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SOLAR AGRICULTURAL WATER PUMPING SYSTEM WITH AUTO TRACKING AND SENSORS

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Abstract*-Most of the people in Bangladesh depends on cultivations. They had to depend on rain forIrrigation before the modern era. For that reason they could not get good harvest. Now adays they use electric pumps to irrigate and where does not have grid electricity, they usefuel-powered pumps. But electricity problem is a major problem in Bangladesh and alsothe prices of fuels as well as electricity are increasing. Another problem is sometimes it ishard to get fuels in rural or hilly areas. Most of theBangladeshi farmers are poor. Toovercome these problems the project is made. It would be implemented in everywhere(in rural & where has grid electricity). Then the farmer does not need to depend on gridelectricity or on fuels. In this project the energy is collected from the Sun and will convertit to electrical energy which will run the water pumps. To make it automated anauto tracking and sensing system is used. In this project solar module, Battery,Microcontroller PIC16F72, DC/DC converter, DC/AC inverter, Sensing elements etc. are used.*

Keywords: Irrigation, Solar panel, Automatic system, DC/AC converter and References.

1. INTRODUCTION

Now-a-days most farmers in the world use electric pumps or fuel-powered pumps to irrigate. It is known to all the electricity problem is a major problem in Bangladesh and also the prices of fuels are increasing. On the other hand organic fuels amount is decreasing day by day. So the world is searching new energy that could be used in replace of conventional electrical energy and fuels. Most of the Bangladeshi farmers are poor. Now Bangladeshi farmers rely on some 266,000 electrically powered water pumps - which consume around 1,300 MW to irrigate 1.7 million hectares (4.2 million acres) of land. An additional 1.3 million diesel run pumps are operated during the peak growing season to irrigate 3.4 million hectares (8.4 million acres) of land, using 900,000 tons of fuel, according to Bangladesh's power and energy ministry.
Solar power is renewable energy which is used in this project. It will minimize the cost of farmers. The farmer does not need to depend on grid electricity or on fuels. He does not need to buy fuels every day. This project is automated. So, the farmer does not need to waste time to operate it.

1.1 Objectives

Objectives of the project are mentioned following:
i. To design an automatic system for Irrigation.
ii.To bring an easier way for our Irrigation system.
iii.To minimize the cost
iv.To save the fuels
v. Easy to operate
vi.To reduce the pressure from grid electricity

1.2 Outline methodology

The methodology of this project is given in below:

(i) Searching varioussolar based projects in the internet.
(ii) Select a project.
(iii) To make a plan to implement the project.
(iv) Searching required equipment in the market.
(v) Analysis the total project.
(vi) Implementation and testing the whole project.
(vii) Analysis the total project and search for available improvement.
(viii) Cost analysis.
(ix) Prepare the final project report.

2. IRRIGATION

Irrigation may be defined as the science of artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growing in grain fields and helping in preventing soil consolidation,[1]. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dry land farming. Irrigation systems are also used for dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, whichis the natural or artificial removal of surface and subsurface water from a given area. Irrigation is also a term used in medical/dental fields to refer to flushing and washing out anything with water or another liquid.

Irrigation is
• Uses for both in Soil & Water.
• Science of artificial application of Water.
• Used to growing of Agricultural Crops.
• Must need for Agriculture System.
• Starting from the beginning of World.
• Must need for human & living.

2.1A Short History of Irrigation

Archaeological investigation has identified evidence of irrigation where the natural rainfall was insufficient to support crops. Perennial irrigation was practiced in the Mesopotamian plain whereby crops were regularly watered throughout the growing season by coaxing water through a matrix of small channels formed in the field. Ancient EgyptiansPracticed Basin irrigation using the flooding of the Nile to inundate land plots which had been surrounded by dykes. The flood water was held until the fertile sediment had settled before the surplus was returned to the watercourse. There is evidence of the ancient Egyptian pharaoh Amendments IIIin the twelfth dynasty (about 1800 BCE) using the natural lake of the Faiyum Oasisas a reservoir to store surpluses of water for use during the dry seasons, the lake swelled annually from flooding of the Nile,[1].

The Ancient Nubians developed a form of irrigation by using a waterwheel-like device called a sakia. Irrigation began in Nubia sometime between the third and secondmillennium BC,[1]. It largely depended upon the flood waters that would flow through the Nile River and other rivers in what is now the Sudan. In "sub-Saharan Africa" irrigation reached the Niger Riverregion cultures and civilizations by the first or second millennium BC and was based on wet season flooding and water harvesting.

