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HARNESSING OPTIMAL SOLAR POWER WITH SELF-TRACKING BASED ON SUNDIAL

S.VIJAYALAKSHMI
P.BLESSY
ELECTRICAL AND ELECTRONICS ENGINEERING,
VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY,
MADURAI.

ABSTRACT--*In this paper, we propose the self-tracking of solar panel in order to obtain optimal power based on sundial such that tracker system is made available in the residential area to meet out the daily demands and make solar power sufficient to houses. The solar panel is animated with the help of pneumatic controllers which receives commands from the Programmable Logic Controller which in turn connected to the photovoltaic cells.*

Keywords—solar panel , PLC , tracking , pneumatic controllers.

INTRODUCTION

The sundials were used in earlier days to measure the time. As days passed they were upgraded each level to accurately give the time based on sun's movement from dawn to dusk. Thus, solar panels can be designed to acquire the characteristics of these sundials to help them get the greatest intensity of sun's rays at each position. The photovoltaic cells are positioned at the places of the numerals. Thus when the sun cast its shadow the maximum optimal position can be tracked. Tracking here is done with the help of Pneumatic controllers which helps in a way to measure the temperature difference and gives command accordingly to the pneumatic controllers set to move the panel in the direction of the sun to get the optimal solar power at each possible position of the sun

SUNDIAL

Sundials were set in a particular angle according the longitude and latitude of the place such that the shadow cast by the sun can give the time from morning six to evening six without much flaws. As the sun rises in the east, the shadow points in the west and as the day advances, the shadow first swings to the north and then to east, where it points when the sun sets in the west . Thus based on the sun's movement the time has been calculated and this can be re-invented in the design of solar panels such that the sun's movement can be traced and it can be tilted towards it. The hour line in the sundial is replaced by the photovoltaic cells. The photovoltaic cells are placed as shown below in the figure 1.

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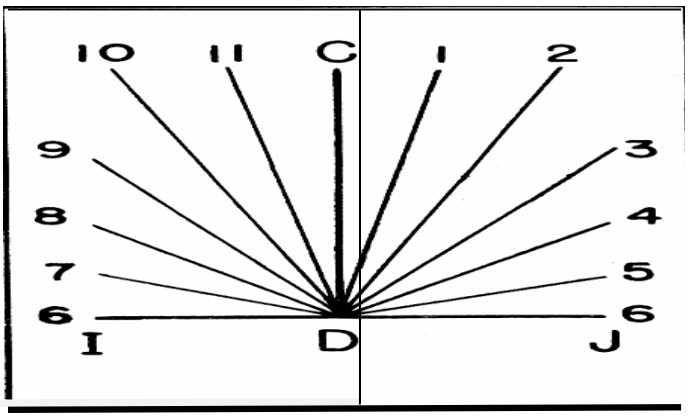
Figure 1



PHOTOVOLTAIC CELLS

Photovoltaic cells also known as solar cells used to convert light energy into electrical energy. This energy is in the form which can be stored in a battery and also can be converted to alternating current which can be used effectively. These solar cells performing three actions, the first one being absorption of light and generating electron-hole pair.Secondly, separating the opposite charges and finally make the majority charge carriers to flow to the external circuit. There are different types of materials used for manufacturing the solar cells, they are monocrystalline silicon, polycrystalline silicon , amorphous silicon, cadmium telluride , etcetera. Yet among them the most commonly used one is crystalline silicon. For both types i.e., mono and poly crystalline silicon , a junction is formed by diffusing phosphorous into the top surface of the silicon wafer. Therefore,each crystalline silicon can produce 0.5volts.Cells are usually soldered in series to obtain high output voltage. The figure 1 as shown above,depicts the positions where these photovoltaic cells need to be arranged in addition to that arranged on the body of the panel. Under the panel, exactly below each solar cell located at the periphery,pistons are fitted such that the panel rests on the pistons.

PNEUMATIC CONTROLLERS

Pneumatic controllers is known as the control method in which air is used as the medium. Hence the compressor is used to store the pressurized air , from which the pistons get there source of energy to do mechanical work. When the piston is to be moved then the amount of air is released through the control valves which can control the mechanical movement of the piston. Double acting cylinders are used in this paper , because it can move in both directions i.e., forward and backward. This pneumatic system can be controlled as a whole system through the commands from Programmable Logic Controllers.

PROGRAMMABLE LOGIC CONTROLLERS

Shortly known as PLC , is a powerful and yet simple control system which can accept input/s, compare, perform mathematical and logical operations, give output/s to another block and can also control another system. The logical diagram can be easily drawn as ladder diagram. There are number of software through

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which this can be done, in this paper we use Omron Zen support software , user friendly and outputs can be extended.

WORKING

When the panel is ready to be implemented at the rooftop of a building, then the latitude and longitude has to be selected accordingly. This can vary from place to place. Hence latitude and longitude must be chosen at that point for proper tracking. Eventually the initial and the rest position is in the east, facing the rising direction of the sun.

