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Solar Based Automatic Water Irrigation System Using BLDC Motor Drive

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ABSTRACT

Agriculture is the backbone of India but now a day's cultivation of crops has become a tedious process especially in remote areas since they face many difficulties in water pumping system due to shortage of electricity and detecting animals that are entering into the field. This system uses Moisture sensor, pH sensor and Vibration sensor for automation in irrigation in order to avoid human interaction in field. The problems in irrigating water to field due to power shortage can be overcome by using Solar based water pumping system which is driven by BLDC Motor on the Moisture level in the soil. The issues regarding entrance of elephant in the field can be detected automatically using vibration sensor and the buffer sound is given in order to alert the people in the field and also to warn the elephant that enters the field. GSM Technology is used to report farmer with an alert message about the elephant's detection and also the Moisture, pH level of soil, battery charging condition, and Motor ON/OFF condition with a text message. The overall system is controlled by PIC 16F877A. The proposed system will avoid the direct interaction of the farmer in field and also avoids the life of farmers in case of entrance of elephant in field.

KEYWORDS: Moisture sensor, pH sensor, Vibration sensor, PIC16F877A.

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INTRODUCTION

Food is essential for human beings in order to survive in this world as we get food only through Agriculture. But Agriculture lies on Water which is anessentialre source in the earth. Ultimately there is a chain betweenFood,Agriculture and Water. In order to increase the productivity of crop cultivations since excess of water may lead to deployment of crop yield. The second major issue is that in remoteareathecontinuityofpowersupplyfordrivingmotors is not a promising deal. In such cases the overall yield from the fields may get reduced due to scarcity of water supply to crops. This is a big drawback since we have huge population which increases in yearly basis. The third major issue is the elephant attacks in fields that are located near remote area. Elephantcausesahugedamagetofieldandalso causes risk to thelife of human being. The crop yield may get reduced rapidly because of the elephant attackstoo.

In rural areas, the availability of electric power supplyis the main problem. In such cases PV system is the most efficientandpromisingwayofpowersupply.Assolarenergy is generated from sunlight, generation cost is almost free. This PV is directly converting the light energy into electrical energy without any intermediate energy conversions, therefore losses are reduced and efficiency is increased. Thesolarsystemcanbeusedforsupplyingthemotorinorder to increase the crop yield in rural area. The BLDC Motor is used for water pumping applications based on the moisture level of soil. BLDC Motor is preferred over Induction Motor since it is energy efficient, less weight, compact in size, produces less noise and EMI, less maintenance cost due to absenceofbrushesandhencetheoverallefficiencyofBLDC Motor is higher than Induction Motor.

Elephant interaction in Agricultural lands causes huge lossofcrops. Elephant comingincontactwithhumanlead to various issues such as decrease in yield of crop, injuries andevencauses death of humans.Theexistingmethodsused by the farmers are not effective to take care of crops and preventwildanimals because, safetyofhumanandanimalsare equally important. Hence animal detection is also completely necessary in remote are a fields.

LITERATURE REVIEW

In the literature, the study of design of automatic irrigation process and animal detection using different controllers and logics were performed assuming BLDC motor will suit the irrigation better in Induction motor in various aspects such as high energy efficiency, higher reliability, high torque to inertia ratio, less maintenance etc...In the literature survey, many systems does not use Solar PV system for power supply which is a promising way of power supply in case of remote areas and electricity is not available so this disadvantage can be overcome by using the proposed

system which is supplied by Solar PV system. Many existing systems do not have animal detection added with automatic irrigation which wastes the farmer's time and money in implementing these two systems separately in the field. The advantage of using solar based BLDC motor for irrigation purpose has been discussed with the help of the difference between BLDC and Induction Motor.

