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Solar Powered Automatic Fruit Drying Syatem

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Abstract: *Solar Powered Automatic Fruit Drying System is a small-scale fruit drying machine which is useful to dry different types of fruit. To make their usage efficient, they can be dried and preserved so that fruits can be used over a long period. Infrared radiation can be used for grape drying purpose. It is unique process and distinctly different from conventional or natural drying. The natural drying process has many drawbacks, such as requiring more time, large investment on space requirement and infrastructure for drying process, which cannot be afforded by a middleclass farmer. The financial up gradation of a farmer in developed countries is possible by providing him the modern, automatic and low-cost fruit drying unit. This paper describes a controlled environment which is suitable for small scale fruit drying process within a closed chamber, using Microcontroller.*

Keywords: Drying System, Microcontroller, Automation, Temp & Humidity Sensor, Solar Power

I. Introduction

Fruit drying is a method of food preservation in which food is dried (dehydrated or desiccated). Drying inhibits the growth of bacteria, yeasts, and mold through the removal of water. Dehydration has been used widely for this purpose since ancient times; the earliest known practice is 12,000 B.C. by inhabitants of the modern Middle East and Asia regions [1]. Water is traditionally removed through evaporation (air drying, sun drying, smoking or wind drying), although today electric food dehydrators or freeze-drying can be used to speed the drying process and ensure more consistent results. In India different types of fruits and vegetables are available in various regions of the country. All these agricultural products grow in different seasons and in a particular area only. These agricultural products are used by people all over India and abroad. It also requires the transportation of fruits from the food production areas to the fruit consumer areas. This needs a proper preservation of fruit during transportation, as the transportation period may be greater than the natural life of the fruit. To avoid fruit damage and long usage, fresh fruits are converted to dry fruits. Healthy and nutritious fruits can be given to people to enjoy dry fruits as snack. Dehydration is also used to lower the cost of packing, storing and as it reduces weight and volume of the final product. Dried food can be made from lower quality fruits and vegetables that might otherwise be wasted. A microcontroller-based system that enables to simultaneous monitoring was utilized. There is a LM35 sensor as the inputs of system which is temperature. The output of LM35 is continuously monitored with the main processor and given functions based on fruit types are executed. The selected fruits were put in a dryer. This will ensure drying even in the poor weather conditions because of an enclosed chamber. The accurate control over the drying process due to a closed loop, control system reduces the drying time. Higher temperatures and the penetration of infrared rays used in the compact drying chamber facilitate the confinement of heat energy. This paper describes a design idea to produce small scale low cost with good quality dry fruit product to the consumer which is perseveres with its original taste without leading to caramelization (Sugar Burning) and reduction in the nutritional value. The quality and color of the dried product depend upon the techniques used for drying process. Another parameter used in analyzing the drying process is drying rate which is referred to as time taken to dry the fruit. The drying rate affects the color and quality of the dried product.

The dependence on non-renewable energy sources for the development of different systems has many inverse effects on humankind. As they are one way of pollution and it may charge the cost. In this context, the search for renewable energy sources and their maximum application have much more importance. Solar energy is one that can be easily harvested and stored in other applications. It is very easy to convert solar energy to electrical energy using solar cells. They have a wide field of applications. Major drying process both in the domestic and industrial sector are using solar energy. It has many advantages over other systems. Solar energy is the best natural sanitizer and UV light can damage the DNA of the bacteria and microorganisms; it can even disinfect the products. The products become cleaner and fresher. For all these uses, there is no special cost on electricity and it is a very cost-effective way. The studies show that in tropical countries, where farming is major occupation uses conventional methods of drying rather than machine drying. But one of the major disadvantages is that, it requires more human effort. As the climate is unpredictable, it is very difficult to dry under the sun and it is time consuming. In this area, we can apply an automatic drying control system over the conventional method of drying under the sun. It will sense the rain and also humidity. According to the program written in the microcontroller, we can automatically control the action of our drying system which was placed under the sun. As the input power is the solar energy, we can place this system anywhere where there is sunlight with the help of pulley system. The drying during the night is the major concern for every industry. Since it saves the total drying time for the material. We used a small dryer within the total system for doing this purpose. This includes a blower and heating coil. The combination of these instruments reduces the humidity in the compartment. This process will make the substance to dry faster in the night, thus saving the time of drying and cost. Power for the drying during the night is supplied by a battery which will be charged by solar energy. Through our project, we designed a circuit which makes the drying of the clothes to be efficient and it can be completed without much more human effort. Drying under the sun has more advantages, but it lags the drying as the changes are unpredictable. The technique used here is to make the automatic drying, which senses the rain and temperature. And the drying can continue during the cloudy atmosphere and also during the night with the help of this blower and pulley system. We designed it mainly for the domestic purposes and it is also designed in such a way as to reduce the environmental impacts as the solar power is the main power source.

