Smart Farming

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Abstract— The comprises of – Solar Tracker (Power source), Auto Irrigation System, A Farm Bot. The project is a green initiative where solar energy from the solar tracker is used to power the automated irrigation system and the farm bot. Solar energy powers all the equipment's in the farm, i.e. pumps and controllers. Also the stored energy in the batteries can later be used by the farmer to light up his home. The automated irrigation system comprises of a moisture level detector which senses the moisture level in soil and triggers the pump to turn ON. The pump can also be triggered every day at a particular time and can also be programmed to work for a predefined period of time. It's framed around a GSM infrastructure where the messages from the farmer act as the commands to the system. The farm bot works automatically and logically performs its tasks in the farm.

Key words: Solar Tracker, Hall Effect, Farm Bot, Moisture Level Detector, GSM Module

I. INTRODUCTION

The projects focuses on making a really affordable and hi-tech aid for the small as well as large scale farmers with the help of affordable components and reliable electronics. It aims towards providing efficient solutions to the agriculture in India with minimal capital investment and good through put.

This project comprises of the simplest components to automate and improve the accessibility of the basic functions required for agriculture such as irrigation, power and harvesting.

The system proposed comprises of three systems to meet the needs-

- Automated irrigation system using GSM.
- A solar tracker power system to power the circuits and the bots.
- A multipurpose bot, which will be the advancement in a line follower bot, made to spray fertilizers and to harvest the crop.

II. DESCRIPTION

The project is a green initiative and focuses on providing affordable solutions to agriculture and focuses on using renewable energy i.e. solar energy to power our farming equipment's.

So at the apex of the block diagram is our solar tracker that will harness solar energy and power all other devices that we will be using namely the farming bot and the moisture level detector and the GSM module.

A solar tracker will be placed in farm, with the help of the servo motors placed at the base the angle of the solar panels will change in the direction where maximum sunlight can fall on it.

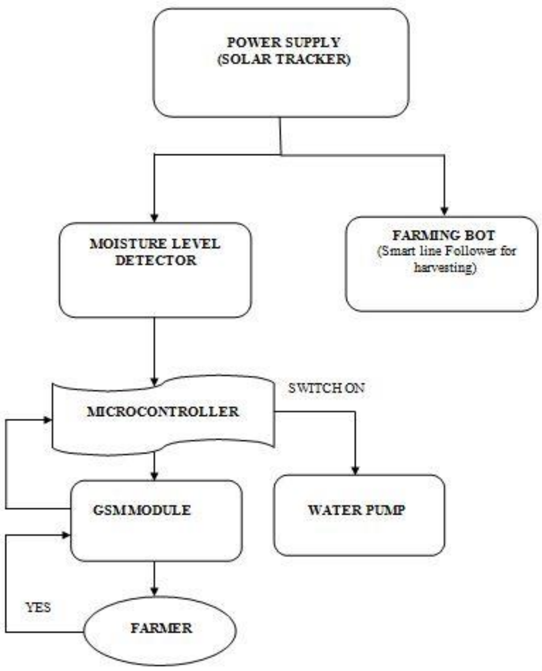

Fig. 1: Block diagram

For automate irrigation we have a moisture level detector. Two electrodes will be placed in soil for detection of water content in the soil. If the water content is appropriate and in match with the mentioned level then sufficient amount of current flows between the two electrodes. When the amount of current flowing between the two electrodes reduces, this is an indication that the water content in the soil has gone below the required levels and the field needs water supply.

With the help of a Arduino Uno R3, this message will be sent to the GSM module present on the field. The GSM module will send message to the farmer on his cellular device asking his permission if the water pump should be switched on.

Once the Farmer sends his acknowledgement, this message is sent to the microcontroller via GSM module and microcontroller in turn turns on the water pump and the field is irrigated.

Farming Bot is a smart line follower. Tracks will be laid out on field. Following this tracks the bot can harvest the crops or plant seeds depending on the requirement.

III. System Design

A. Solar Tracker:

The proposed design of solar tracker has biaxial rotation with a cylindrical base. It will allow us to efficiently track the solar radiation. It has two axis of rotation, horizontal axis and vertical axis.

LDR's are placed in the corners of solar panel as shown in Fig. 2.

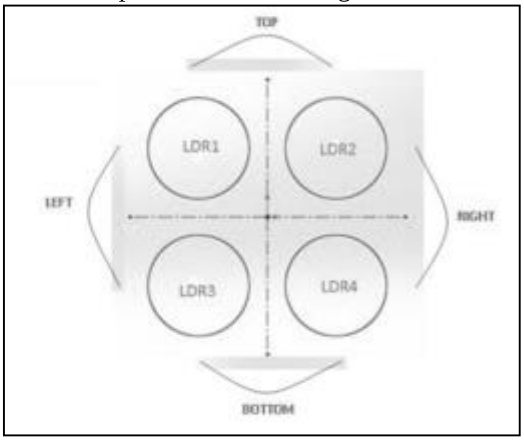

Fig. 2: Positioning of LDR's on the solar panel

LDR's helps to determine on which side there is maximum light during day time. The photoresists need to be kept covered to increase accuracy. The LDR's are grouped in pairs, for e.g., the left and right LDR will be compared depending on the resistance value.

