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3D PRINTED DEVICE AND METHOD FOR CONVERTING AIR INTO THE WATER THROUGH CONDENSATION

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Abstract : Exemplary embodiments of the present disclosure are directed towards a system for converting the air into the water through condensation comprising of a condensation unit comprising, one of fans and a condenser coil wherein, the water vapour is condensed for providing drinkable water; an auto cooling fan configured to cool down the condenser's heated portion configured to maintain a predetermined heating point; a water collector configured to collect the condensed water vapour from the condensation unit through a connected funnel; a sensors module configured to sense at least one of: temperature, cooling and heating point details, water filtration details, humidity, dew point and voltage details; a display unit configured to display at least one of: humidity, cooling temperature, heating temperature, lux, dew point, sensors details and its status of working; a power filter and converter module configured to reduce the noise and the distortion in the current, wherein the voltage may be converted according to the compatibility; and a relays module configured to switch at least on of: a UV lamp, a cooling unit and a fan.

Key Words: Converting Thin Air into Potable Water, Smart Condenser, Auto Calibrated Sensors with LCD colour display, Water Filter, Portable Device, 3D Printed, Mineral Cartage, Microcontroller Based (Atmega2560), Peltier and Thompson's Effect.

I. INTRODUCTION

A. Overview

3D Printed Device which Produce Water from Air

We, as human being are constantly facing the threat of declining amounts of fresh water so much so that people are prepared to pay a premium for a resource that was once readily available for us all in general. The

statistics and metrics show a grim picture of what might be in stock ahead. So this System and method for converting AIR into potable WATER through condensation can bring a revolutionary change in the world.

A device of 800 grams, is just an minor example of where the incredible technology that's running in the back end, can be applied, the ideal precedent that we hope to acquire, after evolving this technology and methodology across different spectrum, prime among which is to be able to generate voluminous amounts of clear and clean water, especially in locations where water is limited.

We tap almost all of our fresh resources except probably the most obvious and most renewable source our atmosphere, our atmosphere is filled with water vapor, which we have tried to tap by developing a small , efficient and cost – effective unit ***"WHICH CAN PULL THE WATER VAPOR OUT OF THE ATMOSPHERE AND CONVERT IT INTO FRESH,DRINKABLE AND PURE WATER THROUGH THE PROCESSS OF CONDENSATION"***

B. Background: The water vapour exists at significant levels in most geographic locations on earth. This water vapour takes the form of moist air. Processing this moist air into dry air and water results in a net surplus of energy for the process. This energy can be captured and converted to commercially transmittable energy, electrical power, through a thermodynamic cycle process coupled to a water vapour separation module which extracts enriched water vapour from naturally occurring moist air.

In the light of the aforementioned discussion, there exists a need a system and method for converting the air into the water through condensation.

II. SYSTEM ANALYSIS

A. Problem Definition

Water scarcity is a major problem in the world. It affects one in three people, almost 1.2 billion people live in places where water is physically scarce. At the same time, water vapor makes up more than 6% of the atmosphere. This through calculation gives about 10,000 billion liters [about 2,600 billion gallons] in the bottom kilometer [about 0.6 miles] of air around the world. So this System will bring a revolutionary change in the water scarcity and provide huge quantity or fresh, clean, potable water as per the need. This system can be applicable in Rural, Urban as well as in Tribal Domain.

B. Proposed System Feature

This Proposed System is based on a revolutionary tech that holds promise to change the way we produce, treat and consume water. The premise of this technology is based on "*Thompson's Effect in association with Peltier Effect and Computer Algorithm with Sensor Technology"*, but the application of this law in this particular method of producing water from, quite factually, thin air, has been first of its kind. Thin air in this context is being correlated condensed moisture which is sucked in the module through suction via a fan, which passé s through chilled Copper coils, thereby triggering sweating. One break through alteration to the coils meant to improve its performance and efficiency was to coat it with an atom's layer of Graphene.

