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Charging Our Electrical Devices in Anywhere and at Any time

Lam Kai Shun
Alumni of University of HongKong

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ABSTRACT: *Being able to charge electronic devices anywhere is a modern-day problem. That said, 'Made in China' external charging devices can solve this problem to some extent. However, these devices are often poor quality and can be a fire hazard. To address this issue, the author suggests using an electromagnetic spread spectrum, which is highly related to harvesting electrical energy from clean, renewable energy sources, and then transmitted to charge all types of electrical devices. By applying this author's proposed probability-random variables assignment — each type of electromagnetic wave is associated with a special channel with a centralized management information system controlled in the background. Such design can avoid EM-wave interference and encourage a delicate (or special) channel for energy transmitting. Hence, it can solve electrical devices charging problem or one may get the device charged anywhere and anytime. Furthermore, with a professional electronic circuit de- sign, together with meta-materials coated on the surface of a set antenna block, 90–100% of harvested renewable-clean energy might be transmitted. There is an alternative way of charging by using induc- tive coils; however, there are some defects in such case. Further advance is the introduction of electro- magnetic wormhole which can shield human beings from the influence of magnetic flux outside the tunnel during charging*

KEYWORDS: charging, electrical devices, anywhere, any time

INTRODUCTION

In our modern world, energy has always been a problem of our humanbeings. This is because fossil fuel usually causes pollution. Clean energy sources such as wind and solar are still in the developing stages although they are expected to re- place fossil one. My proposal aims to study how one can convert those clean energy sources into electrical energy and then charging our usual electrical devices through common electro-magnetic waves wirelessly such as either wi-fi, bluetooth or infra-red etc. My theoretical framework for the research is stated as follows:

Research Framework:
Consider the following imaginary statistical experiment that is often used when teaching statistics:
One should first toss three (or more) coins together in front of the participants, such that heads are on the front and tails are on back. The participants are then required to list all possible outcomes after tossing the coins.
In general, the set of all feasible results (outcomes) would be:
S = {HHH, HHT, THH, HTT, THT, TTH, TTT} (suppose one will obtain such expected result).
There are also other combinations and permutations of heads and tails when each of them are assigned with a number. Hence, the outcome space is not just unique.)

Finally, the participants must count the number of tails for each possible outcome and then list them on a table, as seen below:

Possible Outcomes (S_i)	HHH	HHT	HTH	THH	HTT	THT	TTH	TTT
Number of tails obtained (t_i)	0	1	1	1	2	2	2	3

(Obviously, the above table is NOT just the only one, there are lots of possible outcomes different ways of mapping tails. Instead of using tails, one may use no of heads for the mapping as an example.)
Consider a function *f* (which should be called as the random variable). Intuitively,

f maps all the possible outcomes (s_i) to the number of tails T_i

f_i: $s_i \longmapsto t_i$ (i.e. no. of tails obtained as it takes values t = 0,1,2,3 … [1]
or strictly speaking

f: S ⟶ T (i.e. **R – Real Number**)

One may group the same random variables (with similar outcomes) to the home-used electromagnetic networks (such as wi-fi, RF, infra-red and Bluetooth etc.) respectively.
I.e. 0 ➔ Bluetooth; 1 ➔ Wi – Fi; 2 ➔ infra-red; 3 ➔ RF (Radio Frequency);

Together with an Information management system (including a password login each network individually). In our home environment (can also be extended for street / telephone booth), there are lots of electro-magnetic wave such as infra-red, wi-fi and RF together with Bluetooth etc. By introducing a management information system (MIS) (together with a password) to assign each EM wave with a suitable channel (as mentioned in the previous section), one can login into an individual network system once at a time without causing interference to each other. Upward a step, with the MIS and some meta-materials to the antenna, one can collect EM-wave (e.g. microwave). Although the received electronic signals may not be larger enough, if one can design a suitable rectifier circuit, it is feasible for us to employ the output D.C voltage to charge our electrical devices. That is one can convert the microwave energy backward to achieve our daily usage consumption.

The above plan is only feasible in theory. In practice, the induced current or voltage may be too low to charge any electrical device. In order to make the scheme possible, there should be a special / dedicated channel for the purpose of microwave to devices charging. Hence, the power output for charging devices and the power gained by these devices will be larger. Under my imaginary suggestion, there will be a combined way of collecting electricity from our nature resources like solar and wind etc. These energy are then stored in a charging batteries and will be used as a source for dedicated wifi charging. In addition, these stored energies are then used in places such as our common street light and telephone booth which used as the source of dedicated wi-fi for charging to our usual electrical devices with higher power of electricity output once logged in. Then both the low voltage and current problem will solve immediately once our government or telecommunication company is willing to investigate in a such unprecedented plan of proposed “microwave” charging project.

Therefore, the following is the expected procedure for charging an electrical device:
Step I: Clean Energy Source (Solar / wind energy etc) to charge batteries

Step II: Charged Batteries as sources of energy for special EM wave channel

Step III: Special EM wave channel sources in street light / telephone booth

Step IV: Login street light / telephone booth for wireless charge electrical devices Besides the charging procedure, there are also some practical questions concerning about the possibilities of my proposed charging scheme, thus here comes the

Research Questions:

1. What kind of EM waves will give the maximum current and voltage output that is best suited for wireless charging?
2. How can we achieve the maximum gain of both current and voltage from the rectifier circuit for electrical devices charging? What are those factors influenced?

3. What is the energy convenience and efficiency for this kind of wireless charging scheme when compared with traditional fossil or only clean energy scheme? Does the proposed schedule feasible for us to implement?

Methodology (Mixed & may be Ambiguous)

The main objectives or research aim of this study is to investigate the feasibility of wireless charging to electrical devices through a dedicated or special channel of EM (electro-magnetic) wave (come through street light / telephone booth) where the energy sources mainly from clean energy (such as solar / wind etc) to charge batteries. The core theory has been mentioned in the re- search framework section (tossing coin experiment) while the method of implementation can be employed through the EM wave meta material antenna (for receiving microwave only; other de- signs may be needed for different types of EM waves). The application domain is to use electronic circuit for the transportation of wireless induced current or voltage such that one is able to charge different kinds of electrical devices. The major methodologies that I used in this proposal are com- parative, descriptive together with experimental one. It is because we want to compare people's past / present experience in the convenience and efficiency when using fossil fuels, unconverted clean energy and the suggested charging scheme. We also want to observe (as a means of collecting magnified current and voltage data) how well in descriptive way (what are those factors influence) will the electronic circuit provide a gain to both current and voltage. Finally, one will need to practically perform those experiments through isolating and controlling every relevant condition which determines the events investigated, so as to observe the effects when the conditions are manipulated. Then one can decide the feasibility of my proposed wireless charging scheme.

