

Solar Fencing Unit and Alarm for Animal Entry Prevention

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Abstract: Agriculture meets food requirements of the people and produces several raw materials for industries. But because of animal interference in agricultural lands, there will be huge loss of crops. Crops are vulnerable to wild animals. Therefore, it is very important to monitor the nearby presence of animals. Then the actuation of various devices should follow to repel the hazardous animals. we propose a method to protect farms from wild animals. Operational amplifier circuits are utilized mainly for the detection of animal intrusion from the outside of farms. The proposed monitoring scheme is to provide an early warning about possible intrusion and damage by wild animals. The Solar Electric Fence system is a modern day alternative to conventional methods of fencing to protect your crops & property. Electric Fence is an effective way to reducing losses caused by animals.

Keywords: Alarm, Fencing, Microcontroller, Solar panel, Solar Tracking.

1. Introduction

In the world, the economy of many countries is dependent upon agriculture. In spite of economic development agriculture is the backbone of the economy. Agriculture is the main stay of economy. It contributes to the gross domestic product. Agriculture meets food requirements of the people and produces several raw materials for industries. But because of animal interference in agricultural lands, there will be huge loss of crops. Crop will be totally getting destroyed. There will be large amount of loss of farmer. To avoid these financial losses it is very important to protect agricultural field or farms from animal. To overcome this problem, in our proposed work we shall design a system to prevent the entry of animals into the farm.

The main purpose of project is to develop prohibitive fencing to the farm, to avoid losses due to animals. These prohibitive fencing protect the crop from damaging that indirectly increase yield of the crop. The develop system will not harmful and injurious to animal as well as human beings. Theme of project is to design a intelligent security system for farm protection by using Embedded system. Crops are vulnerable to animals. Therefore, it is very important to monitor the nearby presence of animals. Then the actuation of various devices should follow to repel the hazardous animals. In this project, we propose a method to protect farms from wild animals via ubiquitous wired network devices, which is applied to farm along with traditional methods to improve the protection performance. Operational amplifier circuits are utilized mainly for the detection of animal intrusion from the outside of farms. The proposed monitoring scheme is to provide an early warning about possible intrusion and damage by wild animals. The Solar Electric Fence system is a modern day alternative to conventional methods of fencing to protect your crops & property. Electric Fence is an effective way to reducing losses caused by animals. The objective of this project is to secure people from wild animals using fence electric shock using MOSFET. The farmer from the unknown persons and animals with help of solar energy. In the hills side, due to presents of lot of animals the farms are often destroyed by them, so the human has to protect and secure their farms. But now-a-days there is no time for the human beings to do the work. Hence to avoid the human interface (security) and also to protect the farms, we provide a system called automatic electric farm protection system. The solar panels position is control depending upon the sun light. Nowadays power demand has increased due to this power failure happens many time. This project is designed to provide the solution for this power loss. This project is designed with Idr, amplifier, ADC, microcontroller, driver circuit along with motor and limit switches. Solar Electric fencing is one of the efficient periphery systems to protect your property than conventional barbed wire fencing. When an animal or human being comes into contact with the electric Fence they receive a sharp, short, painful but safe electric shock. The shock does not cause any physical damage. After a period of conditioning, the mere presence of the fence acts as an effective barrier even if it is not powered 'ON'. Electric fence can be made to detect a fault on the fence like shorting or cutting of the wire due to tampering on the fence with the Alarm system. Nano Bright Solar offers customized solutions for solar electric fencing according to your needs.

2. Literature survey

The Solar Fencing Unit and Alarm for Animal Entry Prevention, Abhinav [1] has reported that the aim of this paper is to Design and implementation of an intelligent security system for farm protection from wild

animals. An electric fence was used as a barrier to protect a farm from wild animals. An electric fence was first used in Texas in 1888. Electricity from a generator using an overshot wheel was to charge the top two wires of a four-wire fence. Often solar-powered, such fences were used extensively in the Panhandle to prevent cattle from wandering onto farmlands. One major disadvantage of an electric fence is that it might slow down emergency services from reaching you. This might even result in help reaching you after it is too late. There is a possibility of electric fences posing the risk of fire when bushes or trees grow in close proximity. Hence, it is important to keep the area near the fence cleared of any such vegetation. It will also have to ensure that the grounding has been done properly. Failure to do so might render the electric fence ineffective. In this case there will be loss of animal life and it is very dangerous to human being also. It will be too much expensive for farmers.