III. SYSTEM DESIGN & IMPLEMENTATION.

A. Proposed System for Converting Air into Potable Water

1) Overview Block Diagram

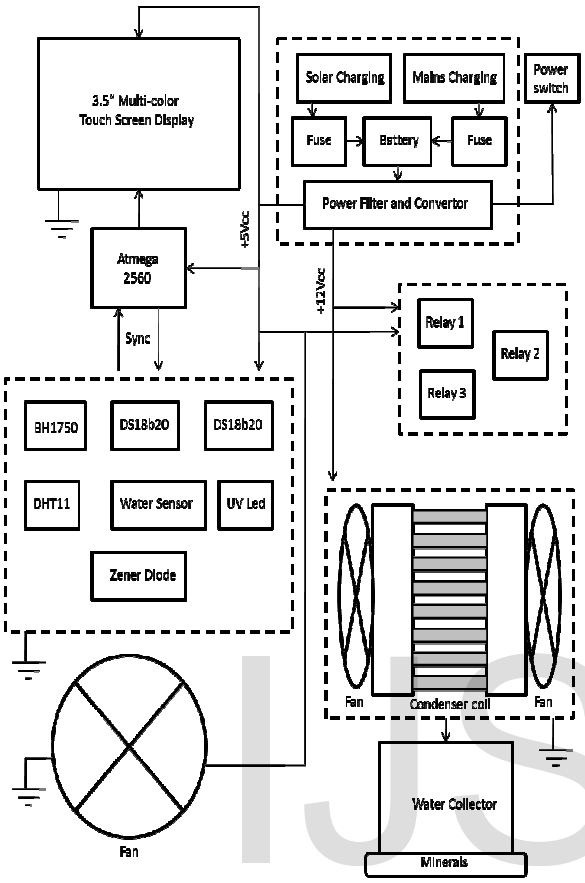

Figure 1

According to the exemplary aspect, a system for converting the air into the water through condensation is disclosed. The system includes a condensation unit configured to condensate the water vapour for providing drinkable water. An auto cooling fan configured to cool down the condenser heated portion for maintain a predetermined heating point. A water collector configured to collect the condensed water vapour from the condensation unit through the connected funnel. A sensors module configured to sense at least one of temperature, cooling and heating point details, water filtration details, humidity, dew point, voltage details and the like. A display unit configured to display at least one of humidity, cooling temperature, heating temperature, lux, dew point, sensors details and its status of working and the like. A power filter and converter module configured to reduce the noise and the distortion in the current, and to convert the voltage according to the compatibility and further the system is inclusive of a relays module configured to switch at least one of a UV lamp, a cooling unit, fan and the like.

2) Electronics Configuration Block Diagram

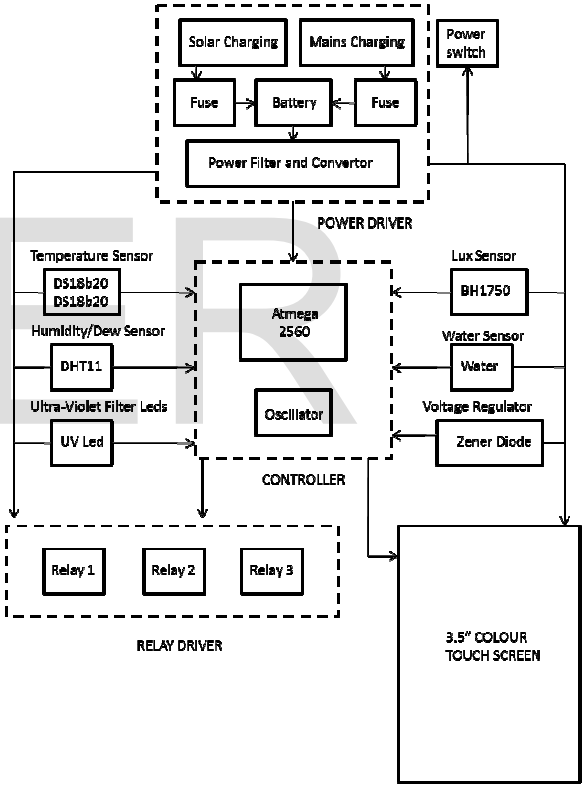

Figure 2

In the above (figure 2) represent the electronic configuration block diagram of the device, each and every electronic component interfacing connection with microcontroller (i:e Sensors, Color LCD, Relays) the figure also shows the block diagram of power supply system to the device.