The side with the lower resistance determines maximum light input. This value goes to the Arduino and it gives instructions to motors to rotate the solar panel in the specified direction.

The motor used draws a very small current. It is used to search for the position from where maximum possible energy could be harnessed. Before sunrise in the morning, both panels are oriented towards the geographical east and wait for sun rise.

At sun set, the system rotates back to the starting position, facing geographical east and waits for the sun rise for next day and repeats the procedure.

Polycrystalline solar panels are used. The reason being they are less expensive than mono crystalline solar panels. They are equally efficient in hot temperature. They provide efficiency up to 13-16% and have longer life span.

The Solar tracker will harness solar energy. This energy will be used to power moisture detecting circuit and the farm bot.

B. Moisture Level Detector

It helps manage the irrigation system more efficiently. The sensor detects the water content in the soil. The sensor used is shown in Fig. 3.The sensor has to be placed in soil while sowing the seeds. Voltage is generated by the electrodes which in turn determine the current flowing between the two electrodes.

If the water content is below a specified level the amount of current flowing and the voltage reduces. When this happens the Arduino in turns send a message to the farmer using a GSM module.

The farmer receives the message on his cellular device stating that the water content in the soil has gone down the required level. The farmer acknowledges the message and sends a response to the GSM module. If the response is positive, the Arduino will start the motors of the irrigation system which will pump water to the field.

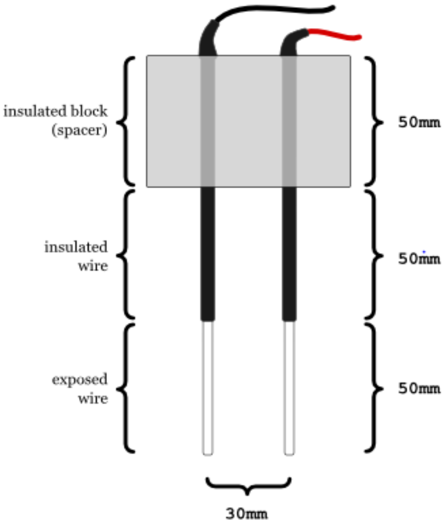

Fig. 3: Soil moisture detector

C. Farm Bot

Fig. 4. Shows the basic block diagram of the bot used. The bot is designed such that it can harvest the crop as well as sow seeds. Farm bot uses use's the Hall Effect sensors which is analogous to line follower robot which uses IR sensors for sensing path

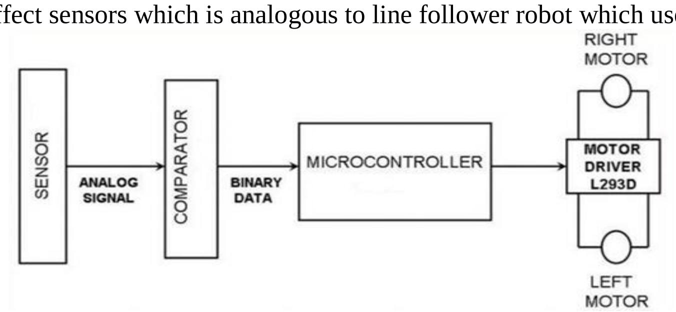

Fig. 4: Basic block diagram of Farm bot

When a current-carrying conductor is placed into a magnetic field, a voltage will be generated perpendicular to both the current and the field. This principle is known as the Hall Effect.

Fig. 5. Illustrates the basic principle of the Hall Effect. It shows a thin sheet of semiconducting material (Hall element) through which a current is passed. The output connections are perpendicular to the direction of current. When no magnetic field is present (Fig. 5), current distribution is uniform and no potential difference is seen across the output. When a perpendicular magnetic field is present, as shown in Fig. 6., a Lorentz force is exerted on the current. This force disturbs the current distribution, resulting in a potential difference (voltage) across the output. This voltage is the Hall voltage (VH). The interaction of the magnetic field and the current is shown in equation form as equation 1. Hall effect sensors can be applied in many types of sensing devices. If the quantity (parameter) to be sensed incorporates or can incorporate a magnetic field, a Hall sensor will perform the task.