Design and Fabrication of Solar Panel, Parasnis and Saranya [2] has presented fabrication of Solar tracking system using DC gear motor. A solar tracker is a device into which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. The solar tracker will attempt to navigate to the best angle of exposure of light from the sun. A brief introduction to solar panel and solar tracker is explained. Basically the solar tracker is divided into two main categories, hardware and software. It is further sub divided into four main functionalities: method of Tracker Mount, Drivers, Motors, and Power supply of the solar tracker is also explained.

New Method of Solar Tracking System Parasnis and Tadamalle [3] has presented a new method of automatic solar tracking system. Light dependent resistors (LDRs) are used to sense the intensity of sunlight and hence the sun's position in the sky. Microcontroller is used for controlling the movement of solar panel. The mechanism used geared DC motor to rotate the solar panel. DC motor are controlled by the microcontroller with respect to signal from LDR.

Concept of Mechanical Solar Tracking System AmanGarg, et al [4] reports a study of various types of solar tracking systems has been presented. To enhance the overall efficiency of solar panels by keeping them aligned along with the sun position, Solar tracking system is used nowadays. Solar tracking is one of the most appropriate technologies so as to increase the efficiency of solar panels. Rather than purchasing additional solar panels, they can help to harness solar energy in more efficient way even with respect to cost.

3. Working principle and fabrication details

The project is designed with microcontroller, solar panel, battery, extra high threshold voltage, MOSFET and MOSFET driver.

- In farm areas nowadays many animals are roaming in people living areas and many people are killed by these animals and also the people are giving torture to animals. This project is to protect the humans and also animal life. The farm fence is fully covered by the electric wire and low amount current is passing through that wire if any animals try to cross the fence it will meet with shock.
- An electroluminescent IR sensor is a product which requires care in use. IR LEDs are fabricated from narrow band hetero structures with energy gap from 0.25 to 0.4 eV. Even though infra red ray spreads in all directions, it propagates along straight line in forward direction.
- When IR rays gets emitted from LED, it moves in the direction it is angled. When any obstacle interferes in the path, the IR rays get cut and it produces secondary wavelets which propagates mostly in return direction or in a direction opposite to that of the primary waves, which produces the net result like reflection of IR rays. The IR sensor and laser sensor are placed in the entrance of the securable area and around area of the farm.
- If any object cross the entrance and surrounded area then the corresponding signal will be given to the microcontroller.
- After getting this signal the alarm will make a sound to indicate some interruption in the farm.
- The MOSFET is used the control the voltage and given to the threshold circuit the MOSFET drivers circuit are taking output from microcontroller.
- The microcontroller controls all device and given condition to all devices. Microcontroller is the main heart of this project.

Solar panel consists of number of silicon cells, when sun light falls on this panel it generates the voltage signals then these voltage signals are given to changing circuit. Depending on the panel board size the generated voltage amount is increased. Naturally suns direction varies per hour. In order to get the efficient voltage amount the solar panel position has to vary as per the suns direction., when sun light falls on this panel it generate the voltage signals then these voltage signals given to charging circuit. Two LDR (light dependent resistor) sensors are attached at the end of panel and the panel is attached with gear mechanism for tracking (to move the panel in the direction of sun). The worm gear arrangement is attached along with motor and sensor

and order to achieve the movement of the panel with the direction of sun. A gear consisting of a spirally threaded shaft and a wheel with marginal teeth that meshes into it. Worm gear attached with spur gear which will rotates at the speed of around 45 rpm and attached square motor with these gear. Square motor can withstand the high speed. The base where panel is fixed is having two limiting switches. In electrical engineering a limit switch is a switch operated by the motion of a machine part or presence of an object. They are used for control of a machine, as safety interlocks, or to count objects passing a point. A limit switch with a roller-lever operator; this is installed on a gate on a canal lock, and indicates the position of a gate to a control system. Two ball bearings are attached at the end of the tracking which helps for supporting the tracking devices. The ball bearing is a type of rolling-element bearing that uses the balls to maintain the separation between the bearing races. The purpose of ball bearing is to reduce rotational friction and support radial and axial loads. Fig.1 shows the working of solar tracking system.

