Republic of the Philippines
Department of Education
Region VII, Central Visayas
Division of Lapu-Lapu City
District 5
MARIGONDON NATIONAL HIGH SCHOOL
Marigondon, Lapu-Lapu City
Tel: 236-1396

Innovation Expo

Dirt-E Battery

Carl Kho

October 2018

TOC

A) Introduction

A1) Features and Specifications

Producing electricity now involves patches of sifted soil lined in an egg-tray like container, with a series of Galvanized Bolts and nuts carrying a solid copper wire going through the patches of dirt. Like our body, dirt has ions and minerals in it, electrolytes to be specific. Which is capable of conducting and producing a little electricity. It is then watered to make it flowing, but not too much. Creating Dirt-E energy. With each patch being capable of producing as much as 1.2 volts[1].

A2) Market Trends and Opportunities

Renewable energy is adored and needed by many. The rich want it, the poor need it. People worldwide suffer from inaccessible, limited electricity. A problem for the common farmers and like especially in the Philippines. Chemical wastes like our traditional batteries aren't properly disposed and are harmful. Our familiar renewable sources of energy can cost, prohibiting us from going green. We live our lives with electricity playing a vital role. We depend on it.

Seeing the SALt lamp (Sustainable Alternative Lighting) by Aisa Mijeno, a Pinay innovator and how solar panels impacted the world, we can be on par with it or perform even better. Projects like these can highly encourage recycling and creative thinking especially in remote areas. Go eco-friendly. The mentioned products aren't very accessible or reproducible though. Dirt-E on the other hand is flexible - it provides electricity and is modifiable. It uses dirt, something found all around us, and is sustainable with

[1] In our 13-gram patch. Adding more grams can increase its output. Explained more in the Results and Discussion area

mere water, which is also easy to obtain. With it, we can live in a world powered by renewable and sustainable energy. A long dream of the people. No bills, electricity for all!

B) Materials and Methods

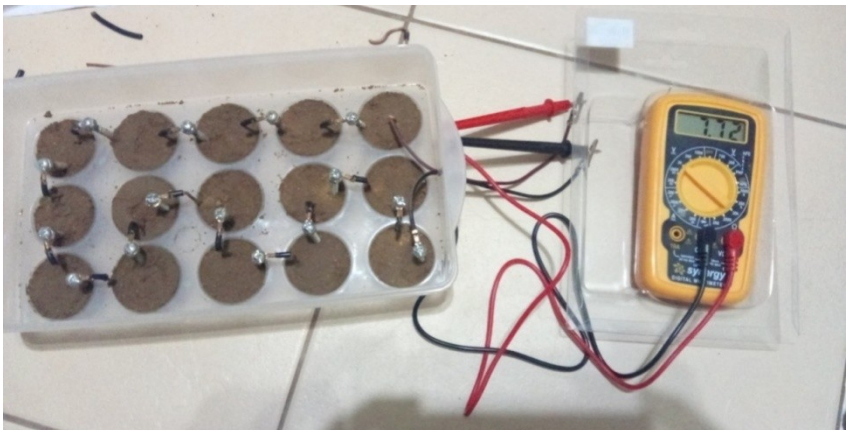
The researcher used accessible kinds of dirt, commonly-found-in-the-household types of liquids, Galvanized bolt and nuts, a conductive crimp pin, and a 1mm solid copper wire. Placing the dirt in a recycled egg tray, this was sifted with a homemade sifter made simply by wire meshes, a syringe to place the accurate amounts of liquids into each patch of dirt, and a multitester to measure its output.

Obtaining soil is an easy task - soil is everywhere. The researcher sifted the soil, garden soil at home, simply by using a wire mesh he found at home. After sifting, the researcher then went on and distributed the different type of soil into a recycled egg tray, 13g in each egg hole or patch. Using a syringe, the researcher filled each patch with 5 mL of regular tap water[2], this part is vital as water is responsible for turning the dirt patches into an electrolyte solution, or to allow the flow of electricity. Without water, dirt alone can only conduct so much (approximately 15% only compared to watered patches). Being careful so as not to short or keep 2 separate dirt patches in contact with either dirt or water. The researcher then compressed each watered patch, preparing it for the two metals, Copper and Zinc, to start reacting.

