Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 3, March 2014, pg.603 – 608

RESEARCH ARTICLE

SMART BATTERY CHARGER FOR SOLAR-POWERED LINE FOLLOWER ROBOTIC VEHICLE

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Abstract— Searching energy sources to satisfy the world's growing demand is one of the foremost challenges for the next coming century. The seasonal movements of earth affects in the radiation intensity on solar systems. The design and construction of an efficient charging system for battery by tracked solar panels. Thus, the implementation of an energy management system applied to line follower robotic vehicle. The main proposals of the project are the implementation of a solar tracking mechanism aimed at increasing power levels in the solar panels. The robotic vehicle battery is charged by the solar panel, optimal charging circuit using the microcontroller and BFO algorithm in programming to increase the efficient for charging battery. To improve the solar tracking accuracy, a mixed solar-tracking system combines BFO (Bacterial Foraging Optimization) with PSO (Particle Swarm Optimization) algorithm is develop. Since the proposed mechanism is capable of tracking maximum light intensity.

Keywords—battery, mechatronic system, photovoltaic, line follower robotic vehicle, solar tracker, charging system

I. INTRODUCTION

Solar panel has been used increasing in recent years to convert solar energy in to electrical energy. The earth receives 84 Tera watts of power and our world consumes about 12 Tera watts of energy per day. So we are trying to consume more energy from the sun using solar panel. The tracking system will move the solar panel so that the sun for maximum energy conversion at all time.

Today, the reducing cost and increasing efficiency of solar energy technology has given rise to practical applications on earth from powering personal devices to provide utility power. Solar energy provides an advantage for satellites because the addition of fuel supply for satellites can be avoided while launching in to orbit.

But the advantages on earth are even greater: solar-generated energy provides abundant and pollution-free energy that's not dependent on fuel delivery antecedent, foreign relations or the price machination of energy brokers. Moreover, solar power generation provides energy, where we need it and is highly scalable to match the electrical demand. Since solar cells are reliable and very easy to maintain.

II. LINE FOLLOWING ROBOT

A line follower robot is basically a robot designed to follow a 'line' or path already predetermined by the user. This line or path may be as simple as a physical white line on the floor or as complex path marking schemes e.g. embedded lines. In order to detect these specific markers or 'lines', various sensing schemes are there. These schemes may vary from simple low cost line sensing circuit to expansive vision systems. The choice of these schemes would be dependent upon the sensing accuracy. From the industrial viewing, line following robot has been implemented in autonomous. My project of tracking system is implemented in line follower robotic vehicle. Line follower robot is a useful robot that is used in ware houses, industries, and stores etc, it follows a dedicated path.

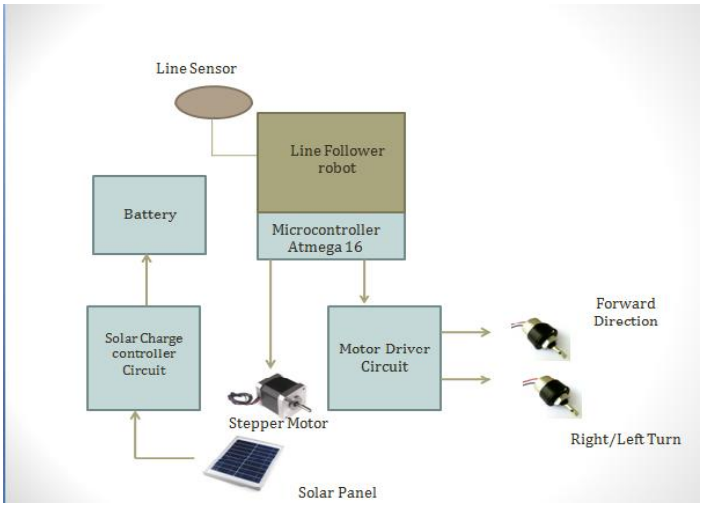


Fig .1 Line follower robot

Practical applications of a line follower: Automated cars running on roads with embedded magnets; guidance system for industrial robots moving on shop floor etc. In my project, the optimized solar tracking system is implementing in line follower robotic vehicle.