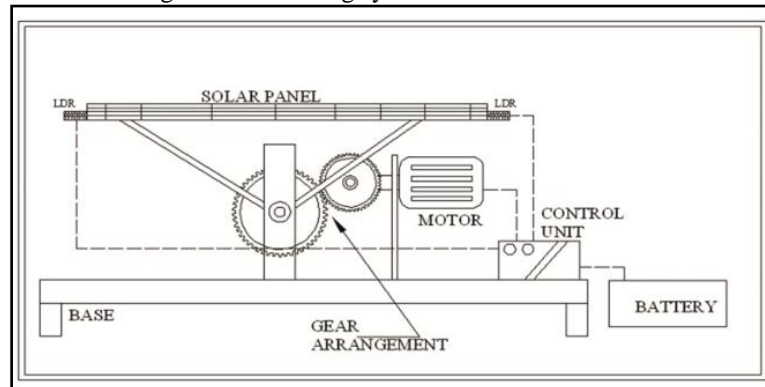


Fig. 1 working of solar tracking system

The main components used to fabricate the model are:

- Microcontroller
- Sun Light Tracking System
- Relay Switches
- DC Motor
- Worm Gear And Spur Gear
- Battery
- Light dependent resistor (LDR)
- Liquid crystal display (LCD)
- Solar panel
- Relays

3.1 Sun light tracking system

A solar tracker will track the sun throughout the day and adjust the angle of the solar panel to make the sun normal to the solar panels at all times. The orientation of the solar panels may increase the efficiency of the conversion system from 20% up to 50%. The sun tracking solar power system is a mechatronic system that integrates electrical and mechanical systems, and computer hardware and software. The provision of sensor make the solar panel to move in the direction of sun. The two LDR sensors are attached at the end which are programmed which will detects the sun light.

3.2 Microcontroller, control system and switches

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer.

Control unit: In our project the main device is a micro controller. It is used to control the whole unit of this project. The micro controller is connected to the control unit. The control unit is connected with the battery to get the power supply. Fig 3.1 shows Block diagram of Control Unit.

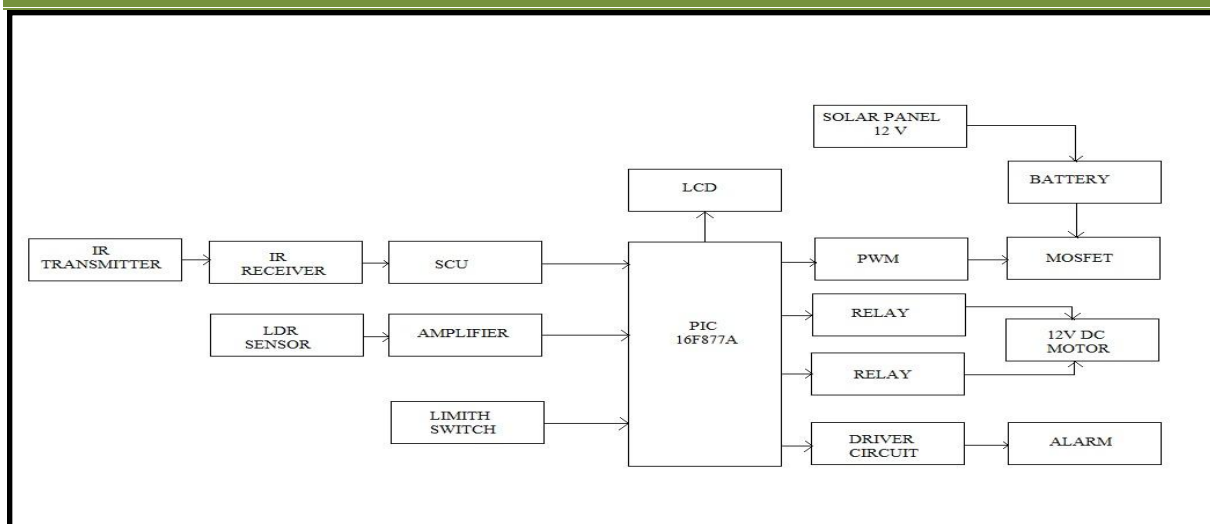


Fig. 2 block diagram of control unit

3.2 Sun light tracking system

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3.3 Relay switches

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit.

Inverter: An AC load can be powered from a DC source by using a converter to change DC to AC. This circuit is designed for taking 230V AC from the 12V DC input. An AC load can be powered from a DC source by using a converter to change DC to AC. The wattage of output depends on these three equipment. A DC-to-AC inverter energized from a 12-volt DC input signal uses a single stage inverter circuit to produce a quasi-sine wave output signal.