DIFFERENCE BETWEEN BLDC MOTOR AND INDUCTION MOTOR

Table 1: The table for difference between BLDC Motor and Induction Motor

| S.NO	PARAMETERS	BLDC MOTOR	INDUCTIONMOTOR
1	Operating Efficiency	High due to absence ofbrushes	Low due rotor copper and rotoriron losses
2	Rotor inertia	Rotor inertia is low. This makes it to have better dynamiccharacteristics	Rotor inertia is high. This makes it to have poorer dynamiccharacteristics
3	Speed/torquecharacteristics	It is flat in nature	It is non-linear innature
4	Energy Efficiency	High	Low
5	Weight and Size	Lighter andcompact	Heavier and notcompact
6	CommutationUsed	ElectronicCommutation	MechanicalCommutation
7	Heat Generation	Less	More
8	Noise and EMI	Produces less noise and EMI	Produces more noise and EMI than BLDCMotor
9	Operating PowerFactor	High	Low
10	Lifetime	Long life time due to lack of electrical andfrictional losses	Reduced lifetime when compared to BLDC Motor
11	Periodic Maintenance	Virtuallymaintenance-free motor	Requires less maintenance

PROPOSED SYSTEM
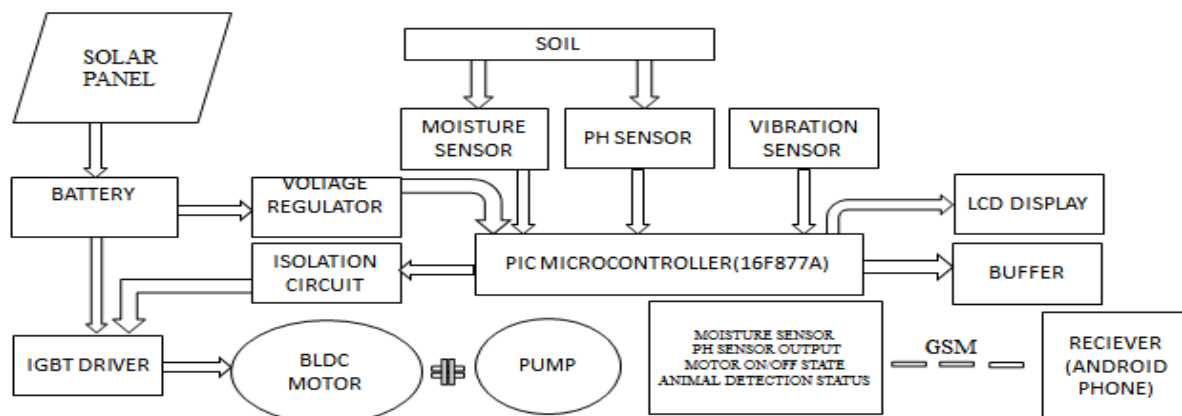
Figure 1. Block Diagram of the Solar Based Automatic Water Irrigation System Using BLDC Motor Drive

TheProposedsystemconsistofsolarpanel,Battery, Voltage Regulator, Moisture sensor, pH sensor, Vibration sensor, PIC Microcontroller, LCD Display, Buffer, optocoupler, IGBT driver, BLDC Motor, GSM Modem. The solar panel generates the DC electricity of which is stored in the Battery. The stored energy from battery is fed to the Voltage Regulator (7805) which converts the 12v to 5v to provide supply to PIC Microcontroller(16F877A) and LCD Display. The Moisture sensor measures the moisture content in the soil and provides the desired analog output signal. Similarly, pH sensor measures the pH level of the soil and produces the required analog signal which is converted into digital signal using A/D Converter. The vibrationsensor measures the vibration that occurs in the soil by means of a board potentiometer and converts the output signal to digital one. The measured moisture sensor output is sent to the PIC Microcontroller(16F877A) which generates the pulse required to turn ON/OFF the BLDC Motor when the Moisture level is LOW/HIGH and any fault in motor such as ifitisnotturnedON/OFFbasedontheLOW/HIGHMoisture level is reported to farmer as text message using GSM Protocol. When there isa signal from Vibration sensor to microcontroller, the microcontroller turns ON the Buffer in order to alert the people in field and warn the elephant that is entering into the field and immediately an alert text message is passed to the farmer regarding the entry of the elephant using GSM Protocol.

