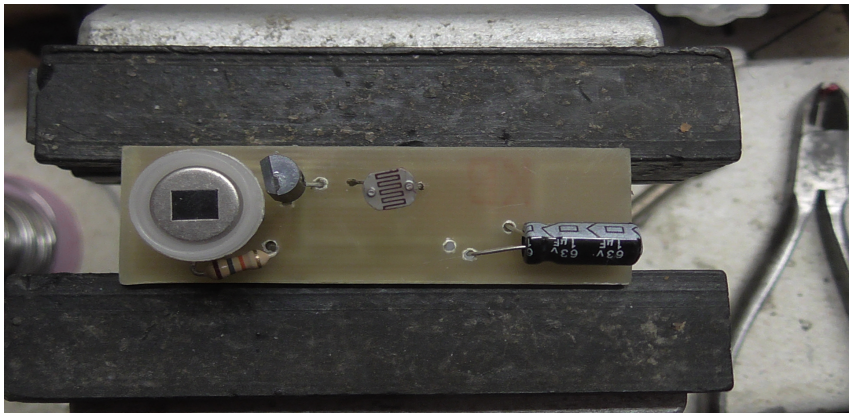
Green energy project ©

Being a business in the midst of a recession with little trade would worry most people. However here at CalenterprisesLtd we do not depend on a reliable income and a down-turn gives a chance to reseach important projects.

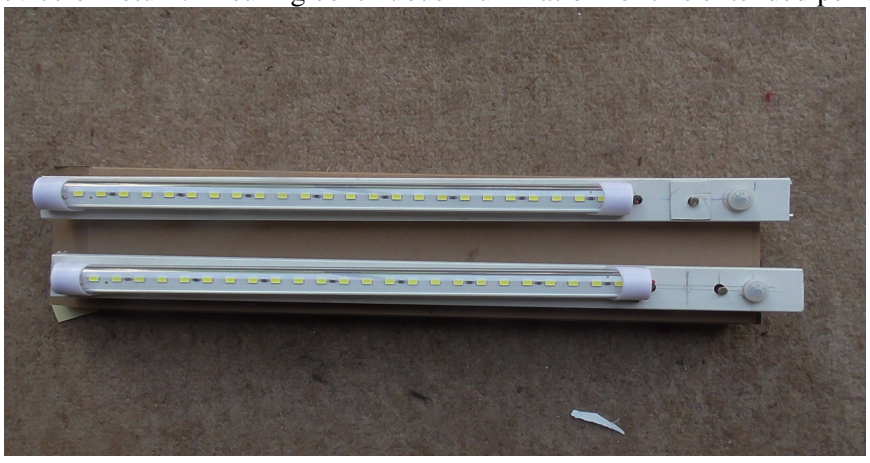
This project intends to research the feasibility of using natural sourced energy to supplement domestic electrical power. The output from both wind and solar sources is thought to be able to take over the lighting of a house. Use for heating and cooking is of secondary importance and be considered at the end of the study.

There has been a delay in putting together the components needed for this task. No study can be done without the means of measuring the results. Accordingly before anything can be started a micro data-logger/ controller had to be designed both to monitor the grid energy at the electric meter and log and ultimately control charge discharge systems from wind and solar sources. The author is an Agilent VEE developer so downloaded data from micro data-logger/controller can be processed and presented in appropriate form.

The 12v lights will operate with mini PIR detectors with a range of 3M and a delay time of up to 15 mins. Their action is dependant on the level of daylight present.