III. BFO ALGORITHM

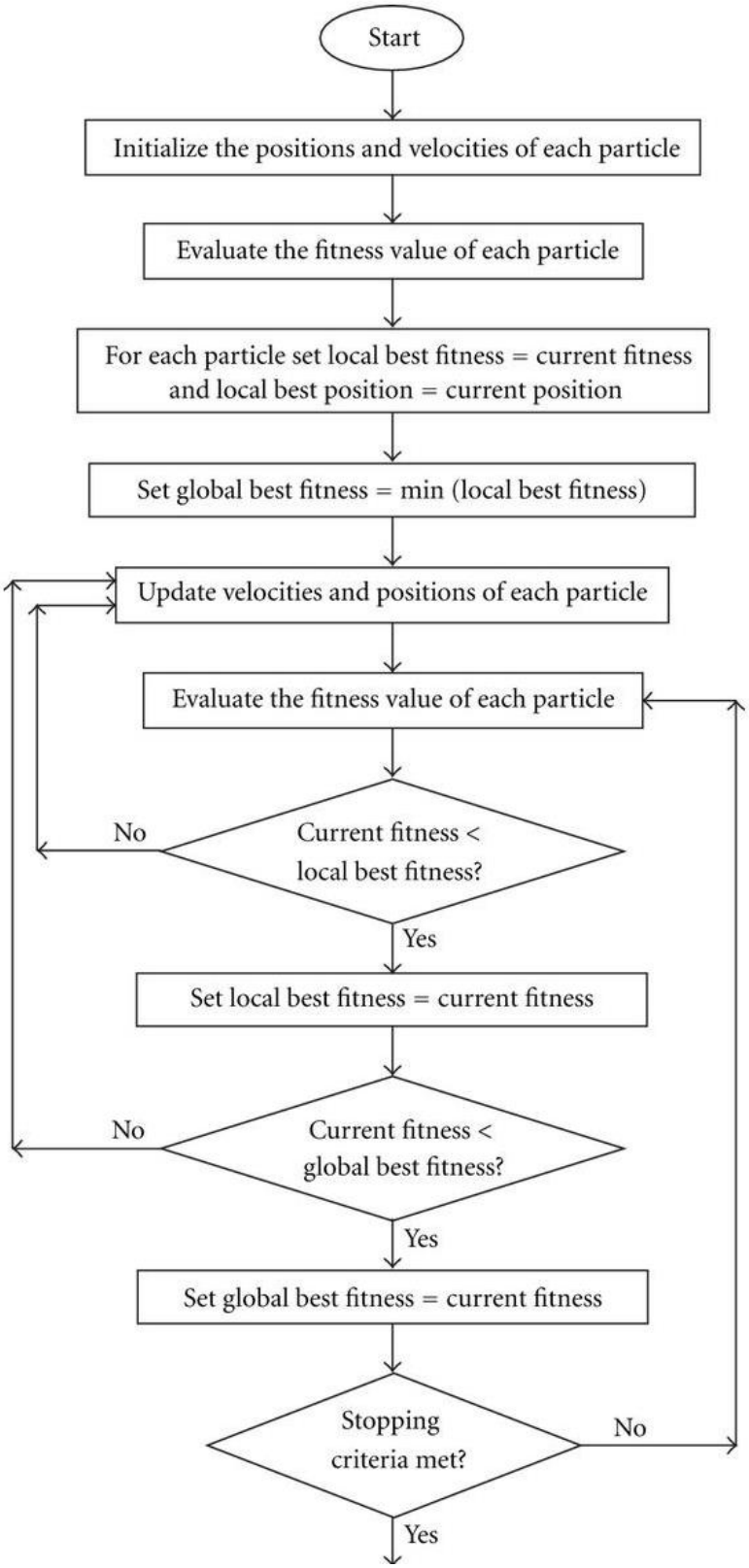
The Bacterial Foraging Optimization Algorithm improves compressed image quality when processing many image patterns. The BFO algorithm is an efficient evolutionary learning algorithm that manages complex global optimal code book generation problems.The BFO algorithm combines bacterial foraging optimization(BFO) behavior with a particle swarm optimization (PSO) learning scheme to obtain fast convergence and self-adaptive learning benefits. To improve the solar tracking accuracy, a mixed solar-tracking system combines BFO (Bacterial Foraging Optimization) with PSO (Particle Swarm Optimization) algorithm is developed. The results show that the proposed BFO-PSO algorithm enhances the output power of the solar cells.