Terrace irrigation isevidenced in pre-Columbian America, early Syria India and China. In the Zana Valley of the Andes Mountains in Peru, archaeologists found remains of three irrigation canals radiocarbon dated from the 4th millennium BCE, the 3rd millennium BC. These canals are the earliest record of irrigation in the New World. Traces of a canal possibly dating from the 5th millennium BC were found under the 4th millennium canal. Sophisticated irrigation and storage systemswere developed by the Indus Valley Civilization in present-day Pakistan and North India in 3000 BC & an early canal irrigation system from 2600 BC,[1]. Large scale agriculturewas practiced and an extensive network of canals was used for the purpose of irrigation.

2.2Types of Irrigation[3] in South Asia

i) Surface/Flood Irrigation

In surface irrigation systems, water moves over and across the land by simple gravity flow in order to wet it and to infiltrate into the soil. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding or near flooding of the cultivated land. Historically, this has been themost commonmethod of irrigating agricultural land,[2]. This is often seen inTerraced rice fields (rice paddies), where the method is used to flood or control the level of water in each distinct field. In some cases, the water is pumped, or lifted by human or animal power to the level of the land.

ii)Localized

Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods.

iii) Drip

Drip irrigation, also known as trickle irrigation, functions as its name suggests. In this system waterfalls drop by drop just at the position of roots. Water is delivered at or near the root zone of plants, dropby drop, [2]. This method can bethe most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized.

iv) Center pivot

Center pivot irrigation is a form of sprinkler irrigation consisting of several segments of pipe (usually galvanized steel or aluminum) joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along its length,[1]. The system moves in a circular pattern and is fed with water from the pivot point at the center of the arc. These systems are found and used in all parts of the world and allow irrigation of all types of terrain.

v) Manual using buckets or watering cans

These systems have low requirements for infrastructure and technical equipment but need high labor inputs. Irrigation using watering cans is to be found for example in peri-urban agriculture around large cities in some African countries,[1]. This type of irrigation is also practiced in poor or developing countries. It is also practiced in small gardens.

2.3Problems of Irrigation in South Asia

Irrigation can lead to a number of problems, [4].
• Competition for surface water rights.
• Depletion of underground aquifers.
• Under irrigation or irrigation giving only just enough water for the plant (in drip line irrigation) gives poor soil salinity control which leads to increased soilsalinity with consequent buildup of toxic salts on soil surface in areas with high evaporation. This requireseither leaching to remove these salts and a method ofdrainage to carry the salts away. When using drip lines, the leaching is best done regularly at certain intervals (with only a slight excess of water), so that the salt is flushed back under the plant roots.
• Over irrigation because of poor distribution uniformity or management wasteswater, chemicals, and may lead to water pollution.
• Deep drainage (from over-irrigation) may result in rising water tables which in some instances will lead to problems of irrigation salinity requiring water table control by some form of subsurface land drainage.

• Irrigation with saline or high-sodium water may damage soil structure owing to the formation of alkaline soil.

3.SOLAR PANEL

Solar panel is the collection of some solar module which are connected in series or parallel to increase voltage or current according to demand. This panel works on photoluminescence principle. Number of module can be selected by following steps.

Step 1 Find monthly average electricity usage from electric bill or amount of diesel usage.

Step 2 Divide the monthly average use by 30 days.

Step 3 Find the locations average peak sun hours per day.

Step 4 Calculate the system size (AC watts) to provide demand Kw.

Step 5 Divide the system AC watts by the CEC watt rating of the modules to be used, then divide by the inverter efficiency, usually 0.94 and get the total number of modules required.(Round this number up.)

3.1 Features of solar panels

i) Solar energy is that it does not emit any greenhouse gases. Solar energy is produced by conducting the sun's radiation – a process void of any smoke, gas, or other chemical by-product.

ii) Solar energy is that beyond initial installation and maintenance, solar energy is one hundred percent free. Solar doesn't require expensive and ongoing raw materials like oil or coal, and requires significantly lower operational labor than conventional power production.

iii) Solar energy offers decentralization in most (sunny) locations, meaning self-reliant societies. Oil, coal, and gas used to produce conventional electricity are often transported cross-country or internationally. This transportation has a myriad of additional costs, including monetarycosts and pollution costs of transport, all of which is avoided with solar.

iv)Solar energy can be produced on or off the grid. On grid means a houseremains connected to the state electricity grid. Off grid has no connection to the electricity grid, so the house, business or whatever being powered is relying solely on the solar or solar-hybrid. The ability to produce electricity off thegrid is a major advantage of solar energy for people who live in isolated and rural areas.

v) One of the biggest advantages of solar energy is the ability to avoid the politics and price volatility that is increasingly characterizing fossil fuel markets. The sun is an unlimited commodity that can be adequatelysourced from many locations, meaning solar avoids the price manipulations and politics that have more than doubled the price of many fossil fuels in the past decade.

vi) Solar doesn't rely on constantly mining raw materials, it doesn't result inthe destruction of forests and eco-systems that occurs with most fossil fuel operations. Destruction can come inmany forms, from destruction through accepted extraction methods, tomore irresponsiblepractices in vulnerable areas, to accidents.