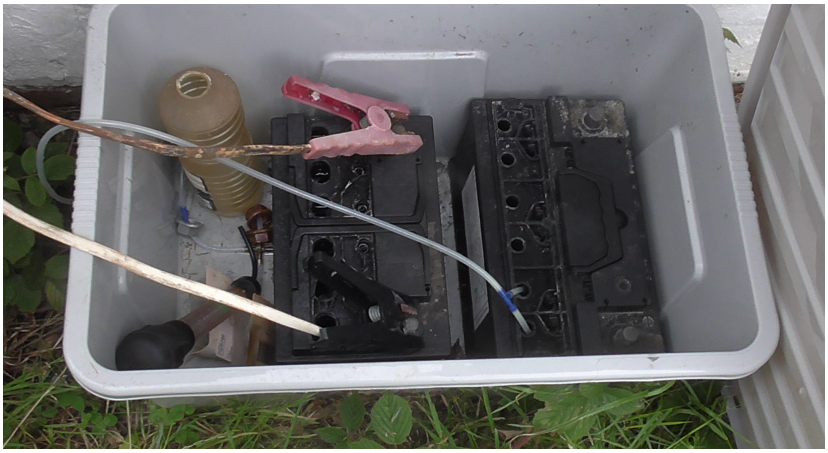
The circuit took some time to develop. The sensor only provides a 3v, 2 second pulse. This means a way of prolonging that time had to be found. Also the circuit had to be able to sense the presence of ambient light and inhibit the operation of the LED light. The circuit can be retriggered provided the light is on so an individual can be away from the vicinity of the PIR sensor for up tp 10 mins and retrigger the device on return. Ensuring continuous illumination for this extended period.



Higher power LED light These took about 700mA as against 500mA for the lights already mentioned. They also used a constant current generator instead of dropper resistances and so were more efficient and also much brighter.

Solar panels These are 12v ,100w panels which cost £100 pounds each. Buying 2 allows flexibility of switching in series /parallel according to solar conditions. They were installed on the roof of my workshop.

Battery box Car batteries are not the cleanest of items, therefore they were installed outside my workshop in a separate battery box which allowed for more than one battery. Most car batteries these days do not allow topping up or specific gravity measurements. However the top cover can be removed with a wood chistle to allow maintenance. It was noted that batteries are most likely to fail in one or two cells. The synario is the rest of the battery is charged when those cells are zero. I am hoping to be able to correct this by just charging those duff cells.



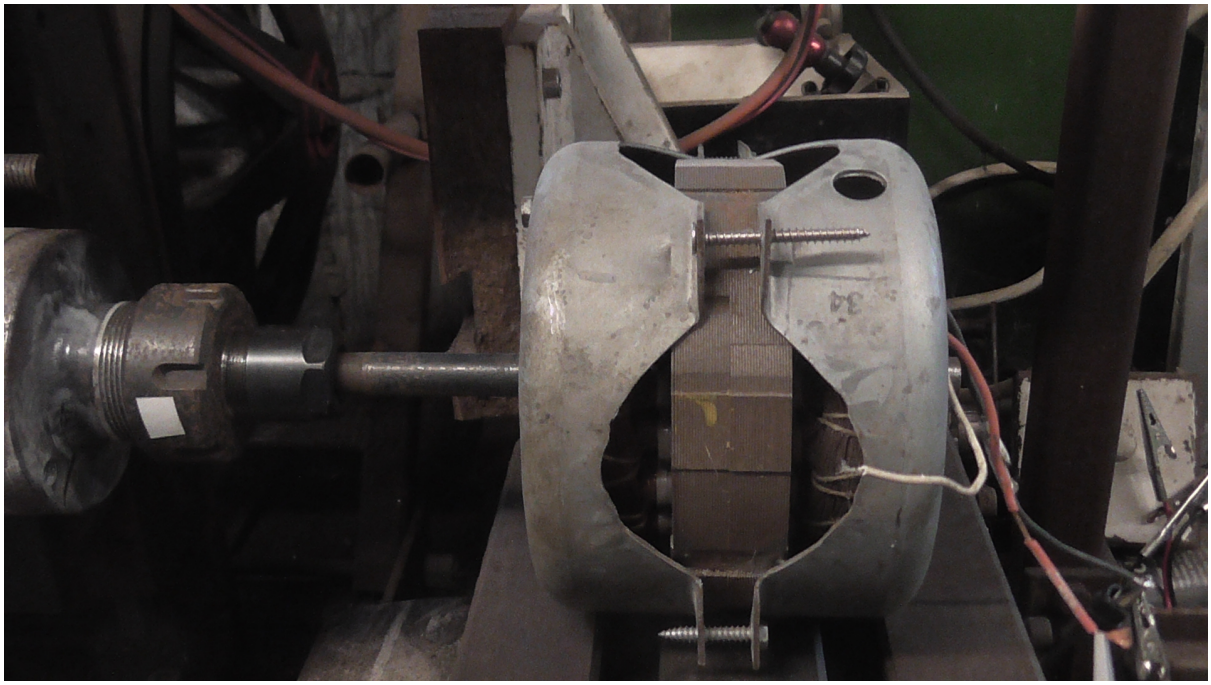
Allotment trials A friend had an allotment not connected to mains electricity this was ideal for trials of 12v lighting.