$$VH \propto I \times B \quad .....(1)$$

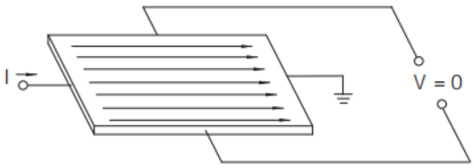

Fig. 5: Hall effect principle, no magnetic field

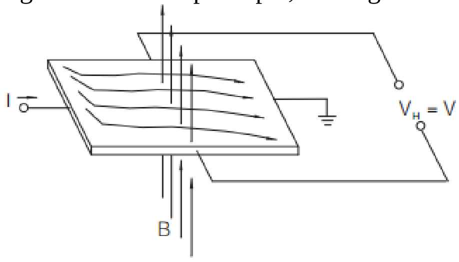

Fig. 6: Hall effect principle, when magnetic field is present

Silicon exhibits the piezo-resistance effect, a change in electrical resistance proportional to strain. It is desirable to minimize this effect in a Hall sensor. This is accomplished by orienting the Hall element on the IC to minimize the effect of stress and by using multiple Hall elements. Fig. 7. Shows two Hall elements located in close proximity on an IC. They are positioned in this manner so that they may both experience the same packaging stress, represented by ΔR. The first Hall element has its excitation applied along the vertical axis and the second along the horizontal axis. Summing the two outputs eliminates the signal due to stress.

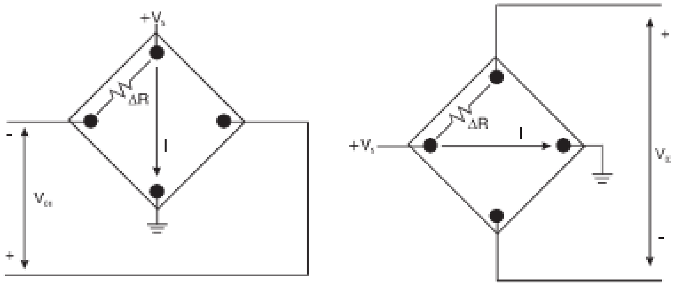

Fig. 7: Hall element orientation

The Hall element is the basic magnetic field sensor. It requires signal conditioning to make the output usable for most applications. The signal conditioning electronics needed are amplifier stage and temperature compensation. Voltage regulation is needed when operating from an unregulated supply. Fig.8. illustrates a basic Hall Effect sensor. If the Hall voltage is measured when no magnetic field is present, the output is zero (see Fig.5.). However, if voltage at each output terminal is measured with respect to ground, a non-zero voltage will appear. The amplifier shown in Fig. 8. Must be a differential amplifier so as to amplify only the potential difference – the Hall voltage. The Hall voltage is a low-level signal on the order of 30 microvolts in the presence of a one gauss magnetic field. This low-level output requires an amplifier with low noise, high input impedance and moderate gain. A differential amplifier with these characteristics can be readily integrated with the Hall element using standard bipolar transistor technology. Temperature compensation is also easily integrated. As was shown by equation 1, the Hall voltage is a function of the input current. The purpose of the regulator in Fig. 8. is to hold this current constant so that the output of the sensor only reflects the intensity of the magnetic field. As many systems have a regulated supply available, some Hall Effect sensors may not include an internal regulator.

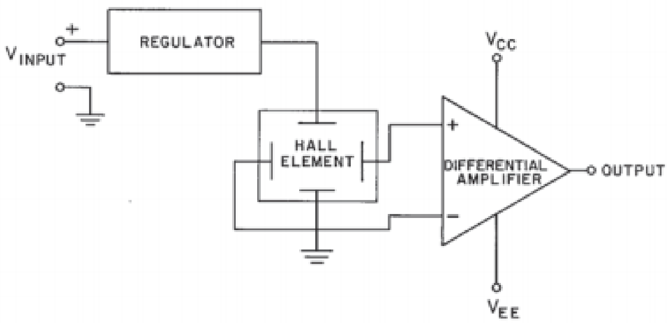

Fig. 8: Basic Hall Effect sensor

Hall Effect sensors convert a magnetic field to a useful electrical signal. In general, however, physical quantities (position, speed, temperature, etc.) other than a magnetic field are sensed. The magnetic system performs the function of changing this physical quantity to a magnetic field which can

In turn be sensed by Hall Effect sensors. The block diagram in Fig. 9. Illustrates this concept.

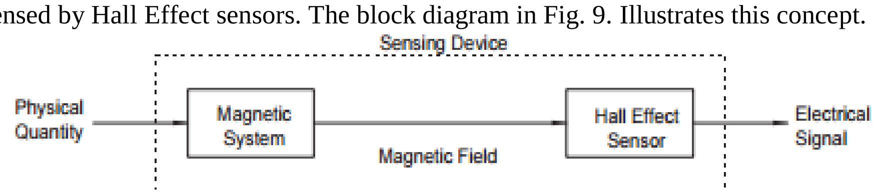

Fig. 9: General hall effect system

Thus Hall Effect guides the motion of the bot in straight line. The bot thus performs the required function while traversing

The given path. If there is any deviation of the bot from this path, the Hall Effect sensors guides the bot back to its path.

IV. CONCLUSION

This paper focuses towards efficient and cost effective farming system using renewable energy. The concept of automated guidance using hall effect has been incorporated in bringing out a new application.

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