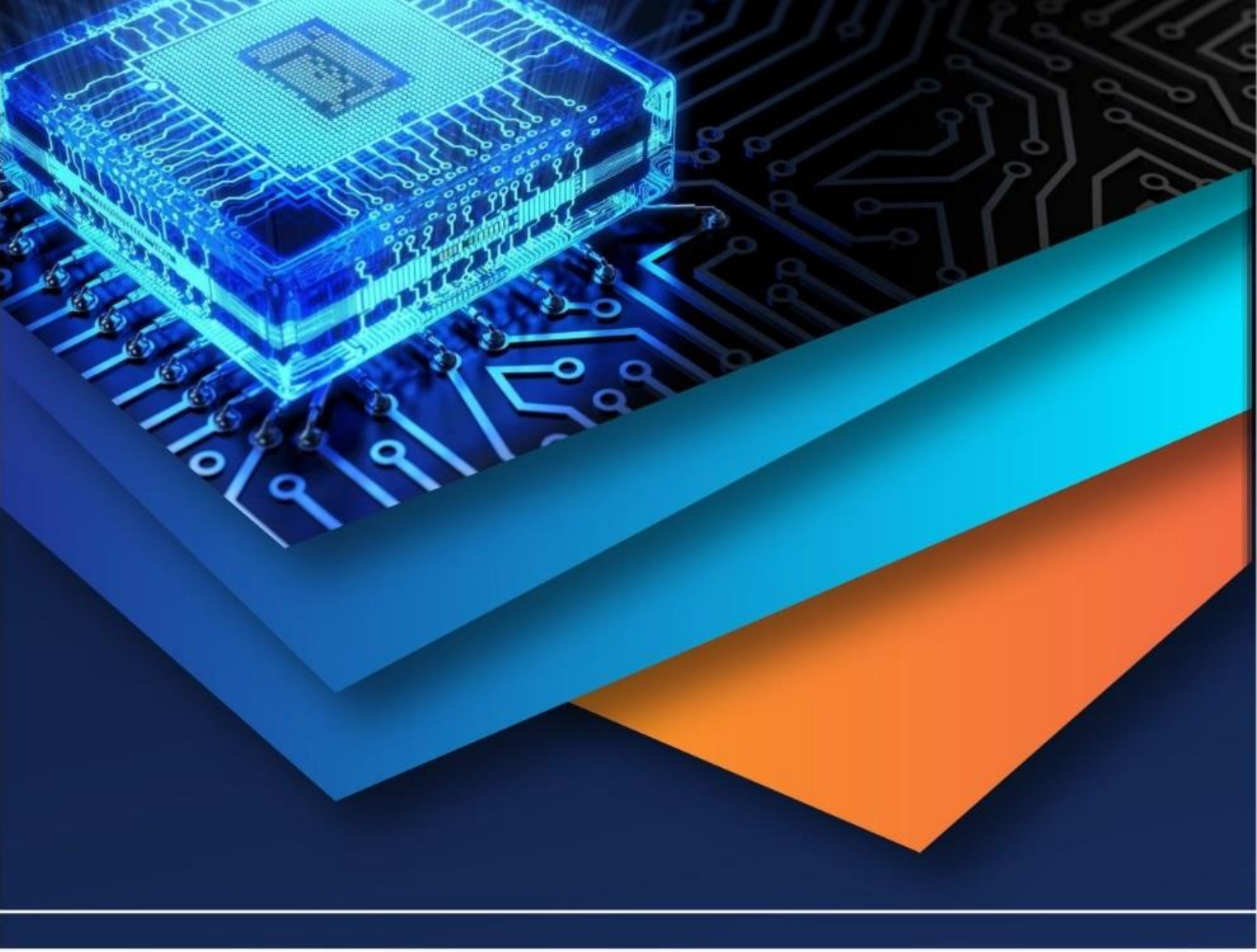

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