



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SELF RECHARGING MOBILE ROBOT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic & Automation) with Honour.

by

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ABSTRAK

Robot mobil secara umumnya terlibat dalam banyak bidang. Ada robot dalam industry pembuatan, robot perkhidmatan, dan lain-lain lagi. Untuk mengkatogorikan robot tersebut sebagai robot mudah alih, kriteria utama untuk robot tersebut adalah robot tersebut perlulah bergerak. Namun, untuk menyambungkan wayar pada robot yang bergerak adalah pekara yang menyusahkan. Sekiranya robot mobil yang tidak ada wayar pembekal elektrik, paras baterinya akan jatuh mendadak. Untuk mengatasi masalah ini, pemasangan penjana kuasa pada robot mobil tersebut adalah satu-satunya cara untuk memanjangkan tempoh pergerakan robot tersebut. Pemasangan penjana kuasa seakan-akan cara yang baik untuk mengatasi masalah tersebut, akan tetapi terdapat kelemahannya dalam cara penyelesaian itu, iaitu kuasa yang dijana oleh penjana tersebut adalah tidak mencukupi untuk robot tersebut untuk berfungsi berterusan. Justeru, pembelajaran ini dibuat khususnya untuk mencari batas-batas yang mengelakkan penjana tersebut untuk menjana tenaga yang mencukupi untuk robot tersebut supaya robot tersebut boleh berfungsi berterusan.

ABSTRACT

Mobile robot is used literally in many fields. There are manufacturing mobile robot, service mobile robot and etc. In order to make the robot to be mobile, the main criterion is the robot must not be stationary. However, a moving robot is inconvenient to attach a power cable to it. But for a moving robot, the battery level will drop significantly without a power source. The only way to overcome this problem is to attach a generator into the robot to prolong its service time. This basically sounds like a good idea, but the major drawback for this solution is that the power generated by the generator is not sufficient to make the mobile robot to go self-sustainable. Thus this study is done to study constrains which is causing the generator unable to go self-sustainable.

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LIST OF ABBREVIATIONS

LIST OF SYMBOLS & NOMENCLATURE

Δ - Delta

CHAPTER 1

INTRODUCTION

1.1 GENERAL BACKGROUND

Energy is a very interesting element. It cannot be created or be destroyed; it can only change from one form into another form. Energy plays a very important role in human civilization. As we can see, the ancients use brute force to build up the great pyramid, Great Wall of China, and etc. Energies are utilized in terms of labor and slave to built infrastructure to keep that certain civilization progress forward.

When it comes to the industry revolution period, human utilizes fossil fuel to power up machines and robots. As a consequence, the economic sectors flourish. When it comes to the world war period, human are able to utilize the energy of atoms to create atomic bomb. In this context, no one are giving a thumb up for the war, but giving a thumb up for the advancement in the science field.

The arrival of 20th century had change the style of how human utilize energy. Nowadays human can obtain energy almost out of thing that seems like nothing; which are solar energy and wind energy and etc.

This project is undergone in order to study the parameters which are affecting the kinetic generator.

1.2 PROBLEM STATEMENT

Kinetic generator existed quite some time in the market. Basically it has no difference compared to a generator, and hybrid car nowadays are using it to reduce the burden on relying fossil fuel to prevent global warming (Akira Kawahashi, 2004). However hybrid cars nowadays still cannot fully relying on electrical energy and energy generated by its own kinetic energy.

In this study, constrains of the generator which causing a machine/robot (or etc) cannot fully rely on only the internal energy source (internal battery and kinetic generator) is studied.

1.3 OBJECTIVES

The objectives for this project are:

1. Determine constrain of the kinetic generator which causes it unable to supply energy to recharge an internal battery and at the same time to power up the machine/robot independently.
2. Determine the parameters which contribute to constrain.

1.4 SCOPE OF THE PROJECT

The scopes for this project are:

1. The design and functionality of the mobile robot is not in consideration.
2. The dead weight of the robot is an assumption.