The controller is an expensive one I was given that can operate with 2x 12v solar panels giving 40v in full sunlight. It was wired with the 2 panels in series so that on dull days it will maintain the 12v battery. I noticed that this controller disconnects when the battery voltage reaches 14.2v. This must represent a waste of energy. It would have been more efficient to have a “dump output” of rough power which could have been used for greenhouse heating etc. Something to design for the future.

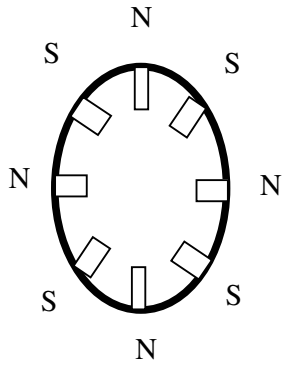
Wind generator There was a design on the internet using a car radiator cooling fan as a generator. This was constructed using the the instructions given in the U tube video. However it produced very little voltage so much so the author must have got his decimal point in the wrong place when measuring it.

It is noticeable that several experimental generators featured on the internet use neo-magnets but with very little iron work for the magnetism to pass through. Typically the frame of these generators

is fabricated from plastic on a 3d printer. Then the magnetic flux is reduced by having to travel through gaps of non-magnetic material.
This being the case the aim of future research is being turned towards modification of existing motors. These have adequate iron core material and larger windings and should be capable of generating reasonable voltages at low revolutions.
More research has featured a small induction motor, the rotor of which has an iron core with built in short circuit loops to prove a repelling force from a rotating magnetic field. The rotating field being built up from the components of the two stator windings, one of which has a series capacitor.



Experiment 1 Using the stator windings magnets have to be attached to the rotor. The aluminium loops were not needed and were removed. Holes were drilled into the rotor and cylindrical neo magnets were glued into the holes.

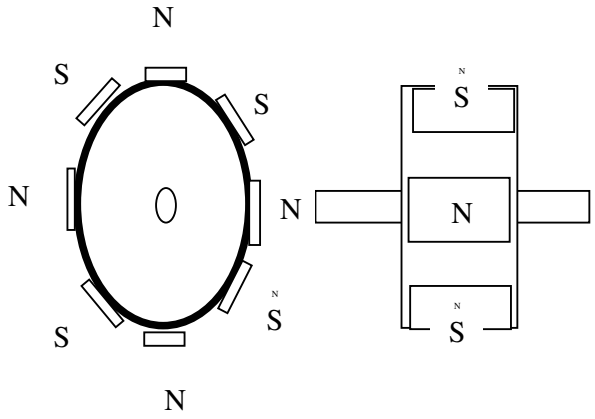


The magnets were actually 2 deep in the length of the rotor core.

