Atmospheric Water Generator using Peltier Device

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***Abstract*— Due to lack of rainfall, in many countries like India it is difficult to get water resources for irrigation or other purposes, especially in the arid regions like desertsetc.The problem of water scarcity is also observed in many places of the world due to lack of rainfall. However, in highly humid areas such as places close to the sea, condensing the water vapour present in air we can places close to sea. Here, the paper presents the method to develop a water condensation system supported on thermoelectric cooler. The system consists of cooling elements, heat exchange unit and air circulation unit. This is the device that can convert atmospheric moisture directly into usable and even drinkable water and these devices is known as Atmospheric Water Generator. Here this device which uses the principle of latent heat which convert molecules of water vapour into water droplets. It has been introduced a bit before, though it is not very common in India and some other countries. It has a great application standing on such age of technology where we all are running behind renewable sources. This paper also describes the experimental results and the system'sperformance.**

Keywords –Thermoelectric cooler, Atmospheric moisture

I. INTRODUCTION

It is difficult to get water resources for irrigation or other purposes in the many countries like India, especially in arid regions. Because of the pure water scarcity in the many regions worldwide, mainly in Arabic Gulf countries, finding differentmethods for the pure water generation becomes more useful to motivate many researchers to work on related topics. In all aspects of life water is needed. It is difficult to purify, costly to transport and it is not possible to substitute, water is an essential element of life nearly 45 crores of people in 129 countries are staying in water-deficit regions.

For irrigation of the Agricultural fields nearly 70% of fresh water is used which has raised water conflict between the urban and rural areas if all this continues, then very soon i.e. by 2032, nearly half of the world's population will be facing the shortage of water problem. It is predicted that within the 21st century there'll be water wars. Due to lack of rainfall it is observed that the problem of water scarcity is there in other places of world. However, in highly humid areas such as places close to the sea, condensing the water vapour present in air we can places close to sea. Here, the paper presents the method to develop a water condensation system based on thermoelectric cooler. The system consists of cooling elements, heat exchange unit and air circulation unit.

The Atmosphere is contains large amount of water in the form of moisture, vapour etc. Within those amounts almost 30% of water is wasted. This amount of water can be used if we are able to extract the water that present in the air in the form of moisture. This Atmospheric moisture convertsdirectly into usable and even drinkable water this is called Atmospheric Water Generator.

This project willhelps to extend the applications of suchdevices further in the future. From previous knowledge, we got to know that the temperature require to condense water is understand as temperature .In this project we are using a of a thermoelectric Peltier (TEC) couple, which is employed to make the environment of water condensing temperature or dew point or otherwise we can also use conventional compressor and evaporator system could to condense water by simply exchanging the heat of transformation of coolant inside the evaporator. After condensing ,the condensed water will be collected to used for drinking, irrigation and various other applications.

II. LITERATURESURVEY

Many products of similar technology are available in the market. But after going through the product develop page of various companies, it was found that the device are very bulky and heavy. The water generated by this gadget are not portable. Since they used a compressor but it consumes heavy electricity and these are not eco-friendly which produces lot of noise and requires maintenance. Hence to make it portable we are using same technology with different device called peltier device

Anbarasu and Pavithra in 2011, title of the paper is "Vapour Compression Refrigeration System Generating Fresh Water from Humidity in the Air" .This paper infers thatdehumidifying unit using vapour compression refrigeration system will be more effective than the Peltier system but it lacks in the sense that it is not portable and it generates a lot of sound. And also this system is morecostlier than any.

Niewenhuis et.al., 2012, title of the paper is "Water generator water from air using liquid desiccant method" , here in this paper we observed that even though this dehumidification by liquid desiccant method is new and it possess a lot of potential theoretically but when the researchers made a prototype and put it for testing ,it was

found that the result was not satisfactory. The device could produce only 72.1 mL of water per kW-hr. Along with Niewenhuis many have tried to use the same liquid desiccant method for dehumidification. After they built the prototype and put it into testing it was found that water created from the gadget was very dismal. Hence from this paper we got to know that not to use this method of dehumidification for our prototype.

Kabeela et.al. 2014, title of the paper is "Solar-based atmospheric water generator utilisation of a water recovery",during this paper they used the tactic of dehumidification unit using Peltier device, it had been found that the device is extremely portable and environment friendly. It consists of straightforward design with high capabilities. This sort of device are often implemented in extreme situations like during floods or in desert and rural areas. This device has greater advantages because it works sort of a renewable source of atmosphere water and doesn't need an important power source. Applying this techniue during a highly humid region almost 1 Litre of condensed water during the day time. Hence due to these many advantages we decided to use the Peltier device which is more portable and eco friendly.