Indeed, one may categorize the research paradigms (or models) into quantitative and qualitative approach. For the quantitative one, it is usually referred to the testing of theories, establishing facts together with the showing causal or other relationships between variables. This will be achieved via statistical, mathematical, or computational techniques. For the qualitative one, it is used for the developing theories, exploring a topic and developing a hypothesis. This can be realized through those scientific method of observation to obtain non-numerical data such as meanings, concepts of definitions characteristics, metaphors, symbols and description of things and not to their counts or measures [2]. Therefore, both of the comparative and descriptive methodologies are of qualitative types while the experimental one is quantitative kind. This research is then a mixed method of study.

When one is concerning about data collecting procedures or research design, one needs to use a questionnaire for the comparison of different experience in energy type of usage. Hence those non-essential characteristics of a phenomena can be eliminated by looking at multiple instance of it. It can be conducted at a marco (revolutions) or a micro level (individual experiences). Actually, the questionnaire is a set of questions.

Qualitative informations will be gathered from a particular population (most likely to be ran- domly selected electrical device users and student researcher as testers). Those responses will not be aggregated for analysis. The questionnaire items will have four response categories like "agree a lot", "agree a little", "disagree a little" and "disagree a lot" [3].The major questions for nor- mal users will focus in their experience of energy using - fossil, traditional clean energy and the pre- sent wireless charging where one will particularly study in their convenience of usage. While for those testers, the energy efficiency of the above three form of charging will also be questioned. I note that testers are those student researchers who will be answered in the energy efficiency questionnaire part's questions as the questionnaire is divided into two pats; one for ordinary user to question about convenience, the other is for student researchers (or testers) who will answer in the matters of energy efficiency. This is for the comparative research design.

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For the descriptive research design, observations will be performed as a means of collecting qualitative data which attempt to examine those normal situations. One will also try to pre-dict the outcome when the same circumstances happened. These observations will be written or recorded for the subsequently analyzed. However, biased questions may result the distorted data in interviews, questionnaire and selective observation of events. In this study, observation is used to investigate what those factors that are influencing electric current is wirelessly transfered from past experienced mathematical data together with interviews to expert researchers [4]. In fact, interviews offers a way for researchers to understand the relationships behind wireless current transportation and those influencing factors [5]. Furthermore, interviews are also well- known as a tool for understanding the reasons behind the gain and factors. I remark that Cool and Xie [6] used interviews as a supplementary way to survey and document choices.Hence, both relationships and reasons will be found between those investigated variables.

Lastly, there will be the practical experiment design with each factor being controlled individual to study the wireless transportation of received current from the electronic circuit.Causes and effects of their relationships will be the most interesting thing for me to research. Thus, correlation and ex post facto is implemented. Quantitative data will be collected in each of the cases. Actually, there are four types of experimental design. The first one is “Pre-experi- mental” where one will made unreliable assumption without sufficient control over variables.The second one is “True experimental” where there will be a rigorous test in the similarity of groups before one is trying to test the influence of a variable to a sample of them when those circum- stances are controlled. The third one is “Quasi- experimental” where only the shortcomings are identified without fulfilling all conditions of true experimental design. The last one is “Correla-tion and ex post facto” where correlation is used for the finding of cause and effect relationshipsbetween two sets of data; ex post facto is a reverse experimentation. It is employed to interprets the cause of phenomenon by observing its effects.

Outcomes and Values

The expected outcome of my research is that: it is feasible for us to make modifications to our street light and telephone booth for the wireless charging of electrical devices through a special EM wave channel from clean energy source’s charged batteries. Although the energy efficiency may not be the best among fossil fuel and traditional clean energy, the proposed charging scheme is more convenient (where one can charge the electrical devices whenever he / she finds the street light / telephone booth) and safer (when compared with explosive external China made charging batteries). In addition, those common electronic symbols are employed to represent the rectifier circuit. Thus, it will easier for one to design, test and make amendments to it such that one can maximize the current and voltage obtained for wireless charging electrical devices when- ever necessary. One of my design’s advantage is that the device will only need an EM wave receiving antenna and rectifier circuit without buying and redesigning any new electrical devices. The most significant value of the scheme is one can charge any electrical devices anywhere in the world without carrying any other extra charging devices when the (modified or smart) street light or telephone booth exists for logging in with the known password.

Limitations and Advantages over other charging

There are also limitations to the above proposed charging scheme. First of all, the energy efficiency (about 37% of conversion, from Duke University, microwave experiment) may not be as good as expected. It is hard to convert all energy during the transmission between EM wave source and receiver since microwave signal propagates in all directions and the power will drop when the source sphere is extending larger (N.B. maximum power may be gained at the pole of it. [7]). Obviously, there must be energy lost during transmission so there may be a need to redesign the antenna. Furthermore, it may be hard to unify all standard of street light / telephone booth around our world's different countries. Hence, it is required to memorise various passwords which leads to the danger of lost. Finally, too strong EM wave power may cause harmful effect to our human life's healthyA Comparison with charging through electric induction

Theoretically, Maxwell equations tell us that if there is a time varying electric field, then a displacement current will be produced which is indeed proportional to the rate of change of the field. As a result, the induced current appears on the sender side will allow energy to be delivered among the space between different plates and hence act as role like a capacitor. When one is ap- plying a load on the plates of the receiver side, there will be an induced electric charges moving between the side of the two plates. The result is mainly due to the time-varying displacement current moving around on the other side. This is known as "Capacitive Coupling". The afore- mentioned theory is widely used in our present daily mobile phone wireless charging. When one move up a stair, one may create an electromagnetic wormhole (which is a virtual one but not thephysical space- time wormhole) with meta-materials and induced current on the plates of theother sides of the coupled capacitor. It is true that the technique can also avoid electromagnetic interference but there are several disadvantages over my proposed one. They are:

Longer Charging Time: If one provides the same power for the charging, most devices take longer (in general) time to charge [23]. From the following graph, one may observe that wired charging is much faster (or the charging rate is better) than wireless charging for mobile phone. This is because about 20 – 30% of the charging energy will be lost in form of heat during wireless charging of mobile phone etc [24]. Thus, this author suggests that it is wise for us to charge electric devices directly. In my design, the energy source is a clean one, then it is transferred through electromagnetic waves (e.g. microwaves) to the receiver (my expectation is that one may harvesting more than 90% of energy and reduce as much as energy lost in some feasible ways such as heat cooler etc). The resultant electrical energy is charged directly to the mobile phone in a wired direct way. Hence, the whole process may be faster.

