

SOLAR BASED SEMI-AUTOMATIC AGRO WATER SPRAYER AND WEED DETECTOR

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Abstract: *Keeping in mind the prevalent energy crisis, new technologies are developed more to make use of renewable sources as the energy source. Solar energy is one such non-conventional energy source which is both inexhaustible and environment friendly i.e. does not emit greenhouse gases. Using this alternative energy source in agricultural purpose also. A farmer serves this entire world with the food, without any interference on the field. Therefore, proposed system is Solar based Semi-automatic agro Water Sprayer and Weed Detector which will reduce their field work. This complete mechanism will be such that it will be under the control of the user (remote controlled).*

Keywords: *Renewable sources, Solar-energy, semi-automatic, water sprinkler, weed detector, remote controller.*

I. INTRODUCTION

There is a huge demand for the limited energy resource which is decreasing day-by-day. Thus in such energy crisis, the only solution is to make use of non-conventional energy resources. Renewable resource is of many types namely wind energy, hydro power, bio-fuel and solar geothermal so on. One of resource is solar energy which is an inexhaustible energy resource i.e. its availability is plenty. Using the solar energy the proposed system has agro-based applications. Solar system consists of solar panel along with the solar cell, which converts solar energy into electrical energy. Some advancement has been done by using the proposed system for agricultural applications. Usually find large heavy machineries used for agricultural purposes. An idea evolved of transforming laborious farmer into smart farmer. Thus, proposed system is a Solar based semi-automatic agro water sprayer and weed detector. This system is such that it will be sprinkling water to the crops as well as detects the unwanted plants and simultaneously eliminating those using herbicides. This mechanism will be implemented using real time system and such that it will be reliable and easy to use. The most important part is that it will be completely under the control of user that is it will be remote controlled prototype.

II. LITERATURE SURVEY

New technologies are being proposed for introducing certain advancement in agricultural vehicles. The only purpose is for ease of work and for efficient yield through it.

1) PulkitHanswal, Ojaswi Dale, Deepika Gupta, R.N.Yadav: Designing a central control unit and soil moisture sensor based irrigation water pump system, TIIEC.2013.61.- this project is based on microcontroller acting as central control unit and the communication takes place using GSM module. Here, each field will consists of water pump controlled by micro-controller, with the help of soil moisture sensor.

2) Designing of a mobile irrigation system S.kumar, N.chand, N. Senh. Komaitai INSPEC Accession Number: 16005059.- This project is a movable type. They have used IR Remote control in order to control the vehicle, the nozzle positioning & the pump control.

3) Development and Evaluation of Solar powered sprayer with multi-purpose applications:

Yallappa this prototype has bag like structure and of such a type that it is manually handled. As the complete system is solar powered, it is eco-friendly model. But the limitation we found out that the system is quite heavy for the user to carry.

One more survey related to weed detector is

4) Design and Development of Automatic Weed Detection and Smart Herbicide Sprayer Robot by Aravind R, Daman M, Kariyappa B S :For completely eliminating weeds they have used the method of digital image processing . By differentiating between the grayscales of weeds and the main plants, weeds can be easily detected. Then using herbicides the weeds are removed.



Fig. 1 Developed model of solar based pesticide sprayer

III. HARDWARE SPECIFICATION

SOLAR PANEL

Solar panel is made by cells called photovoltaic cell which convert sunlight into electricity. When sunlight hits a PV cell electron are knocked and loose from pv cells of semiconductor material atoms. Positive and negative electrical conductor of each pv cells form a circuit that capture energy in the form of an electrical current.

BATTERY

Battery is used here to give power supply to the system. Batteries are kept charged by solar panel. lead acid battery we can use for power storage.

BUCK CONVERTER

A buck converter is DC to DC power step down converter which step up the current while stepping down the voltage from its supply to its output load. It is one of the classifications of switch mode power supply. Buck converter gives greater power efficiency than linear regulator.

BOOST CONVERTER

A boost converter is a DC to DC power step up converter that step down current while stepping up voltage from it supply to its load. It is one of the classifications of SMPS. Boost converter output voltage is greater than supply voltage. Its step ups the source voltage.

DRIVER CIRCUIT

L293D is a DC motor driver which drives the motor on both directions. It has 16 pin IC which can control two DC motors simultaneously in any direction. L293D has a 4 pins, pin 2& 7 on the left and pin 10,15 on the right direction rotated.

STEPPER MOTOR



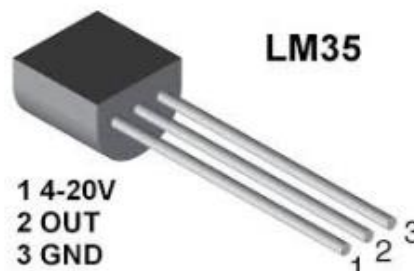
Fig. 2 Stepper motor

A stepper motor is a brushless DC electric motor which divides a single rotation into a number of equal steps. It automatically move and hold without any position sensor for feedback.

ZIGBEE

Zigbee is an IEEE 802.15.4- high-level communication protocols. It is low power consumption device. Transmission distance limit is about 10-100 meters line of sight.

