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Smart Solar PV Monitoring using Cloud Computing

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Abstract

Renewable energy sources are proven to be reliable and accepted as the best alternative for fulfilling our increasing energy needs.As technology is advancing, cost of renewable energy equipments is decreasing which has resulted in a massive increase in solar photovoltaic installations. Most of these installations act as auxiliary power source. A majority of these are installed in inaccessible locations – as close as a rooftop to as far away as a dessert. Hence, they require sophisticated systems for remote monitoring of these installations using wide area networks. The system described in this paper is capable of measuring the values of Solar PV voltage and current and temperature and sending them over on mobile networks to the internet for data logging and review by the user. In case of a deviation from normal specified values of current, voltage or temperature, the system is also capable of alerting the user via an IOT. The idea is to connect all sensors and devices on a common network i.e. internet through wired or wireless means so that the user can access the data and control the devices from anywhere around the globe with an internet connection. Along with this, the aim is to automate the process using pre-defined logic to reduce human intervention as much as possible. It has gained a lot of attention in recent years due to its diversified usage in the fields of consumer electronics, home automation, health care, smart car, smart city and security purposes. The Solar PV voltage is sensed by voltage divider circuit. Current is sensed using Hall Effect Current Sensor ACS712. The temperature and humidity is sensed using DHT11 temperature an sensor. A dedicated computer system is set up to store the data obtained for future reference and review. This data now can be viewed anywhere on the globe using an internet connection on an IP by an IoT module. As the conventional sources of electricity generation are depleting, mankind is in need of renewable sources such as solar and wind energy to sustain itself. Hence all we need is a good, up-to-date monitoring system which can perform major tasks automatically without human intervention and can provide data to the user whenever and wherever needed. IOT is the best solution for monitoring of solar installations. IOT based remote monitoring of the Solar PV installation will also save energy and man-labour.

INTRODUCTION

Power generation is a major factor in many developing countries. Due to the improvement of the industrial and commercial sector, energy demand reaches its peak. Hence all are poignant towards renewable energy source to produce green energy for meeting out our energy consumption. This can help the society to decrease greenhouse gas emission and ozone layer depletion for future generation. Among this solar photovoltaic technique is gaining popularity due to huge availability, reduced cost, easy installation, and maintenance. Currently, Internet of Things (IoT) is an evolving technology that makes things smarter and user-friendly when connected through the communication protocol and cloud platform. The efficiency of the solar panel is influenced by basic parameters such as current, voltage, Irradiance, and temperature. Hence real-time solar monitoring system is essential for increasing the performance of the PV panel by comparing with the experimental result to initiate preventive action. In recent years there had been a lot of research attempts made in solar energy. In addition, machine intelligence techniques are used for forecasting to obtain robust performance. A real-time supervising. A low-cost solar panel monitoring is developed based on IoT for online visualization and improving the performance. This helps to take preventive maintenance and tracking the fault location. A remote Solar monitoring and control system is proposed for implementation at the plant level and promotes the decisional process for central control station which has the crucial role for processing, storage, warning and displaying. Arduino controller is used for analyzing the measured parameters and sends the data to the server for making a useful decision which improves the performance of PV panel.

LITERATURE SURVEY

[2] Monika P. Tellawar PG Scholar, NileshChamat Assistant Professor, Department of Electrical Engineering Ballarpur Institute of Technology Balharshah, Maharashtra, India "An IOT based Smart Solar Photovoltaic Remote Monitoring System", ISSN: 2278-0181 IJERTV8IS090068 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by: www.ijert.org Vol. 8 Issue 09, September-2019. "The proposed design and development of a monitoring system is to get information on the defected solar panels for timely repair and maintenance". Based on a low-cost wireless sensor network; the design, development and the work of monitoring system of distributed solar panels along with automated data logging has been reported to help the current situation.[1] "The proposed method provides a fast, secure and reliable system by making the system database-ready for performance analysis of PV systems. The solar panel is connected to the battery and then with sensors."[3] "The designed control unit can monitor and program the device functionality by means of a touch-screen graphical display that to check or correct operation and quickly reveal any fault, to manage and view locally the plant functioning by serial connection to PC with terminal role, and also remotely viewing and monitoring actions, by IoT connected to internet network". This module has proposed a conceptual system in, to monitor the state of a photovoltaic system through an IoT based network to control it remotely. Through the mobile, the information from the sensors is transmitted. This modulecomprises of current sensor, voltage sensor, temperature and humidity sensor for the measurement of temperature and humidity and a microcontroller-based data processing of data acquired from sensors. The microcontroller communicates with a wireless module to initiate and transmit data to the server.