3) Flow Chart of the system

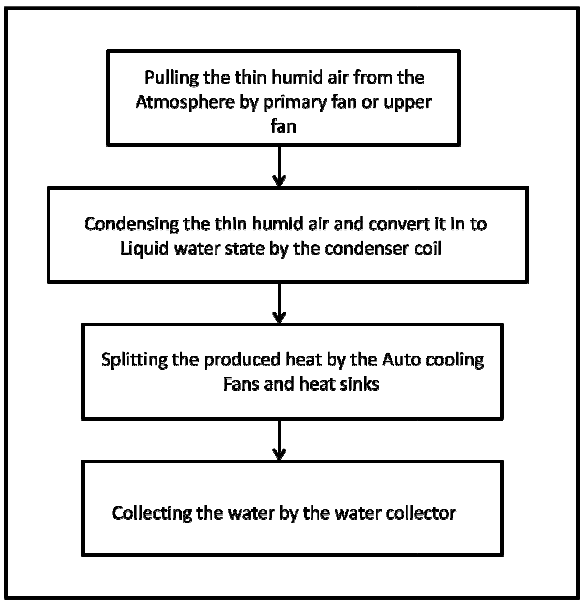

Figure 3

In the above figure 3 shows the flow chart of the device which converts the air (thin air) in to pure potable drinking water, the air can be suck in the device through the suction fan which is place on the top of the device and then get bombarded on the chilled surface of smart condenser(fig4) which condense the thin air so as to convert in liquid state, the condensed water get passes through various semi-permeable membrane to filter out the dust particles and then treated for minerals adding process by passing it through the minerals cartage because the condense water is having absolute zero TDS (total dissolved solid) according to standard drinking water it should be less then 500mg/L so we make it reach till 173 to 180mg/L of TDS which comes under the portability factor. After passing the condensed water through the minerals cartage the processed water get pass through the ultraviolet light emitting diodes which kill all the unnecessary microbes present the water then after treating through this all process it get stored in the attached water container.

Steps of Converting Air into Water

1) Air In taking/ Air Suction
2) Condensation
3) Filtration
4) Minerals Adding Process
5) UV Filtration/Treatment
6) Collection of Potable Water

4) Condenser

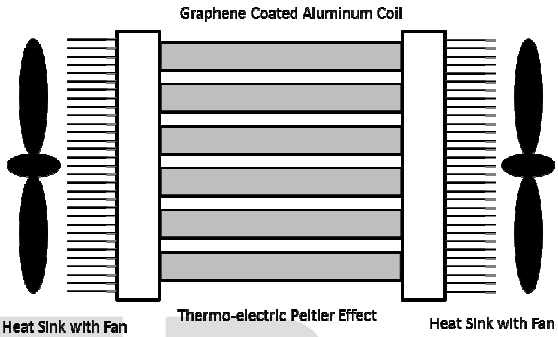

Figure 4

In the above figure 4 shows about the condenser arrangements, the thermo-electric peltier module is linked up with copper coil which is coated with 1 atm of graphene layer which increases the sweating of the coil and the heat generated on the other side of the condenser can be exchange by the heat sink with automatic sensor interfaced cooling fan which trigger ON when the temperature raises, this condenser is interfaced with multiple sensor with auto calibration algorithm which cools down the condenser surface with respective to the atmospheric parameters according to the atmosphere it get automatically calibrated itself to produce same amount of water every hour in different places. The arrangement of the condenser are made in such a that the heat can be displaced easily and provide better functionality.