Why Zinc and Copper? Because zinc tends to lose electrons more easily than copper. Dirt-E's setup was made by using a galvanized bolt and nut and a solid copper wire. Since galvanizing something means coating a metal with zinc. It's a win-win for this case. Galvanized materials are less likely to corrode, where corrosion is bad for electric conductivity. Plant it in the ion-rich dirt. An electrical flow is then witnessed. Its power output is then increased by adding and connecting more patches into it. Take note that there are 3 ways to increase its voltage: a larger patch of soil, more patches of soil, and a more "compatible" liquid to use in a *series* connection. For increased amperage, use a parallel connection.

[2] Other liquids can be used as well. Recorded in Results and Discussions.

Dirt-E's positive electrode (+) is the copper, whilst the Zinc is the negative (-) one. Connect its terminals to a load and Dirt-E can then be applied as long as it's compatible like a lamp or alarm clock. It can even charge your phone with proper modifications. It can supply DC electricity to any low-power consumer electronic devices. For now[3].



C) Results and Discussion

[3] Huge potential, our traditional farms will soon be responsible for our electricity!

Dirt-E Battery wouldn't be possible without dirt. The researcher ran through his patches with different kind of water-free dirt. Though it is observed to be very inefficient since it barely touches the conductors:

Type of Soil	Voltage Output (without water)
Garden Soil (Humus)	0.46V
Loan	0.52V
Limestone	0.43V
Fine Sand	0.34V

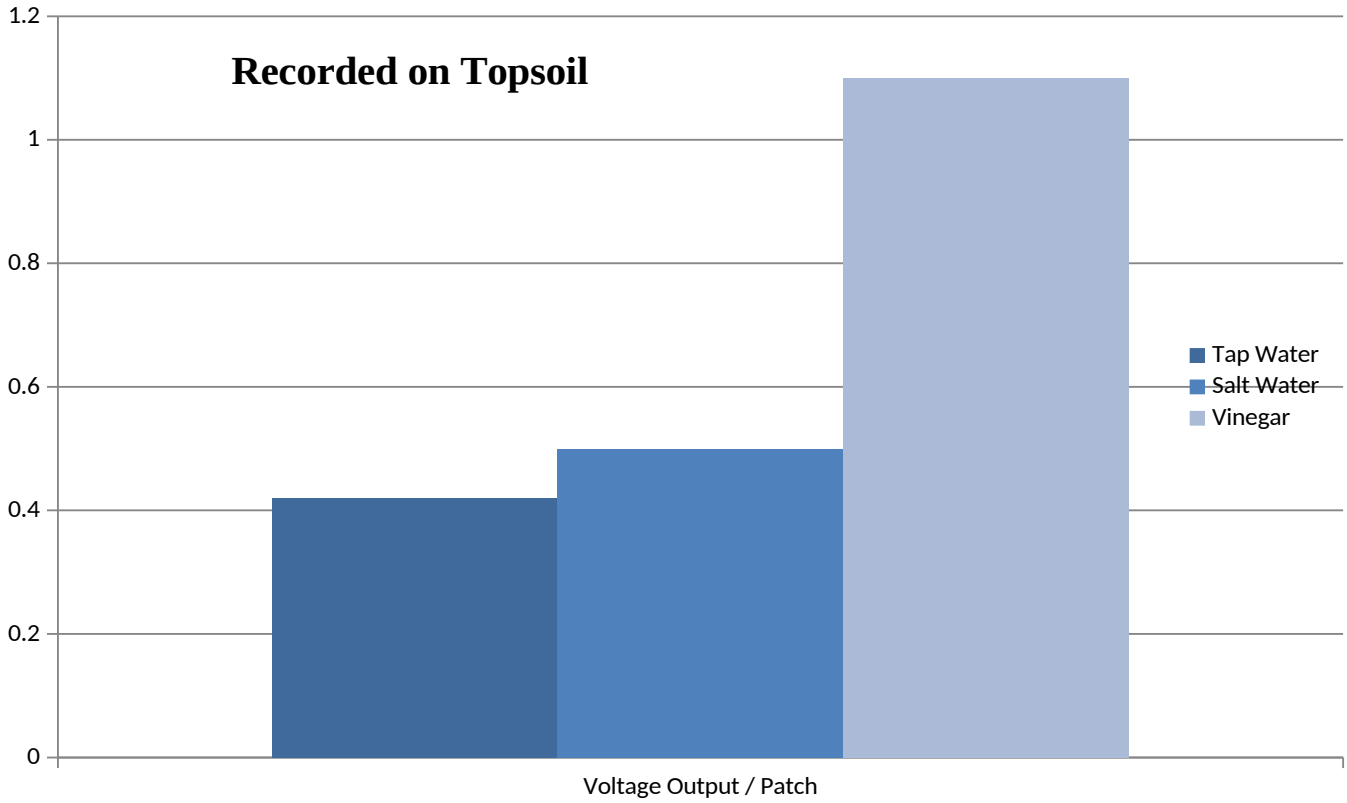
Dirt itself can conduct electricity as it is an ion. But as shown in the table above, it isn't very efficient. Different kinds of dirt have different output.