RESULT AND DISCUSSION

Agriculture is the basic necessity for survival. It is not that much easy for the farmer to monitor the field regularly due to various difficulties faced by the farmer such as remote location of land, animal attack, no proper time allotment for monitoring the field etc... The result of Solar Based Automatic Irrigation System Using BLDC Motor Drive is shown in Figure 2.
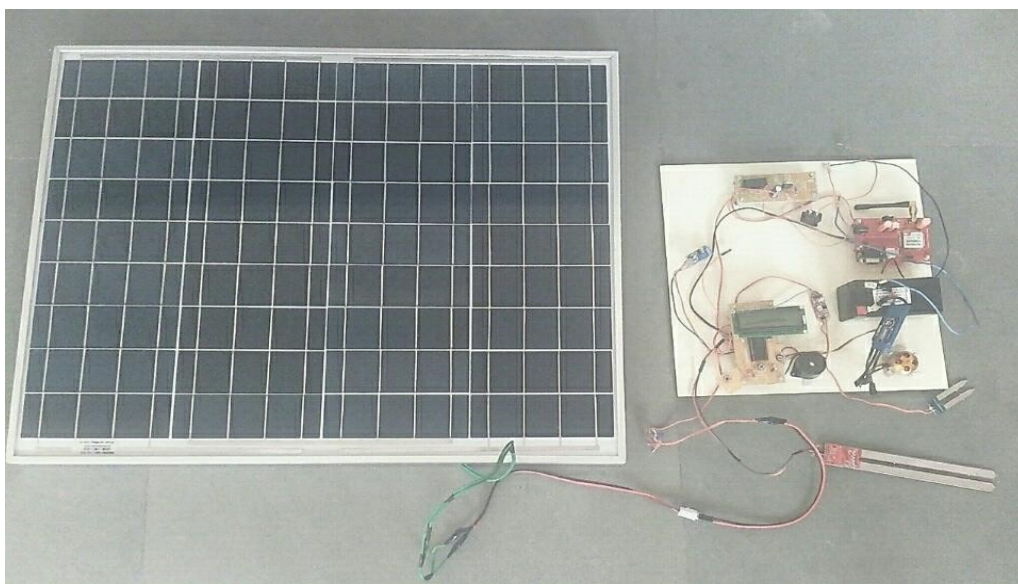

Figure 2.Result of Solar Based Automatic water Irrigation System using BLDC Motor Drive

Automatic Irrigation is done with the help of Moisture Sensor and pH Sensor.BasedontheMoistureSensorvalue,themotorturnsON/OFF,pHSensor gives the pH level of soil. Automatic Animal Detection is done with the help of Vibration Sensor which detects the elephant and sends signal to Microcontroller and Buffer is turned ON to alert the farmer as well as elephant in field. The Irrigation control and animal detection Information are reported to the farmer's Mobile Phone through GSM as a Text Message. The images of those results are shown in Figure 3. This system can be operated in dual mode i.e. it can be either controlled automatically by setting Auto Mode or ON/OFF control of Motor can be donemanually.

Figure 3.Monitored Parameters in the Field

The parameters that are reported to the farmer through the LCD Display are Moisture level, pH level, Mode of Selection of control, output Voltage from Solar Panel, pulse level given to the Driver Circuit, Time for Automatic Intimation of these parameters as shown in the Figure 4.
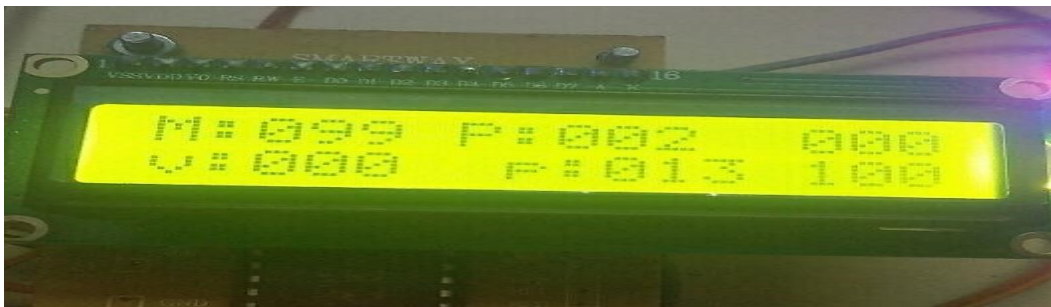