TEMPERATURE SENSOR



LM35 is a temperature sensor with its output in $^{\circ}\text{C}$. Operating range from -55°C to 150°C . It can measure more accurately than thermistor. It is three pin IC.

SOIL HUMIDITY SENSOR

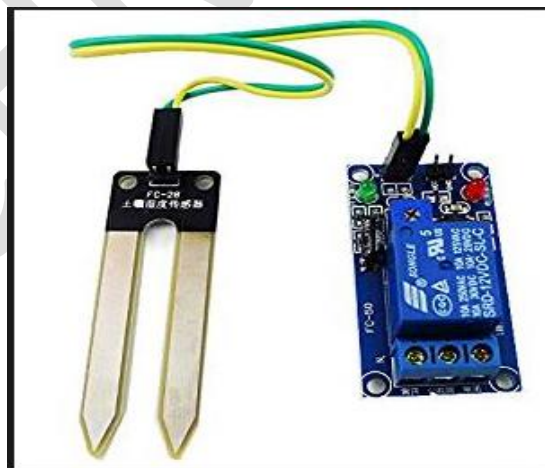
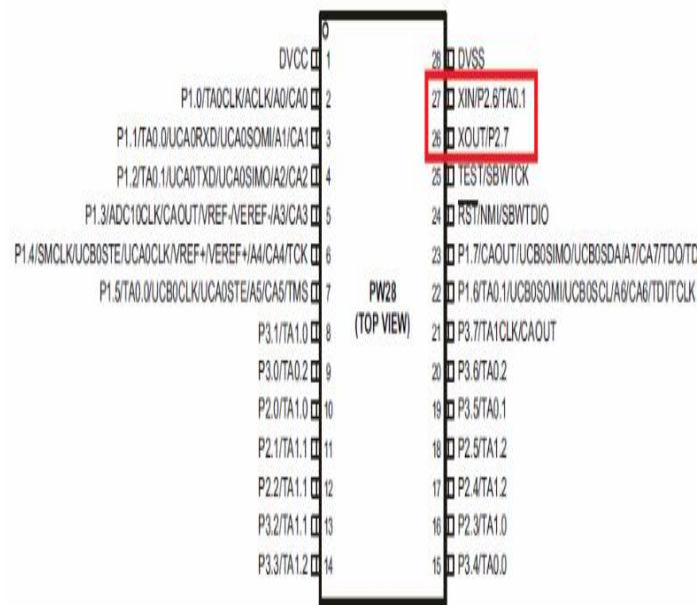


Fig. 3 Soil humidity sensor

Humidity detection sensor applied to soil. The blue potentiometer modules are for soil moisture threshold adjustment, adjust clockwise, humidity will be under the control of the greater and turning it counterclockwise smaller. Because of this module with the time delay function, adjust the humidity value, about every mobility need to wait 5-8 seconds, relay changes in corresponding changes in the Green LED lights, until transferred to meet the requirements.

NEAR INFRARED

Near-infrared is widely applied in agriculture for determining the quality of grains, and grain products, oilseeds, coffee, tea, spices, fruits, vegetables, sugarcane, beverages, fats, and oils, dairy products, eggs, meat, and other agricultural products. It is widely used to quantify the composition of agricultural products because it meets the criteria of being accurate, reliable, rapid, non-destructive, and inexpensive.



MICROCONTROLLER

Fig .4 Microcontroller (MSP430)

- The MSP430 is a mixed-signal microcontroller family from Texas Instruments.
- Built around a 16-bit CPU.
- MSP430 is designed for low cost.
- Low power consumption embedded applications.
- The MSP Low-Power MCUs are ultra-low power, mixed signal microcontrollers from Texas Instruments.
- The strengths of the MSP family lie in the easy-to-learn.
- C-compiler friendly.
- CPU partnered with flexible low power modes and intelligent.
- Low-power peripherals.
- Its versatility is applied across a number of different end-equipment's including medical equipment, electricity and sub-metering, and home appliances such as smoke detectors, thermostats, etc... With over 500 parts available, there is likely to be an MSP430 for almost any application.

NOZZLE

A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube

of varying cross sectional area and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

IV. SOFTWARE

The Texas Instruments MSP430 family of ultralow power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low power modes is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 6 μ s. The MSP430F15x/16x/161x series are microcontroller configurations with two built-in 16-bit timers, a fast 12-bit A/D converter, dual 12-bit D/A converter, one or two universal serial synchronous/asynchronous communication interfaces (USART), I2C, DMA, and 48 I/O pins. In addition, the MSP430F161x series offers extended RAM addressing for memory-intensive applications and large C-stack requirements. Typical applications include sensor systems, industrial control applications, hand-held meters, etc.