This is where the liquids come in. Liquids have 3 roles in Dirt-E battery:

i. To turn the dirt into an electrolyte solution
ii. To compress the dirt and have full contact with the conductor
iii. Helps in conducting as well

Without it, Dirt-E is ineffectual.

Dirt-E is then observed to have higher output compared to the pure dirt patches. Bit apart from water, other electrolytic choices like salt water and vinegar can even increase Dirt-E's power outputs. Here is a chart comparing the per patch voltage output with various liquids:

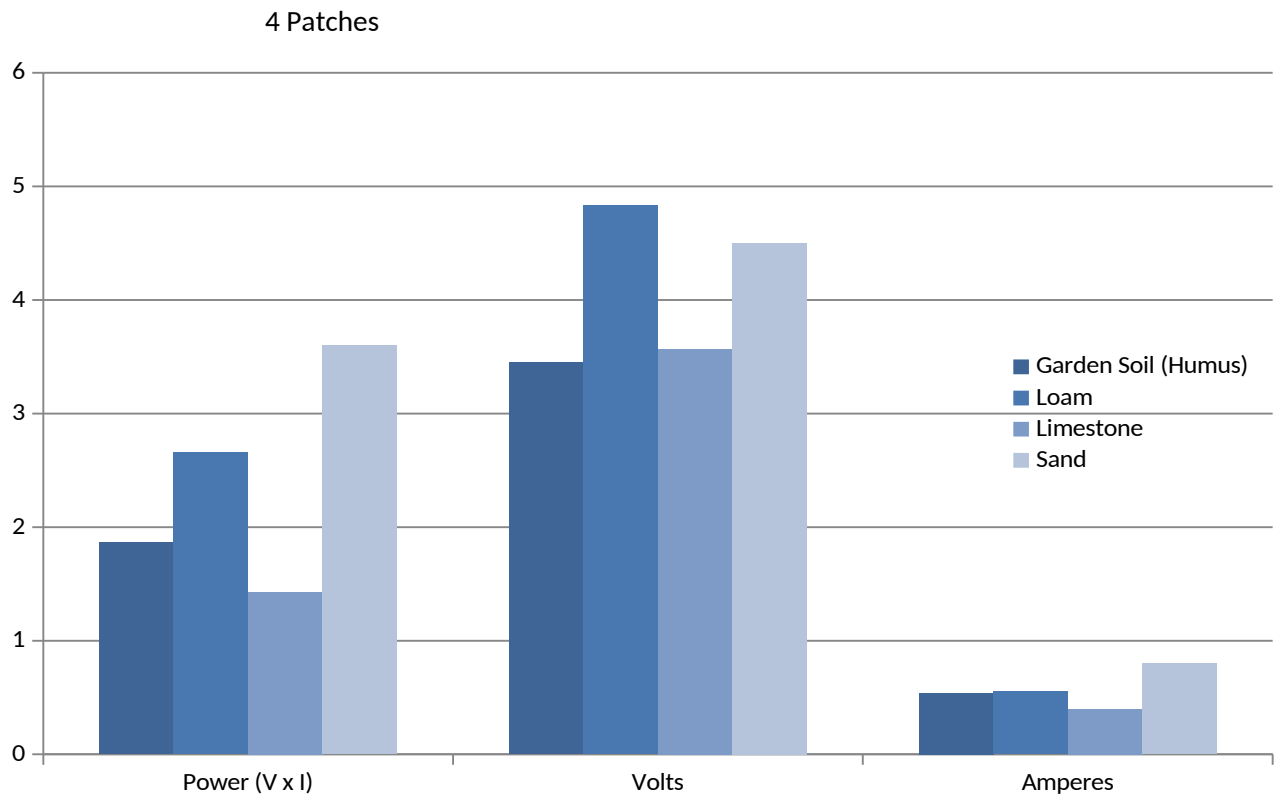


Without water, dirt can only conduct as much as 15% of what watered dirt has to provide. The researcher used 4 patches of dirt since getting its per patch output, it's too small for the multitester.

Vinegar, as observed so far, the most efficient common household material available to increase Dirt-E's voltage output. We will be sticking with vinegar for demonstration purposes. But if we're talking about accessibility, tap water can suffice.

Using vinegar as it provided the highest power output, the researcher added it in to different types of soil in dirt patches. Curious to discover which amongst the soil would give the highest power output.

Here is a chart comparing the different outputs of different kinds of soil, watered with vinegar:



Fine sand distinguished itself as the best type of soil to be used in Dirt-E battery. Which was unexpected, since the initial tests showed how inefficient it was. The researcher found out that the more dirt that clung to its conductor, the more efficiency it would get.

However, they are all but small differences. The researcher still considers the **closest** one to you the **best** type.

Aside from it being expandable through more connections, adding more grams of dirt in each patch and then adding the suffice amount of liquid in it can and will increase its voltage.

The researcher used a weighing scale and then wrapped the amount of dirt wanted in a thin and cut bond paper. Knowing its weight, the researcher then proceeded to add water into the soil starting from 5 grams + 3 milliliters of vinegar Repeating the process when in doubt for the sake of accuracy.

RECORDED IN **GARDEN SOIL**

Every gram of garden soil added and saturated with vinegar is equivalent to

0.09 (estimated) / 0.09 DCV (0.49 from 5 grams + 0.09 = 0.55 total V)

More dirt is equal to more need of liquids, here is how much you need to add for every 5 grams of dirt added, starting from **5 grams** as well:

Initial/First time watering: 3mL + 3mL/5 grams of dirt

Weekly watering: 2mL + (1.5mL / 5 grams)

Here is the "formula" for adding the amount of dirt(g) to a reach a specific number of its voltage output:

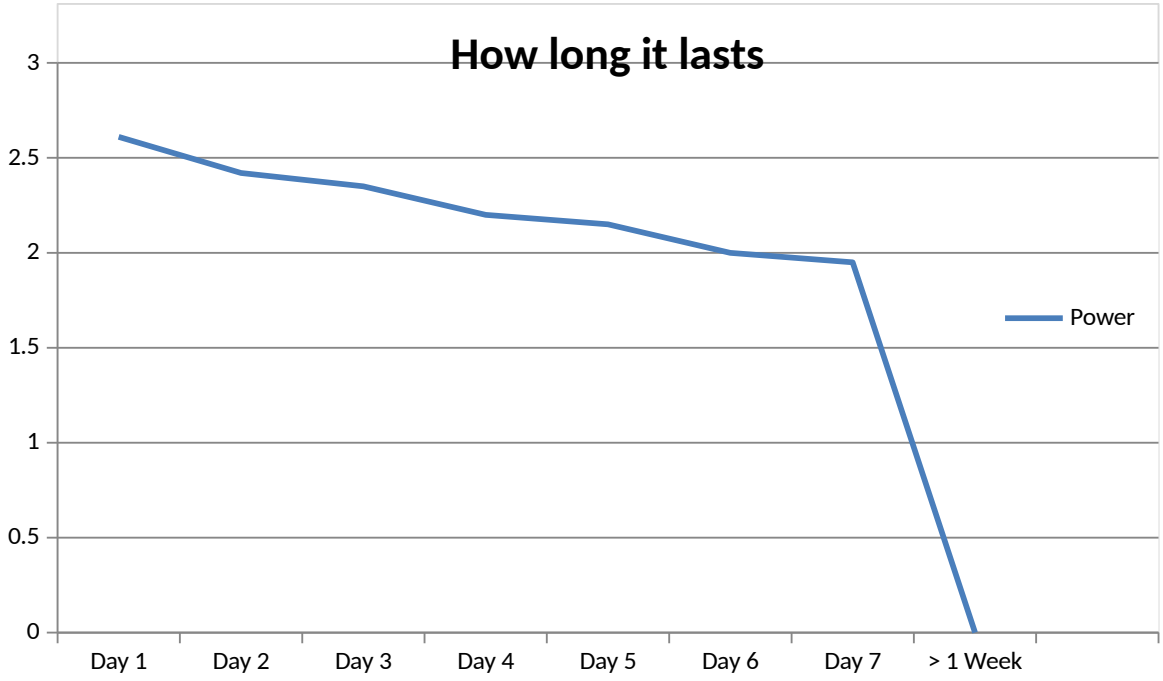
Desired amount ÷ 0.09V (per gram)