Figure 4. Parameters Displayed on LCD

OBSERVATION FROM SOLAR PANEL

Table 2:Observations from solar panel

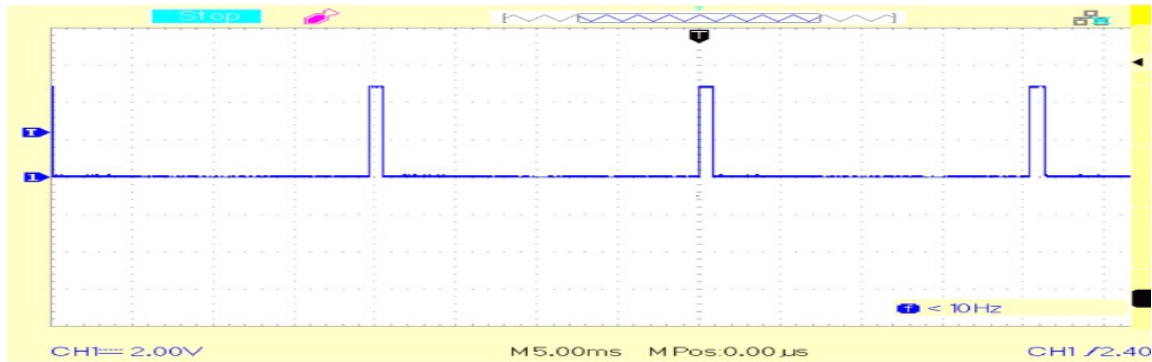| S.NO	DATE	TIME	VOLTAGE (V)
1.	19.3.2019	1.45	18.6
2.	19.3.2019	2.15	18.8
3.	19.3.2019	2.45	18.8

Figure 5.Gate Pulse to Driver circuit

The above Figure 5shows the gate pulse given IGBT switches in driver circuit in order to drive the BLDC motor current in continuous sequence.
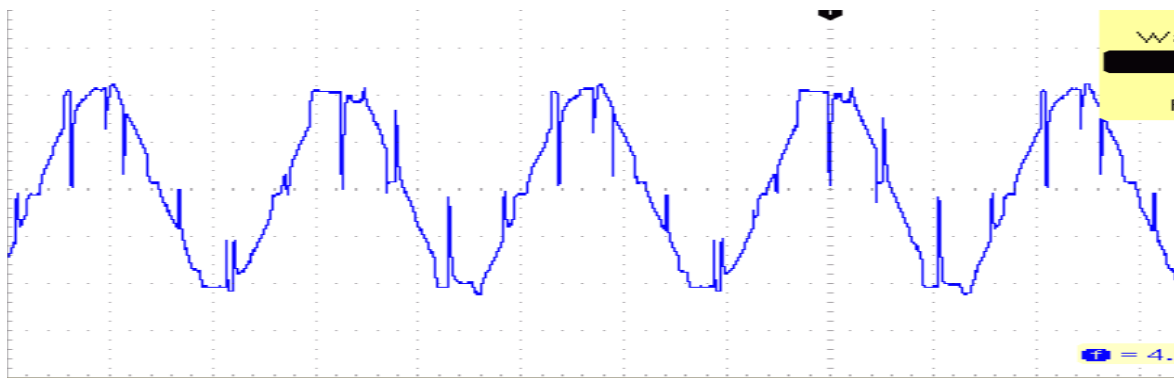

Figure 6.Input Voltage Waveform of BLDC Motor

The above Figure shows the input voltage waveform of BLDC Motor.

CONCLUSION

The proposed system is the best suitable one in remote areas where there is scarcity of electricity. By using this System, the Farmer can avoid the Direct Interaction in field in order to turn ON/OFF the BLDC Motor by using the moisture sensor, the pH level of the soil can also be known with the help of pH sensor, these information's are sent to farmer using GSM Protocol. This system uses BLDC Motor in stead of Induction Motor since it has several advantagesover Induction Motor in variou saspectswhichhavebeendiscussedabove.Automatic Animal Detection System helps the Farmer in detecting the elephant that enters intothefieldusingvibrationsensorandreportsthefarmerregardingtheelephant detection using GSMProtocol. By using this system the farmers can reduce their time and money since it combines

both automatic irrigation system with animal detection system as a single unit.

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