

Designing an automated lawn mower



Chapter 1: Introduction to the study

Background to the research

The first lawn mower was contrivance in 1827 and patented in 1830 by Edwin Beard Budding, an engineer from Stroud, Gloucestershire, England.

He got this idea after seeing a machine in a textile industry, they used a cutting cylinder (or bladed reel) mounted on a bench to trim cloth to make a smooth finish after weaving. Budding realized that a similar concept would enable the cutting of grass if the mechanism could be mounted in a wheeled frame to make the blades rotate close to the lawn's surface.

First lawn mower was all made of cast iron and featured a large rear roller with a cutting cylinder (reel) in the front. Cast iron gear wheels transmitted power from the rear roller to the cutting cylinder. These machines were remarkably similar to modern mowers.

By 2000, robotic are most important things in the future, no matter if they are used to work in industry or at our homes, mimic some of the human capabilities, or used to access dangerous environments, launched to space, or simply used to play with. They are help to reduce human dependencies in performing a task and to reduce time for production while maintaining consistent quality of production outputs. Robotic devices are commonly used in manufacturing industries and for domestic use as well.

Modern houses normally garden with grass need to be maintained at a short height, is most user upset. Traditional lawn mowing is often a trouble, dangerous and time consuming in cutting the grass. The task of manual lawn

mowing can be replaced by automatic lawn mower using a robot programmed to perform such task. A automatic lawn mower is designed and installed in this project.

Automatic Lawn mower also can act as an aid to homeowners who can no longer perform physically demanding tasks, such as the elderly or disabled. On the residential side, many elderly and disabled enjoy lawn maintenance, but are no longer able to enjoy the satisfaction of maintaining their own lawn due to the physical demands of traditional lawn mowing equipment. These researches (automatic lawn mowers) are very elderly and disabled friendly with the simple. Automatic lawn mower also has the Perfect Balance Between Eco-friendly and Practicality.

Robots are very expensive, not any people really want to buy costly robotic devices. Create a low cost inexpensive automatic lawn mower will allow house owners to maintain their lawn without spending much time and money. An autonomous robot can mow the lawn of a given specific area of the garden without any human supervision.

Research problem / Research question

However with the continuous development, several resources also make the arbitrary abuse. Oil coal resources are depleting shortages of energy and serious pollution.

In the 20th century, energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy

crisis may be referred to as an oil crisis, petroleum crisis, energy shortage, electricity shortage or electricity crisis.

The near future, the petroleum crisis already is a very big problem. Globality by way of disburden, they would increase the petroleum price, and debase their expense. Still got another country, “ hit sb. when he’s down” increase the petroleum price, and gain profit. Market failure is possible when monopoly manipulation of markets occurs. A crisis can develop due to industrial actions like union organized strikes and government embargoes. The cause may be over-consumption, ageing infrastructure and sometimes bottlenecks at oil refineries and port facilities restrict fuel supply. That crisis involves the industry, business, carrying trade, until economic policy.

In response to the petroleum crisis, the principles of green energy and sustainable living movements gain popularity. This has led to increasing interest in alternate power/fuel research such as fuel cell technology, liquid nitrogen economy, hydrogen fuel, biodiesel, solar energy, geothermal energy, tidal energy, wave power, and wind energy, and fusion power.

Rotary mowers can throw out debris with tremendous force is one of the most dangerous tools around the home. Each year, approximately 80, 000 people with injuries caused by power mowers were treated in emergency departments. More than 9, 000 of the people hurt were younger than 18 years.

Lawn mower injuries include deep cuts, loss of fingers and toes, broken and dislocated bones, burns, and eye and other injuries. Some injuries are very serious. Both users of mowers and those who are nearby can be hurt.

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More than 20 percent of lawn mower injuries involving the hands, fingers or wrist. Some time the users want to adjust the height of the mower's wheels, forget pull out the spark plug after that the lawn mower suddenly turns on. When the user use lawn mower also need to make sure all debris (rocks, sticks and toys) are removed from the yard before you begin mowing. Loose objects can project out of the lawn mower and cause serious injury.

Aims and objectives

In the course of design and installation of an autonomous robot, the following criteria are set to fulfill its objectives:

The robot must cutting grass in the surface area

The robot must not be too costly and be affordable to all

The lawn mower cutting tool can be adjustable with servo motor

The robot also can be rechargeable energy with solar planer.