5) Diagrammatic Representation of the process in the device

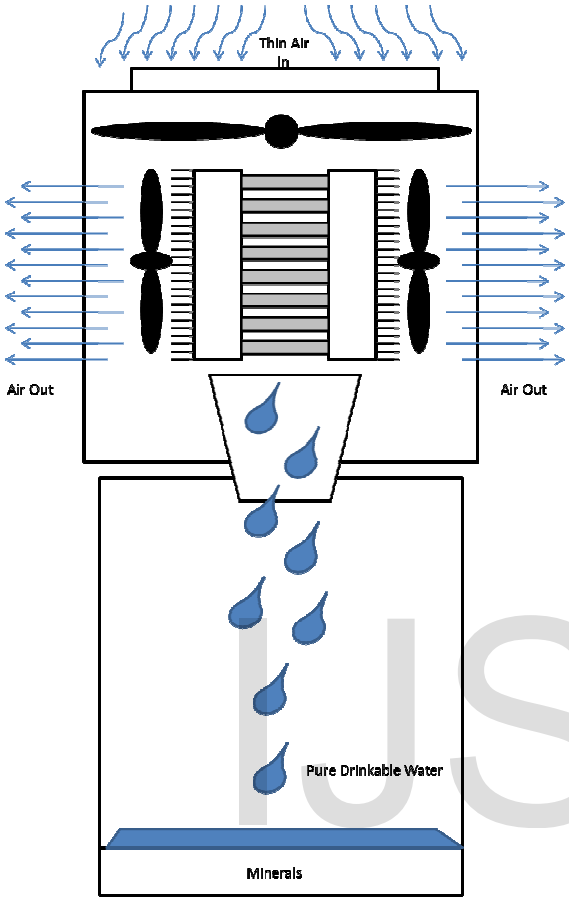

Figure 5

As shown in *figure 3* about converting the thin humid air in to potable water, the above figure 5 shows the same process in device arrangements.

B Mathematical Proof

G = (K*Q*G) GRAINS PER HOUR

where **: 'G'** is the total weight of the water vapor released (moisture content)

'Q' is the air quantity in CFM (cubic feet per minute) = *variable a*

'g' is the change in moisture content of the air between input and output = *variable b*

'4.5' is the constant **K**

Let X and Y are the two Variables

X = As a general rule, the higher the CFM, the larger and more powerful the fan required to produce the airflow, and the more water we can get. Through trial and error, we came up with the value of 500 CFM, keeping in mind portability, size and energy efficiency of the machine.

Y = This change in moisture content directly relates to the change in temperature done by the Peltier elements. The heat produced by one side would heat up the incoming air, and then this hot air would then be cooled by the cooling produced by the other side of the Peltier element. We used a psychometric chart to come up with the value of 12.8, inputting all the values, we got a result of 28800 grains per minute,

So, we have

K= 4.5

Q= 500 cfm

Temp by psychometric chart = 12.8

4.5x500x12.8 = 28800

G = 28800

G = (K*Q*G)

We know that,

1mg/L = 0.05841

1 L = 0.2641 gallons

G/0.05841 = 493066.25

493066.25/0.2641 = 1866968.005

1866968.005/10000

186.69l/h

Which is about **1.86 liters per hour.**

This proved the feasibility of the system.

IV. USER INTERFACE

The UI of this system is as simple as it could it shows the various values of the atmospheric parameter on the color LCD display with sensor functionality, The automatic cooling system indication, UV filter indicator also indicated on the display

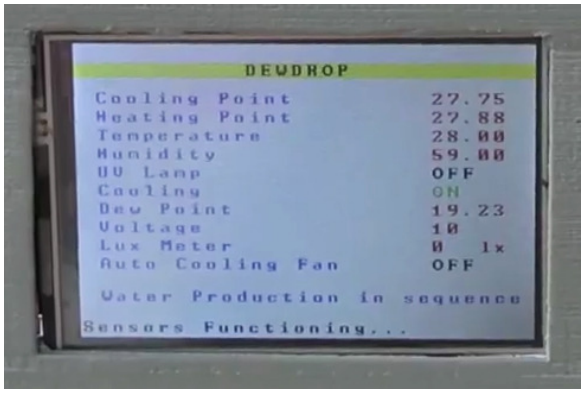

Figure 6

The device consist of power (on/off) switch, water pouring switch and a USB Female B-type port for charging and firmware upgrade

V. DESIGNING AND 3D PRINTING

A. Device Designing (2D)

This air to water converting device is completely 3D printed device, 3D printing is also known as rapid prototyping method , In which the 3D product can be printed by 3D printer with ABS plastic, this device consist of three 3D printed parts in combination are shown in below figures