3.2 Applications of solar irrigation pump

Solar irrigation pump systems can be used principally for three applications, [5]:

i) Town and City Water Supply

ii) Livestock Watering

iii) Irrigation

4. SYSTEM DESIGN AND IMPLEMENTATION

4.1 Block diagram and circuit diagram of entire project

The block diagram of the whole system is shown in figure 1 and the circuit diagram is shown in figure 2 in below.

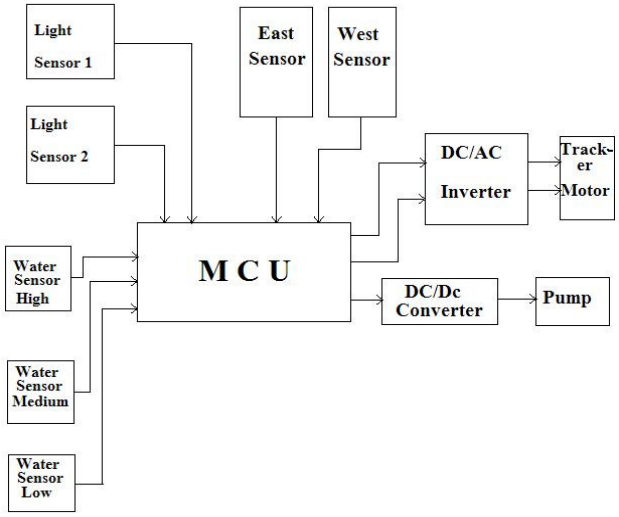

Fig. 1: Block diagram of entire system

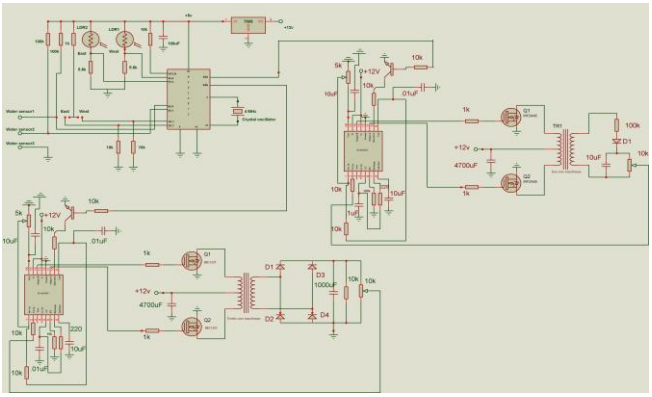

Fig. 2: Circuit diagram of whole system

4.2 Working principle

The solar panel will create voltage with the sun light intensity. To get maximum light intensity automatically auto tracking system is used. Battery will help to store charges during the working period of the solar panel. The dc-ac inverter circuit will run the tracker motor and dc-dc converter circuit will run the pump. Sensors are used to control water levels. If the sensor detects more water on the tanks it will disconnect the motor from the electric supply and if it detects low water level on the tanks then it will connect the motor to the electric supply. It is the basic principle of this project.

4.3 List of Components & Cost Analysis

Table 1 represents the component details, and total cost of the components required for the project.

Table 1:List of Components & Cost

SL.	Component name	Quantity	Price (BDT)	Total (BDT)
1	Resistor	30	1	30
2	Capacitor (non-electrolyte)	5	3	15
3	Capacitor 1000µF	1	5	5
4	Capacitor 100µF	1	3	3
5	Capacitor 10µF	5	2	10
6	MOSFET (IRFZ44 [7] and IRF3205 [8])	4	50	200
7	Heat sink	4	5	20
8	Transformer 9/220v	1	200	200
9	HF transformer	1	500	500
10	SG3525 [6]	2	50	100
11	Transistor	1	5	50
12	Diode	5	2	10
13	Volt regulator 7805	1	20	20
14	LED	4	3	12
15	LDR	2	20	40
16	Crystal oscillator 4MHz [10]	1	40	40
17	PIC16F72 [11]	1	120	120
18	28 pin IC base	1	15	15
19	Vero board	3	25	75
20	Solar panel [9]	1	150	150
21	AC motor unit	1	500	500
22	Pump	1	3000	3000
23	Relay	1	30	30
24	Variable resistor	4	5	20
25	Others	-	3000	3000
	Total			**8120**

5. RESULT AND SNAPSHOT

5.1 Result

The Solar Irrigation System maintains 100% accuracy using these seven sensors which are used here as switch. Solar agricultural water pumping system is able to works under any normal conditions of Bangladesh.

