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DESIGN AND FABRICATION OF MOBILE CHARGER WITH THE AID OF COMPOUND GEAR MECHANISM

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ABSTRACT

Mobile phone is our means to remain connected. While the phones have progressively got more powerful processors and large touch screen interfaces, their power requirement has increased correspondingly. Unfortunately, battery technology has not been growing at a comparable pace. Hence, there is a need to frequently charge the batteries. While travelling, people face a common problem of charging electronic appliances. Our solution to this problem is mechanical based hand crank charger [2]. Mechanical hand crank mobile charger is a device that utilizes mechanical energy, converts it into electrical energy and charges the mobile. It doesn't require any electrical source. Also by going for this alternative source of energy we can reduce the human footprint on Earth as we are using human effort instead of conventional electricity. We have used a gear train and intermediate gears for transformation of mechanical energy from hand crank to generator

1. INTRODUCTION

With ever increasing demand for energy, man has left no other alternative to switch over to non conventional sources of energy which are cost effective, reliable and permissible emissions. Many methods of extracting energy have been experimented and analyzed and thereby to list out the best sources of energy and their extraction methodologies. Of all the thus experimented methods of extraction. The generation of electrical energy from mechanical energy proved to be the most efficient to other methodologies. In this present research we have explored various ways of generation methods and at the last we choose it as the best solution and we appraopriately designated as the mechanical driven crank mechanized mobile charging unit. In general cell phone battery requires 3.6 – 6 volts DC and 180 – 200mA current for charging. Since we are using a 6 volt dc generator in our model by this we are planned to achieve the desired output in easier manner [1].

According to the International Energy Agency, in 2011, 1.4 billion people around the world did not have access to electricity and if access they are facing severe power failure issues due to some controllable and uncontrollable situations. To overcome this severe problem and to provide electricity to the underdeveloped places, Cal Poly has initiated the DC House Project. It is led by Professor Taufik and his team of Electrical Engineering Department, in which his research scholars conducted various experimentations on energy extraction and storage which has the purpose of providing help with the energy crisis which is now faced by the world.

The DC house runs solely on produced sustainable energy in the form of DC power. The house has no dependence on the power grid. The three year project began in the 2010-2011 school year. During the first year, phase one consisted of students developing various forms of DC power generation. These forms of power include: solar, Wind generated, hydro-electric, and human generated. We are currently in phase two. This phase includes the design and construction of the house, along with the design of various converters and electrical systems for the house to have the ability to supply power to various appliances for the users. The third and final phase will begin in the 2012-2013 school year.

Our goal by the end of phase three is to manufacture a well defined product that provides safe, cheap, clean and reliable energy to under-privileged families, villages, developed areas and third world countries as stated earlier, the DC House will provide sustainable DC power for users that are outside the grid. The initial design is very primitive and focuses mainly on providing the simple amenities such as the use of fans and lights for domestic usage. Currently, project members are working on making the house have the ability to provide energy for more complex appliances such as electrical stoves, refrigerators and air conditioning units. The ability to provide use of appliances through safe, reliable, generated energy independent of the grid is a huge step towards helping the energy crisis[3].

The kinetic powered charger utilizes the movement and energy produced through the linear movement of the components utilized to mobile charging. Whether you are walking, running, or biking or performing any of the physical activities, this charger is able to convert the energy of your body's motion into energy that can be used to charge your phone. It is rather similar to a mechanical watch, which uses the swinging motion of one's arm to produce energy and it is well known for being very energy efficient.

2. DESIGN METHODOLOGY

Our research design consists of a compound gear train and simple gear train [4] i.e. more than one gear is present on a shaft, because compound gear train is used for high speed reductions. The gear connected to the hand crank is driving gear and the gear connected to the generator is driven gear. There are intermediate gears in between driving gear and driven gear. Intermediate gears are used to increase the speed ratio. By using these intermediate gears the speed ratio is increased by33.75 times i.e., when driving gear rotates with 1 rpm, the driven gear will rotate with 33.75 rpm. This is the main advantage of using intermediate gears.

Fig 1: Gear train

Hand Lever:

A crank is an arm attached at right angles to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It consists of a handle. The main purpose of hand crank is used to rotate the driving gear

Fig.2: Hand Lever

D.C. Generator:

A DC Generator is a machine which converts mechanical energy into electrical energy. Generator used is a permanent magnet geared dc motor. The stator consists of two magnets aligned with opposite poles facing each other and the rotor consists of three coils. When the shaft of the motor rotates, there is a relative motion between the permanent magnets and the coils which generates ac current in the coil. The flux associated with the coil is radial in nature.