2 V ÷ 0.09 = 22.22 grams of dirt in a patch

12mL initial / 8mL weekly watering

Our series connection can now get 2 V per patch. Useful for saving space.

Moisture loss in the soil is inevitable. Hence, Dirt-E requires regular “watering” of individual patches. With Dirt-E sealed indoors to prevent moisture from escaping in a room temperature of 20.7°C, the researcher observed how long it would take for its expected power output drop. Surprisingly, a it lasted well over a week before going really downhill.



A 9% decrease in voltage was observed (observed in Topsoil). Although this is still efficient and usable, going beyond 1 week without watering Dirt-E will produce drastically reduced power. Just add 1 mL of water weekly to keep its power output consistent.

Dirt-E Battery compared to Solar Panels, a familiar and similar, yet **developed** source of renewable source of energy.

Dirt-E Battery	Solar Panels
Lasts 1 week in room Temperature Water is it's maintenance. Expandable.	Works when daylight energy is present
Galvanization reduces the threat of corrosion	Lasts 20 years. Difficult to recycle
Easy to replicate materials are accessible, alternatives are easy to find	Hard-to-assemble A professional is required which is added cost
Stored Potential; Further researching can utilize and efficientize Dirt-E battery	Expandable as well but can be very expensive
Inaccurate measurement of weekly watering risks overwatering	Requires very little maintenance

The first solar cells were only capable of converting 1 – 2% of light to working electrical energy and then received proper research. Dirt-E here will be following a similar path where it will then, after many researches, shine brighter than our traditional sources of renewable energy.

If given more time, the researcher would try to make large patch, a Dirt-E collection of dirt patches, sort of like a solar farm except it is applied in real farms. To use it to its maximum potential and try to

compete with a solar panel. The researcher would improve Dirt-E as much as I can. What kind of two metals work the best? Avoid rust. What kind of soil and liquid is the best? Even go as far as automating the watering process.

To go even greener, the researcher would like to try working with plants, doubling the eco-friendliness of this project. Make it smaller, simpler and more efficient. Incorporate it into our daily lives. With further research and growing technology's help, Dirt-E may even attempt to power our houses. The future will be cleaner, safer, and happier.

D) Conclusion

With Dirt-E energy, our traditional farms, jungles, rainforests may become one of our largest sources of electricity. Clean and green electricity. Slowly cleaning our planet Earth from its impurities, from the threat of global warming and the damage from the deathly disease of climate change. A new source of energy can spark collaborations from innovative companies, innovating Dirt-E further. Compact Dirt-E batteries to replace our traditional, harmful, chemical ones.

The next generation won't have to suffer anymore, we can change our ways, not just with Dirt-E but also with our lifestyle. More jobs can be supplied with the production of Dirt-E being implemented. Dirt-E helps us take a step towards a greener and especially cheaper future. The statement is redundant, but it is true. Greener innovations can also be made by future researchers powered by Dirt-E. A total win-win for Dirt-E.

E) Acknowledgement

I would like to express my gratitude to my father Ben Rommel Kho for guiding me in every path of this project. As well as my school, Marigondon National High School for continuously feeding me opportunities. To our Almighty God for breathing life into me and my research, I give him my eternal thanks. Doing a lot of Research, I came to know about so many new things. I am really thankful to them. The wisdom and knowledge gained is going to be treasured.