Figure 7,8,9

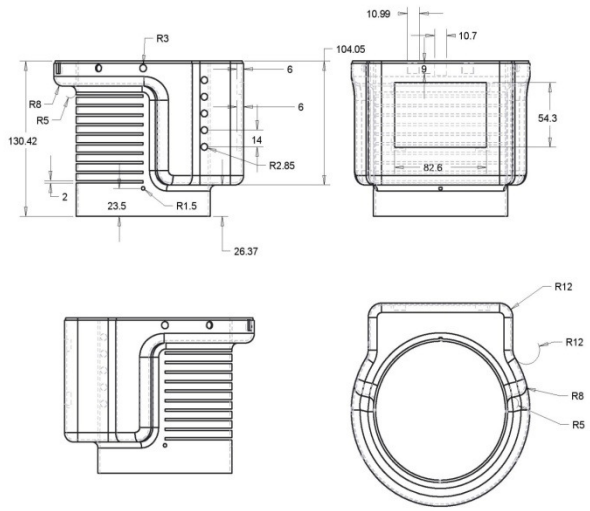

Figure 7

In the above figure 7 the diagram shows the main enclosure of the device which holds all the electronic components in it like sensor, battery pack, display etc.

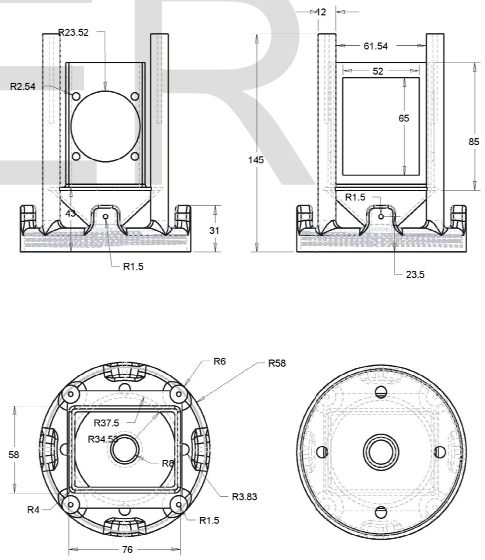

Figure 8

In figure 8 is the chassis of the device which holds the condenser, Filter Unit and other components and also hooked up with the main enclosure (fig7) This is also 3D printed.

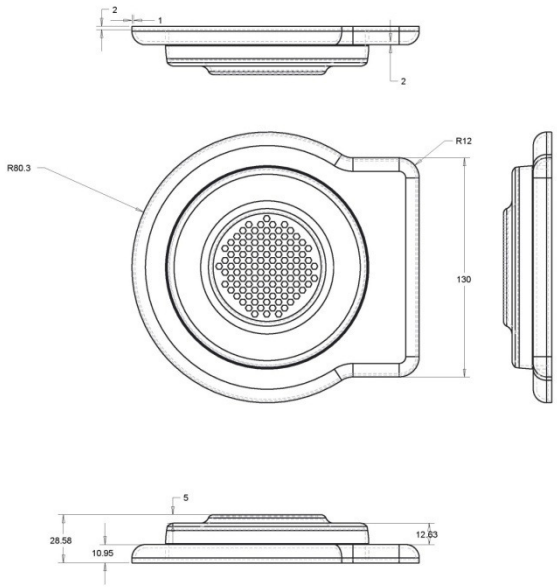

Figure 9

This figure is a cap for the main enclosure which cover up the upper electronics of the device and can be use for cleaning of the device.

B. 3D Design

The 3D model and design is developed in Autodesk Inventor following are the 3D parts of the device

Figure 10 – Main Enclosure

Figure 11 – Chassis

Figure 12 – Cap

VI. Hypothesis

If we can artificially induce condensation, we can capture the water vapor in the atmosphere, and convert it into a liquid , potable form which can be used almost free of cost

Therefore, we would be using an unexploited and safe source of water to help ease the water shortage faced by millions of people around the world.

