Bioelectricity-A Novel Approach to Power Generation

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***Abstract*—What do you think a plant can give?? Of course pure oxygen, fruit and aesthetic look but what if it can generate electricity?? During Photosynthesis plants take Carbon-di-oxide and water in presence of sunlight to produce oxygen and organic matter. Small Part of this organic matter is used for plant growth. But a large part of this can't be used by the plant and is excreted into the soil via roots. Around the roots naturally occurring micro-organisms break down the organic compounds and free electrons are released. The released free electrons are harvested using electrodes. Cu and Al electrodes are connected in series combination in order to increase both current and voltage. Voltage is stored in the battery can be used for small appliances. Microcontroller is used to continuously monitor the battery status.**

Keywords – Bioelectricity, power, generation, plant, Cu, Al, Carbon-di-oxide.

I. INTRODUCTION

In today's day to day life, the whole world is facing a severe crisis of energy resources. Moreover almost all the conventional energy sources will get extinguished if the current level of consumption continues in future. That's why world countries have started to concentrate on other sources of energy which are termed as "Renewable Sources of energy". Till now many renewable energy sources have been discovered and various means have been invented to harness these sources to convert into usable electricity form. For example: electricity from solar power, wind power, geothermal energy, bio gas and even more. However these are really innovative sources but still these sources contribute to mere 2% of the energy sources consumption and thus even today conventional sources of energy like: coal and petroleum continues to be the sources of energy. The main reason for the limited use of these sources are the non-availability at all the places and these sources are quite costly. Hence it is not possible for common man to install such means to harness energy as there in the case of solar power.

Due to a growing world population energy demand is rising. Apart from the general increase in energy demand, a specific and even faster increase in electricity demand can be seen over the last decades. It is expected that this increase in electricity demand will continue and might even go faster than before. Worldwide electricity generation is still mainly dependent on fossil resources (Figure 1). Over 67% of the electricity produced is originating from coal, oil or natural gas. Other sources are nuclear (13.4%), hydropower (16.2%) and others including wind, solar biofuels and waste (3.3%). The share of fossil fuels in the total electricity generation has decreased over the last 50 years and is expected to further decrease within the coming decades. The gap that arises from the increasing demand for electricity and the decreasing share of fossil fuels to produce them is expected to be met by natural gas and renewables.

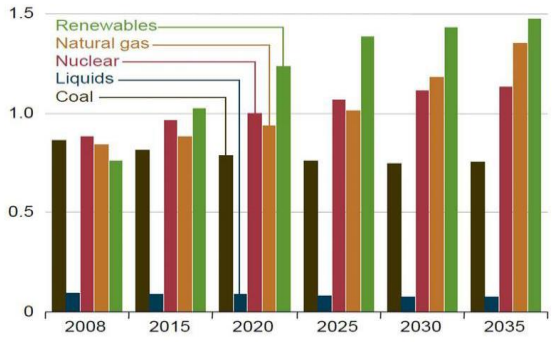

Figure 1: Net electricity generation by fuel 2008 - 2035 as forecasted by the International Energy Agency

One estimate of population growth, coupled economy growth at current levels puts a global demand of 41TW in 2050 at current energy growth rates. However, considering anticipated energy trends, a more reasonable projection is 27 TW by 2050 and 43TW by 2100. Major concern is the fact that release of stored carbon in fossil fuels is increasing the concentration of carbon dioxide in the atmosphere, with increases from 316ppmv in 1959 to 377 ppm in 2004. By 2100 it is estimated that CO2 concentration will reach anywhere from 560 ppm to 970 ppm. Today greatest environmental challenge is to simultaneously solve energy production and CO2 release. There is strong need to develop a whole new energy platform that produces sufficient energy while at the same time reduces CO2 emissions. The use of

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fossil fuels, especially oil and gas, in recent years has accelerated and this triggers a global energy crisis (Figure 2).

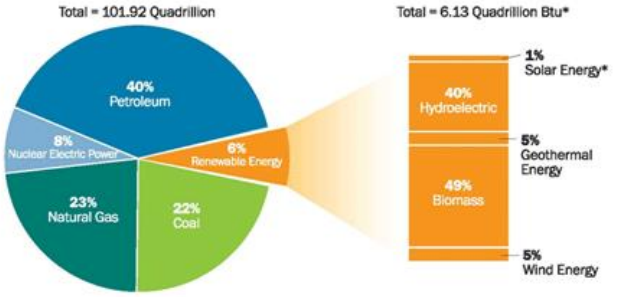

Figure 2: Role of renewable energy consumption in Nation's Energy supply

It is therefore important to be able to distinguish not only between electricity productions that uses renewable or non-renewable sources, but also to identify other characteristics of the production process that may impair the environment or society, directly or indirectly. Developing alternative electricity production methods are given prime importance. New electricity production from renewable resources without a net carbon dioxide emission is much desired.