G) References/Bibliography

Decker, Franco (January 2005). "Volta and the 'Pile'". *Electrochemistry Encyclopedia*. Case Western Reserve University. Archived from the original on 2012-07-16. Retrieved 2012-11-30.

Feldman, Isaac (1956). "Use and Abuse of pH measurements". *Analytical Chemistry*. **28**(12): 1859–1866. doi:10.1021/ac60120a014.

Watt, Alexander; Philip, Arnold (2005). Electroplating and Electrorefining of Metals. Watchmaker Publishing. pp. 90–92. ISBN 1929148453. Reprint of an 1889 volume.

Vad Mathiesen, Brian; et al. (2015). "Smart Energy Systems for coherent 100% renewable energy and transport solutions". *Applied Energy*. **145**: 139–154.

iea.org (2014). "Technology Roadmap: Solar Photovoltaic Energy" (PDF). IEA. Archived (PDF) from the original on 7 October 2014. Retrieved 7 October 2014.

Lamont, J. V., *Der Erdstrom und der Zusammen desselben mit dem Erdmagnetismus*. Leopold-Voss-Verlag, Leipzig und Muenchen, 1862. (Tr., *Telluric currents and their relationship to geomagnetism*)

Dieckmann, George F., "U.S. Patent 329,724 *Electric Earth Battery*". November 3, 1885.

Stubblefield, Nathan, "U.S. Patent 600,457 *Electric battery*". May 8, 1898.

Horn, Delton (1993). *How to Test Almost Everything Electronic*. McGraw-Hill/TAB Electronics. pp. 4–6. ISBN 0-8306-4127-0.

Carrington, D. (21 February 2000). "Date set for desert Earth". BBC News. Retrieved 31 March 2007.

William L. Masterton, Cecile N. Hurley Chemistry: Principles and Reactions, Cengage Learning (2008) ISBN 0-495-12671-3 p. 379

Amundson, Ronald. "Soil preservation and the future of pedology" (PDF). *Faculty of Natural Resources*. Prince of Songkla University, Songkhla, Thailand. Retrieved 17 December 2017.

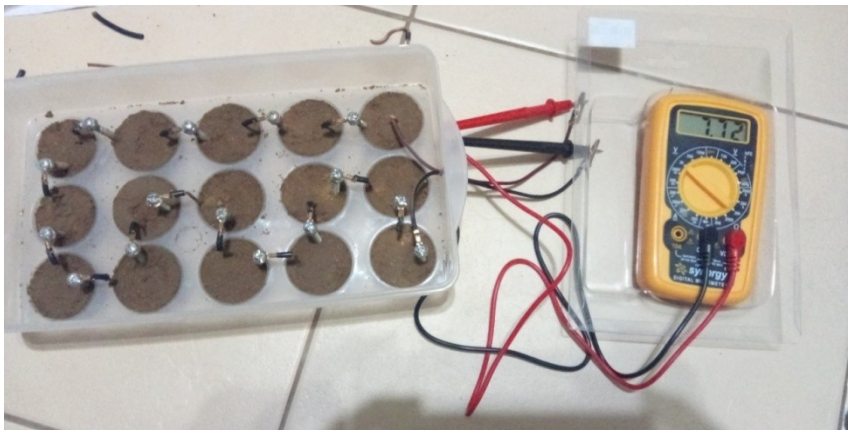
Eugenii Katz, "*Alexander Bain*". The history of electrochemistry, electricity and electronics; Biosensors & Bioelectronics.

Finn, Bernard S. (September 2002). "Origin of Electrical Power". National Museum of American History. Retrieved 2012-08-29.

Pauling, Linus (1988). "15: Oxidation-Reduction Reactions; Electrolysis.". *General Chemistry*. New York: Dover Publications, Inc. p. 539. ISBN 978-0-486-65622-9.

Electric Battery History – Invention of the Electric Battery. *The Great Idea Finder*. Retrieved 11 August 2008.

E) Appendices



Budget

Dirt	FREE (found nearby)
Liquids	FREE (found at households/nearby)
Galvanized Bolt & Nuts	32 Php (20 pcs)
Plastic Egg Tray (Optional)	99 php/box
Solid Copper Wire 1 mm	12 php (1 meter)
Crimp	22 (20 pcs)
TOTAL	**165 Php**