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IFCS: An Intelligent Farm Controlling System Powered by Solar Tracking

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Abstract— An emerging and promising simple wireless communication system which is microcontroller-based and measure the values of soil moisture, pH level of the natural environment that are continuously modified and controlled in order to use them in optimized way to achieve maximum plant growth and yield is presented here. It communicates with the sensor modules in real-time in order. The system also employs a GPRS-based system for keeping the user continuously informed of the conditions. The AC devices can also be controlled by the user via his computer. The Solar tracking system provides power for the whole system. Solar energy tracking system converts maximum solar energy into electrical by proper alignment of solar panel depending upon the sun position. Thus the tracker system will keep the solar panel perpendicularly aligned with respect to sun so as to trap maximum solar energy. The sun's positions are determined by the photo sensors whose output is given to microcontroller, which is designed in an embedded software platform. The microcontroller depending upon the sensor information will align the solar panel through a DC motor.

***Index Terms*—**Embedded software platform, GPRS, Solar tracking, Sensor modules.

I. INTRODUCTION

We live in a world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. One such field is that of agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. Various factors such as humidity, soil moisture, soil pH, temperature, etc directly or indirectly govern the plant growth. These factors are sensed using various sensors and the respective real time module are controlled according to the data obtained from these sensors. This kind of farming is known as precision farming. The data from these sensors is also sent to the user to keep him informed about the conditions of the farm.

When any of the parameters sensed by the sensor modules cross the threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The microcontroller then performs the needed actions by employing relays until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up low-cost and effective nevertheless. As the system also employs a GPRS system for continuously alerting the user about the condition in the field, the entire set-up becomes user friendly.

An automatic irrigation system is also implemented in this system as a power source, the sun offers some impressive advantages over typical battery cells, it generates virtually limitless energy, requires no recharging and is expected to last for another 5 billion years. Today more efficient, less expensive solar cells provide a practical means of converting the suns power into electricity to run our gadgets.

The most significant benefit of this project is its reliability as it operates with the world's most powerful non-conventional energy source, the sun. Thus the sub systems acquire their power continuously from the (stored) solar power. Another important benefit of our project are the solar tracker is able to work independently without supervision to meet the objectives and to achieve the deliverables required on time increasing the efficiency by 30-40% .Also, the space requirement for a solar park is reduced, and they keep the same output. The main aim of the project is to make farming user friendly with the use of renewable resources.

2. PRECISION FARMING

Sustainable agriculture has to meet production efficiency, sensitivity of ecosystems, appropriate technology, and maintenance of the environment, cultural diversity and satisfaction of the basic needs. Automation in farming can increase agricultural productivity while ensuring that dependent resources are not depleted. Using the latest green technology solutions and agricultural practices, farmers can enjoy smart farming.

.2.1 Present Scenario of Indian Farming

Agriculture is the mainstay of the Indian economy because of its high share in employment and livelihood creation. It supports more than half a billion people providing employment to 52 per cent of the workforce. Its contribution to the nation's GDP is about 18.5 per cent in 2006-07. It is also an important source of raw material and demand for many industrial products, particularly fertilizers, pesticides, agricultural implements and a variety of consumer goods. Though agriculture in India plays a vital role in the overall socio-economic framework, current agricultural practices followed are neither economically nor environmentally sustainable. Lack of the use of hi-tech irrigation systems, crop failures due to lack of monsoon, poor seed quality, inefficient farming practices, undue output costs – the list of problems in most regions goes on. Suicides by farmers still hit the headlines.

2.2 Existing system

Agricultural production system is an outcome of a complex interaction of seed, soil, water and agro-chemicals (including fertilizers). Therefore, judicious management of all the inputs is essential for the sustainability of such a complex system. The focus on enhancing the productivity during the Green Revolution coupled with total disregard of proper management of inputs and without considering the ecological impacts, has resulted into environmental degradation. The only alternative left to enhance productivity in a sustainable manner from the limited natural resources at the disposal, without any adverse consequences, is by maximizing the resource input use efficiency. now this is done by precision farming.