A. *Objectives*

- To generate Electricity which is renewable, sustainable, economically feasible and easily available?
- Generate electricity with living plants and soil. While the plant is growing, electricity can be produced.
- To use the generated electricity for low power applications. For example, charging a phone.

II. METHODOLOGY

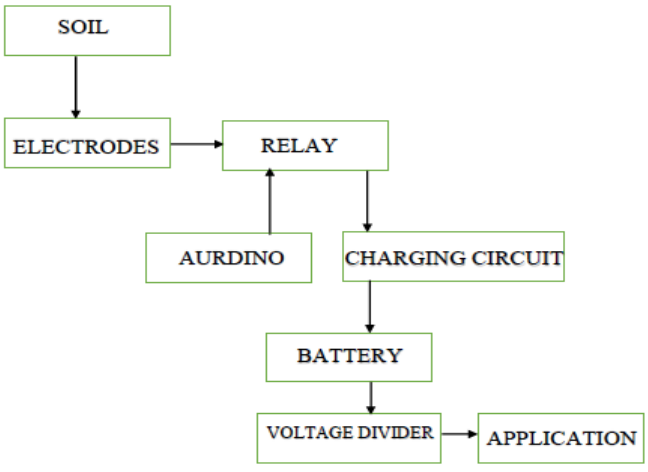

Figure 3: Block diagram of the Proposed System

A. *Soil*

During photosynthesis a plant produces organic matter. Part of this organic matter is used for plant-growth, but a large part can't be used by the plant and is excreted into the soil via the roots. Around the roots naturally occurring micro-organisms break down the organic compounds to gain energy from. In this process, electrons are released as a waste product in the soil. Soils contain clay minerals and organic matter as a result of weathering and the addition of organic debris soils act as buffer zone between atmosphere and ground water, and provides plants a steady supply of nutrients. Soils have this sorptive property because of electrical charges and large surface area of the clay minerals and humus.

B. *Electrodes*

Copper and Aluminum are used as cathode and anode respectively .The released free electrons are collected at the cathode. The anode is coupled to a cathode. Due to the potential difference between anode and cathode, the electrons flow from the anode through an electrical circuit with a load to the cathode this results in the generation of electricity.

C. *Charging Circuit*

Booster is known for its high-current, high-voltage capacity. The drivers can be paralleled for even higher current output. Even further, stacking one chip on top of another, both electrically and physically, has been done.

D. *Relay*

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

E. *Arduino*

Arduino is an open source computer hardware and software company, project, and user community that designs single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself (DIY) kits.

F. *Battery*

A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is

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supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead–acid, nickel–cadmium (NiCd), nickel–metal hydride (NiMH), lithium-ion (Li-ion), and lithium-ion polymer(Li-ion polymer).

G. Voltage divider

A voltage divider is a simple circuit which turns a large voltage into a smaller one. Using just two series resistors and an input voltage, we can create an output voltage that is a fraction of the input.

III. HARDWARE & SOFTWARE DETAILS

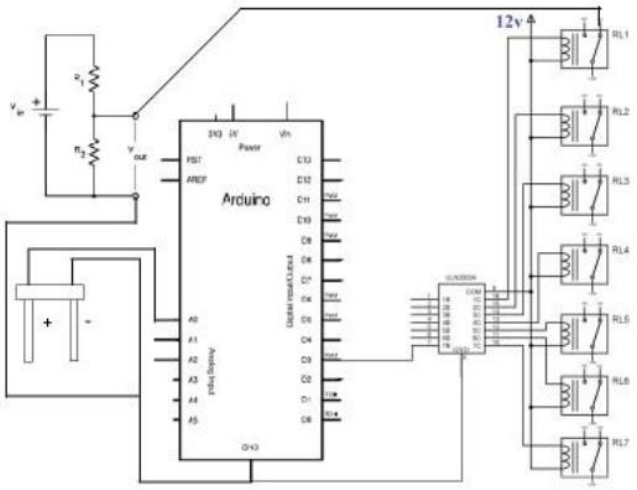

Figure 4: Circuit Diagram of the system.