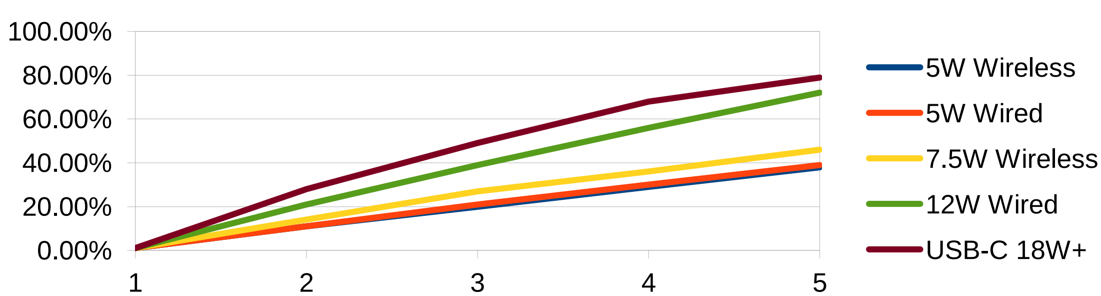

Figure 1: A Comparison between the wired and wireless charging rate from 0 min(1) to 60 mins(5). [23]

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More money is spending [25]: It will increase the complexity of the charging process and manufacturing cost. This is because inductive charging needs drive electronics and coils in both sides of senders and receivers. This is practically known as resonance inductive charging. However, in my proposed design, it seems that only (digital) electronic (devices) circuits are required for receiving transmitted energy from the sender. The next part that connected to the devices is wired. It should be much simpler and cheaper. Indeed, my suggested scheme is a kind of induction/energy harvesting (forward-backward) philosophy etc.

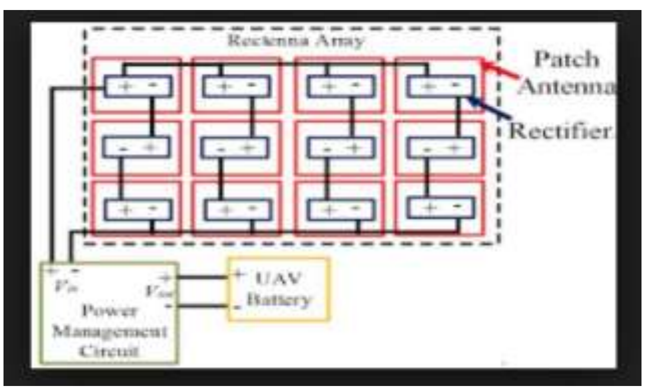
Poor mobility [25]: In most cases, the present practical inductive pad's mobility is very poor. This is because people should place their phone statically on the induction pad without moving. However, for the wired charging, one may move the phone anywhere if the wire is long enough and even listen to the phone call. In my design, since the telephone booth and street light are all over any countries, it must be a con- venient and safe method for charging outside homes.

No common standard exists [25]: Until recently, there is no common standard in theinductive charging standard. Different devices require different charging devices. Devices may need to fulfill multiple stand- ards. However, wired charging standard has been unified for some times which is not same as wireless one. My design employs wired charging which does not have the problem of standard.

Low efficiency [25]: The efficiency of wired charging is much higher than the wireless one.Moreover, devices may get hotter during inductive charging. This may harm the battery. In my de- sign, there will be a warning signal when the device is full charged through wire. This can prevent it from overheated or charged. (N.B. It is true that one may directly connected with wire from present oil/gas power station to the telephone Booth and charged through inductive coil. However, this may validate my elementary will of providing clean energy for wireless charging anywhere and anytime. Moreover, the charging efficiency may be lower as aforementioned. Indeed, both types of my proposed wireless charging & di- rectly wired – inductive coil charging may constitute a kind of forward-backward philosophy).

Miscellaneous for Receiver Electronic Circuits and Antenna Array Design:

Figure 2: A set of array of patch antenna with rectifier (Rectenna array) - I suppose to add a set of matching circuit array in-between and the energy efficiency may be maximized more than 90% [8]. (N.B. Rectenna array may also mean the rectifying antenna that may consist of rectifying circuits etc.)



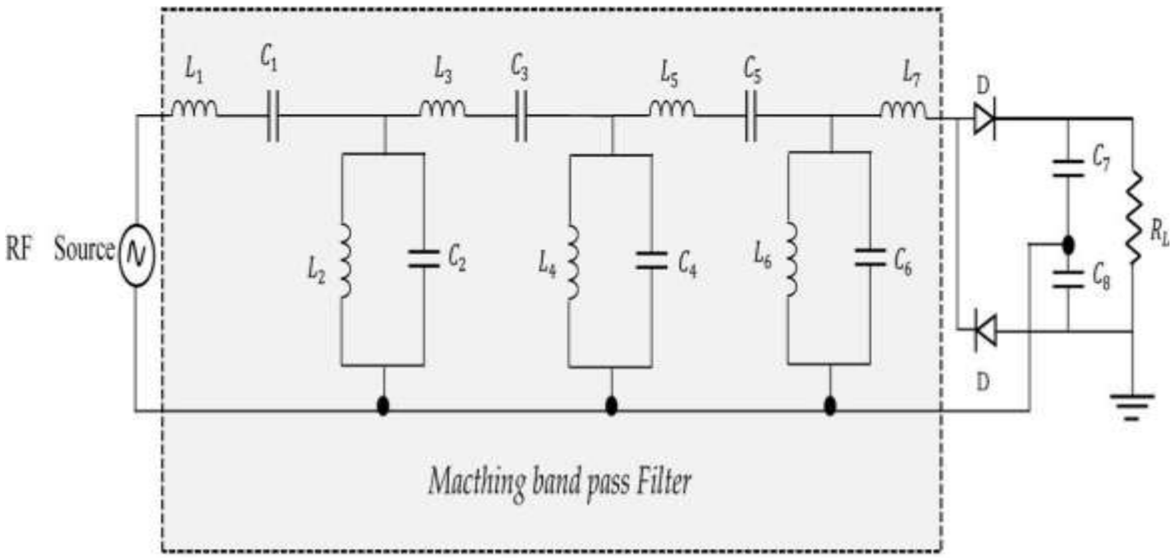


Figure 3: Rectifier with matching circuit [12]

Next, to the matching or resistance connections network, there is a rectifier circuit that usually consists of Schottky diodes. It is well-known that the sensitivity of the circuit to convert the harvested RF signals ina DC signal is directly related to the sensitivity of the used rectifying diode [11]. Hence, I suggest that one needs to further design one's own matching and a rectifier circuit for this project such that it will best fit those requirement (where one of a similar case study is shown in figure 3.

Theoretically and under my imagination, by using a set of rectenna array together with the suitable meta-materials coated on their surface which connected with matching & rectifier circuits, one may expect to receive nearly 90 - 100% of transmitted (microwaveenergy. This author suggests the actual result should be experimented or obtained in the laboratory first by establishing a similar testing model before the practical implementation. Finally, this author remarks that the proposed idea can be extended to a mini- electrical power station for charging electric transportations devices. Indeed, the station may replace our present oil stations in the future. This can reduce the air pollution in most of the highly commercial and densely populated cities like Hong Kong, New York and London etc as most of the oil cars will soon be diminished.