PROPOSED SYSTEM

The proposed system is for monitoring and controlling the output of solar energy using IoT. Solar panel helps to store the energy in the battery. Battery has the energy which is useful for the electrical appliances. To read the sensor values Arduino, which is a micro controller, is used. Current sensor and voltage divider are connecting to the Arduino.The main intention of this proposed project is to get maximum power output from the solar panels. Additionally, if there is any improper functioning of the solar panels will be shown and also the parameters like voltage and current are monitored by using the sensors and displayed by using the IoT technology. This model is explained by using the solar radiation i.e., sunlight from the sun is trapped by the solar panels and then these solar panels capture sunlight and turn into useful energy forms of energy such as heat and electricity. Then the obtained electrical energy is sensed by the sensors such as voltage sensor sense the voltage generated by the solar panel with the help of voltagedivider principle and current is obtained by using mathematical formulation. The designed structure of the proposed monitoring system. The experimental arrangement of the introduced system consists of solar panels, Regulator power supply, Wi-Fi module-ESP8266, Voltage sensor, Current sensor, LCD (Liquid Crystal Display) and Arduino Uno microcontroller. Programming codes are developed on Arduino IDE.

The main objective of this proposed work is to monitor the output of PV system using the current and voltage value sensed by the arduino. To implement in smart grid, this system helps for efficient usage. In this section we present the IoT based monitoring system design of the Solar Energy Monitoring System. The IoT based solar energy monitoring system is proposed to collect and analyzes the solar energy parameters to predict the performance for ensuring stable power generation. The main advantage of the system is to determine optimal performance for better maintenance of solar PV (photovoltaic). A PV monitoring system improves the plant performance in various ways: by acquiring the energy generation and consumption data, optimizing energy usage and alerting damage that occurs (or might be occurring) to the system

METHODOLOGY

DESCRIPTION OF THE SYSTEM HARDWARE

FIG: ARDUINO

An Arduino board is a one type of microcontroller based kit. The first Arduino technology was developed in the year 2005 by David Cuartielles and Massimo Banzi. The designers thought to provide easy and low cost board for students, hobbyists and professionals to build devices. Arduino board can be purchased from the seller or directly we can make at home using various basic components. The best examples of Arduino for beginners and hobbyists includes motor detectors and thermostats, and simple robots. In the year 2011, Adafruit industries expected that over 3lakhs Arduino boards had been produced. But, 7lakhs boards were in user's hands in the year 2013. Arduino technology is used in many operating devices like communication or controlling.

BATTERIES

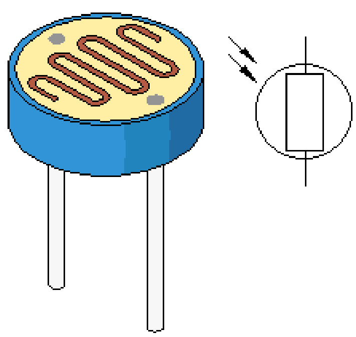
A Lithium-ion battery or Li-ion battery (abbreviated as LIB) is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of a lithium-ion battery cell.

Lithium-ion batteries are common in home electronics. They are one of the most popular types of rechargeable batteries for portable electronics, with a high energy density, tiny memory effect[9] and low self-discharge. LIBs are also growing in popularity for military, battery electric vehicle and aerospace applications. For example, lithium-ion batteries are becoming a common replacement for the lead–acid batteries that have been used historically for golf carts and utility vehicles. Instead of heavy lead plates and acid electrolyte, the trend is to use lightweight lithium-ion battery packs that can provide the same voltage as lead-acid batteries, so no modification to the vehicle's drive system is required.

LDR(LIGHT DEPENDENT REGISTER)

A photo resistor or Light Dependent Resistor or CdS (Cadmium Sulphide) 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 hole partner) conduct electricity, thereby lowering resistance.