A dc generator produces direct power. Both of these generators produce electrical power, based on same fundamental principle of Faraday's. According to these laws, when an conductor moves in a magnetic field it cuts magnetic lines force, due to which an emf is induced in the conductor. The magnitude of this induced emf depends upon the rate of change of flux (magnetic line force) linkage with the conductor. This emf will cause an electric current to flow if the conductor circuit is closed.

The most basic essential parts of a generator are

(a) A magnetic field and

(b) Conductors which move inside that magnetic field.

Commutator is used as a mechanical rectifier to convert AC current to DC current. The output of generator is 12 vat 435 rpm. The generator consists of a base motor and a gear box. The base motor rpm is quite large and to reduce the rpm it consists of a gear box. The gearbox consists of various gears such last gear is attached to the shaft. Gear3 is mounted on gear 2 and gear 5 is mounted on gear 4. Gear 1 is attached to the shaft of the base motor.

Fig.3: D.C Generator

TABLE 1: Generator Specifications

Motor parameters	Symbol	value
Operating range voltage	V	2.5 - 6
Rated voltage	V	6
Rated RPM	N	9072
Current at rated voltage	I	35mA

Printed Circuit Board:

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from. The components on our PCB are Diode, Transistor, 3 Resistors, Capacitor, DC jack and Zener diode.

PRINTED CIRCUIT BOARD:

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer. Conductors on different layers are connected with plated-through holes called vias. Advanced PCBs may contain components - capacitors, resistors or active devices - embedded in the substrate.

When the board has only copper connections and no embedded components it is more correctly called a printed wiring board (PWB) or etched wiring board. Although more accurate, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is

called a printed circuit assembly (PCA), printed circuit board assembly or PCB assembly (PCBA). The IPC preferred term for assembled boards is circuit card assembly (CCA) for assembled backplanes it is backplane assemblies. The term PCB is used informally both for bare and assembled boards.

The proposed design has modeled by using PRO-ENGINEER (PRO-E) software, which is a 3D solid modeling application used worldwide by Engineers to design, develop, and analyses products. We have given mechanical input to driving gear so that the driven gear is rotated by power transmission through intermediate gears. Gears are shown in grey colour and pinions are shown in green colour. By using these intermediate gears the speed ratio we achieved is nearly 74. When the driver gear rotates with 1 r.p.m then driven gear will rotate with 33.75 r.p.m. We have done simulation of circuit in NI MULTISIM software. NI Multisim is an electronic schematic capture and simulation program. We have designed our circuit by using this software and simulated it. The input given is 6volts dc and we are getting the output as 5.6 – 5.7 volts dc which is sufficient to charge the mobile battery.

Design of compound gears:

The Gearbox consists of two plastic plates constituting the top and the bottom surface. The bottom surface (fig 2) has got a hole for generator and two holes for pinion gear . The top surface (fig 1) has got a hole that the shaft of the generator can come out and two holes for pinion gear. Both the surfaces have got a linear track so that the other shaft with 40mm gear can linearly move through it [7].

TABLE 2: Assembly of compound gears

Description	No. of teeth
Driver gear	30
Compound gear (2and 2^{l})	10 and 30
Compound gear (3 and 3^{l})	10 and 30
Driven compound gear (4 and 4^{l})	8 and 28
Pinion gear	12

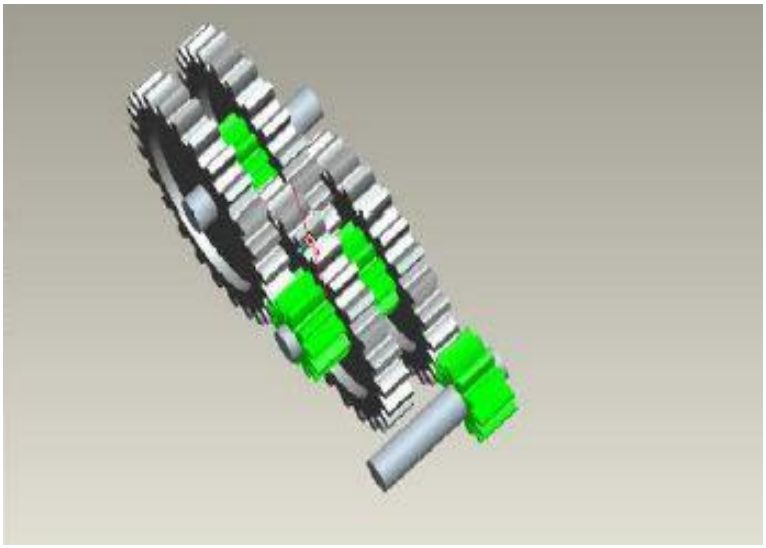

Fig.4: Assembly of compound gears

Working process: The hand crank is rotated so that mechanical energy is produced and then the produced mechanical energy is transmitted to the generator by using gear train. A compound gear train with spur gears is used. The compound gear train has one driver gear, one driven gear and 2 intermediate compound gears. Generator converts mechanical energy into electrical energy and transfers it to PCB. PCB regulates dc voltage up to the required output. Voltage regulation is done by using zener diode [8,9]. An LED is mounted on the PCB to indicate that the Output is being produced when the hand crank is rotated. The electrical output supply is given to the led and output pin mounted on PCB. By connecting the output pin to mobile, the mobile battery can be charged.