To provide an automated lawn mower which follows a programmed path of data point without the use of calibration marker, lights, wires, or buried conductors

To provide an automated lawn mower that is versatile in programming such that it can be maneuvered to follow any physically possible path including crossing over itself and reversal of direction

Justification for the research

On the residential side, many elderly and disabled enjoy lawn maintenance, but are no longer able to enjoy the satisfaction of maintaining their own lawn

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due to the physical demands of traditional lawn mowing equipment. These researches (automatic lawn mowers) are very elderly and disabled friendly with the simple.

Methodology

Automated lawn mower, are mower automatically along the edge of a swath which has been cut within or around an area of uncut grass. That includes a sensor assembly mounted on the front of the mower to detect the edge of the swath by sensing the different in height between uncut grass and the cut grass in the swath. In front of the lawn mower, also got a one touch sensor, that means it will be automatic avoid collision with obstacles along its pathway. Automated lawn mower also can adjustable the cutting tool about 1cm~3cm, this function is let the user choose which height with the grass. This mower using the solar planer to generate the power, and rechargeable lithium battery, let the mower moving more time.

Conclusion

Automatic grass cutters are environmentally friendly (no petrol, oil or emissions). No need bagging and disposal of clippings is eliminated. It also can healthy and beautiful looking lawn. In addition to environmental protection, also can save user time and money.

Chapter 2 : Literature review

Most people do not associate air pollution with mowing the lawn. Yet emissions from lawn mowers, snow blowers, chain saws, leaf vacuums, and similar outdoor power equipment are a significant source of pollution. Today's small engines emit high levels of carbon monoxide, a colorless,

odorless, poisonous gas. They also emit hydrocarbons and nitrogen oxides, pollutants that contribute to the formation of ozone. While ozone occurs naturally in the upper atmosphere and shields the earth from harmful radiation, ozone at ground level is a noxious pollutant. Ground-level ozone impairs lung function, inhibits plant growth, and is a key ingredient of smog.

Each weekend, about 54 million Americans mow their lawns, using 800 million gallons of gas per year and producing tons of air pollutants. Garden equipment engines, which have had unregulated emissions until very recently, emit high levels of carbon monoxide, volatile organic compounds and nitrogen oxides, producing up to 5% of the nation's air pollution and a good deal more in metropolitan areas. According to the U. S. Environmental Protection Agency (EPA), a traditional gas powered lawn mower produces as much air pollution as 43 new cars each is being driven 12, 000 miles.

Among various types of outdoor equipment, lawn mowers are an important contributor to community noise, with the blades contributing up to 50% of noise (Tauro & Mann III, 1997). Lawn mowers can be just as loud as leaf blowers. According to the Canadian Hearing Society (1991), lawn mowers can emit 80-96 dB(A) when measured at a distance of three feet.

Like gas-powered leaf blowers, gas-powered lawn mowers emit air pollutants. As indicated in Table 4 below, these air pollutants include hydrocarbons, carbon monoxide, nitrogen oxides and particulate matter.

These emissions represent less than 5% of the total emissions of these individual pollutants in Canada, except for hydrocarbons, which are nearly 14% of total hydrocarbon emissions (Environment Canada, 1994).

Two-stroke lawn mowers tend to be more polluting than four-stroke models. For example, one study found that lawn mowers with two-stroke engines emit hydrocarbons at an average rate in excess of seven times the rate of emission from lawn mowers with four-stroke engines (Priest et al., 2000). Evaporative fuel emissions from lawn mowers are estimated to be 5.8 grams/day (Wong, 2001). Lawn mowers can be more polluting than driving a car. One half-hour of lawn mowing with a typical walk-behind mower produces as much hydrocarbon emissions as driving a 1995 automobile for about 100 miles or 160 kilometres (California Air Resources Board, 2000). A Swedish study found that the emissions produced from a lawn mower engine during one hour of operation were around $4000 \frac{1}{4}g/h$; this is comparable to driving more than 150 km in a car with a three-way catalytic converter (Christensen & Westerholm, 2001).

Both lawn mower users and bystanders can be exposed to noise and air pollutant emissions. Figures from Statistics Canada indicate that there were 5,850,000 lawn mowers in Canada in 1985, the majority of which were gas-powered (73.3%). There were comparatively fewer electric (23.9%) and push mowers (2.8%) (Environment Canada, 1994). Most lawn mowers that are available in the Canadian marketplace are imported (Maillette, 2001). According to information obtained from Statistics Canada, 126 walk-behind lawn mowers were imported into Canada during 1996-1999. Figures on domestic production of lawn mowers are not available from Industry Canada (Maillette, 2001).