VOLTAGE SENSOR:

Voltage Sensor is a precise low-cost sensor for measuring voltage. It is based on the principle of resistive voltage divider design. It can make the red terminal connector input voltage to 5 times smaller.

FIG: VOLTAGE SENSOR

ACS712 CURRENT SENSOR:

The ACS712 is a fully integrated, hall effect-based linear current sensor with 2.1kVRMS voltage isolation and a integrated low-resistance current conductor. Technical terms aside, it's simply put forth as a current sensor that uses its conductor to calculate and measure the amount of current applied.

FIG:CURRENT SENSOR

DHT11 TEMPERATURE AND HUMIDITY SENSOR

The percentage of water present in the air is termed as humidity. Water as gaseous state called vapor. As the temperature of the air increases more water vapor can be generate.

Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. So, its huge importance of humidity sensor is very important, especially in the control systems for industrial processes like chemical gas purification, dryers, ovens, film desiccation, paper and textile production, and food processing. In agriculture, measurement of humidity is important for plantation protection (green house), soil moisture monitoring, etc.

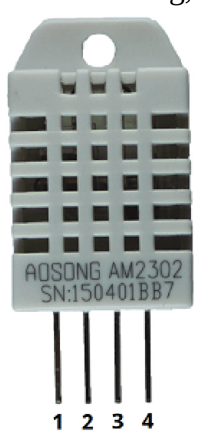


FIG: DHT11 SENSOR

CLOUD

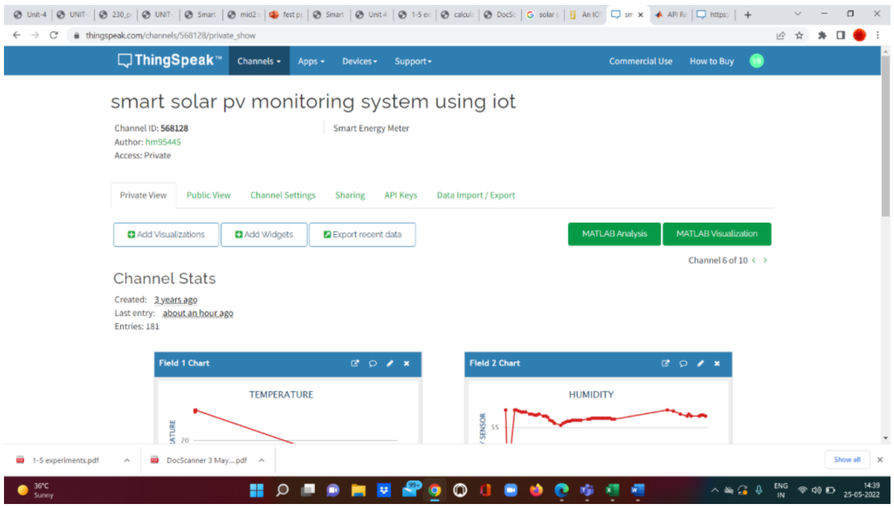
Explanation of cloud login and data store and retrieve on web page.This tutorial explains how to setup account with ThingSpeak and basics. ThingSpeak is an open cloud data platform where you can store and retrieve data.