A. Software

An integrated development environment (IDE) is a software application that provides comprehensive facilities to computer programmers for software development. An IDE normally consists of a source code editor, build automation tools, and a debugger. Most modern IDEs have intelligent code completion. Some IDEs, such as NetBeans and Eclipse, contain a compiler, interpreter, or both; others, such as Sharp Develop and Lazarus, do not. The boundary between an integrated development environment and other parts of the broader software development environment is not well-defined. Sometimes a version control system, or various tools to simplify the construction of a graphical user interface (GUI), are integrated. Many modern IDEs also have a class browser, an object browser, and a class hierarchy diagram, for use in object-oriented software development.

Integrated development environments are designed to maximize programmer productivity by providing tight-knit components with similar user interfaces. IDEs present a single program in which all development is done. This program typically provides many features for authoring, modifying, compiling, deploying and debugging software. This contrasts with software development using unrelated tools, such as vi, GCC or make.

One aim of the IDE is to reduce the configuration necessary to piece together multiple development utilities, instead providing the same set of capabilities as a cohesive unit. Reducing that setup time can increase developer productivity, in cases where learning to use the IDE is faster than manually integrating all of the individual tools. Tighter integration of all development tasks has the potential to improve overall productivity beyond just helping with setup tasks. For example, code can be continuously parsed while it is being edited, providing instant feedback when syntax errors are introduced. That can speed learning a new programming language and its associated libraries.

Some IDEs are dedicated to a specific programming language, allowing a feature set that most closely matches the programming paradigms of the language. However, there are many multiple-language IDEs. While most modern IDEs are graphical, text-based IDEs such as Turbo Pascal were in popular use before the widespread availability of windowing systems like Microsoft Windows and the X Window System (X11). They commonly use function keys or hotkeys to execute frequently used commands or macros.

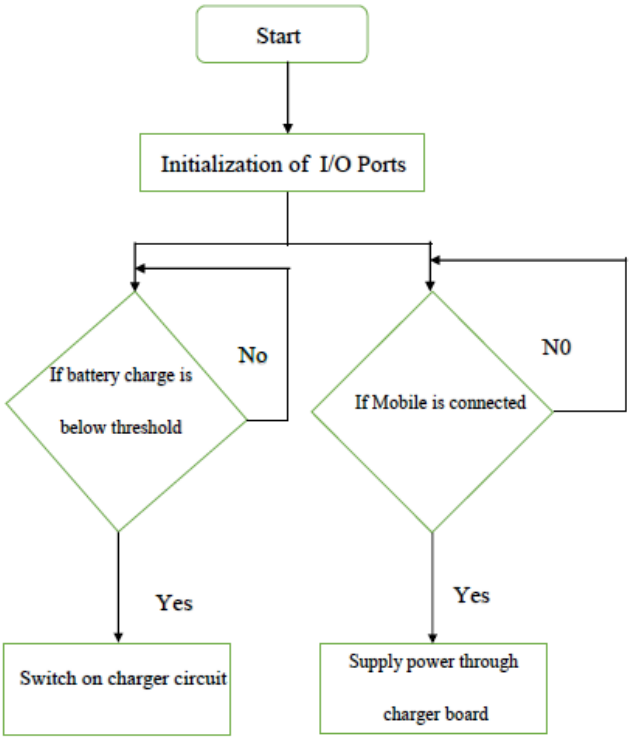

Figure 5: Flow chart of the software logic Implemented

IV. RESULTS

In this section, detail procedures of several experimental steps are described. The experimental work is divided into three parts: - selection of electrodes and energy sources,

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optimization of the harvesting system and factors affecting the conductivity.