3.4 DC motor

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

3.5 Worm gear and spur gear arrangements

A worm gear is type of mechanical gear. Worm gears are used when large gear reductions are needed. It is common for worm gears to have reductions of 20:1, and even up to 300:1 or greater. Many worm gears have an interesting property that no other gear set has the worm can easily turn the gear, but the gear cannot turn the worm. This is because the angle on the worm is so shallow that when the gear tries to spin it, the friction between the gear and the worm holds the worm in place. Very interesting usage of worm gears is in the Torsion differential, which is used on some high-performance cars and trucks. A gear consisting of a spirally threaded shaft and a wheel with marginal teeth that meshes into it. The toothed wheel of this gear a worm wheel. Compact structure saves mounting space. Highly accurate. Runs forward and backward. High overload capacity. Stable transmission with reduced vibration and noise.

3.6 Battery

In our project we are using secondary type battery. It is rechargeable type. Battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out.

3.7 LDR sensor

A photo resistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its whole partner) conduct electricity, thereby lowering resistance. Fig 5.7(b) shows example of LDR sensor.

3.8 Liquid crystal display (LCD)

A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly and this

3.9 Solar Fencing

The solar fence is scientific fence and works on solar energy with backup facility to run uninterruptedly during the nights as well as cloudy days. The whole system can be derived into two segments, one is the central control unit or solar power generating system unit and the other one is the Fence.

3.10 Alarm

The smart fence voltage alarm systems monitor effective voltage on the fence at all times and generates an alarm any time an array is cut, shorted or grounded.

3.11 Solar panel

A solar panel (photovoltaic module or photovoltaic panel) is a packaged interconnected assembly of solar cells, also known as photovoltaic cells. The solar panel is used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications.

4. Design calculation

The design calculations are listed below

4.1 Solar panel specifications

Maximum Power (P_{max}) = 15 watts

Maximum Power Voltage = 12 volts

Open Circuit Voltage (V_{oc}) = 10.8 volts

Short Circuit Current (I_{sc}) = 0.57 amp

Temp coefficient of ISC = 0.08×10^{-2} A/C°

Cells - 36

Cell Technology - Polycrystalline

Cell Shape – Rectangular

Therefore the intensity of solar panel = 15 watts

Power generation from solar energy with tracking system is given by;

Since we attached solar tracking with solar panel. As we go through the study we got the conclusion that the tracking system will increase around 30-40% of power as that of normal panel without tracking.

Therefore, power generation with tracking = $P_{max} + 30\%$ of P_{max}

$$= 15 + 30\% \text{ of } 15$$

= 19.5 watts

Hence with the use of solar tracking nearly 5 watts more of power can be generated as that of without tracking.

Therefore total power generated from solar energy = 20 watts

4.2 Battery Calculation

$B_{AH}/C_1 = 8 \text{ ah}/420\text{ma} = 19 \text{ hrs}$

To find the Current

Watt = 18 w

Volt = 12v

$$P = V \times I \quad (1)$$

$$18 = 12 \times I$$

$$I = 18/12$$

$$= 1.5 \text{ AMPS}$$

4.3 Worm gear calculation

Number of teeth on worm wheel (T_w) = 48

Outer diameter of worm wheel, (D_w) = 60mm

Inner diameter of worm wheel = 12mm

Number of starts on worm (n) = 3

Axial pitch of worm (p_a) or circular pitch of gear (p_c): 6.23

Center to center distance between worm and gear C:

Pitch circle diameter of worm (D_w) : 16.07

Pitch circle diameter of gear (D_G) : 63.47

$$X = D_w + D_G * 4 \quad (2)$$

$$X = 16.07 + 63.47 * 4$$

$$X = 39.774$$

Motor speed (N) = 30rpm

Power of motor (p) = 18watts

Diameter of shaft = 15mm

Mild steel shaft shear stress (f_s) = 210N/mm²

$$\text{Torque of the motor } T = \frac{P * 60 * \pi * N}{2} \quad (3)$$

$$= 18 \times 60/2 \times 3.142 * 30$$

$$= 5.729 \text{ N-m}$$

The gear ratio of a worm gear is worked out through the following formula:

= Number of teeth on worm wheel / Number of teeth on worm

$$= 48/3$$

$$= 16$$

$$\text{Gear ratio } i = \frac{n_1}{n_2} \quad (4)$$

(n_1) worm shaft speed = 30rpm

(n_2) worm wheel speed = 30/16

$$= 1.875 \text{ rpm}$$

$$\text{Torque of the worm wheel } t_2 = \frac{P_2 * 60 * \pi * N_2}{2} \quad (5)$$

$$= 18 \times 60/2 \times 3.142 \times 1.875$$

$$= 91.67 \text{ N-m}$$

$$\text{Angular velocity of worm wheel} = \frac{2 * \pi * 1.875}{60} \quad (6)$$

$$= 0.196 \text{ rad}$$

$$\text{Maximum torque rate of the worm wheel} = \frac{\pi}{16} * f_s * d^3 \quad (7)$$

$$= \frac{\pi}{16} * 0.210 * 15^3$$

$$= 2226.6 \text{ N-m}$$

Worm wheel torque is limited to the maximum limit.

Hence the worm wheel used here rotates at 1.875rpm

5. Fabrication Details

5.1 3-D Model of automatic paper cutting machine by using geneva mechanism

The below Fig 1 shows the 3-D CAD geometry of the project having all required components in it. The 3-D view of the project gives an appropriate idea to fabricate the real model with more idea and less waste material.

This CAD model was designed by using exact dimensions of every components which helped in defining their properties and behavior to the different load conditions while simulation.

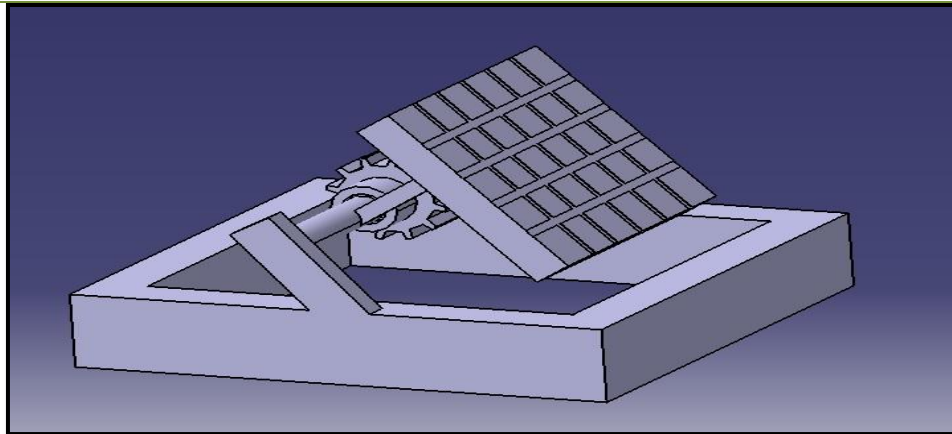


Fig.3CAD model of solar tracking system

5.2 Assembled model

The Fig 4 and Fig 5 shows the assembled model of the solar fencing unit and alarm for animal entry prevention proposed system.



Fig.4Side view of assembled model



Fig. 5Top view of assembled model

5.3 Results and analysis

If any object cross the entrance and surrounded area then the corresponding signal will be given to the microcontroller. After getting this signal the alarm will make a sound to indicate some interruption in the farm. The solar panel is used to generate the electric supply and store it to battery, battery will give to supply to fence wires, the extra high threshold voltage generates the equivalent shock voltage.

5.4 Validation

Due to presents of lot of animals the farms are often destroyed by them, so the human has to protect and secure their farms. But now-a-days there is no time for the human beings to do the work. Hence to avoid the human interface (security) and also to protect the farms, we provide a system called automatic electric farm protection system.

6. Advantage Disadvantage and Future Scope

The advantages and future scope of this proposed model are

6.1 Advantages

The advantages are as follows

- Low power consumption
- Less cost
- High Efficiency
- Power consumed is available free of cost
- Man power reduction
- Farm protection.

6.2 Future scope

- Simple circuit and easy to operate.
- Fast and simple installation.
- Location flexibility.
- Low cost maintenance.
- Automatic operation.
- High reliability and long lifetime.
- Digital display

7. Conclusion

The progress in science & technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. The proposed system based on Atmel microcontroller is found to be more compact, user friendly and less complex, which can readily be used in order to perform. Several tedious and repetitive tasks. Though it is designed keeping in mind about the need for industry, it can extended for other purposes such as commercial & research applications. Due to the probability of high technology (Atmel microcontroller) used this “solar fencing unit and alarm for animal entry prevention” is fully software controlled with less hardware circuit. The feature makes this system is the base for future systems. The principle of the development of science is that “nothing is impossible”. So we shall look forward to a bright & sophisticated world.

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