Results The voltage induced in the stator windings was disappointingly low . The conclusion reached was that the magnetism was being “shorted out” by the near proximity of the hole ends,

Experiment 2 It was determined that it would be better to lay strip neo magnets on the outer surface of the rotor core. Before this could be done considerable difficulty was experienced

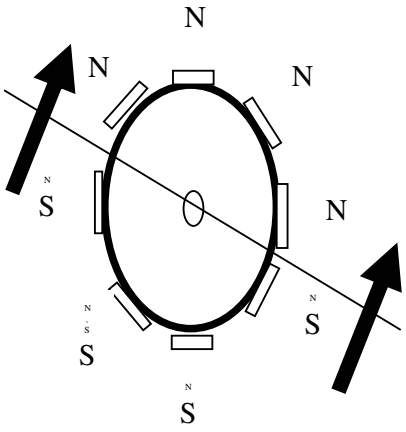
removing the cylinder magnets which were tightly glued in. Being made up of laminations and not being conducive to machining it was decided to replace the rotor with one made of cast iron. It would have been easy to give up at this point but we wanted to find the optimum configuration. Once this had been found then the appropriate modifications to a new motor would be straight forward.



Strip neo magnets are now glued to the outer surface of a fabricated cast iron rotor. They were covered with a layer of fibre glass tape for extra security.

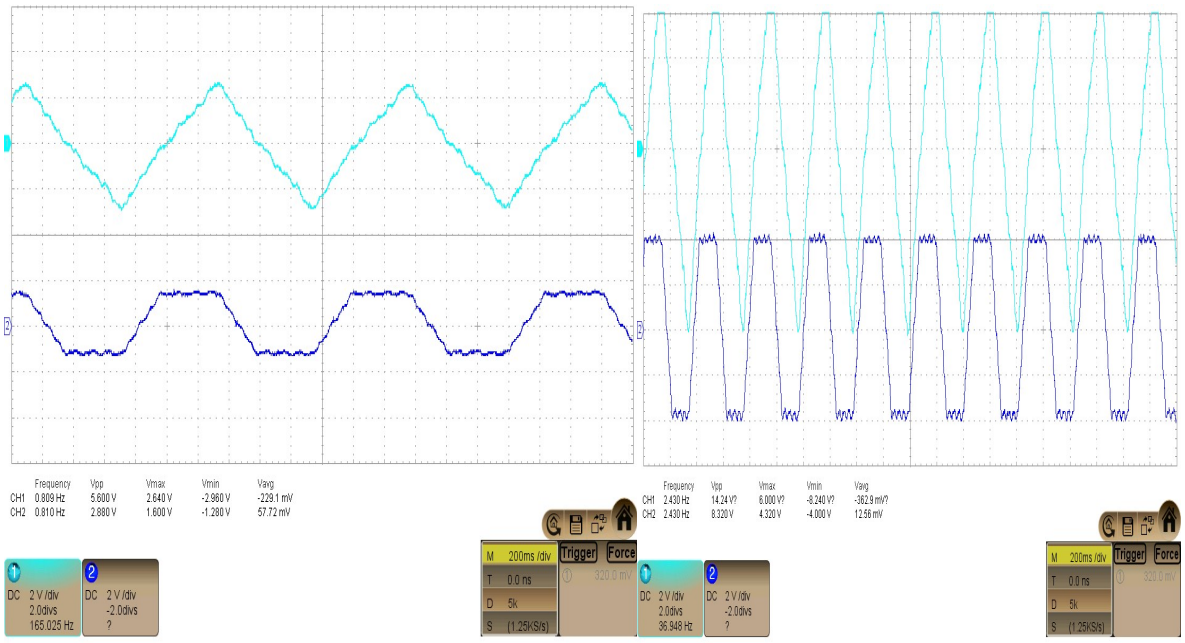
Results Again the results were incredibly disappointing, Not much current being induced in the stator windings.

Experiment 3 At this point we harkened back to the normal operation of the motor. It uses a rotating magnetic field , could it be we needed a single rotating field. Obviously the strip neo magnets could be arranged to provide this.