2.4.2 Solar Tracker System

Since the sun moves across the sky throughout the day, in order to receive the best angle of exposure to sunlight for collection energy a tracking mechanism is often incorporated into the solar arrays to keep the array pointed towards the sun. A solar tracker is a device onto 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. When compared to the price of the PV solar panels, the cost of a solar tracker is relatively low. Most photovoltaic (PV) solar panels are fitted in a fixed location. Since the sun moves across the sky though the day, this is far from an ideal solution. Solar panels are usually set up to be in full direct sunshine at the middle of the day facing South in the Northern Hemisphere, or North in the Southern Hemisphere. Therefore morning and evening sunlight hits the panels at an acute angle reducing the total amount of electricity which can be generated each day. The design of the Solar Tracker requires many components. The design and construction of it could be divided into six main parts, each with their main function. The following are the six main parts of a Solar Tracker

- Methods of Tracker Mount
- Methods of Drives
- Sensor and Sensor Controller
- Motor and Motor Controller
- Tracker Solving Algorithm
- Data Acquisition/Interface Card

Methods of Tracker Mount

Single Axis Solar Trackers

Single axis solar trackers can either have a horizontal or a vertical axle. The horizontal type is used in tropical regions where the sun gets very high at noon, but the days are short. The vertical type is used in high latitudes where the sun does not get very high, but summer days can be very long. The single axis tracking system is the simplest solution and the most common one used.

Methods of Drive

Active Trackers

Active Trackers use motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction. Active trackers typically have two photo sensors, such as photodiodes, configured differentially so that they output a null when receiving the same light flux.

Passive Trackers

Passive Trackers use a low boiling point compressed gas fluid that is driven to one side or the other (by solar heat creating gas pressure) to cause the tracker to move in response to an imbalance.

Chronological Tracker

Chronological Tracker counteracts the earth's rotation by turning at an equal rate as the earth, but in the opposite direction. Actually the rates aren't quite equal, because as the earth goes around the sun, the position of the sun changes with respect to the earth by 360° every year or 365.24 days.

Sensors and Sensor Module

Light Dependent Resistor

Light Dependent Resistor (LDR) is made of a high-resistance semiconductor. It can also be referred to as a photoconductor. If light falling on the device is of the 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 hole partner) conduct electricity, thereby lowering resistance. Hence, Light Dependent Resistors (LDR) is very useful in light sensor circuits. LDR has very high-resistance, sometimes as high as 1000000Ω, when they are illuminated with light resistance drops dramatically.

Motor and Motor Control

Motors are use to drive the Solar Tracker to the best angle of exposure of light. For this section, we shall look at some of the motor types available on the market..

Servo Motors

Servos contain a small DC motor, a gearbox and some control circuitry, and feed on 5 volts at about 100mA maximum, and about 10-20mA when idle. They have a three-wire connector, one common wire (0 volt, usually black), one +5v wire (usually red), and one signal wire. In normal use they are controlled by pulses of about 1 to 2 milli-seconds at a repetition rate of about 50 per second. A short pulse makes the servo drive to one end of the travel, a long pulse makes it drive to the other end, and a medium one puts it somewhere proportionally between.

Some servos have gear components that allow them to rotate continuously. This method needs the servo to have a feedback potentiometer used by internal circuits to measure the position of the output shaft. If this is disconnected and the wires taken to an external pre-set potentiometer, the servo will drive continuously in one direction if fed with short pulses and vice-versa. If there are no pulses, the servo stops. It is uses to drive the Solar Tracker Eastward and Westward. The pulses are at normal TTL levels.

The speed though, is not greatly affected by the pulse repetition rate, as long as it is above about 30 per second. These pulses can easily be provided by an output port of just about any computer. If an RC servo is used as a drive motor, wheel motion sensors are needed on at least one wheel as in any DC motor system. The use of an RC servo for driving only simplifies the mechanics.