SUN TRACKING

When the sun rises in the east, the panel is facing the sun. As the sunrays fall on the panel and the gnome at the centre of the panel which is also immovable, casts its shadow at the other half of the panel denoting 6 a.m. Since the solar cells at the periphery at opposite ends are connected in series, there will be a potential difference because the light intensity varies at both ends due to the shadow falling on one cell of a pair at a time. This potential difference causes a current flow from the cell at higher potential to that at the lower potential, which is fed to the PLC. The direction of the current flow shows the direction to which the panel must be tilted, since the first position is already facing the sun, only little adjustments or no adjustments is needed. Following this will be the next position which is the average position of the sun for two hours. Hence we obtain six positions from morning six to evening six.

PISTONS

The pistons or the double acting cylinder causes the movement of the solar panel. When the PLC gives the command for the pair of piston for its movement , the situation will be like moving a piston forward and the other one backward thus obtaining the position needed. At noon, the panel comes to perpendicular position to the gnomon as the sun moves to the centre. At this position the output would be maximum since the distance between the panel and the sun reduces than the other positions since the morning and also the positions following noon.

SIMULATION

The movement of the piston as been simulated using the Omron Zen support software. The cylinders have been represented as bulbs in the simulation. Each position from the start to the end can be shown as follows.

Start:

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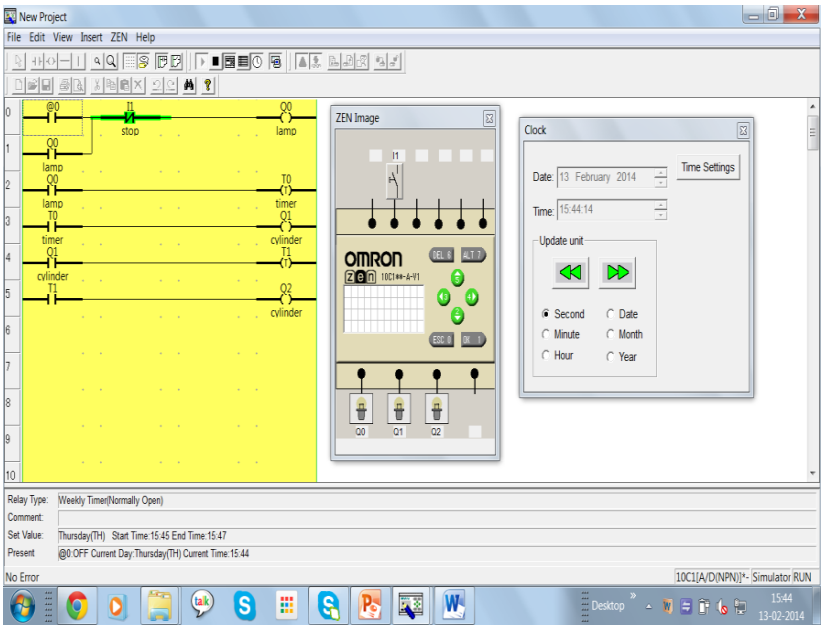

