

Arduino Based Green Veggie Chamber: Harnessing Kinetic Energy from Water Flow in Kitchen

Chayalakshmi C. L¹, Krishnamurthy Bhat², Triveni Angadi³

Basaveshwar Engineering College, Bagalkot-587102, Karnataka, India

Abstract: Electrical energy has its applications in each and every domain of our life. It is directly or indirectly involved in every aspect of human life. Its usage has increased to a large scale nowadays. As of now the major portion of electric energy generated is by hydro and thermal energy. There is a danger of its depletion soon. Technical community is consistently searching for renewable, sustainable, and feasible energy source. Generating the energy from the economic and available resources has become very much essential nowadays. Bioenergy, solar energy is yet to prove their efficiency. Hence, we are proposing an idea of generation of the electric power by converting kinetic energy of flowing water in water pipe. This type of power generation is carried out here by one of the natural resources which is water, along with some necessary arrangement of turbines and pipes to produce the desired electric power efficiently. This proves to be one of the smart solutions of converting one form of energy to other and utilizing the converted energy as the basic need in everyday purposes.

Vegetables being the essential part of food need to be adequately included in our daily diet. It is a tedious and time-consuming work to cut vegetables for working class in their busy schedule. Everyone is interested in reducing the time of cooking by preserving the cut vegetables in their free time for future use. Hence there is a huge demand for ready to use fresh cut vegetables. One of the simplest methods is to preserve vegetables in the refrigerator, which is not an effective way. Cut vegetables do not retain real freshness as their flavour and taste reduces with time if it is preserved in refrigerator or kept open. Many methods were proposed by researchers to preserve the freshness of cut vegetables. Some of them include chlorine washing of vegetables, use of antioxidants and modified atmosphere packing. However, none have yet gained widespread acceptance by the industries and people. In this paper, an indigenous, simple and cost-effective method to preserve the freshness of the cut vegetables is proposed. Vegetables are preserved in specially designed glass chamber fitted with controlled suction unit and use them later when needed. This is a regulated method, where the gases liberated by the vegetables kept in glass chamber are pumped out at certain intervals of time by the suction motor. Suction motor is controlled by a relay and Arduino Uno microcontroller. In this way, both quality and freshness of cut vegetables and fruits are preserved.

Keywords: Turbines, Electrical Power, Turbine Flow, Kinetic Generation, Microcontroller, Suction Pump, Preserving Vegetables

I. INTRODUCTION

Plant derived products such as vegetables and fruits can be consumed in raw form without processing or cooking. Fresh cut vegetables and fruits are usually cleaned, peeled, sliced, cubed, or cooked for convenience. The word vegetable was first recorded in English in the early 15th century. It derives from Medieval Latin vegetables “growing”, “flourishing”, a semantic change from a Late Latin, meaning “to be enlivening quickening”. Vegetables are certain part of the plant that are consumed by human as food as part of spicy meal. Some commonly used vegetables are cabbage, turnip, radish, carrot, parsnip, beetroot, lettuce, beans, peas, potato, tomato, cucumber, pumpkin, onion, garlic and many more.

Fruits and vegetables present an important part of the human diet in almost any culture of the world. There is also a long tradition in the view that fruits and vegetables should be consumed because of their nutritional and health benefits. Most fresh vegetables and fruits retain their freshness for a short time under ideal conditions of storage. Eating a variety of fruits and vegetables ensures an adequate intake of most micronutrients, dietary fibre and essential non-nutrient substances. Despite these positive nutritional and health aspects, consumption rates of fruits and vegetables are still low or insufficient in many countries.

Vegetable play an important role in human nutrition. Hence, these must be compulsorily included in the daily diet. Most vegetables are low in fat and calories. They supply dietary fibre and are important sources of vitamins and minerals. Particularly important are the antioxidants, folic acid, vitamin A, C and E. United states Department of Agriculture

suggests and encourages human beings daily to consume half plate of vegetables and fruits. Chances of chronic diseases such as cancer, cardiovascular disease, stroke, and other chronic ailments can be reduced. Consuming vegetables and fruits in daily diet, increases the body resistance against diseases. Potassium helps to maintain blood pressure. Dietary fibre present in vegetables helps in reducing blood cholesterol levels and reduces the risk of heart attacks. Folate (folic acid) helps to form healthy red blood cell in the body. Folic acid is essential at the time of pregnancy in the first trimester, which reduces the risk of neural tube defects and spina bifida during development of foetal inside mother's womb. Study recommends that the 30% of our food should be vegetables and fruits. Research reveals that the risk of developing coronary heart disease is lowered by 20% in these people who eat more than 5 servings of fruits and vegetables compared with those who eat 3 servings of fruits and vegetables.