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Further Advances in Wireless Charging

In the future, may we hope that there will be advances in the application of electromagnetic wormhole. It is actually not the physical wormhole that proposed in our cosmological theories for shortening the distance traveling in the universe. As this author may suggest in the research, the energy sender and the receiver antenna parts can establish an electromagnetic wormhole in between with suitable meta-material installed. Hence those magnetic sensitive apparatus from outside can be shielded in between them[13]. One more important thing is that we can manipulate how well the magnetic sensitive apparatus being exposed to the internal electromagnetic waves or even the permissibility of the man-made electromagnetic wormhole.

This is because one may create the electromagnetic wormhole through controlling the amount of meta-material used externally on the surface of the shielded tunnel. Therefore, another ap- plication of the magnetic wormhole is: one may place a moving magnetic device (as the source) long distance away from the receiver side's conductor with the immediate part being magnetic wormhole shielded. An electric current will then be induced on the receiver side relative to an electrical load installed. Or electrical devices can be charged through magnetic resonance from long distance automatically. Thus, people are freeing from the claustrophobic environment of the magnetic resonance machine (or the source of resonance).
Conversely, one may imagine a thought experiment, instead of a transport vehicle's outside being shielded from magnetic flux, the vehicle's inside is shielded and people are seat- ing in it. Then the magnetic resonance charging can be occurred outside the vehicle without cause any harmful effect to the human tissues. Hence, such vehicle can be charged wirelessly whenever and where-ever necessary. But the inside or the outside vehicle shielded experiments is actually a kind of (forward-backward) philosophy with the practical possibilities.

The Source Side of Butterfly (/wireless) Charging— Microwave Emitter Electronics

Theoretically, there are several ways to emit microwave as the source part for whole Butterfly charging system. One of the method [17] to emit microwave is through (digital) electronic devices. Basically, for each small part/cell of the solar panel, it will generate 0.5v electric potential. If there are 18 cells, then the total electricity provided will be 9v — the operating potential voltage for the laser diode emission (control). Hence, when there is Sun shining on the solar panel, electricity or potential voltage will be generated for the laser emission control circuit. In fact, after the solar panel, there may be a need for the large electricity or (lithium) capacitor for capturing electric charge and may be released during the nights or those rainy days. Next to the lithium capacitor, is the laser emission (control) circuit with the elementary prototype as shown like the following figure 4 in the next page. Ideally, the circuit uses a PNP translator with the supply from the 9v solar panel, this will supply a current to the laser emitting diode which may them generate light as the source for the silica micro comb with stabilization by fibre photonics. In practice, a portion of the laser emitted falls on the photodiode that may convert to a very small current — say 10 mu A. In other words, the photo diode is in reverse mode. In the case without light, a leakage or dark current occurs in the photo diode and hence will overload the amplifier. The base of the transistor is now initially placing itself in saturation and pulls the current limited by a resistor. The current starts to flow through the transistor and the laser emitting diode will begin to emit laser light. In such case, the photodiode will convert a portion of this laser light to a current that flows through the first resistor say R_G. When we increase the current, the voltage will drop accordingly across R_G. If the voltage continues to approach the ground voltage, say V_{Bias}, the loop will then close and start to maintain the correct drive to transistor for the current n the laser light emitting diode and thus may keep a constant light level.

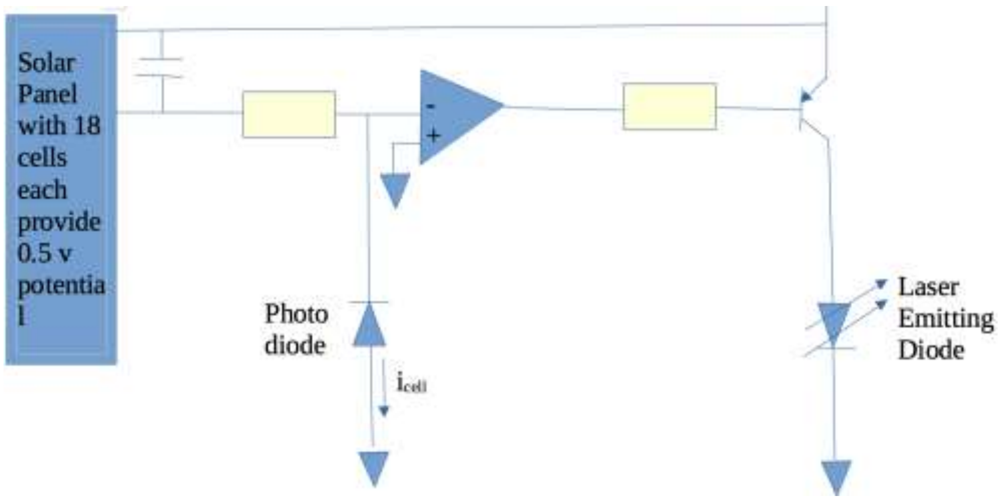

Figure 4: The prototype of the digital control unit of Laser Emitting Diode, modified from [16]

According to [18], the last part of the digital control unit is the laser emitting diode and the light emitted may then be used as the source of Silica microcomb. The silica micro-comb is then connected with repetition rate stabilization together with the OE conversion for the output of microwave. In practice, there is a pulse train with 22-GHz repetition rate which is generated via FWM and soliton mode-locking processes in a silica micro-resonator. Ideally, the silica micro-resonator is indeed driven by the laser emitting diode like the figure XX as shown above (or may need to be refracted by fibre etc). Hence, a 22-GHz microwave is thus extracted from an optical pulse train by an optical-to-electronic (OE) conversion process through a modified unitraveling carrier (MUTC) photo-diode followed by a radio-frequency (RF) bandpass filter and an RF amplifier. As the timing jitter and repetition-rate phase noise from a free-running micro-comb will diverge over time, the repetition rate is thus stabilized by a fibre photonic stabilizer. In fact, the stabilizer's signals contain the frequency noise of two comb modes. The noise difference between two comb modes may be extracted by mixing the signals. If we further close the feedback loop, the stability of the micro-comb repetition rate can reach up to the stability of the time delay of the fibre link etc. Next, if we install a magnetic wormhole with surface coated with meta-material, on the microwave output of the silica micro-comb, then we can prevent the microwave signal from being hacked outside. The microwave will thus be induced on the other side of the receiver etc (will be shown in the figure 5). Certainly, the vice versa may also be true. In such a way, there may be a new and novel way of forward-backward secrect communication. Moreover, we may input the microwave signal into the silica micro-comb with other related instrument parts and all of the digital electronics being shielded with meta-materials inside, an electric current will be induced on the surface of the magnetic wormhole [19] without causing harmful effects to these electronic devices. Indeed, the final result of the microwave-to-silica micro-comb process may be the emission of a laser beam as a source of signaling etc. In brief, all of the aforementioned may

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be kinds of both forward-backward communication/charging philosophy etc.