II. Literature Survey

This involves the machinery to humidify and dry the paddy grains within the limited period of time. They used solar power Kerala Technological Congress (KETCON 2018 - Control and Instrumentation) Page 69 as the energy source to two alternating batteries, the main source of energy in the system. It is programmed by the microcontroller to set the desired level of humidity and temperature according to the quantity of rice [1]. This method of drying is used to dry fruits with the help of microcontroller-based system and also with the help of IR rays. Energy for this project is obtained from solar energy. Infrared rays are passed to hydrate the water content and blower is used for further drying [2]. The use of both solar and electrical energy so called hybrid solar energy. The air flow occurs inside the dryer by the motor fan arrangement and heating of substance is done by falling of the sunlight. Here the temperature is controlled by sensing the temperature and thus control the temperature of heating substance. Thus, it is a good example for future drying system [3]. The authors intended to implement a closed circuit which can monitor the utilization of electrical energy and its automatic control on it. The radio frequency signals emitted detects the electricity status in each room and power off the circuit when user leaves the room. A microcontroller is programmed to ensure safety measures [4]. This is the alternate method of drying the agricultural products under the sun with solar dryer which consist of a heating element. It is a cost-effective way and can be used in large scale by local people. The energy trapped by the absorbers is the main element of the system [5].

Sharma et al. [6] experimentally compared the performance of three types of dryers namely; cabinet type of natural convection solar dryer, multitasked natural convection solar dryer and indirect type of multitasked forced convection solar dryer. The comparison was based on removal of the moisture content and the weight loss of chillies before and after drying process. It is concluded that indirect forced convection solar dryer was faster when compared to both natural convection cabinet and the multitasked solar dryer. Cigdem et al.[7] also experimentally studied the performance of forced convection solar dryer which was used to dry banana. The dryer was equipped with electric

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power fan, and auxiliary heater inside the drying chamber. Based on evaluation, this type of dryers shortened the drying time and improved the quality of the dried products. Schimer et al [8] studied the performance of drying system consisting from solar collector covered with plastic sheet and connected to drying tunnel to dry banana. Three fans were used to supply hot air directly to drying tunnel. The banana to be dried were spread in one layer on plastic net in drying tunnel to receive energy from both hot air supplied by collector and the incident solar radiation. The results showed that drying bananas using this dryer took shorter time which is 5 days compared to natural sun drying which needed 5-7 days. Hawlader et al. [9] compared the drying process using natural convection solar dryer and forced convection solar dryer. Mass and moisture content of the apple, guava and papaya with different thickness were analysed during the experiment. It is concluded that the drying rate of forced convection dryer is higher than that for natural convection dryer. Incident solar radiation affects the performance of the solar dryers. Hassanain [10] examined the effect of incident solar radiation on the temperature of solar collector and drying chamber as well as the drying time.