The second part is about of generation of electric energy from the flowing water in pipelines. As it is known that electrical energy has their application in each and every domain of everyone's life. It is directly or indirectly involved in every aspect of human life. Its usage has increased to a large scale nowadays. As of now the major portion of electric energy generated is by hydro and thermal energy. So there is a danger of its depletion in the near future. Technical community is consistently searching for renewable, sustainable, and feasible energy source. Generating the energy from the economic and available resources has become very much essential nowadays. Bio energy, solar energy is yet to prove their efficiency.

Fresh vegetables and fruits are essential to keep the person healthy. In present day situation, where both the parents work, the consumption of fresh vegetables and fruits is highly impossible. For a working woman, spending time in kitchen in the morning hours is very difficult. In this regard this paper aims to design the system which can keep the vegetables and fruits fresh, and the power required for the system is generated by the kinetic energy of the flowing water in the pipe. This type of power generation is carried out here by one of the natural resources, water, along with some necessary arrangement of turbines and pipes in order to produce the desired electric power efficiently. This proves to be one of the smart solutions of converting one form of energy to other and utilizing the converted energy as the basic need in everyday purposes.

II. LITERATURE SURVEY

There are basically two parts of the work.

- A technical method of maintaining the quality and freshness of cut vegetables and fruits
- To generate electricity required for the above-mentioned system making use of the kinetic energy of the flowing water in the water pipes at homes.

The technical papers are surveyed to understand the above concepts:

This paper examines the use of fresh fruits and vegetables especially consumption of fresh cut lettuces and it gives an idea to preserve the freshness of fruit-vegetables for a long time. In recent decades the Chlorine solutions have been widely used for fresh cut fruit and vegetables in industry. However, the use of chlorine with the possible form of carcinogenic chlorinated compounds in water which can cause cancer. Hence, there is a necessity to develop the color, taste or preservation of fresh-cut fruit and vegetables to improve extension of life. Some modified methods have been proposed, as Hydrogen peroxide, organic acids, hypochlorite, and warm water etc. For moisture transfer, gas exchange or oxidation processes, fruits and vegetables need to be monitored [1].

This paper intends to review the most significant contributions regarding preservation of fresh-cut fruits without a significant modification of its color, taste, texture, smell. It covers aspects concerning conditions in each one of the processing steps such as washing, cutting, dipping treatments or preservation under modified atmospheres, as well as those works studying the influence of these operations on the shelf life and quality extension of fresh-cut fruit products without modification of their color, taste, texture, smell. The factor that reduces the shelf life of fruits and vegetables is gas, water content [2].

This technical paper discusses about the flow of water for energy generation. Energy production and power generation systems are the major goal of this report. Water is used for energy production Even power can be generated by fossil fuels, nuclear, geothermal, biofuels and hydrogen etc. This article discusses water use for extracting primary energy source. Primary energy sources considered in this category include coal, petroleum oil, natural gas and hydrogen fuel primary energy sources are considered as energy carriers within the energy supply system. It is the important to note that

water is required during the production of power generation. The process of where and how water is used for each energy sources is described in this paper [3].

This paper discusses about a detailed search of consumptive water use for energy generation. A sewage micro hydropower system can be reliable and provides stable electrical energy. Micro-hydropower system using wastewater from community neither requires a large damage nor is land flooded. Only wastewater from different parts of the city is collected to generate power which has minimum environmental impact. These issues are beyond the scope of this paper. Turbine is connected either directly to the generator or is connected by means of gears or belts and pulleys, depending on the speed required for the generator. The choice of turbine depends mainly on the head and the design flow for the proposed micro-hydro power installation [4].

This paper describes an alternative energy source that is micro hydro power generation. A micro hydro power generation system has been designed, developed, and practically verifying to provide reliable energy source of electricity. Hydroelectric power is the technology of generating electric power from the movement of water. Water is fed via a channel to a channel to a turbine where it strikes the turbine blades and causes the shaft to rotate to generator which converts the motion of the shaft into electrical energy. The kinetic energy of flowing water in pipe has to be converted into electrical energy [5].

III. METHODOLGY

The idea of this system is to maintain the freshness of fruits and vegetables. Following are some of the methods used for preserving fresh cut vegetables and fruits.

1. Canning



Fig.1: Canning Method of preservation

In this method, fruits and vegetables are placed in an airtight container so that it is prevented from bacteria. The food with canning process can be preserved for years, if necessary. One method of canning requires specialist machine and hence it is not practical and are of high cost, not affordable by common people. Another is the pressure canning method, in which temperature of food is maintained above boiling point of that food and low acidity so as to neutralize the bacteria. This method is popular and requires pressure canning machine. The jars in which the vegetables and fruits are placed need to be sterilized[6].