Tracker Solving Algorithm

Microcontroller 16F877A

The microcontroller can perform arithmetic and logic function as defined in program. Only that the feature of a microcontroller chip is the inclusion, on a single chip, of all the resources which permits the IC to serve as a controller in a system or an instrument. From a basic PIC 16F877A which is used in this system, the main hardware is data RAM, Special Function Register, I/O port, UART, Programmable Timers and counters and external interrupt. Microcontroller is programmed to track the sun's position and rotate the motor according to its position. This board is used to simulate data from sensor and make a decision to control the motor. Main component for microcontroller board is the controller integrated circuit.

Programming Language for the Solar Tracker

The programming is done to the microcontroller using the software Protel 99SE. The programming is done in Embedded C language. The program is presented in MPLAB IDE V8.36. The application software is MS Visual Basic 6.0. Although C was designed for implementing system software, it is also widely used for developing portable application software. Embedded C is one of the most widely used programming languages of all time and there are very few computer architectures for which a C compiler does not exist.

The Data Acquisition/Interface Card

The Data Acquisition/Interface Card is the feedback of the Solar Tracker. This section covers the card itself and the programming language that is going to be use to control the Solar Tracker. The main aim of the Data Acquisition/Interface Card is to provide testing functionality of the mains parts of the Solar Tracker. It should provide available ports for the sensors input, motor controlling output bits and also other interfaces to be controlled as simply as possible and in the shortest time. It must be within specifications and should be small enough to accommodate all the required components and not draw too much power. Popular choices for Data Acquisition/Interface Card are PCI-7334 and EMANT300.

CHAPTER 3.DESIGN OVERVIEW

The sensor modules system consists of various sensors, namely moisture, humidity, and pH sensor. The sensors sense various parameters – soil moisture, humidity and fertiliser content and this information is sent to the microcontroller which is the heart of the proposed embedded system. It constantly monitors the digitized parameters of the various sensors and verifies them with the predefined threshold values and checks if any corrective action is to be taken for the condition at that instant of time. In case such a situation arises, it activates the AC devices to perform a controlled operation.

The AC devices such as motors and pumps perform the controlling operation. A complete working system can be realized by simply replacing these simulation devices by the actual devices after making it to pass through suitable relays.

The solar tracking section aligns the solar panel in such a way that the panel always faces the sun thereby receiving maximum solar energy and increasing its efficiency. The GPRS module used in the circuit keeps the user informed about the current status of the parameters via internet.

3.1 Solar Tracking Section

LDR also known as photoconductor or photocell is a device which has a resistance which varies according to the amount of light falling on its surface. Since LDR is extremely sensitive in visible light range, it absorbs the sunlight falling on them. Depending on the intensity of light on the LDRs, the solar panel is rotated in so as to obtain maximum light intensity. The LDR output is given to the microcontroller rotates the panel accordingly. . The motor is connected mechanically to the solar panel thereby rotating the solar panel such that the solar panel gets the maximum radiation. The solar panel generates electricity which is stored in a rechargeable battery.

3.2 Power Supply for the System

The battery used as the power supply is a rechargeable battery which is charged using the solar energy obtained from the solar tracking section. The power supply to all the other section including the tracking section is obtained from this battery. Wherever needed voltage regulators are used.

3.3 Sensor Module

3.3.1 Moisture Sensors

Moisture sensors are the electrodes placed at various positions in the soil. Based on the electrode conduction, the moisture level of soil is sensed and its output is fed to the microcontroller