3. FABRICATED DESIGN OF A MODEL

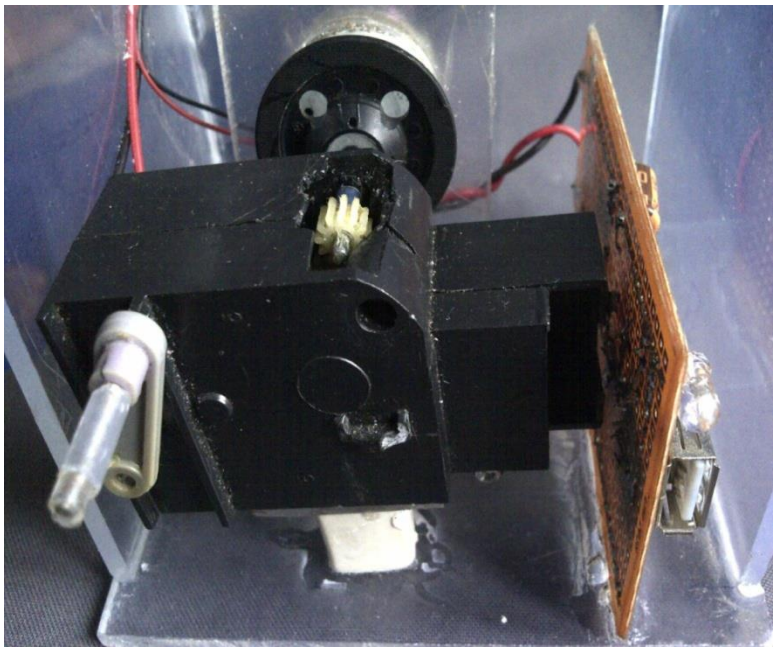

Fig.5(a) : Assembly of a charger model

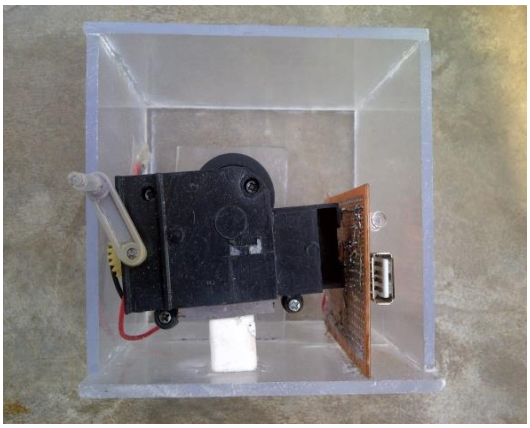

Fig 5(b) : Front view

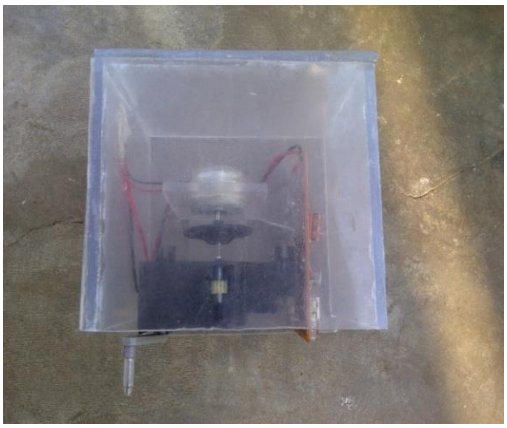

Fig 5(c) : Top View

4. CONCLUSIONS

- Mobile charging unit with compound gear mechanism is installed in a successful manner and working successfully.
- This is a versatile charger apart from other developed mechanical chargers which can generate electrical energy by our motion activities either in static and dynamic condition.
- Its functionality is checked for all kinds of android and i-phones and different parameters are checked.
- The mobiles such as Samsung, Celkon, Sony, Oppo and Honor are checked and its working functionality is successful and its charging time is checked and found to be 12 minutes gear mechanism for 1 hour battery utilization.
- Charging of a mobile phone was performed by the aid of hand driven crank mechanism and no provision of rigorously straining the body during the rotation.

- It was also observed that the rate of charging from the developed charger is less than the normal charger and the battery discharging is decreased by 30% when compared to electrical charging unit.

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