2. Salting



Fig.2: Salting Method of preservation

This is one of the oldest methods of preserving food. This technique can be used for non-vegetables also such as meat and fish. There are two methods in salting. In one method, low salt to vegetable ratio is maintained between two and five percent salt for every weight of vegetables

In another method, higher percentage of salt is used between 20-25%. If second method is adopted, even when vegetables are water washed, the salty flavour still remains. In both methods, after salting the food need to be stored in refrigeration[7].

3. Drying



Fig.3a: Drying carried out in sun light



Fig.3b: Drying carried out in oven

This method involves removing all water content from vegetables and fruits along with bacteria, yeast, and mould which live in the moisture environment. The texture is altered, taste is modified. Dried food is easy and safe to store. Drying of vegetables and fruits can be carried out in two ways-either in sunshine or oven.

4. Freezing



Fig.4: Freezing Method

This method preserves flavour and freshness of fruits and vegetables. The method of freezing and melting a vegetable or fruits provides a product that almost like the flavour of fresh food. The fruits and vegetables must be washed in hot water

for a minute which restricts the enzyme activity, which may spoil the product if stored for a long time. For long term storage the temperature must be maintained below freezing point. It is recommended to use the food once it reaches room temperature.

For the said reasons, the development of an alternative is necessary. In this paper, an idea to maintain the freshness of cut vegetables and fruits by removing the excess CO₂ and ethelene released by the cut vegetables and fruits using electrical energy is proposed. The block diagram of this system is depicted in Fig.5.

The primary objective of design of this system is to preserve the cut vegetables for minimum two days without compromising on the loss of freshness, minerals, and other qualities. The working mechanism of this idea is quite simple and executable. Basically, this idea can be implemented everywhere where there is availability of the sufficient water flow from one of the sources. To be in specific we can consider the very familiar example of the water flow in water pipes in houses. The kinetic energy of flowing water in pipes is the energy that must be converted to the electrical energy.

To do this, fit the blades of the turbines inside the flowing water pipe. The turbines will be fitted at regular distances on the pipe so that there will be no obstruction for the flow of water in pipe. The turbine must be selected according to the point of use. Each time the energy is generated as the turbine spins. As the velocity of the water increases, the rotation of the turbine increases and there will be generation of more electric power.

A miniaturized suction pump operated by 12V DC motor is used to deplete the gases liberated by the cut vegetables. The motor is controlled by a relay, so that at regular and pre-determined time interval, the suction takes place. The frequency of switching on the suction pump is determined by the amount of gas released and the type of vegetable. To overall consumption of electric energy is negligible because the motor is intermittently switched on and miniaturized suction pump. The whole system can be operated by a 12V battery.

Generally, switching on the motor for every 5 minutes for time duration of 30 seconds is enough to preserve the freshness of vegetables in a glass chamber.