VII. Advantages of this device over conventional device :

- No moving part, so maintenance is required less frequently.
- No use of chlorofluorocarbons and other toxic cooling agents
- Temperature control within fractions of degrees can be maintained.
- Flexible shape (form factor) in particular, they can have a very small size. Ideal for modern technology trends.
- Can be used in environments that are smaller or more severe than conventional refrigeration.
- Has a long life, with mean time between failures (MTBF) exceeding almost 100,000 hours.
- Controllable via changing the input voltage/current very easily.
- Draw comparatively low current than a compressor based system.
- Micro-Controller Controlled Device
- 12 inch 800 Grams device
- Easy to carry (Portable) and Easy to use
- Environment friendly
- Automatic Calibrated Sensor controlled
- Attractive

VIII. Application

This type of device can be use in each and every domain of water, this revolutionary method and technology of converting thin humid air in to potable water bring a revolution in water scarcity , this device can be use in all areas such as rural, urban and tribal and also can be use in extreme situations such as flood affected areas, desert areas, etc. it's a kind of portable device which we can even carry it in our backpack, you'll never have to worry about being in a situation where you'll need to hunt for water, because right at your disposal is Device that literally makes water, whilst you do just anything. Just take the device out and quench your thirst!

IX. 3D Printed Device

The first prototype of the device is totally 3D printed which bring more laurel in the features of the device and never compromise with its looks.

X. Results

The Battery Pack is Placed in the device with charging module which provides the potential difference to the smart condenser unit and the inlet system and cooling fan, the air inlet fan place on the upper side of the device pull in the humid air form the atmosphere and bombard it on the chilled surface of the condenser which is made up of peltier modules with graphene coated coils and in association of microcontroller controlled auto-calibrated sensors which calibrate itself according to the atmosphere and stabilized the output, the smart computer (microcontroller) controlled condenser also exchange the heat of other side of the peltier module, the heat exchanger is link up with automatic cooling fan and the arrangement of dry air out of the condenser part passes through the hot side which decreases its temperature and increases the life of peltier module. The bombard air get condense and get converted in to water (liquid state) this condensed water is having zero TDS so this water get

passed through the minerals chamber which consist of all necessary minerals to make it potable, before passing the water through this chamber it get passes through semi-permeable membrane to filter out the dust and other particles then it get processed for minerals, after adding the minerals to it its get re-filter by the UV treatment process to kill the all germs and unnecessary microbes and then after completion of this all process it get collected in the attached water container, and the water is ready to drink !

XI. Conclusion and Future Work

Applying this technological system in a highly humid region almost 1.86 Liter of potable water can be produced per hour during the day light, this is a promising result, then a more enhanced system can be designed that encounters higher power solar cells and also has the adroitness to store the excess energy during the day light that is to be used at night; indeed the economical advantage of this kind of system is a bit obscure due to the relatively high installation cost.

This idea can be extended further in future – **1**) For large scale implementation, RO and UV water filter can be used for producing such water that meets the standard of WHO and BIS easily. **2**) Peltier device has many types of models which are much efficient than TEC1. Those can be used. **3**) As the project aims at producing water from atmosphere (Air) and keeping this device handy and very portable with attractive looks, large sized scrubbers are not used for better air filtration. Scrubbers can remove all the oxides from the air. For large implementation it can be handled. **4**) The concept of this project can also be used as a better alternative in refrigeration science against conventional systems.

It can also be observed in this way i.e. the usage of such low power semiconductor devices are indicating towards more prominent evolution of cooling engineering that is going to alter the whole scenario and myths about the power consumption of refrigeration science. Thus in near future we will be able to use such devices that are now limited within the project works.

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XIII. AUTHOR PROFILE

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Is 22 year old Pursuing B-Tech in Electronics and Communication Engineering from Lords Institute of Engineering and Technology, Hyderabad, He has been an electronics freak since his childhood, He stared working on electronics when he was as young as 10 year. Later on in schools and college period he won many competitions in electronics and robotics field, his ideas led him to invent new things every now and then, his working domains are Water, Health, Energy and Agriculture, being an inventor himself holding 2 patents in the fields of Electronics and publish many national and international research paper, He Got featured in over 200 media channels in about 50 countries across different streams – print, radio, TV and Web He owns his Personal Lab and a website.