V. BLOCK DIAGRAM

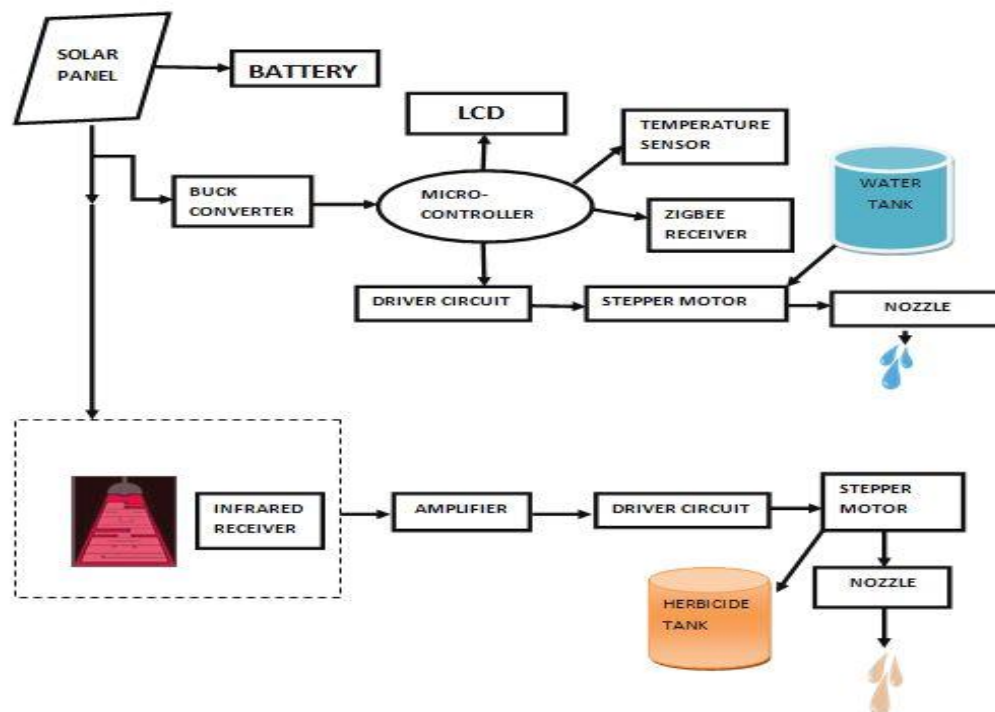


Fig. 5 Block Diagram (Water sprayer and Weed detector)

VI. WORKING

WATER SPRAYER ON CROPS

Using solar panel for giving power to entire water sprayer system. Firstly, solar cells convert sunlight into electrical energy. That energy is stored into the Lead –Acid battery. Battery is going to use for backup. Using microcontroller MSP430 to control the system. MSP430 it is heart of the system. MSP430 is low power consumption up to 1.8v to 3.6v. Using 10v 5 watt solar panel as power supply but the operating ranges of MSP430 is very less so to prevent it from damage, by connecting a buck converter to step down the voltage up to 3V. Microcontroller is interfaced with LCD, Temperature sensor, Driver circuit (all operates at the same voltage i.e 5v) and a ZigBee module (operating range: 2.8v to 3.4v). Driver circuit is used to drive stepper motor. Stepper motor connected to the nozzle. And using nozzle water will be sprayed on crops. Both the soil humidity sensor and a ZigBee transmitter module will be placed on the field which will help to indicate the result of humidity level of the ground. When the humidity level increases below a certain point, ZigBee transmitter will transmit to the receiver which is interfaced with the microcontroller in order to control the action of driver circuit and then water will be sprayed.

WEED DETECTION AND HERBICIDE SPRAYER

Here we use NIR (Near Infrared) technology to detect weeds on field and spray herbicide on it. Basically, bright red LED light will be made to fall on the unwanted plants on the field. Now the chlorophyll present in the plant will absorb some of the red light and will convert it and emits it as near infra-red light (NIR). The IR sensor will detect the presence of NIR and turns the nozzle ON. This method helps to spray herbicide on a particular area instead of spraying the whole field. These two systems will be placed on the bot and will be controlled by remote, which will be handled by the user.

VII. ADVANTAGES

- 1) It does not create any type of pollution such as noise, air and so on.
- 2) It does not require fuel to energize.
- 3) Solar power is economical. It involves high initial expenses like installation of both the solar panels and the complete system, but this cost is soon offset by savings on energy bills.
- 4) Easy to operate and portable.
- 5) Eco-friendly
- 6) This complete system can be manually operated but can be used as automatic machine.
- 7) Both the units (water-sprinkler and weed detector) work independently.

VIII. LIMITATIONS:

- 1) Initially the cost required to purchase is a bit high.
- 2) The efficiency of the system decreases during cloudy and rainy seasons.

IX. CONCLUSION

This proposed model demonstrates a solar based application, such that it makes use of concept of robotics and mechatronics. Being a semi-automatic type of model, we have used a ZigBee technology for wireless communication. This system ensures elimination of human labour completely. It is much efficient than a petrol based water sprayer. Using the proposed weed detector we can easily eliminate the overgrown weeds around the main plant.

X. FUTURE SCOPE

The propose system can be modified for future application. In advancement of weed detection process we can make use of the concept of digital image processor. Instead of spraying herbicide on the weeds we can use robotic arm to pluck from the roots. At the same time, we can also use 3d data acquisition for weed removal. As our proposed system is a semi-automatic type, we can completely transform it into an automatic system.

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