ThingSpeak Basics and account setup

URL : https://thingspeak.com/

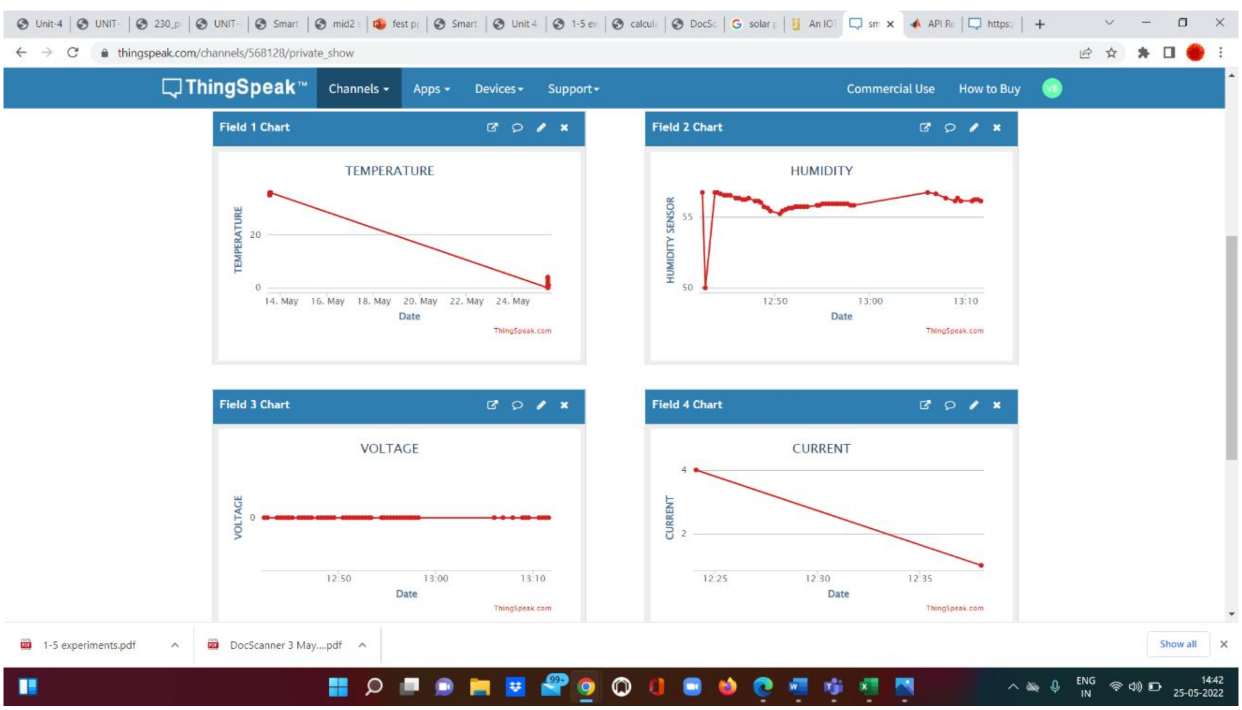
If you do not have a ThingSpeak account create one. Once you have a ThingSpeak account login to your account.

Create a new channel by clicking on the button as shown in below image – A channel is the source for your data. Where you can store and retrieve data. A channel can have maximum 8 fields. It means you can store 8 different data to a channel.



