

Comparison advantages and disadvantages of dc motor engineering essay



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Robot is a device that has been created to overcome the human limited senses. Robots would help human in continuing quests [1]. From the Merriam-Webster, it is defined as a machine that looks like a human being and performs various complex acts, a machine guided by automatic controls and device that perform complicated repetitive task automatically [2]. The word of robot is originally used by Karel Capek in 1921 in his writing of Rossum's Universal Robot. This word was taken from robota which mean of forced labour in Czech word [3].

There are numerous ways how to define types of robots. It can be separated into its application and the way it moves which is the most crucial aspect in classifying them. Further explanation about the robot will be discussed in further subtopics.

2. 2. 1 Types of Robot by Application

Nowadays, robots do a lot of different task in many fields. This caused development of robot to grow rapid in carrying any task thinkable. Therefore the distinction of the robot types is made by its application differences in the practical world which are:

Industrial robot

Household robot

Medical robot

Military robot

Entertainment robot

Service robot

The explanation about the types of robot above will be explain briefly in the next subtopics.

2. 2. 1. 1 Industrial Robot

This type of robot is largely utilized throughout the industrial field. By definition, industrial robot is automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes.

Figure 2. 1 Industrial Robot

2. 2. 1. 2 Household Robot

Household robots are more tasked to doing jobs such as housekeeping to ease human burden. Usually, what the household robot is applied to is vacuuming, floor cleaning, gutter cleaning, pool cleaning, and trash taking. Although this kind of robot is not widely used, it can entertain people through daily routines and many more.

Figure 2. 2 Household Robot

2. 2. 1. 3 Medical Robot

In conducting surgeries, medical robot is used to develop treatment for various illnesses because of health have always been an important issue to human. For example, medical robot is used to do millimeter-precise surgeries. It included therapeutic robot, nano-robot and many more.

Figure 2. 3 Medical Robot

2. 2. 1. 4 Military Robot

Military purpose is one of the most important issues for every country in the world. Every country is racing to develop their defence technology for the protection of respective lands at all times. Military robot basically applied in search and rescue, fire fighting, surveillance, mine clearance, unmanned ground vehicle, armed robot and many more.

Figure 2. 4 Military Robot

2. 2. 1. 5 Entertainment Robot

These are just ordinary robots only for human entertainment. They are built only to serve their limited purpose such as smiling, dancing or listen to music. Sometimes some people also call them as toy robots.

2. 2. 1. 6 Service Robot

As named, service robots commonly are defined as the robots that could provide services to its owner. This kind of robots is various in tasks which assist people to do some job. It usually is used in many places such as public area, home, factory and others. Also this type of robot is ordinary comparing to other type of robot.

2. 3 Types of Robot by Moving (Kinematic)

As state before, these type of robot is based by its moving where the robot designed how its move from one point to another point. The medium for the robot to move used wheels, legs, tracks, and so on. Some of the types are:

Stationary robot

Cartesian

Cylindrical

Spherical

SCARA

Articulated(arm)

Parallel

Wheeled robot

Single wheel

Two wheel

Three or more wheel

Legged robot

Bipedal robot

Tripedal robot

Quadrupedal robot

Hexapedal robot

Swimming robot

Flying robot

Mobile spherical robot

Other (snake)

Basically, human are interested with the robot because of their advantages. One of the advantages is that the robot can carry out duty over the human capabilities. So with the perfect of memory and operate with instruction given, the robot need to be control by microcontroller as their brain.

Besides, there are four characteristics of robot that are usually embedded to ensure the functioning of robot. Firstly is sensing where it is able to sense the surrounding environment. Secondly, is their movement which able to move around its environment whether by rolling on wheel, walking with leg or propelled by thrusters. Third, energy capacity in which it is able to power itself. It might be solar, electrically, org battery which depend on what the robot need to do. Lastly is microcontroller which is kind of brain of the robot to be smart.

2. 4 Motor

Motor is one of the actuator or muscle that has been using to build the robot. The basic principle of motor is to convert the electrical energy to mechanical energy. It contains two fundamental of operation with electromagnetism and electrostatic energy. Motor has been divided into four types which is AC motor, DC motor, stepper motor and servo motor. All the discussion will be explain later.

2. 4. 1 DC Motor

DC motor is the first type of energy converter used in industry. It became more widely use in machinery control because their speed and torque easy to control. DC motor operates on the principle of basic magnetism. The DC motor is made up of three basic components with designed slightly different type of function motor. There are the series motor, shunt motor and the compound motor.

For the series motor this is the connection between the field and the armature. The series motor provides high starting torque (speed) and able to move very large shaft load when it is first energized [4]. It advantage also can be operated by using either an ac or dc power source. The amount of current that passes through the winding determine the amount of torque the motor shaft can provide.

In the shunt motor type of connection, the armature will be connected in parallel with field winding which is different from the series motor. At the same time, shunt motor is capable to operate with rpm control while it at the high speed [4].