BFO is a new algorithm which has simple implementation to track the maximum power point of photovoltaic array or a solar panel. Now a days Bacteria Foraging technique is gaining importance in the optimization problems. Because

1. Biology provides highly automated, robust and effective organism.
2. Search strategy of bacteria is salutary (like common fish) in nature.
3. Bacteria can sense, decide and act so adopts social foraging (foraging in groups).

A dynamic rapid method for tracking the maximum power angle of solar cell arrays known as Bacteria Foraging Optimization (BFO) algorithm. The analysis is presented for the comparison of different positions of the sun for maximum power alignment.

A. Flow chart for BFO Algorithm



IV. METHODOLOGY

The prediction of solar radiation for various inclined angles and orientations on the surface of earth using the measurement of current and voltage characteristics of various latitude and longitudinal angles on the hemi sphere surface (for just imagine as an earth equator). The different points are to be taken on the hemi sphere surface. Then voltages and current are measure with the help of solar panel and multi-meters to acquire accurate readings with respect to the time and the position of sun's radiations.

All measurements and data collections are recorded in terms of true solar-time. This facilitates the computations involving solar energy on unit hemi-sphere surface of earth equator and subsequent comparison of data for different locations. After that, readings are recorded in computer and then BFO algorithm is to be applied to the readings. The maximum power point is to be tracked by using BFO algorithm with the help of solar panel then power output is applied to the load . BFO is a population-based numerical optimization algorithm so that maximum power point to be tracked.

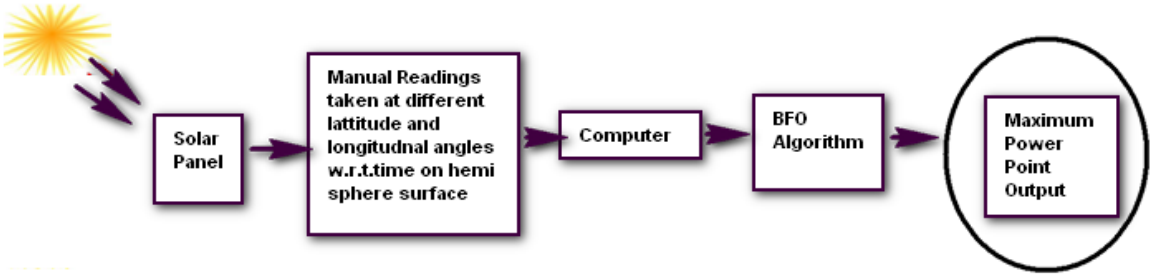


Fig. 2 solar power optimization using BFO algorithm

V. CHARGING SYSTEM

Recharging of secondary battery efficiently is very important. In the past, The chargers only charged batteries, and the charging method and efficiency were not designed well, so that the excessive charging time damaged the batteries and reduced the lifetime. The battery life can be prolonged and the charge efficiency can be increased with the help of charge control design. So that the charging effect of secondary battery will increase.

The charger of PV system use single-buck converter to discuss the overall MPPT and charge control system. This single-buck converter system is unable to implement MPPT and charge control simultaneously. Battery life may be reduced, when this single-stage design is applied to MPPT, the battery load has not controlled the voltage and current.

This project designed a portable solar energy battery charger with the principle of two-stage system. The first stage uses a DC/DC boost converter. It adopts the variable step size incremental conductance (VSINC) method to control the solar power system working at the maximum power point. The second stage uses a DC/DC buck converter, which controls the charging system by battery voltage and current feedback for the battery, so as to make the system attain voltage charge, constant voltage and current.