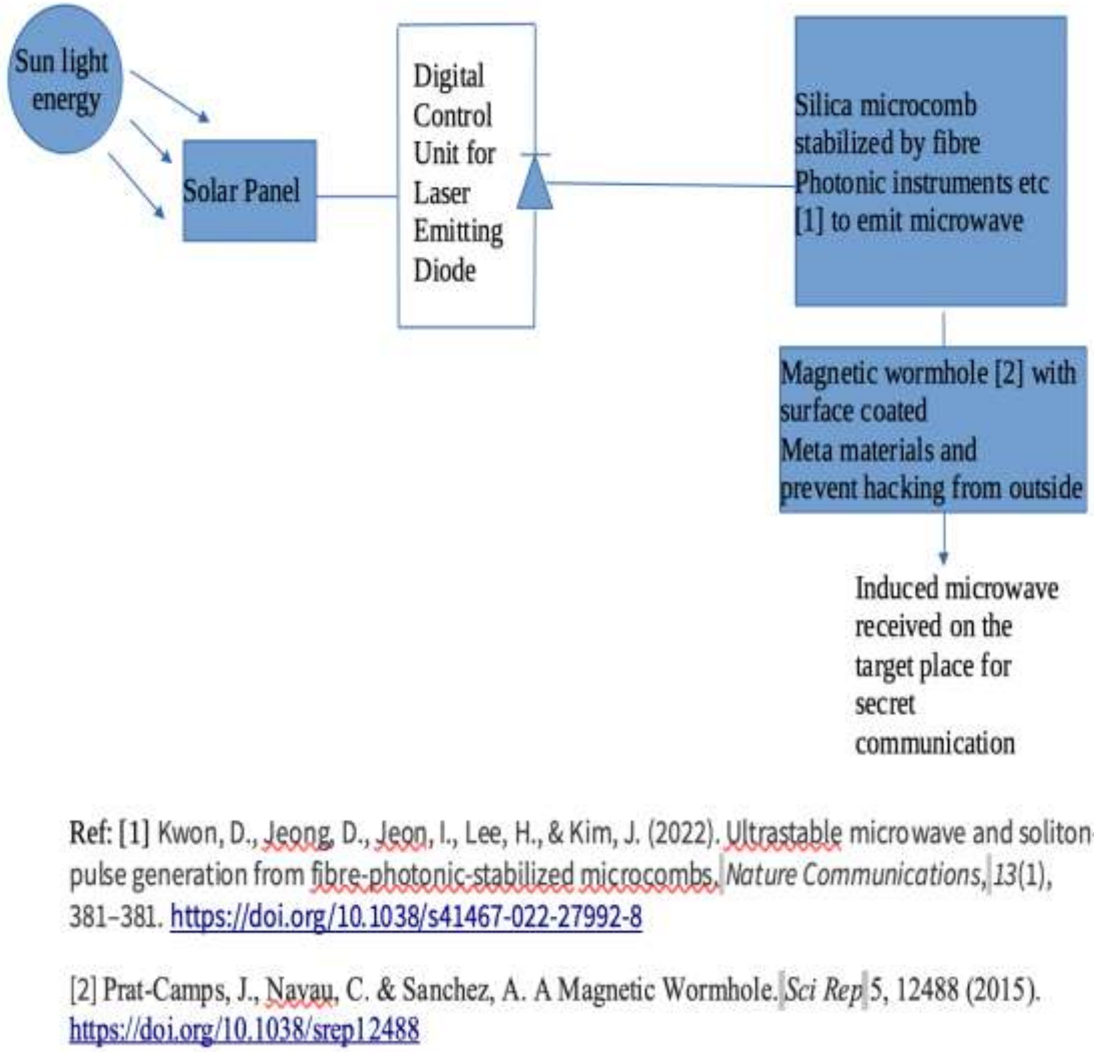

Figure 5: Solar panel with digital control unit for laser emitting diode for silica micro-combs with a (forward-backward), (secret) communication/charging source [18] (or philosophyAnother way for the source of emitting the microwave is by using the gunn diode that is very popular in the physics laboratory for microwave transmitters and receivers etc. In fact, the usual common microwave emitting gunn diode emitting circuit has been shown in the following figure 6:

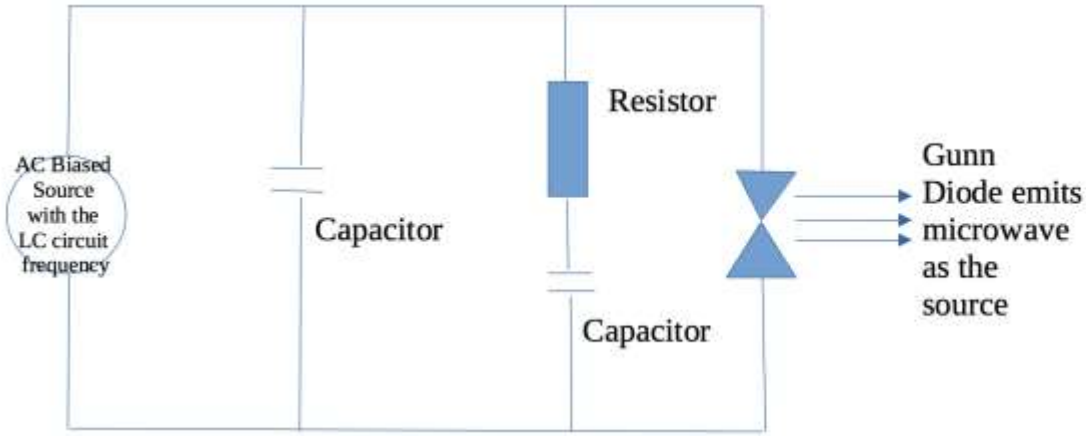

Figure 6 [20], [21]: A simple gunn diode LC tuned resonance circuit that can emits microwave as the source of my Butterfly charging with AC biased electric source

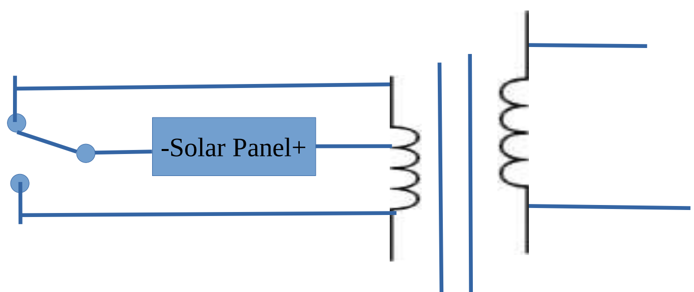

Figure 7 [22]: A simple inverter circuit with an electromechanical switch and solar panel as the electrical po**Conclusion**