Automatic lawn mower (e. g., lawn mowers) contribute to noise and air pollution that can adversely affect human health and the environment,

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minimize noise, exhaust and evaporative emissions from lawn/garden equipment and protect public health.

Chapter 3 : Concept development and evaluation

Timing Belt

Belt driver are provides a convenient means for transferring power from one shaft to another. Belt are frequently necessary to reduce the higher rotative speed of electric motors to the lower values required by mechanical equipment. But in this project are contrary, because the cutting tools need a top speed to operate. Normally in industrial, are using two general type of belt driver, v-belt and timing belt (synchronous belt).

Since the cost of v-belt is relatively low, the power output of a v-belt system may be increased by operating several belts side by side. All belts in the drive should stretch at the same time rate in order to keep the load equally divided among them. When one of the belts breaks, the entire group must usually be replaced. The drive may be inclined at any angle with a tight side at either the top or bottom. Since belts can operate on relatively small pulleys, large reduction of the speed in a single drive are possible.

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Pitch diameter of a pulley $P = \text{No teeth on pulley} \times$

Drop distance $d =$

Belt contact angle $\hat{I}_{\pm} = \arcsin [C = \text{centre distance}]$

Belt fall length $f_l =$

Contact length small pulley $CL_2 =$

Contact length big pulley $CL_1 =$

Belt length $L = 2(f_l) + CL_1 + CL_2$

Total number of teeth on belt =

Big pulley, $P_1 = \text{No teeth on pulley } x$

$= 38 \times$

$= 61.4465\text{mm}$

Small pulley, $P_2 = \text{No teeth on pulley } x$

$= 18 \times$

$= 29.1063\text{mm}$

Drop distance, $d =$

$=$

$= 16.1701\text{mm}$

Belt contact angle, $\hat{I}_{\pm} = \arcsin [C = \text{centre distance}]$

$= \arcsin$

$= 7.87^\circ$

Belt fall length , fl =

$$= 116.9815\text{mm}$$

Contact length small pulley, CL2 =

=

$$= 41.7221\text{mm}$$

Contact length big pulley, CL1 =

$$= 61.4465$$

$$= 104.9601\text{mm}$$

Belt length, L = 2(fl) + CL1 + CL2

$$= 2(116.9815\text{mm}) + 104.9601\text{mm} + 41.7221\text{mm}$$

$$= 380.6452\text{mm}$$

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Using micromagic system software determine the belt length.

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Imperial XL section

$$\text{ht} = 1.27\text{mm}$$

$p = 5.08\text{mm}$

$h_s = 2.30\text{mm}$

Spur gear

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Spur Gear Formula

14 degree

Pressure Angle

20 and 25 degree

Pressure angle

Addendum, a

$a =$

$a =$

Dedendum, b

$b =$

$b =$

Pitch diameter, D

$D =$

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D =

Outside diameter, D_o

$D_o =$

$D_o =$

Number of teeth, N

$N = D \times P$

$N = D \times P$

Tooth thickness, t

t =

t =

Whole depth, h_t

$h_t =$

$h_t =$

Clearance, c

c =

c =

Center distance, C

$$C =$$

$$C =$$

Working depth, h_k

$$h_k =$$

$$h_k =$$

Chordal tooth thickness, t_c

$$t_c = D \sin ()$$

$$t_c = D \sin ()$$

Chordal addendum, a_c

$$a_c = a +$$

$$a_c = a +$$

Diametral pitch, P

$$P =$$

$$P =$$

Center distance, C

$$C =$$

$$C =$$

Ball and roller bearings

A ball bearing usually consists of four parts: an inner ring, an outer ring, the balls and the cage or separator. To increase the contact area and permit larger loads to be carried, the ball run in curvilinear grooves in the rings. The radius of the groove is slightly larger than the radius of the ball, and very slight amount of radial play must be provided. The bearing it thus permitted to adjust itself to small amounts of angular misalignment in the assembled shaft and mounting. The separator keeps the balls evenly space and prevents them from touching each in the sides, where their relative velocities are the greatest.

Ball bearings are made in a wide variety of type and size. Single row radial bearings are made in four series. “ Extra light, light, medium, and heavy”, for each bore, as illustrated in Fig 1