For a test the system is held in 15'C in an AC room also in 45'C of hot temperature. Also a test is taken in low & high humidity conditions. The system gave proper output in both situations. Only the system gives some errors in the time of storm and cloudy conditions. Overall, the Solar agricultural water pumping system with auto tracking and sensors project was successful, but it was quite a fun to go through all the process. It wasrealized that there were many things to consider practically such as pump & ac power supply. This experience hopefully would be helpful in the future work.

5.2 Snapshot

In this topic some snaps of the project is aded which are shown in figure 3, 4, 5 respectively

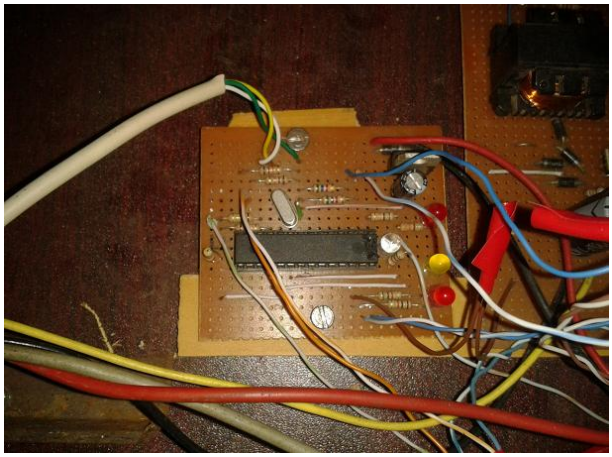

Fig.3: Controller circuit section

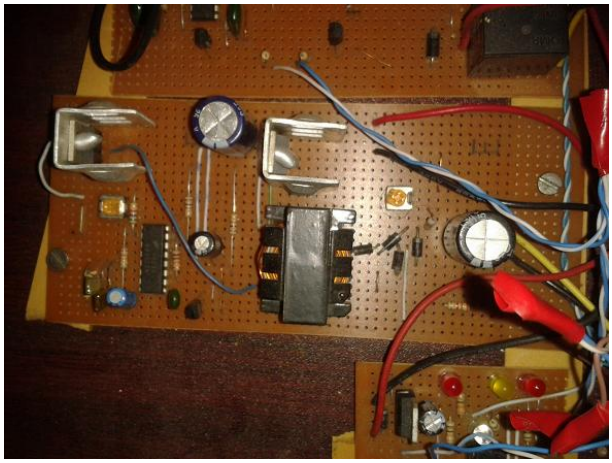

Fig.4: DC-DC Converter section

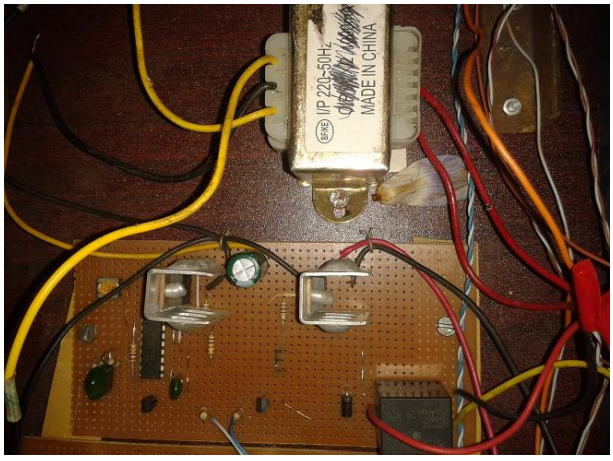

Fig.5: DC-AC Inverter section

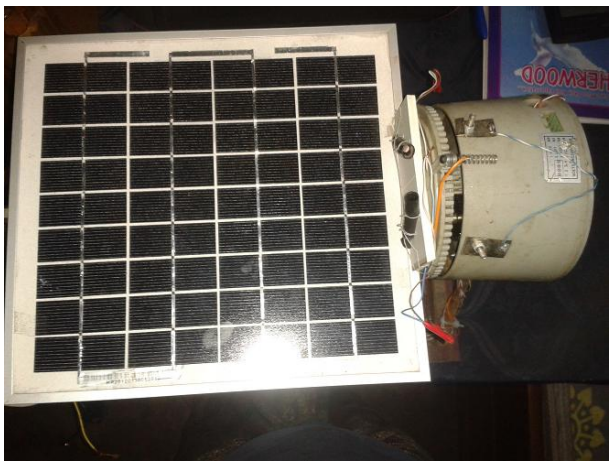

Fig.6: Solar panel with auto-tracker.

6. CONCLUSIONS

Most of the farmers in Bangladesh are illiterate and poor. In many areas still there is no electricity. Also load-shedding problem is a big problem in Bangladesh. Our farmer needs to spend a lot of money for irrigation purposes every day. By using this project farmers will be able to irrigate their plants regularly and it will save their money. It will reduce burning of fuel. It will limit the risk of global warming and climate change. It is hope that this project could build up a new path in our Agriculture System. Though there have some limitations in this project but it will add a new horizon in our agricultural system.

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