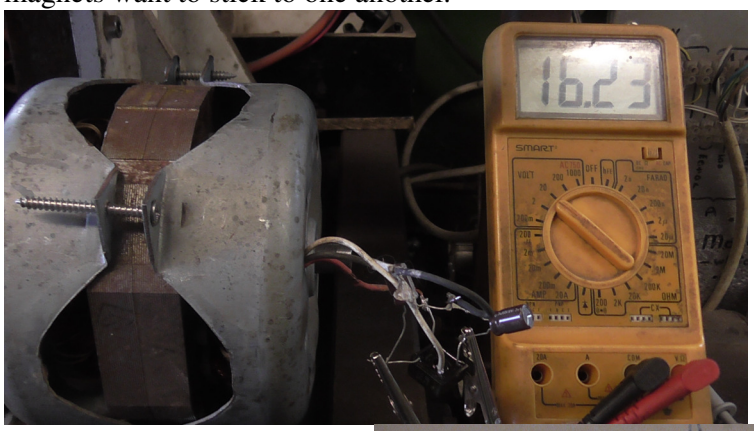
The configuration shown sets up a single magnetic field. The results were promising as measured on a digital multi-meter with the shaft turned by hand.

Results At this stage it was apparent that more complex measurement equipment was needed. There are two windings which could be used, one embracing two pole pieces on the stator. Therefore phase may be worth measuring. Also it has been noted that the ordinary digital multi-meter is inaccurate below 50Hz AC. We did not like the idea of taking a large oscilloscope into the workshop in order to drive the generator with constant revs (as in the picture) in order to assess performance. An affordable PC oscilloscope the MP720017 was ordered for this task.

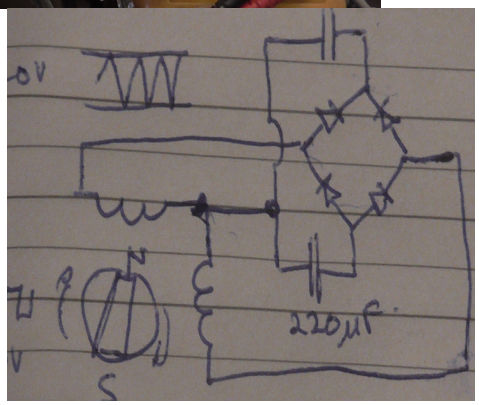


Showing two displays 45 rpm giving 4.5v p-pk and 145 rpm giving 14.2 v p-pk. However the other winding gives halve this voltage but is slightly out of phase. In use both windings could feed a 3 phase rectifier giving a greater average out put. Further improvements could also be had by grooving the rotor at the point where the magnetic fields oppose.

Grooving did not make any improvement so the grooves were filled with cast iron plugs and a great deal of effort was employed to secure 12 magnets around the rotor. This was a difficult task as the magnets want to stick to one another.