To conclude, one may apply the concept of random matrix to the different range of the electromagnetic wave spectrum within various channels. From these EM wave channels, we
— human beings may upgrade our telephone booth into a multimedia centre together with the novelly wireless Butterfly charging method for energy harvesting. Practically, one may employ the business information management system for these various channels with different functions. Hence, the problem of charging small sized electronic appliances will be solved completely instead of using low quantity China made external charging device. To go a further step, researcher may apply the same technique with suitable meta- material coatings and creating the electromagnetic wormhole [19], then the transportation vehicles may also be charged externally in any-where and at any place without causing any harmful effects to those people seating inside [13]. That is also the contribution of the present paper to the wireless charging research field. Last but not least, the wireless Butterfly charging method is indeed a philosophy which is out of the scope of my present paper's discussion.

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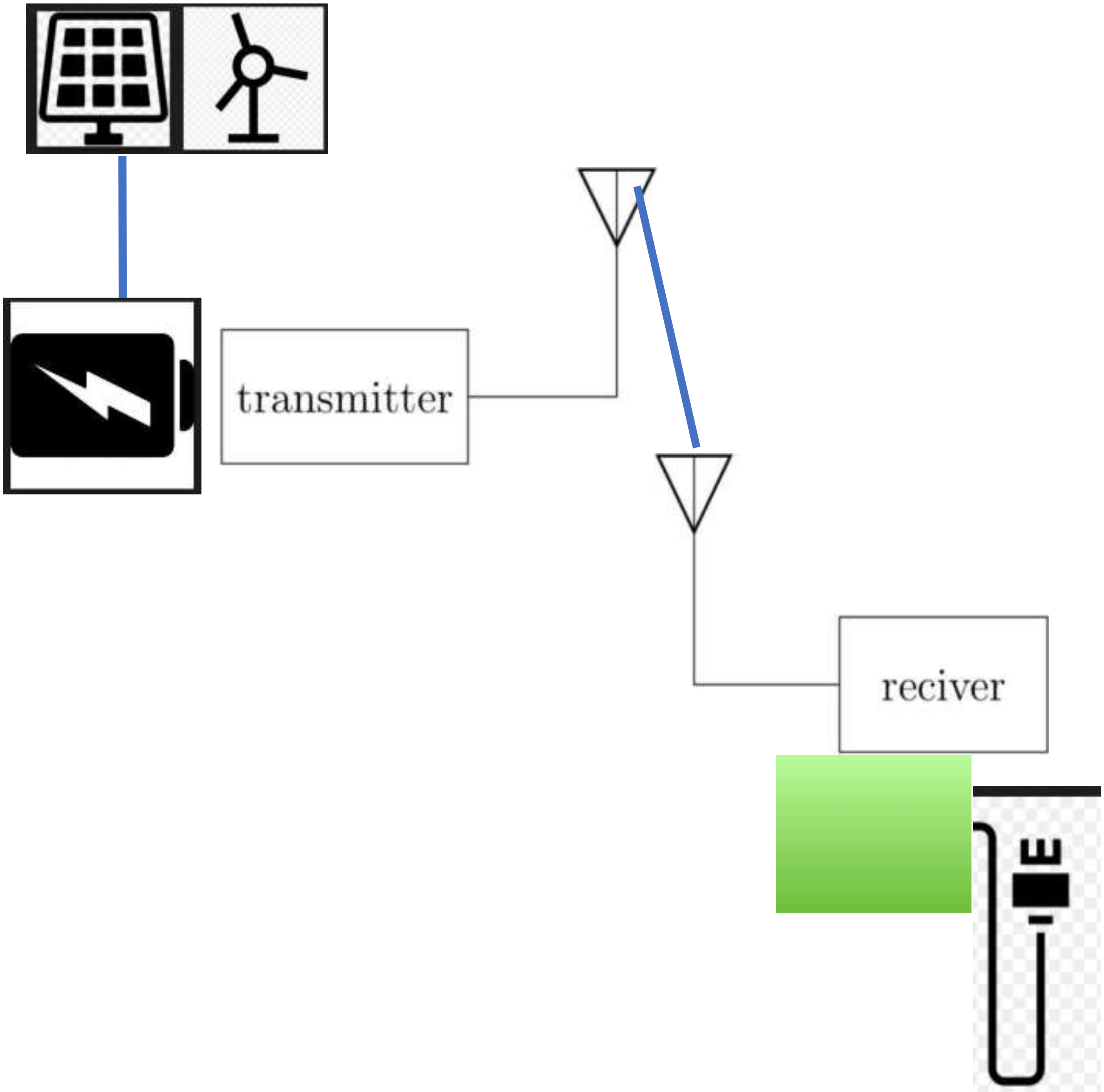
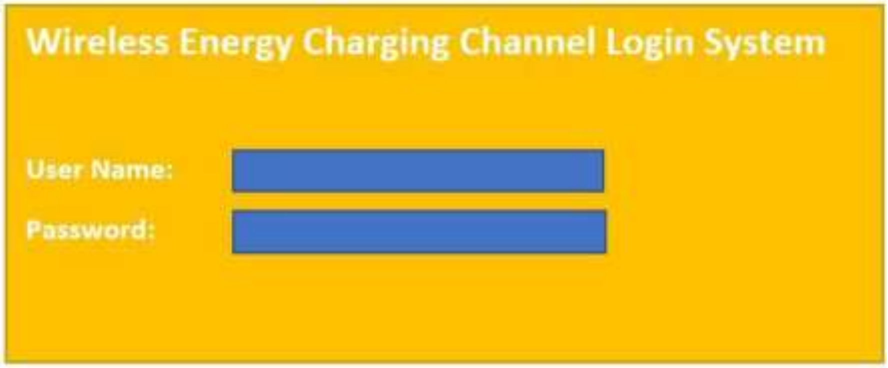
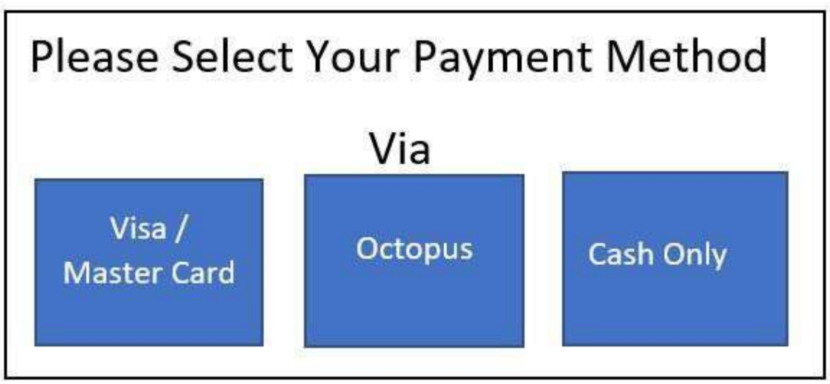
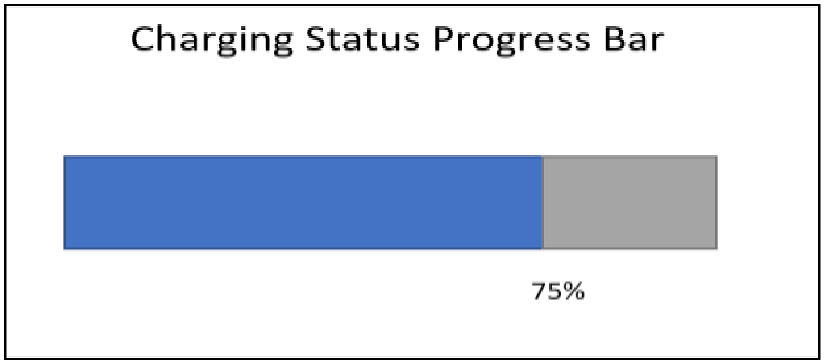
Appendix One: My Proposed Clean Energy Butterfly (/Wireless) Charging Scheme for Street light/Telephone Booth as the Transmitter Electrical Voltage Source