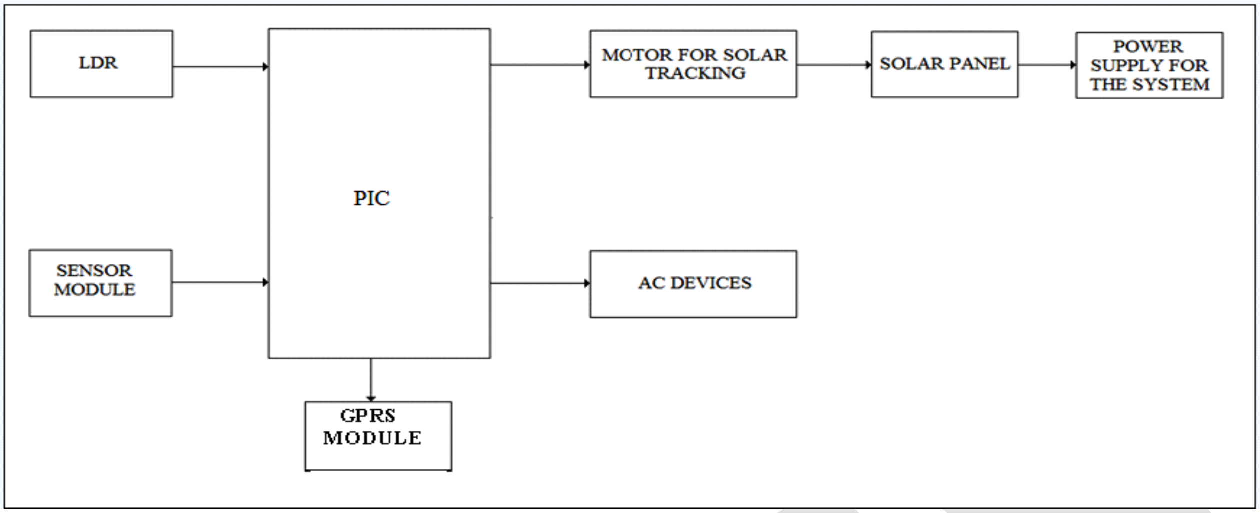


Figure: Blockdiagram

which in turn operates the motor to pump the field.

3.3.2 pH Sensors

pH sensors are those which measure the pH level of soil from time to time. The lack of nutrients and manures are detected using these sensors. When the nutrient level falls below the required level, the microcontroller activates the fertilizer sprayers so that required nutrient is provided at the adequate level.