The combination of the series motor and the shunt motor make DC compound motor. The series field windings connect in series with armature and shunt field connected parallel to armature. When the shunt field is connected in parallel with the series field and armature, it is called a long shunt. Otherwise it is called a short shunt. It allows the motor to have torque characteristics of series motor and regulated speed of shunt motor.

(b)

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(c)

Figure 2. 5: DC Motor (a) Series Motor.

(b) Shunt Motor

(c) Combination Series and Shunt Motor

2. 4. 1. 1 Comparison Advantages and Disadvantages of DC Motor

There are several of advantages and disadvantages of DC motor available that are listed in the Table 2. 1.

Table 2. 1 Advantages and disadvantages of DC motor.

Type

Advantages

Disadvantages

Brushed DC motor

Provide variable speeds.

Brush wear out and need replacement which undesirable

Process of brush create dust

Brushless DC motor

Variable speed operation but without the drawbacks of brushes.

High performance motion control

Electronic controller used to control the electrical current flow

Stepper DC motor

Very accurate and position control

Low speed but high torque

High cost

Need switching control

Difficult finding

2. 4. 2 AC Motor

Compared to the DC motor, AC motor is more widely used in industrial applications. It is broken into two types of operation which is it capable to operate in single phase and three phase voltage system. Whether single phase or three phase, it is chosen by depending on its application.

It can be seen that the general advantage of the AC motor is in the design itself which is it doesn't need for brushes and commutator while keeping armature stationary. AC motor are easy to understand and cheap to make and can reliable. However AC motor operates at a fixed speed in certain appliances.

Figure 2. 6: Example of Connection of AC Induction motor

2. 4. 3 Stepper Motor

The stepper motor is a specialized motor that can be used in open loop and closed loop positioning system. Its operation begins with supply a pulse of direct current to its winding and the stepper will move a specific number of degrees [4]. Three type of stepper motor commonly used which is variable – reluctance (VR) motor, the permanent – magnet (PM) motor and hybrid motor where it is from combining the VR and PM motor.

Basically these are the main advantage of stepper motor:

High rate of accuracy

No maintenance

High reliability

No feedback component are needed

However stepper motor also has its disadvantage, their disadvantages are listed below:

Resonance effect and relatively long settling time

Rough performance at low speed unless a microstep drive is used

Liability to underfeeled position less as a result of operation open loop

They can exhibit lag-lead oscillation which is difficult to damp

Figure 2. 7 Circuit Diagram of Stepper Motor

2. 4. 4 Servo Motor

The servo motor is a mechanical motorize device which can be instructed to move the output shaft attach to servo arm to specific position. The servo motor is built in gearing and feedback control loop circuitry. It needs to be controlled by pulse sending called pulse width modulation (PWM) from electronic device to their receiver to be translated. Usually servo motor is unable to continually rotate, so suitable to use in arms robot and legs.

Advantages

Disadvantages

High efficiency which it can approach up to 90% at light loads.

Requires tuning to stabilize feedback loop.

High torque to inertia ratio.

Motor can be damaged by sustained overload.

Audible quiet and high speed.

Power supply current 10 times average to use peak torque.

Resonance and vibration free operation.

Poor motor cooling.

High output power relative to motor size and weight.

Figure 2. 8 Structure of Servo Motor

2. 5 Microcontroller

Microcontroller is an integrated chip that is often part of an embedded system. It is included a central processing unit (CPU), random access memory (RAM), read only memory (ROM), input port, output port and some of special function like timer. But, usually microcontrollers including erasable programmable read only memory (EPROM) and programmable read only memory (PROM). These types of memories are permanently integrated into a chip and connected internally by an internal bus. It is designed to execute only a single specific task to control a single system. They are much smaller and simplified so that it can include all the function required on a single chip.

In microcontroller, it can be categorized as 8-bit, 16-bit and 32-bit which is that is the most used. There are five major types which are Freescale, Semiconductor (Motorola), Intel 8051, Atmel's AVR, Zilog's 28 and PIC from Microchip technology. Comparing PIC and Motorola microcontroller, PIC has flash memory so it has the best performance. Every of these types has their different unit of instruction and matching internal hardware are not compatible from another [5].

2. 5. 1 Central Processing Unit (CPU)

The Central Processing Unit (CPU) is a part to control the operation of the microcontroller and capability to multiply, divide, subtract, and move its contents from one memory location onto another location. It is memory location is called registers. All the instructions or data that CPU process will be store in the registers. This current process of transferring is conduct along the internal data bus.

2. 5. 2 Memory

Memory is almost important as CPU because it is part of the microcontroller whose function is to store data. Memory comes in a variety of packages, pin configuration, types and format. Today there are varieties common in used are RAM, ROM, EPROM and PROM. The memory stored two kind of information which is a unique instruction code and data.

2. 5. 3 Input Output Port

Input Output port is a link that been used to exchange information from outside world into the system to control such as led, LCD, or anything with the right interface. Most microcontrollers will have at least 8 digital I/O lines but 12 to 32 I/O line also are pretty common. But the advantage of the I/O port is it can be input, output and bi-directional port which is can be programmed as input or output.