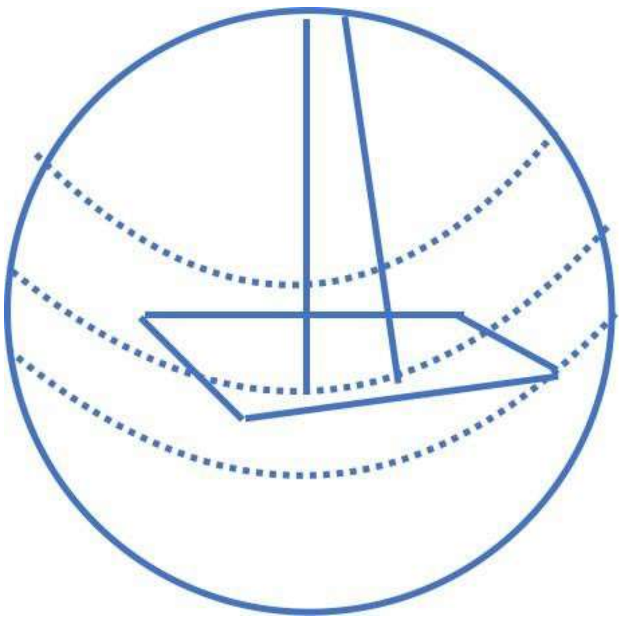
Appendix Two - A Suggested Information Management System For Logging into Special EM Wave Channel

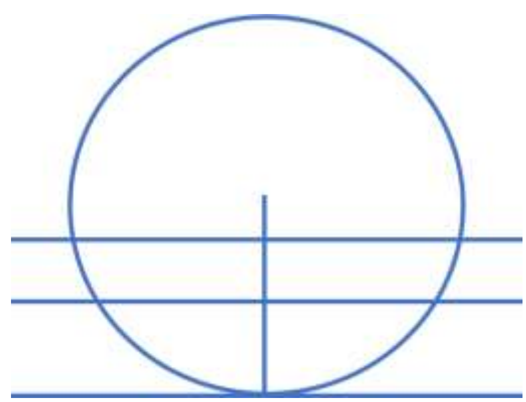




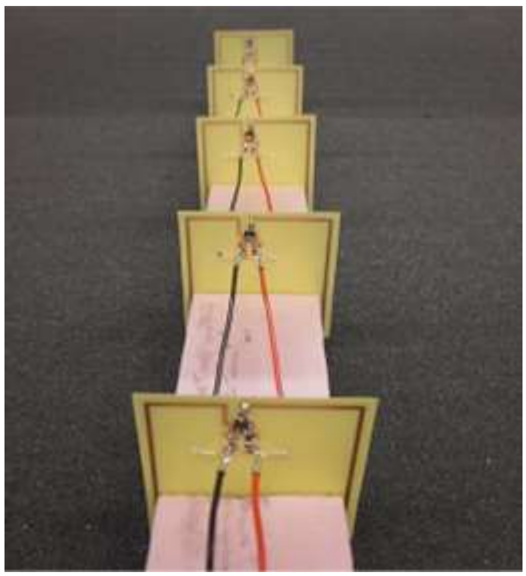


Appendix Three - Antenna's Mathematical Details

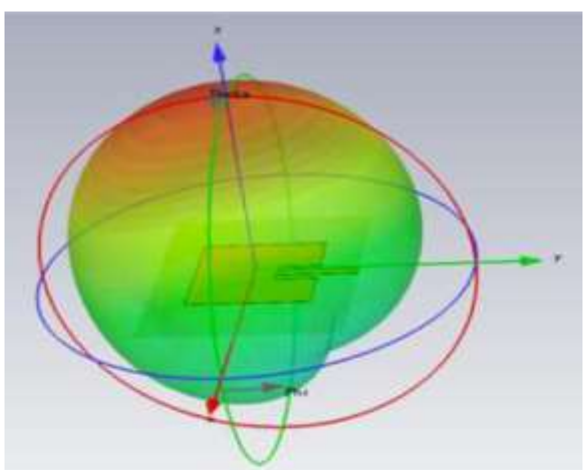




Consider a sphere with several latitudes and the one in the middle of it. If we place a square plane on it, the distance between the transmitter and the receiver antenna can be approximated. When furthermore, one consider the plane as a secant to the circle as shown on the right, one may push it such that it gradually approaches (like taking limiting values) to the pole of the circle. Then for the distance of the receiver sphere's pole to the transmitter's antenna, it is just the closest approximate shortest distance from the pole's square plane to the transmitter's antenna. From [7], it shows that directivity gain attained its highest value at the pole, thus it is natural for us to place a meta-material coated small plane near to the receiver's sphere pole so that one may maintain the short- est distance (together with highest energy harvested) from the transmitter. Indeed, ac- cording to [7], low incident energy power can be achieved if an array of antenna is used. In addition, when they are coated with EM meta-materials on the surface, the energy harvesting result may become much better [12].