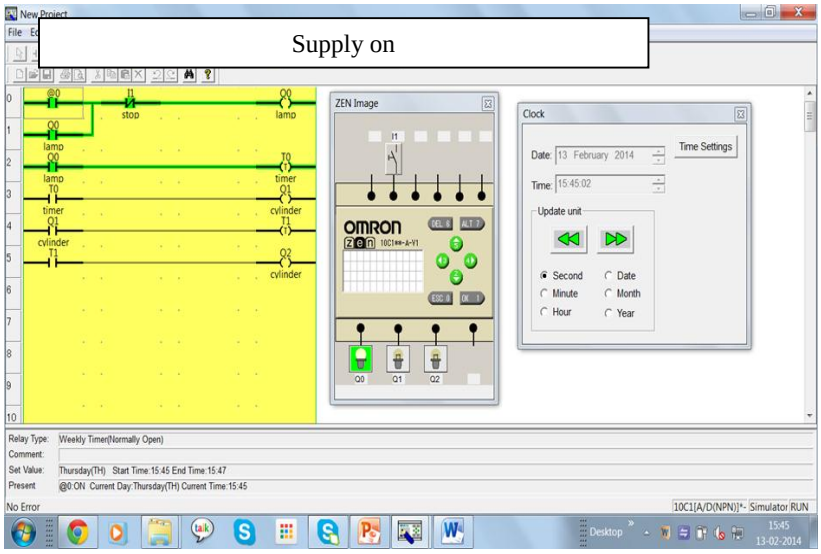

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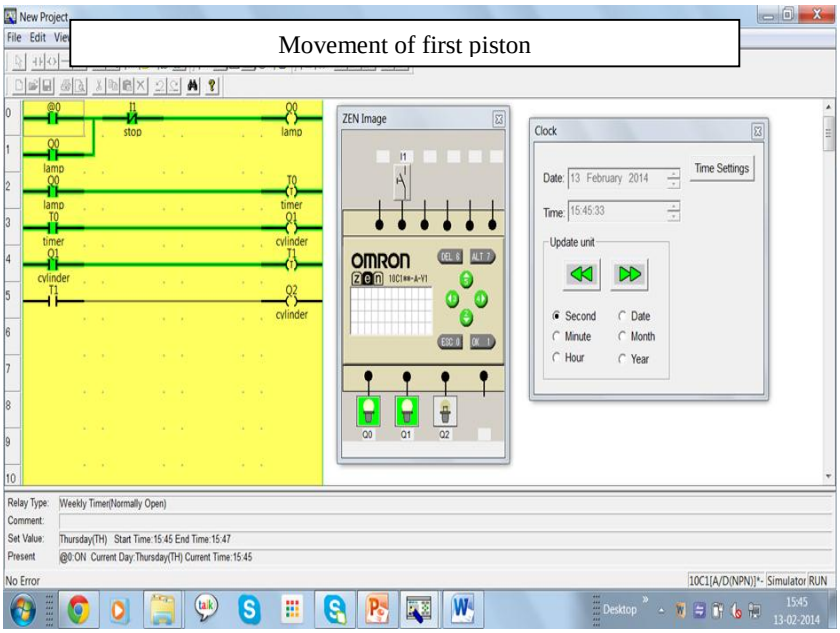

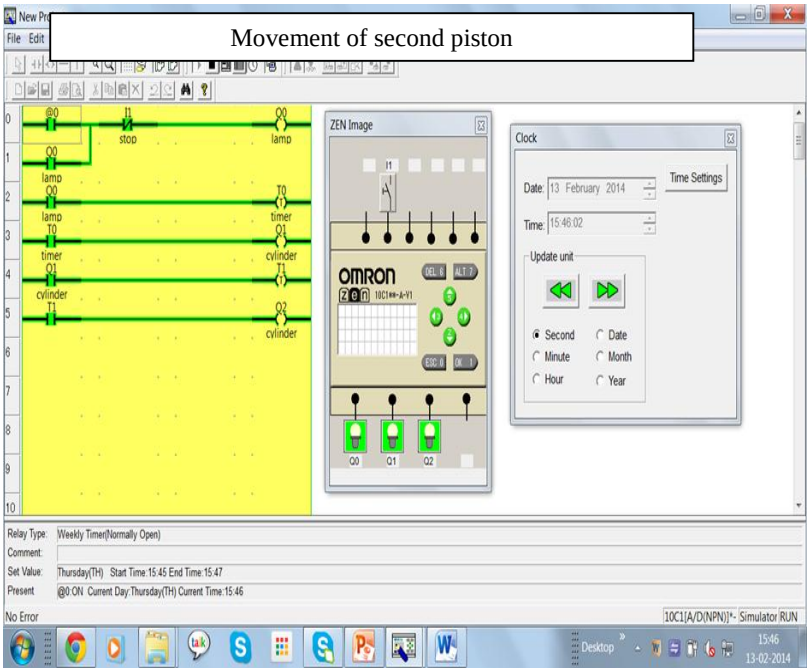

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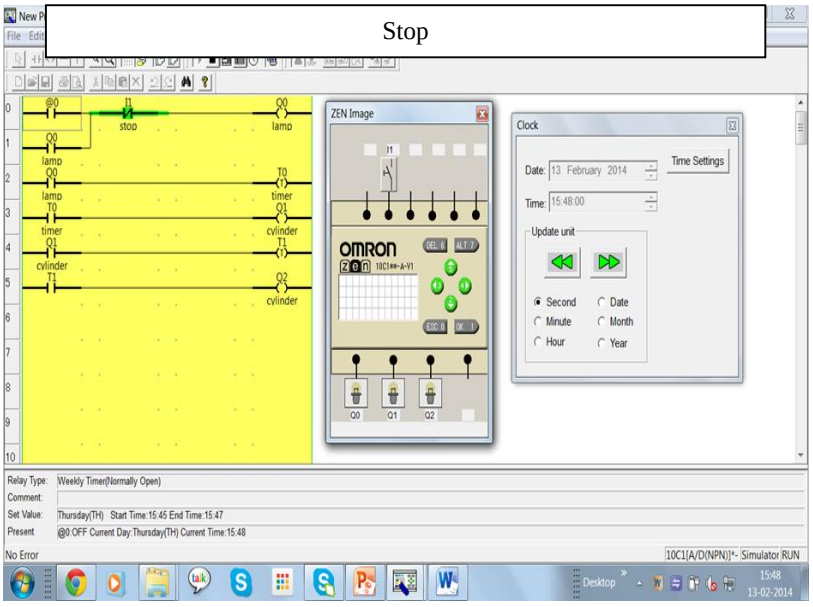

MERITS

1.Pneumatic Controllers dose not cost much more and also pose no risk of fire or explosion.
2.Programming in PLC is pretty easy and a visual operation can also be seen on the screen.
3.The system gives 24*7 automatic control,flexibility and reliability.
4.Self tracking is done without employing motors.

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