VI. SOLAR TRACKING SYSTEM

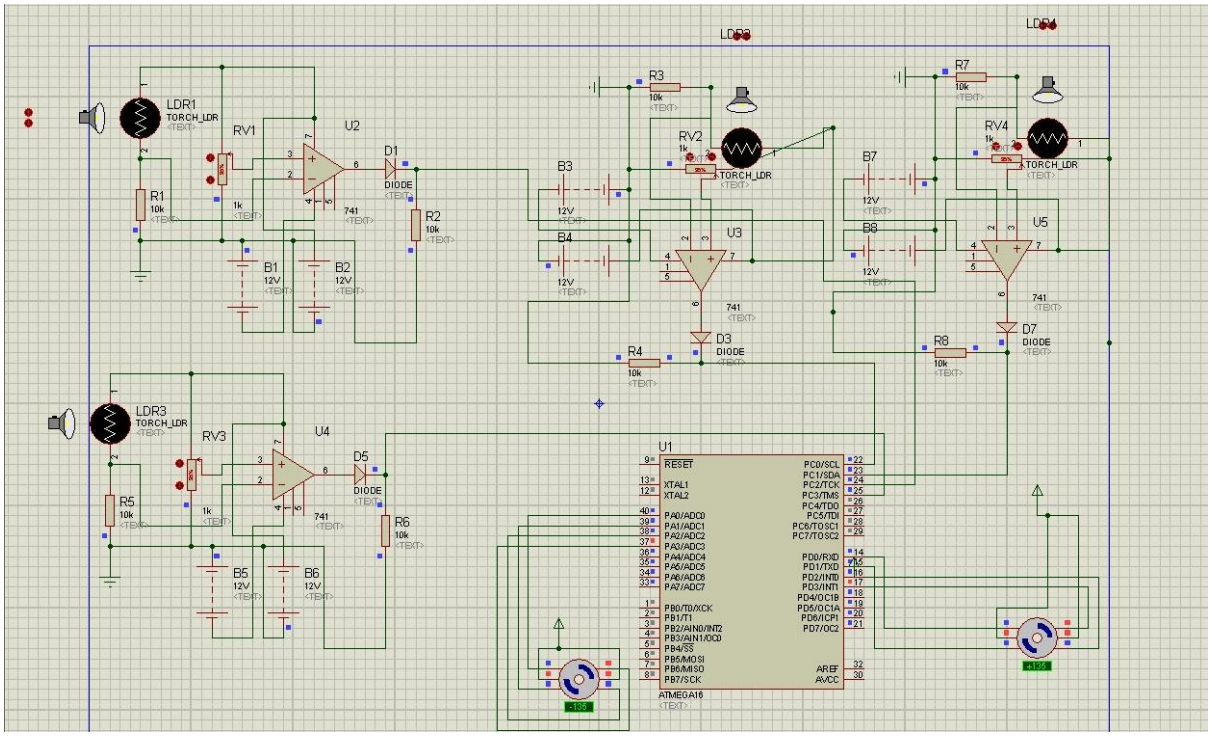
LDR is used to detect the light intensity in all directions, five LDR's are fixed on the solar panel at different locations to observe light and those values are send to microcontroller atmega16 Analog port pins of port A. Controller receives an analog value according to the light intensity and programmically we check that which ldr receives the more intensity of light and according to that we change the angle of motor so that the solar cells in the solar panel produces more voltage.

Microcontroller cannot directly drive the high current component so that motor cannot be driven directly from the controller. Port D Pins are configured as motor output and the pins are connected to driver IC ULN 2003 and output of driver ic is connected to Motor. According to the motor angle rotation the solar is tilted.

12V Battery Can be charged upto 14.5 V and the charging voltage must be higher than the voltage of the battery to be charged, so the voltage to be charged is 14.5V and the charging voltage is to be 15.5v. For 12V battery charger solar panel voltage range is to be 12V. In 12V solar panel open circuit voltage will be 21.6V and

Rated voltage will be 17.1V, using the adjustable Voltage regulator LM317 the regulated voltage is designed for 15.5V output and the output is connected to the battery terminals for Charging. Feed back is taken to the controller, when the battery is charged to the maximum then the controller makes the transistor to on then the adjacent pin of LM317current will be drained and the battery will be stopped charging.

A. SCREEN SHOT FOR SOLAR TRACKING SYSTEM



VII. CONCLUSION

Mainly focus on to determining maximum power spot of solar panel, which gives maximum power at the position. Maximum solar power calculated using automated system which is based on advanced algorithms. The bacteria based algorithm is fast and fully automated algorithm to locate maxima point.

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