Agbossou, A., Q. Zhang, G. Sebald, and D. Guyomar. 2010. title of the paper is "Solar Micro-Energy Harvesting Based on Thermoelectric and heat of transformation Effects. Part I: Theoretical Analysis.". during this paper they used a way of harvesting ambient renewable micro energy by using both TE and heat of transformation effects. A prototype was designed for work unit made from phase-change material as well as a TEG.

After browsing all the available options and referring from several papers, we are decided to use a Peltier device which is portable and eco-friendly to create the Atmospheric Water Generator. Using the tactic of dehumidification are going to be costlier and not portable, hence we are generating water from air using Peltier device at coffee cost and efficient in terms of amount of water collected and portability.

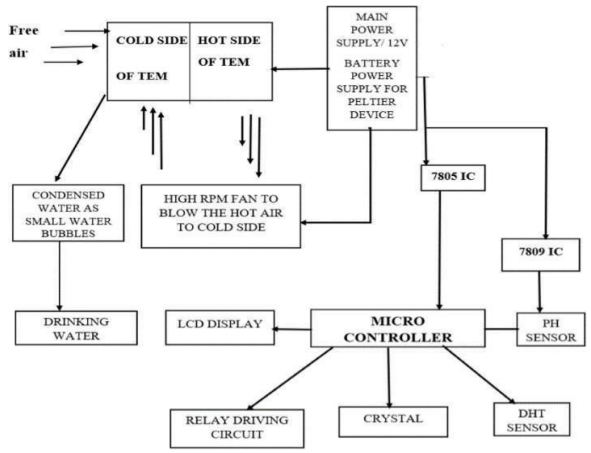

Fig 1: diagram

III. METHODOLOGY

According to the temperature of the air and humidity, the capacity of air holding water vapor will varies, warmer the air more water vapour it can hold. Here we areusing the device called peltier device which consists of both hot side alsol as cold side. Firstly free air is passed to the cold side of the peltier element which helps to decrease the temperature of air and air gets cools down, its capacity of holding water decreases and water moisture startsto condense. This air is then passed through hotter side of peltier device which cools the temperature of hot side. Because the peltier device is connected to power supply, it starts running and it's necessary to stay running peltierdevice otherwise temperature at the recent side will increase which will damage the device.

The water droplets obtained after condensation are often collected using any reservoir then passes through the filter. The microcontroller operates effectively at 5V but the most power supply will produce fluctuated output voltage to avoid that weareconnecting 7805 voltage regulator IC microcontroller. Similarly pH sensor operates at 9V so we are connecting 7809 transformer to provide constant 9V to the pHsensor.

In LCD display we are getting to display the pH value, humidity percentage and temperature value., The aim of relay driving circuits, we are setting humidity threshold intensityl we are setting humidity threshold level the device will Automatically shutdown and when the humidity percentage goes above the humidity intensity the device will automatically activate.

- **Hardware Components**

A. pH sensor

Fig 2: pH sensor

pH meters measure the voltage between two electrode and display the result converted into the corresponding pH value.

B. Conductor with fan

Fig 3: conductor with fan

Heat sink is another one which is typically made from aluminium is in touch with the recent side of a thermoelectric module.

C. Peltier cooler

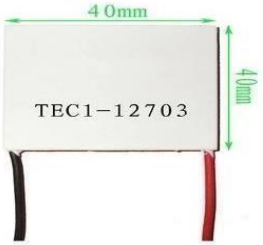

Fig 4: Peltier cooler

The design is more convenient for water collection and so simple such the device are often carried anywhere. This gadget is extremely helpful for explorers, mountaineers, fisherman etc. At the present climate as heating increases and therefore the water resources over the planet diminishes, so this equipment is extremely helpful to mankind. The concept of this techniue also can be used as a far better alternative in refrigeration against conventional systems

D. DHT11 sensor

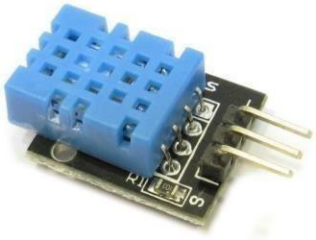

Fig 5: DHT11 sensor

They measure both the moisture and temperature within the air and express ratio as a percentage of the ratio of moisture within the air to the utmost amount which will be held within the air at the present temperature. A side becomes hotter,it holds more moisture, so the relative humidity changes with the temperature.