1.5 EXPECTED RESULTS

The following results are expected from this study:

1. The internal energy dissipation of the mobile robot is significant.
2. The energy needed to overcome friction is very great.
3. A kinetic generator is unable fully substitute the dependence of robot/machine by using other energy source such as fossil fuel or provided energy source.
4. The efficiency of a kinetic generator is low.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION OF ENERGY

In physics, energy is usually link together with the capacity in doing work or initiating a motion. There are a few kinds of energies are very common to everybody, which are, heat energy, kinetic energy, potential energy, solar energy, sound energy, and etc. In many occasion these energy will change from one body to the other in order to suit itself in their designated nature; in a closed system. For example, if a person were to lift his or her hand upward, immediately this consists of conversion of 3 types of energies which are chemical energy, potential energy and kinetic energy. How does this come about? This is because the food that he or she consumes is considered as chemical energy and after digestion the food will eventually turn into blood sugar or simply glucose. At the moment he or she raise up his hand, the movement of the hand will be considered as the hand gain in kinetic energy, and in the same time when the hand gaining height, the hand is considered obtaining potential energy.

Energy can be converted from one form to another form in various ways in order to suit the application. The most common applicable energies are mechanical and electrical energy which is came from the conversion of fuel burning heat engine, generators, batteries, fuel cells, and magneto hydrodynamic systems.

2.2 CONSERVATION OF ENERGY

According to theories and principles of physics, energies of interacting bodies or particle in a closed system will always remain constant. Imagine there is a leveled glass floor which has indefinite area and frictionless. On the glass floor there are two glass marbles is colliding. One of the glass marble is stationary (marble B) and the other one is moving (marble A). Say, marble A collided with marble B at the energy of 10J and come to a stop, and marble B started moving immediately after the collision. In this moment marble B will be moving with the energy of 10J.

In other occasion, say, a ball is being thrown up to the sky; when the kinetic energy provided to the ball had ran out due to overcoming the gravitational force; at that particular moment the ball will be stop at the middle of the air. In fact, the ball did not actually lose the energy; it is just that the kinetic energy had been converted into potential energy. At a point when the gravitational energy overcomes the potential energy, the potential energy in the ball will eventually converts back into kinetic energy that causes the ball to move downwards.

Conservation of energy was independently recognized by many scientists in the first half of the 19th century. In a close system, if friction is being assumed to be zero, then, disregarding of kinetic energy, potential, and elastic energy; the conversion of each of them into another is proven valid. Latter, upon the experiment in closer inspection; friction serves as limitation on classical mechanics, because friction tend to express itself in the generation of heat at the contacting surface in that particular closed system.

Energy may exist in a lot of forms in within a system and able to convert from one form into another form within the constraint of the conservation law. These forms are include thermal, gravitational, kinetic, elastic, electrical, chemical, radiant, nuclear, and mass energy; these energy is so useful and because they are universal applicable

yet they obey the law of energy conservation (Encyclopedia Britannica 2009).

2.3 COMMON TYPES OF ENERGY

There are many types of energy around us, for example electrical energy, heat energy, chemical energy wind energy and etc. For those which are more common types of energy would be Potential Energy, Kinetic Energy, and Electrical Energy.

2.3.1 POTENTIAL ENERGY

Potential energy is stored energy that depends upon the relative position of various parts of a system. (Encyclopedia Britannica, 2009) Potential energy is best described in the case of a spring. A spring has more potential energy when it is being compressed or being stretched. The spring is able to do more work when it is being stretched apart and being compressed compared to its actual length.

Potential energy is not only limited to springs and ball-earth system only. Potential energy can also exist in the forms of electrical, where the scientists will call them as electrical potential energy. In terms of electrical energy, a capacitor will serve analogously like a spring to collect the energy and release it in latter time.

If this two is not considered great enough, why not consider something really big, which is gravitational potential energy. The gravitational potential energy near the earth surface can be calculated by multiplying the weight of an object by its distance above the reference point.