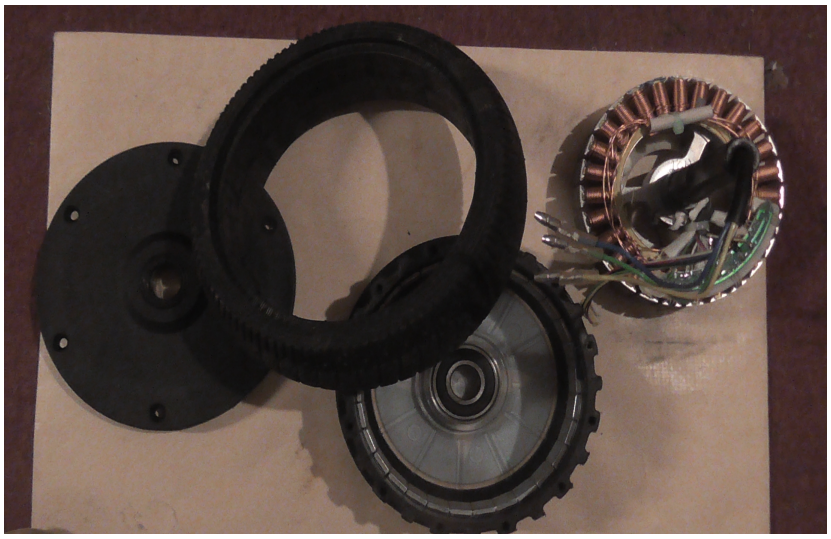


The circuit was wired as shown and the DC voltage was measured across the ends of 220uF capacitors. At 120rpm the frequency was 1Hz so the capacitive reactance was 2640ohms limiting the available current.

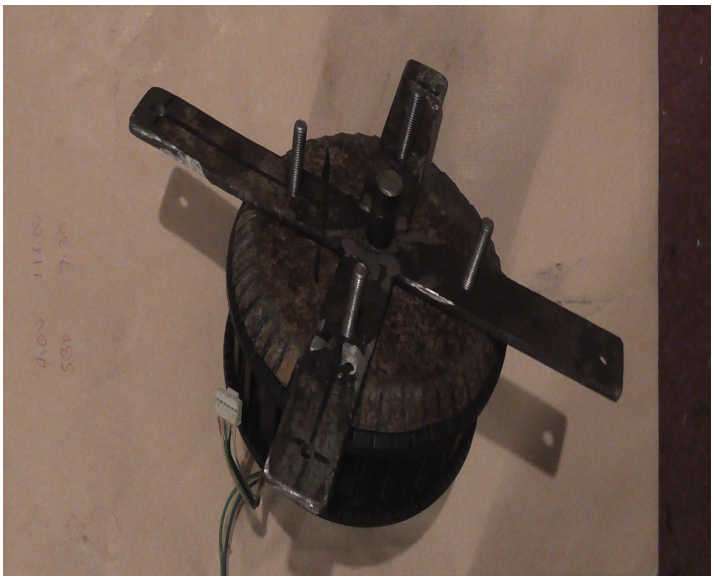


As mentioned in experiment 3 the induction generator cannot produce much power being such a low frequency source.

Experiment 4 There were some people on the internet using a hover platform wheel motor (Segway) as a generator, so one was procured.



Once the six screws on the back plate were removed the tyre could be removed and the stator with the coils could be pulled out. Both bearing retaining plates were made out of thick plastic the outside one being transparent plastic for some decretive lights.



The cross carries a centre spindle which will engage with the colette for RPM /voltage tests .The plastic bearing carrier is reinforced with a metal plate inside and out. If successful the blades will be mounted on the cross. The RPM for a reasonable voltage will be noted as it dictates the blade sizes for reasonable wind speed.

There was some doubt about the best rectifier set up to use. The double voltage doubler set which used a bridge rectifier was tried first .

This gave 12v dc at 240 RPM when loaded with 100 ohm load and 14.2 volts open circuit.

This corresponds to an internal resistance of 17 ohms for this small bridge rectifier set up.

From wind calcs wind speed 15mph = 6.7 M/s
30mph = 13.4 M/s

Using a tip speed ratio of 4 to 1 tip speed 15mph = 26.8M/s rpm 256
30mph = 53.6 M/s 512

This gives (256*2*3.142)/60 = 26.8 M/s a 1m radius blade for 12v at 256 rpm

In it,s present form the generator would only be any good at above 27 MPH wind speed. Also the this is for a wind speed to tip ratio for 4 to 1.

With this in mind the coils on the generator were modified and further tests have verified that .12v could be obtained at 70 RPM, a considerable improvement.

The modification was based upon the fact that the “segway” uses a Y connected three phase winding in which each of the coils consist of 3 windings in parallel. All of the windings are commoned in a large pigtail but this neutral is not used . There are 3 connections ie delta. So connecting the winding in series will give 3x the voltage output.