III. PROPOSED SYSTEM

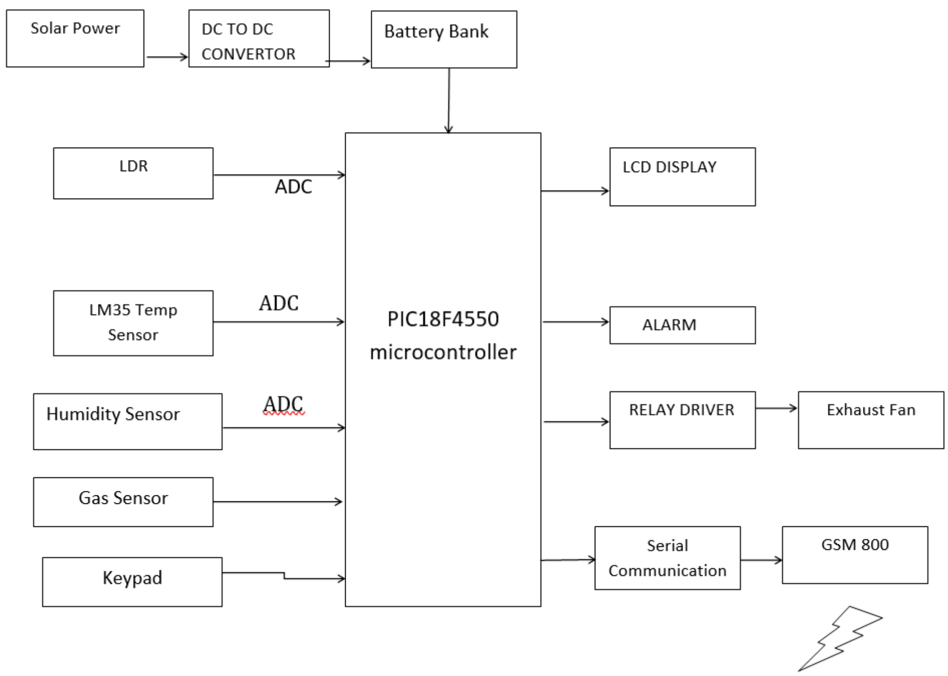

Figure 1: Block Diagram

The fig. shows that the block diagram of Solar Powered Automatic Fruit Drying System. It consists of solar panel, battery, LDR, temperature & Humidity sensor, Gas sensor, Pic controller, LCD display, Exhaust fan, input switches, GSM module etc. Microcontroller pic works as CPU. It controls all operation in system. Solar panel is used to charge the battery. Battery is used to supply power to the system. In this system a LM 35 sensor is used. Sensor is used to read the temperature in the unit. Sensor is connected to microcontroller through ADC. A controlled environment which is suitable for small scale fruit drying process within a closed chamber, using Microcontroller pic18f4520This automation process when completed is informed to the farmer. Solar energy is utilized for dehydrating the fruits and vegetables. Over drying and under drying are harmful, for agricultural products. Over drying causes discoloration due to caramelization and reduction in nutritional value. On the other hand, under drying or slow drying results in deterioration of the food quality due to fungal and bacterial action. The solar panel is used to power the microcontroller. The microcontroller is used and programmed to control and manage the overall process of the unit. Different fruits will have different temperatures to dry. The switch buttons are used to set required temperature. LM 35 Sensors is used to read the temperature in the cabinet connected to 89s52 Microcontroller through ADC. A display is use to see the process continuously for the temperature value and time to dry the particular fruit. If the monitoring temperature is greater than the set temperature value, turn on the fan else turn off.

3.1 PIC 18f4520 Microcontroller

It is an 8-bit enhanced flash PIC microcontroller that comes with nanoWatt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.

- Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF
- Divided into 256-byte banks

There are total of F banks

- Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bit
- Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
- Program memory stores the program and also static data in the system.
- On-chip External
- On-chip program memory is either PROM or EEPROM.
- The PROM version is called OTP (one-time programmable) (PIC18C) The EEPROM version is called Flash memory (PIC18F).
- Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000

Figure 3: PIC18F4520

3.2 Humidity Sensor

A humidity sensor is an electronic device that measures the humidity in its environment and converts its findings into a corresponding electrical signal. Humidity sensors vary widely in size and functionality; some humidity sensors can be found in handheld devices (such as smartphones), while others are integrated into larger embedded systems (such as air quality monitoring systems). Humidity sensors are commonly used in the meteorology, medical, automobile, HVAC andmanufacturing industries. DHT22 capacitive humidity sensing digital temperature and humidity module is one that contains the compound has been calibrated digital signal output of the temperature and humidity sensors. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability.