2.3.2 KINETIC ENERGY

Kinetic Energy is a form of energy that an object or a particle has by reason of its motion. (Encyclopedia Britannica 2009) Kinetic energy is a special property that a moving particle or an object posses. It does not depend only on the movement, it also

depend on the mass of the particle or the object. The motion of the particle or object can be in various forms. It can be in translation, rotation about an axis, vibration, or any combination of motions. Kinetic energy also being defined as the energy that a moving body possesses because of its motion, dependent on its mass and the rate at which it is moving; equal to $\frac{1}{2} mv^2$, where m is mass and v velocity. (Christopher Morris 2009, Dictionary in Energy)

2.3.3 ELECTRIC ENERGY

Electrical energy is generated through the conversion of other forms of energy, such as mechanical, thermal, or chemical energy. (Encyclopedia Britannica 2009) Electrical Energy does not exist naturally normally. Even electrical energy exist naturally, eventually it will be neutralized. The best example can be described by using the thunder. When cloud layer passing through each other, a static electric charge is formed. When the charge reaches the maximum limit, it will neutralize itself by speeding electron to the ground. In the same time the electrical energy is converted into light energy and sound energy which causes thunder.

Due to the property of “keep on wanting to neutralize itself”, electric energy is considered as one of the energy which is tough to preserve. This is the main reason why electrical energy is only considered as a local commodity and it is very tough to perform cross national trade.

2.4 GENERATOR

Generator is a device which converts mechanical energy into electrical energy and for transmission and distribution over power lines to domestic, commercial, and industrial customers (Encyclopedia Britannica 2009). For vehicle such as aircraft, automobile, ships, trains and etc, the electric needed is also provided by generator.

Generators usually generate electrical energy from mechanical power. The source of mechanical power usually came from many sources, such as hydraulic turbines at dams or waterfalls, steam turbines, wind turbines, gas turbine and gasoline and diesel engines. The steam turbines, gas turbine and gasoline and diesel engine are generators which falls in a category which combust on fossil fuels, gas, gasoline, diesel and nuclear fission in order to power up a shaft into a rotating motion. The rotating shaft will produce a mechanical power which is calculated by multiplying the torque of the shaft and the angular velocity.

Generators have a wide range of variety in terms of size. It can be as small as a palm size device ranging to the size of a building, depending on the purpose of usage. The creation of generator to facilitate humankind, all thanks to 2 great scientists which are Mr. Lenz and Mr. Faraday. The hard work of this two great scientist is later combined up and thus the formula of $E = -N \frac{\delta\phi}{\delta t}$ is formed.

Where

N is the number of coil

E is the induced emf (electro motive force)

(-) “Negative sign” is for taking into account Lenz’s Law

$\frac{\delta\phi}{\delta t}$ Is the change of magnetic flux over the change of time.

With this simple equation, many great achievements had been realized.

2.4.1 WATER TURBINE (Hydro generator).

Water turbine or hydro generator generally formed up by two categories, which are impulse turbines and reaction turbines. Impulse turbines are usually used for high heads of water and low flow rates, however, for reaction turbines, it usually employed for head below about 450 meters and moderate or high flow rates. The arrangement of turbines can be horizontal or vertical shafts. The designs are dependent on the specific local hydraulic conditions (Encyclopedia Britannica 2009). However, according to Green-Trust.org they stated that the first hydroelectric generator was built in the year of 1882 in Appleton, Wisconsin in order to provide 12.5 kilowatts to power up two paper mills and a home. However today's hydropower plants produces power ranges from several hundred kilowatts to 10,000 megawatts in order to supply electricity to millions of peoples.