A. *Experimental Setup*

Figure 6: Hardware arrangement of the cells

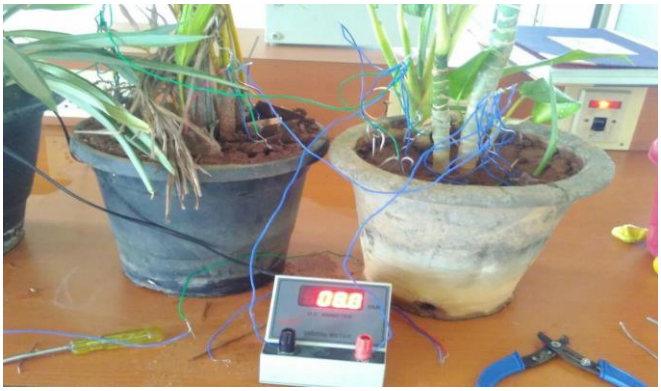

Figure 7: Current Generation From Two Cells

Experimental results show that with just two cells, 8.8mA current and 0.5v voltage is being drawn. Likewise cancatenating the cells in series will lead to generation of greater current and larger volatge.

Figure 8: Cells arrangement & Circuit Setup

The cells are arranged in an circular series pattern and arranged in an customized and efficient manner. And there by, the circuit arrangement is displayed. This arrangement of cells is most efficient for the generation of the required voltage and current which is needed to charge the battery of the Smartphone.

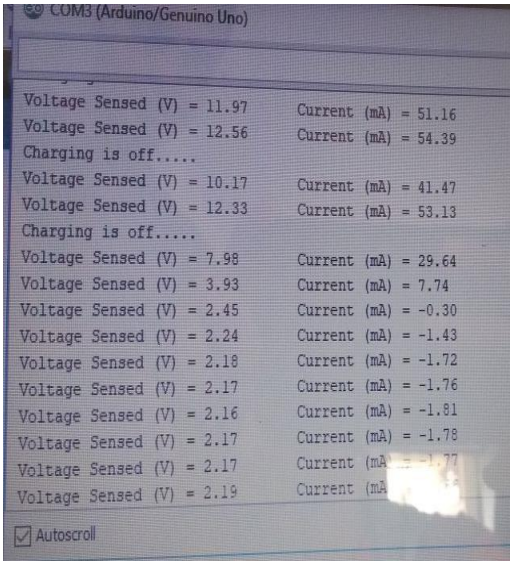

Figure 9: Display of volatge and current being produced using arduino.

The voltage being produced in the cell is being monitored using arduino software and hence, the working of the system is detected and confirmed.

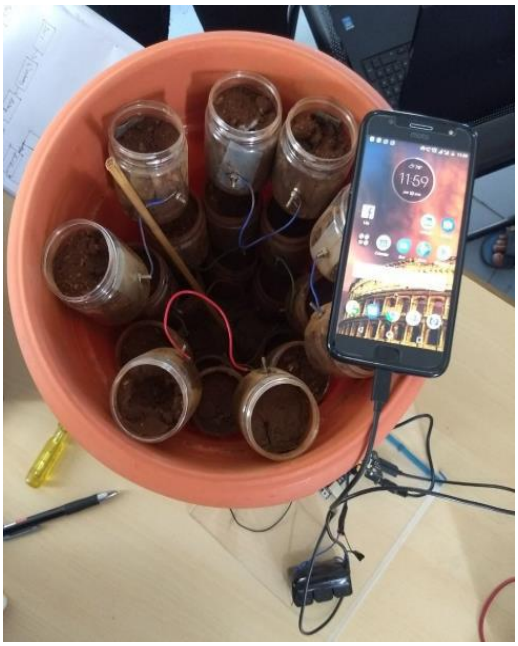

Figure 10: Charging of a Smartphone with the obtained voltage

The Smartphone is charged with the obtained output and hence the core objective of the project is completed with this section. The Smartphone getting charged is the indication that the energy being produced is sufficient enough to charge the mobile battery.

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V. Conclusion & Future Scope

A. Conclusion:

In this project, a new renewable energy source from living plants was investigated. The electrical power from the organic energy source was harvested using pair of electrodes embedded into the plant. It was found that the electrodes combination influences the harvested energy output. Optimization of its voltage output was obtained as the number of electrodes pair connected in parallel-series increases. Besides that, the type of plant, soil contents, moisture, and temperature also influences the output voltage. Till this end, it was shown that using this new organic energy source, a mobile phone can be charged.

B. Future Scope

This project can change the way the world thinks about electricity production. Natural areas can be conserved, and the production of food and feed could be combined with production of electricity. Worldwide this could be a huge transformation. Especially in places where it is needed the most, where they have no access to electricity available at all. The added advantage that it is portable adds more of a value to this innovation. The very fact that mobile battery is being charged without any external power and purely from the soil is a raring thing and this technology will pave way in the way power charging of smart phones are being charged.

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