5 X 1 array of power harvesting SRRs [12].



Far field of the micro strip patch antenna at frequency 0.9 GH

Remarks:

Field Effect Transistor (FET) [14] or Metal-Oxide-Semiconductor-Field Effect Transistor (MOSFET):

Suppose we use the microwave as the energy transmitter This author proposes that in this paper's thought wireless charging project, there is a possibility for one to employ the FET or the MOSET as part of the electromagnetic waves receiver [16]. The advantage is that the FET has a very high input impedance even at low frequencies (as microwave employs lower one when compared with high frequency Gramma ray etc). Hence, there will not be a voltage drop due to divider effect w.r.t. the source impedance. In order to amplify the power transferring, one should implement another transistor circuit behind the former FET receiver circuit for the amplification of the receiver's current. Then the current induced from the receiver's transmitted voltage will be amplified on the output. The output power will attain a maximum as the final output current is now be- ing amplified (Note: P = VI and high impedance implies high voltage and low current). Hence, one can ensure the best power outcome during the charging process for our deserved electrical devices. Indeed, the gain of my proposed circuit is:

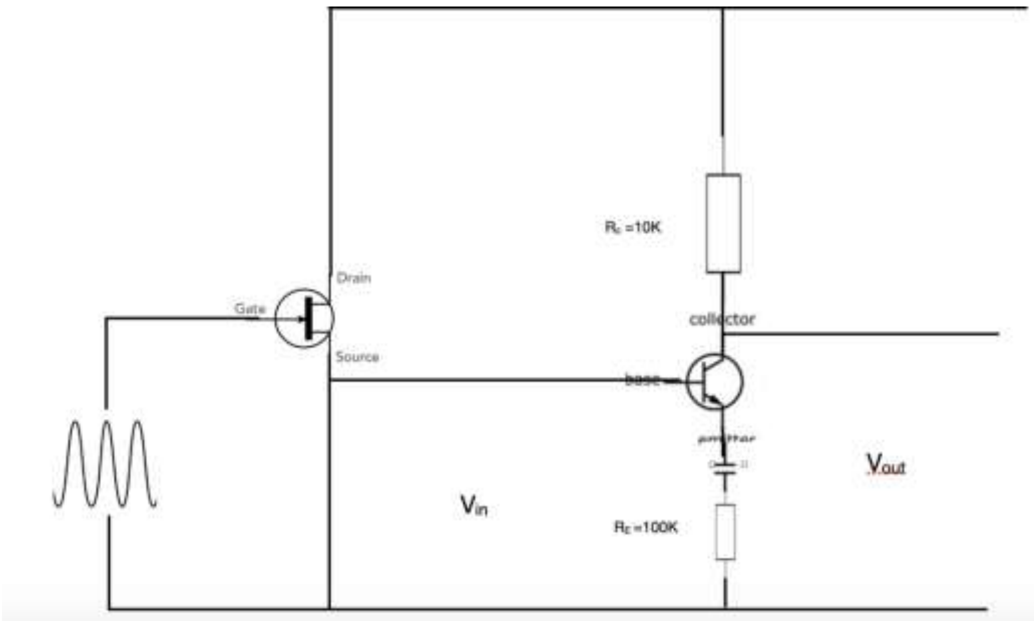
Voltage Gain G = change in V_{out} / change in V_{in}

$= - (R_C / R_E)$

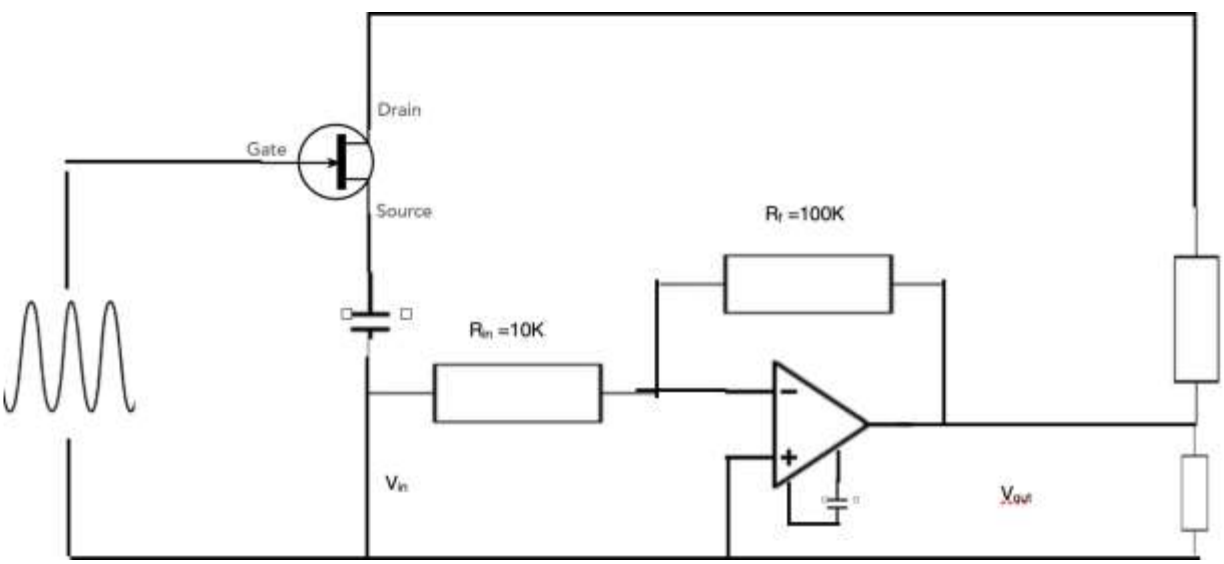
Gain in power for my proposed circuit is:

$P_{out} / P_{in} = G^2$

It is observed that both the power gain and the voltage gain are independent of the current amplification factor. The energy gain comes from the battery (or the capacitor) located on the circuit. However, the voltage gain from a transistor is unstable [15] and thus I propose another kind of the receiver circuit with the inverting operational amplifier installed.
My thought microwave receiver circuit with the FET and the transistor will then be shown in the following (Suppose microwave is used as the source to the circuit):



The modified receiver circuit with the inverting operational amplifier is shown below:



I note that the voltage gain for the modified circuit is: $G = R_f / R_{in}$ with the feedback parameter equals to: $1 / G$ or R_{in} / R_f.

In this case, one can easily control the power gain by varying the ratio of the feedback resistor to the input resistor.

2. Advance development in the materials of producing solar panel

According to the journal, nature photonics[15], scientists can use the strain engineered material like MoS_2 — a kind of monolayer which can capture a broad range of solar spectrum with concentrated excitons or charged carriers to act as a photovoltaic device for this wireless charging project. This event can ensure the maximum usage of our solar energy that transmitted into our Earth and is more environmental friendly. The energy loss will be less than traditional solar panels.

3. Wireless charging the Robot

Once we have the circuit technology of wireless charging, advancement in the materials of producing new solar panel together with the meta-material coated inside the robot, we can charge the robot in anywhere and at any time on the surface of the robot without causing any harmful
effects to its complicated electronic devices.