2. 5. 4 Register

Registers are small memory elements of size in few byte or word. Registers can be accessed quickly by the ALU (Arithmetic and Logic Unit) of micro controllers.

Figure 2. 9 Example of Microcontroller

2. 5 Sensor

Sensor is a device that measures nanoelectrical physical or chemical quantities and convert it into a signal of electrical which can be read by an observer or by instrument [6]. There are too many type of sensor to be categorized. But the most common seen is sound sensor, vibration sensor,

light sensor, thermal sensor, pressure sensor, ultrasonic sensor and position sensor. Sensor can turn into contact sensor and non-contact sensor. For the contact sensor, it is reacting when then sensor touches something that can be activating the circuit. While the non-contact sensor act without touch the sensor such as temperature, hearing or smell sensors.

Each of these two criteria has their own advantage. For the contact sensor, it is valuables for detection motion where need the correct time to activate. This type can see for the explosive mine, door detection, or traffic light detection for a car crossing the line when red light. But for the non-contact sensor, it is more to activate before the object been touch. These types are available in sonar sensor, temperature sensor, distance sensor and many more. It has their certain level before the circuit will be activates.

In order to choosing the sensor, there are certain criteria for a good sensor to be select. Firstly it must sensitive to the measured property. It explain that the sensor only influence only their character not to other. Then it need insensitive to any other property likely to be encountered in its application. So these sensors will not influence to two or three property at the same time which cause some confusing.

2. 6 Power Supply

One important aspect of robotic is power supply. The type of the power supply or power storage set the limits the capability of a robot. So the function of the robot is decided by an availability of power consumption whether it is stored on the robot itself or supplied externally. Power supply is defined as a device that can produce source of electrical supplies or energy

supplies to the load. There are a few types of power supply that will explain later.

Battery

There has been a massive surge in a battery application whether rechargeable or non-rechargeable batteries to suit a robot's demands. With a large of advantage, it advent many of electronics device, cell phone, laptop and even watches use the application of batteries. It is the supply that is independent of the availability of mains electricity. The movement of electrons from negative to positive is caused by electric current. If there is no path for electrons to travel, therefore there is no current flow but the voltage is still present [7].

Battery technology is rapidly improving, so it come with variety of types such as alkaline battery, fuel cell, lead acid, lithium, Nickel Cadmium and Nickel Metal Hydride. It work is based on the electrons flow through a conductive path like a wire and called a complete circuit. Basically it contains of three parts an anode, a cathode and the electrolyte. So the chemical reaction in the battery will cause potential difference and flow of electrons.

Some of the advantages by using the battery are that it can be rechargeable for a certain type. Then the lifetime of battery is longer which may achieve almost 20years. Most types of batteries are free maintenance because of their characteristics. Besides that, the size of battery is the most important which consist of variety of size and only depend on how it to be use.

However, battery also have the disadvantages which the battery may lose about 8 to 20 percent charge in for every year and also depend on the <https://assignbuster.com/comparison-advantages-and-disadvantages-of-dc-motor-engineering-essay/>

temperature where it called as self discharge of batteries. For a non-rechargeable battery, the usage is very limited for only certain time.

Solar cell

Solar cell is a device that converts the sunlight energy into electricity energy which the conversion process is based on the photoelectric effect. The photoelectric effect is describes as the release of positive and negative charge carrier in a solid state when light strikes its surface. Basically the solar cell operate also using the concept of the flowing electron which it energy acquire from the sunlight energy. The solar panel is only the medium intercession for the process of conversion energy. It contains two different layer with p-type or silicon positive type and n-type or silicon negative type.

The advantages of solar cell are it using the renewable energy to operate. With the endless energy it becomes convenient sources for the future electricity supplies. Secondly, the solar powered panels are typically extremely easy to install. Wires, cords and power sources are not needed at all which this making easy prospect to employ. Lastly, solar cell absolutely no noise at all while absorbing the energy from the sun.

Nevertheless it also contains the disadvantage of the solar cell. Although it renewable source, during a storm or cloudy day solar energy cannot be harnessed. And the solar cell and solar panel that are needed to acquire solar energy which is very expensive to purchase.

Generator or alternator

Generator is a device used for convert mechanical energy to electrical energy. Generator and motors are built commercially the same way because of the generator can operate as a motor and vice versa [8]. The mechanical energy is obtained from the source of fuel, chemical, wind or other sources. The most common method to supply mechanical energy is through steam, gas combustion turbines, electric motor and water. .

Since the source of mechanical energy is renewable sources, so the advantage of generator is it easy to acquire to generate the power. It can produce long term electric power as long as the sources always in the generator. However the generator is device that is very expensive equipment to buy. And it is not applicable for certain application of electric devices.

The operation of generator is based on electromagnetic induction phenomenon. Magnet inside the generator creates a magnetic field that induces an electric current in the conductor whenever it moves through it. With constant and continuous motion of the conductor comes a constant stream of electricity

Conclusion

In making a conclusion, this chapter contribute the basic knowledge some of the important part of crawling robot. Besides it gives the advantages and disadvantages of the part in order to considering select the components for continuing further chapter.