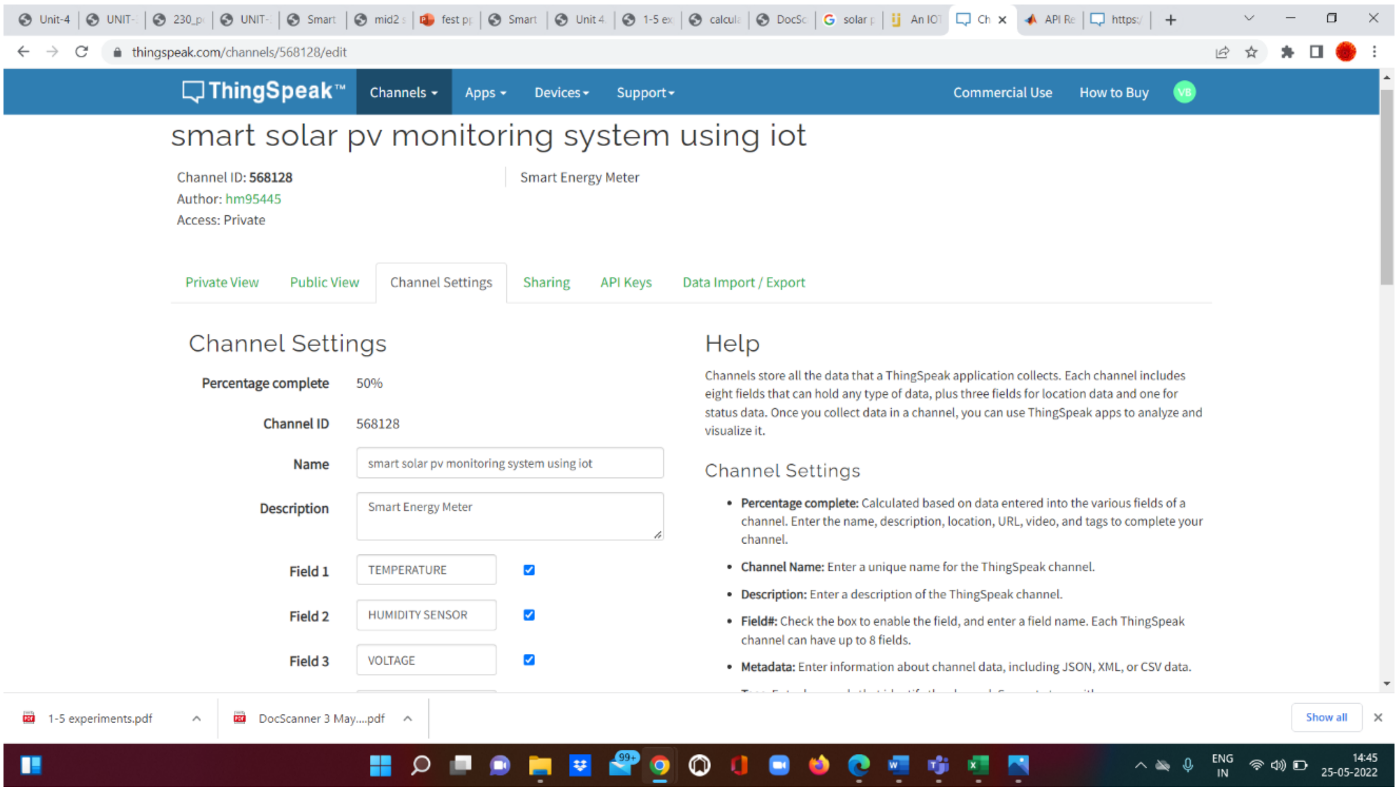
Enter basic details of the channel

here we are creating channel to store data from temperature humidity, light and gas sensor so we need 4 fields.



Channel ID

Channel Id is the identity of your channel. Note down this.