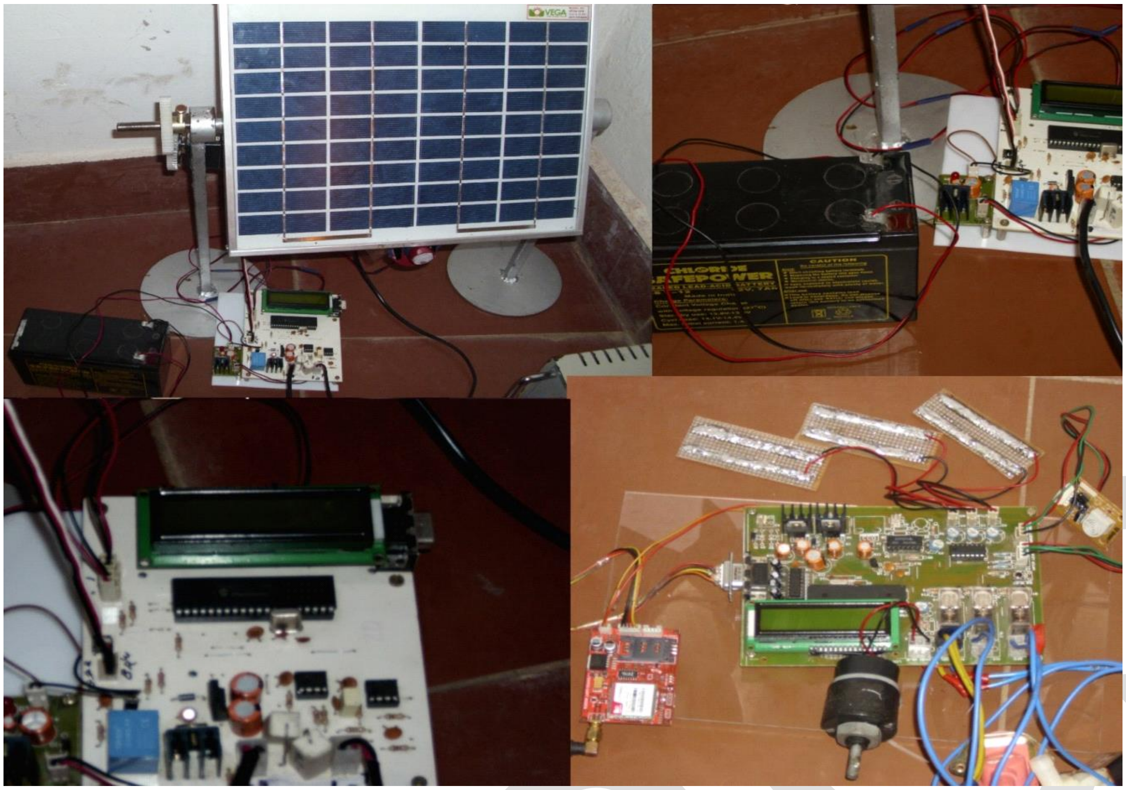
3.4 GPRS Module

The GPRS facility is included so that the owner of the field can get all the sufficient data about the working of the system from anywhere round the globe. All the data, values regarding the functioning of the whole system and image of the land can be viewed by the owner with this facility. Thus an update of the system performance is automatically done.

RESULT

Solar tracking section which helps in collecting the maximum solar energy which is stored and used for the irrigation purpose

Drip irrigation is chosen which prevents the wastage of water by directly injecting water to the tip of the root of the plants. The requirement of water is sensed using moisture sensor placed inside the soil. The moisture is sensed and the motor is switched on and off accordingly. For the use in precision farming humidity sensors are provided. The aim is to make a simple and cheaper object automated farming. We have given more importance to achieve the aims such as the product should be simpler, less expensive, reduced man power and most importantly eco friendly



V. FUTURE SCOPE

By using double axis solar trackers which have both a horizontal and a vertical axle, the Sun's apparent motion can be tracked exactly anywhere in the World. Thus tracking the sun, the efficiency of the solar panels can be increased by 60-70%.Also in this system we have all wired connections in the farm. Hence by implementing wireless technology to this it can be made highly advanced.

VI. CONCLUSION

By conveying this idea of automatic farming using solar energy we could create an awareness of maximum usage of non-conventional sources of energies. During this session we came out with certain facts that are to be considered for the future improvement with much more efficiency. Here we have programmed the tracking circuit AND the irrigation circuit in PIC 16F877A. It will be cost efficient if the whole set up can be combined by programming into a single microcontroller. The percentage estimate of moisture content will be displayed digitally and comparing to the preset values the motor works. Humidity sensors sense the amount of water required by each plant and the motor supplies water as needed. The solar panel in our project is aligned on a single axis. This could be made more efficient in harnessing energy if the panel is made to rotate in dual axis. The amount the sunlight falling on the panel will be increased with this technique. If the efficient implementation of this system is popularized, undoubtedly this can be proven to be the best solution for difficulties faced in manual farming.

REFERENCES:

1. A.K.Ray and K.M.Burchandi, '**Advanced Microprocessor and Peripherals-Architecture, Programming and Interfacing**' Tata McGraw-Hill Publishing Company Limited, 2009.

2. Charles M. Burt and Stuart W. Styles '**Drip and Micro Irrigation Design and Management for Trees, Vines, and Field Crops**' Irrigation Training and Research Centre, 2007.

3. D.Roy Choudhury and Shail B.Jain, '**Linear Integrated Circuits**' New Age International Publishers, 2009.

4. S.Dasberg, Dani Or '**Applied Agriculture-Drip Irrigation**' American Society of Agriculture, 1999.

5. William David Lubitz, '**Effect of Manual Tilt Adjustments on Incident Irradiance on Fixed and Tracking Solar Panels**', Applied Energy, Volume 88, 2011.

6. Lei Xiao and Lejiang Guo, '**The Realization of Precision Agriculture Monitoring System Based on Wireless Sensor Network**', International Conference on Computer and Communication Technologies in Agriculture Engineering, IEEE 2010.

7. Himli and Azim, A.K, ' **Improved Structure of Solar Tracker with Microcontroller Based Control**', Second International Conference on Advances in Computing, Control and Telecommunication Technologies, IEEE 2010.