The sensor includes a capacitive sensor wet components and a high-precision temperature measurement devices, and connected with a high-performance 8-bit microcontroller. The product has excellent quality, fast response, strong anti-jamming capability, and high cost. Standard single-bus interface, system integration quick and easy. Small size,

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low power consumption, signal transmission distance up to 20 meters, making it the best choice of all kinds of applications and even the most demanding applications.

Figure 4: Humidity Sensor

3.3 LM35 Temp Sensor

LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor does not require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

Features of LM35 Temperature Sensor

- Calibrated directly in Degree Celsius (Centigrade)
- Linear at 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee-able (at a25°C)
- Rated for full -55°C to a 150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 mA current drain
- Low self-heating, 0.08°C instill air
- Non-linearity only 0.25°C typical
- Low impedance output, 0.1Ωfor 1 mA load

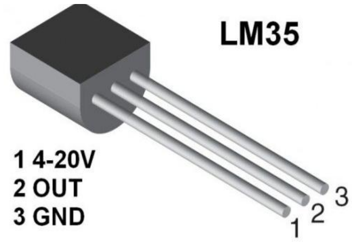

Figure 5: LM35 Temp Sensor

3.4 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like

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initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

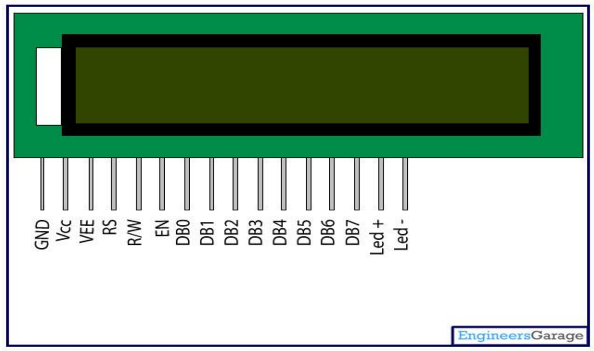

Figure 6: LCD Display

3.5 LDR

What is an LDR (Light Dependent Resistor) An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.Light Dependent Resistors (LDR) are also called photoresistors. They are made of high resistance semiconductor material. When light hits the device, the photons give electrons energy. This makes them jump into the conductive band and thereby conduct electricity.

Light dependent resistors, LDRs or photoresistors are often used in circuits where it is necessary to detect the presence or the level of light. They can be described by a variety of names from light dependent resistor, LDR, photoresistor, or even photo cell, photocell or photoconductor.

Figure 7: LDR

3.6 GAS Sensor

Winsen Electronics, manufacture original and new methane gas sensor, nature gas sensor, LNG gas detection sensor with long lifespan and low price. Sensitive material of MQ-4 gas sensor is SnO2, which with lower conductivity in clean air. When the target flammable gas exists, the sensor's conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit.MQ-4 gas sensor has high sensitivity to methane, also has anti-interference to alcohol and other gases.

Figure 8: GAS Sensor

IV. Conclusion

It was observed that automatic drying unit gives better performance in terms of drying rate compared to conventional method. Using automatic drying unit, it requires 3 to 4 days to dry grapes whereas conventional method requires 7 days for the same. Quality of dry fruit is better as compared to conventional method. As solar panel is used for it does not cause pollution. Also, the maintenance cost is less. This unit can be used in remote area as solar energy is available everywhere. Dust does not come in contact with the fruits thereby ensuring good quality of the dried product. The system requires lower space and minimal installation time, less time to dry the product (as compared to natural drying), is durable with minimal maintenance. Unit can be made available in varied capacities, depending on the effective tray area and user requirement. The system can be made more economical by making a provision for drying variety of fruits in a single unit. This arrangement can be made possible by using sensor networks for various fruits. To make it economically viable for farmers, an application specific integrated circuit by embedding the digital circuit into a chip, can be produced in a large scale.

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