Only three pins are available for use: VCC, GND, and DATA. The communication process begins with the DATA line sending start signals to DHT11, and DHT11 receives the signals and returns a solution signall.

E. Relay

Fig 6: Relay

A Relay is an electrically operated switch. Relays are used where it's necessary to regulate a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

F. Voltage regulators

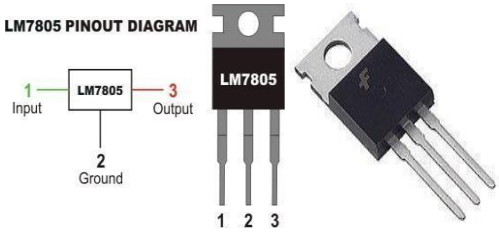

Fig 7: LM7805 & LM7809 voltage regulator

A transformer may be system designed to automatically maintain a continuing voltage level.

The 7805 may be a transformer microcircuit.7805 provides +5V regulated power supply.

The IC 7809 have 3 pins, Pin 1 may be positive input, Pin 3 may be positive output and pin 2 is negative footing between both input also as well as output voltage.

G. LCD Display

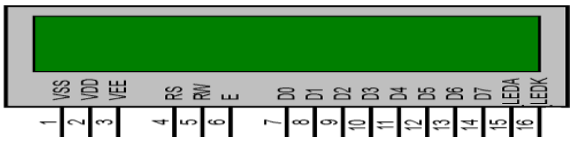

Fig 8: LCD display

A liquid-crystal display (LCD) may be flat-panel display or other electronically modulated device that uses the light-modulating properties of liquid crystals. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.

H. quartz Oscillator

Fig 9: quartz Oscillator

Crystal oscillator is emoloyed to supply clock to micro- controller. Clock is employed to hold all the function that micro controller provides.

I. Arduino Uno

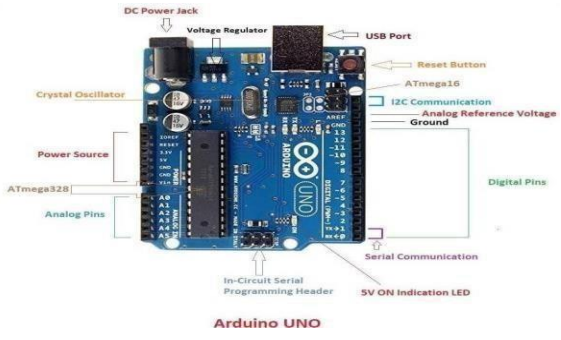

Fig 10: Arduino UNO

Arduino Uno is a microcontroller board developed by

Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328. Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins are often used for PWM output. It allows the designers to regulatel and sense the external electronic devices within the world.

J. Conductor compound

Fig 11: Conductor compound

Heat sink compound or thermal paste may be very high heat conductive paste that's used between two objects (usually a conductor and a CPU/GPU) to urge better heat conduction. We'd like physical contact to move heat from the recentt side of the Peltier to the warmth sink.

K. Battery

Fig 12: Battery

Sunlight isn't always same thanks to cloud, rain and already dark. For that reason, within the system, we've used batteries as copy when there's not enough sunlight.

o **Software Components**

The Arduino integrated development environment (IDE) may be a cross-platform application (for Windows, macOS, Linux) that's written within the programing language Java. It's wont to write and upload programs to Arduino board. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. We are using embedded C to program the device.

Embedded C programing

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. In day- to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embeddedC.

CONCLUSION & FUTUREWORK

The design is more convenient for water collection. The design is so simple such that the device can be carried to anywhere .The equipment is very helpful for explorers, mountaineers, fishermen etc. The concept of this system can also be used as a better alternative in refrigeration against conventional systems. At the current climatic conditions as global warming increases and the water resources over the world diminishes, so this equipment is extremely helpful to mankind**.**

Future Scope

1) For now, in this prototype we have used only two peltier device. In future the prototype may incorporate with multiple number of peltier device to increase the production of water.
2) This idea can likewise be utilized as a superior option in refrigeration science against traditional frameworks.
3) RO water filter which kills the bacteria and also UV water filter which kills all the pathogens present in the water can be used for large scale implementation for producing such water that meets the standard of WHO water guidelines.
4) As this project aims at producing water from atmosphere, small sized scrubber can be used to remove all oxides from the air and made it portable for drinking and other purpose.

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