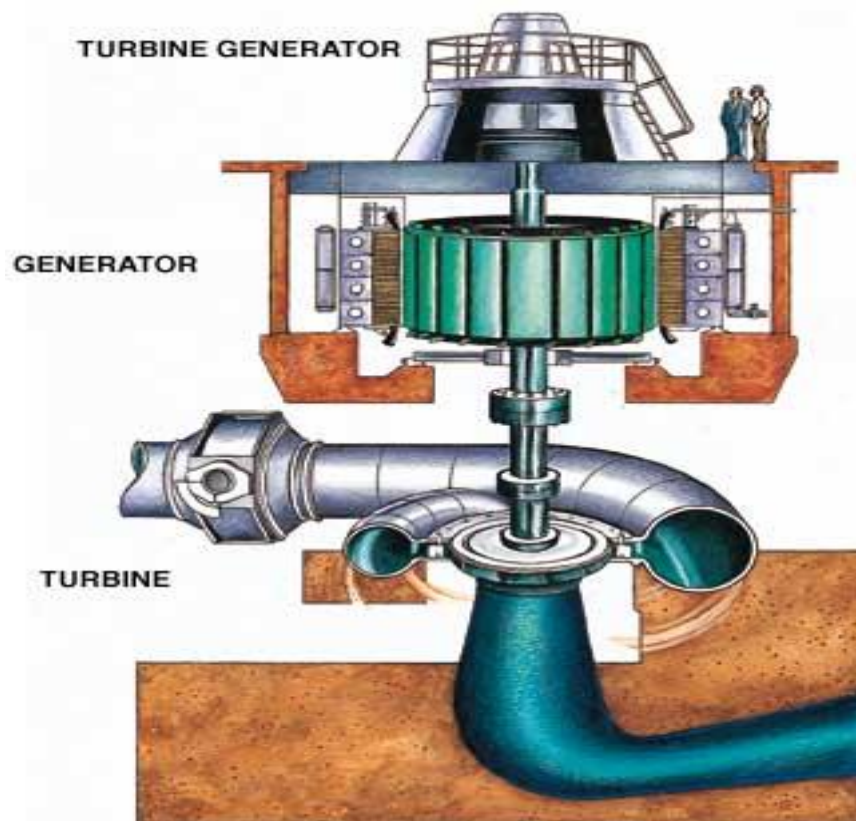


Figure 2.1: A water turbine. (Research Institute for Sustainable Energy, 2008)

2.4.2 STEAM TURBINE. (Steam Generator)

Steam turbine is formed up by a few major components which are a rotor which is resting on bearings, and an enclosed in a cylindrical casing. The rotor is turned by steam impinging against attached vanes or blades on which it exerts a force in the tangential direction. Thus a steam turbine could be viewed as a complex series of windmill arrangements. However, all components are assembled on the same shaft.

Steam turbines are widely used; this is because of its ability to develop tremendous power within a comparatively small space. Steam turbines are able to generate large amounts of electricity; in other application such as the ship propelling system, the steam turbines are able in providing propulsive power for large, high speed ships (Encyclopedia Britannica 2009).

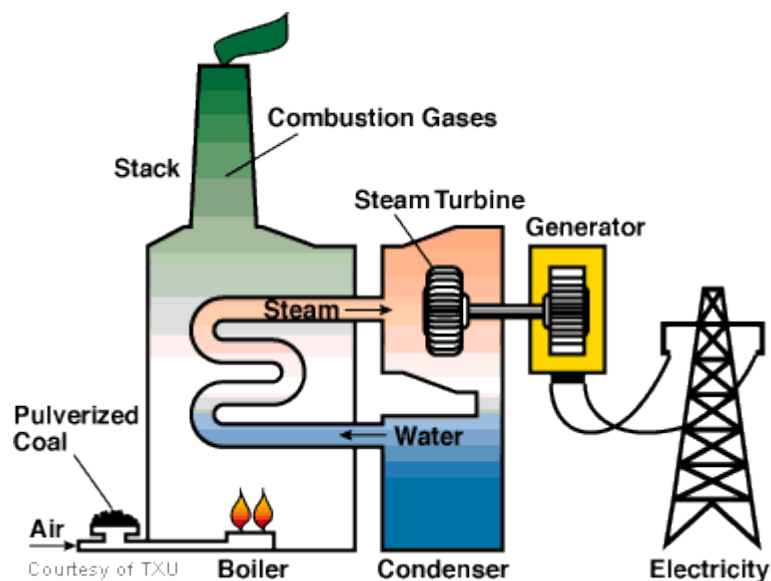


Figure 2.2: A steam turbine. (Luminant, 2010)