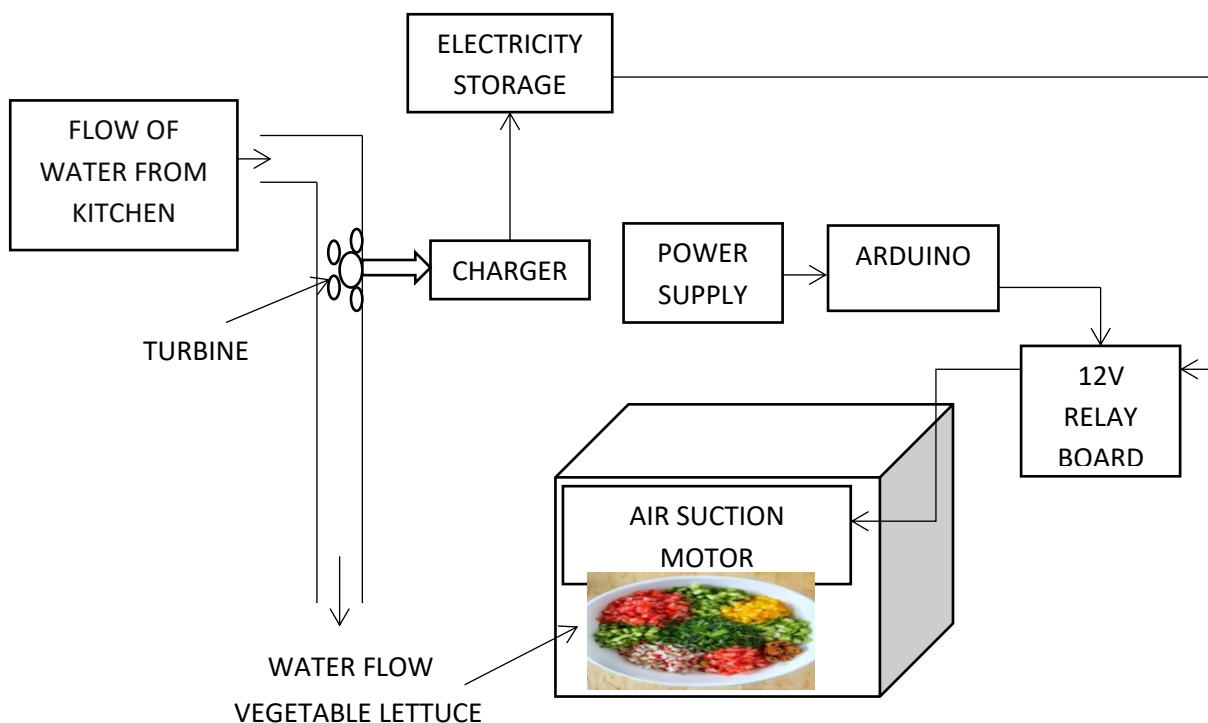


Fig.5: Block diagram of the system

IV. IMPLEMENTATION

In this system, in closed glass chamber, some vegetable is placed. Then the glass chamber is connected to air suction motor. It sucks air content from that chamber which is operated by 12V relay to turn on and off. The required electricity for the relay is generated from flow of water in kitchen pipeline. To do this the turbine is fitted in the sink pipe of kitchen and is connected to the charger circuit. This charger circuit consists of LM317 regulator because it is popularly adjustable positive linear voltage regulator. It is constructed with five register and one LED. The charger circuit is connected to battery cell to store the generated electricity and this battery gives electricity supply to 12V relay and to suction motor.

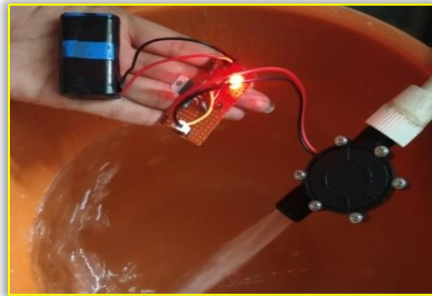


Fig.6a: Generation of electricity



Fig.6b: Maintaining the freshness of vegetables

TURBINE CAPACITY:

PRESSURE	VOLTAGE
0	0 V
Medium	2.2 V
High	4.5 V

This system includes mainly two parts, first part is to generate electric charge from water flowing in the pipes and another part is to maintain the freshness of cut vegetables and fruits. When the water flows through the pipes, it results into rotation of turbine. That will convert kinetic energy of water into electrical energy. The generated electricity flows through the charger circuit and stores in battery. In other part a glass chamber is used to maintain the freshness of cut vegetables and vegetables and a suction motor is connected to the chamber. This suction motor is controlled by relay board and Arduino Uno.

V. RESULTS AND DISCUSSIONS

This system includes mainly two parts, first part is to generate electric charge from water flowing in the pipes and another part is to maintain the freshness of cut vegetables and fruits.



Fig.7a: Experimental set up: Fresh potato cuts



Fig.7b: Chamber retaining freshness compared to the one kept outside



Fig.7c: Clear Comparison

In first part, the generation of electric power from the water flowing in the pipes, which is fascinating and challenging too. Hence it is implemented by taking into concern with the issue of depletion of electric power in the near future. This project proves to be one of the most innovative techniques of electrical energy generation. Here we used a turbine or micro hydro generator which means the potential energy conversion of water into electrical energy that is connected to a charger circuit which charges the battery.

In second part a glass chamber is used and a suction pump operated at 12V DC is connected to the chamber. The operation of suction pump is controlled by relay and that is connected to Arduino Uno of pin number 12. A small vent is provided to remove the gases liberated by the vegetables out of the chamber. The suction pump is turned on for every 5 minutes for duration of 30 seconds. The cut vegetables kept inside the chamber remained fresh for a period of 3 days, while the vegetables kept outside the chamber were rotten.

It has a wide range of uses for working class people from the household chores to the industrial purpose; this project holds great impact on the society. Because of low-cost characteristics this also promises a considerable saving of electricity board and cut vegetables and fruits. From this implementation we can live better healthy in next generation.

VI. CONCLUSION

The system with appropriate turbines can be easily implemented as the turbines can be easily fitted into the municipality pipelines, wastewater pipelines, irrigation pipelines, kitchen pipeline and in many more applications. Presently the cut vegetables are either wasted or preserved in an orthodox way which is non-viable the proposed product is targeted to be used by working class people due to its cost effectiveness. The product is currently not available in India. It is quite useful to every Indian kitchen. The total cost of implementation of this project is also very less and can be afforded by a common man. The cut vegetables can be preserved for a minimum duration of 3 days through this system. Thus, the idea when implemented solves the major problem of shortage of electric power and work for working class people.

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