BLOCK DIAGRAM

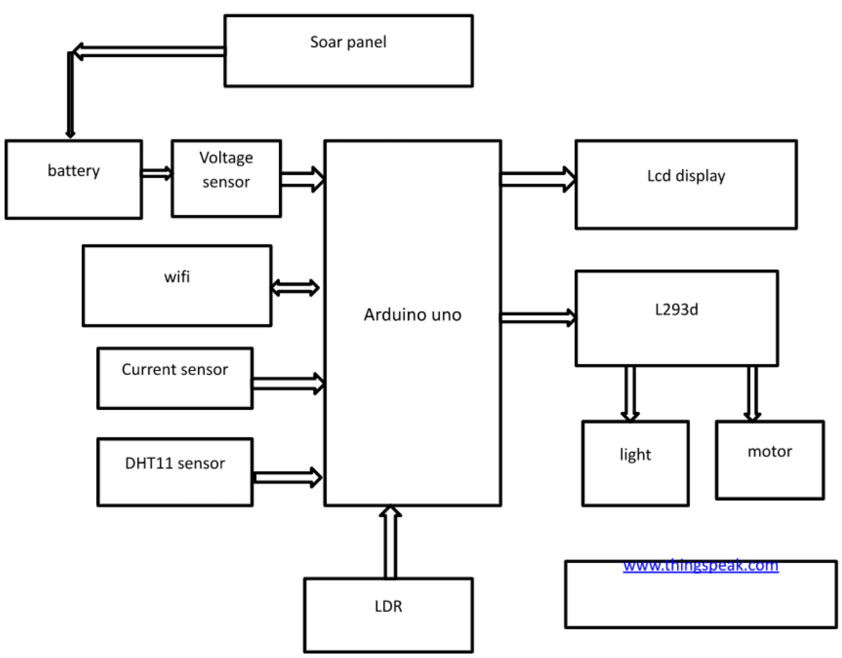


FIG: BLOCK DIAGRAM

CIRCUIT DIAGRAM

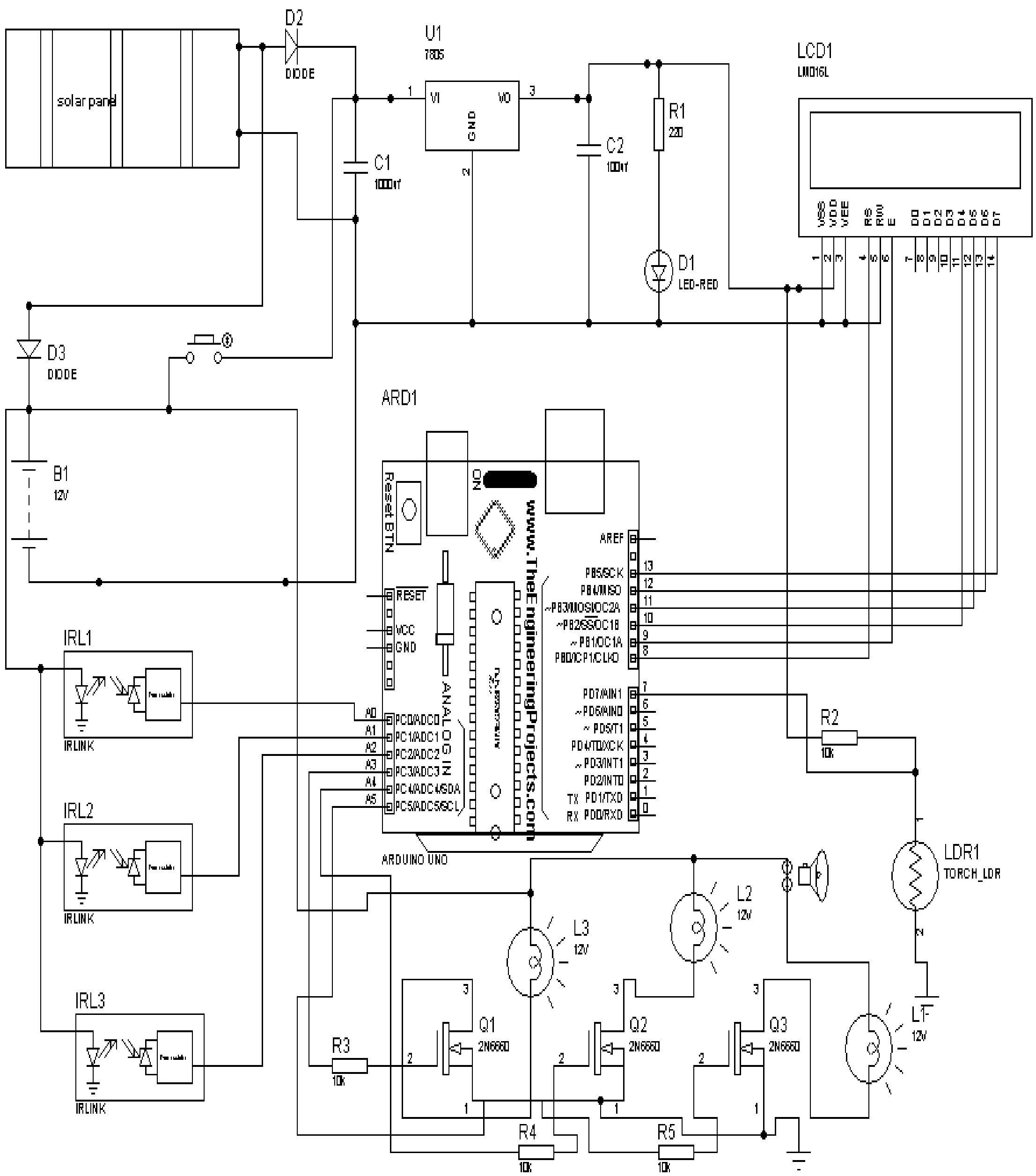


FIG:CIRCUIT DIAGRAM

PROCEDURE

The IOT-based solar energy monitoring system is proposed to collect and analyze the solar energy parameters to predict the performance for ensuring stable power generation. A solar panel is made of multiple panels that are wired together, more electricity is generated by the more panels we employ. DC current is generated when the solar panel is directly exposed to the sunlight. The energy which is generated from the solar panel is stored in the battery. The battery gets charged when the appliance is not in use and gets discharged when requires the supply. The battery is connected to the Voltage sensor and Current sensor (ACS712). The inputs from the voltage, current ,temperature and humidity sensors along with LDR and WIFI Module(ESP8266) is given to the Arduino and the output is displayed in the LCD(liquid crystal display).Hence the parameters voltage, current ,temperature and humidity values are displayed in LCD and the respective graphs are seen in ThingSpeak.

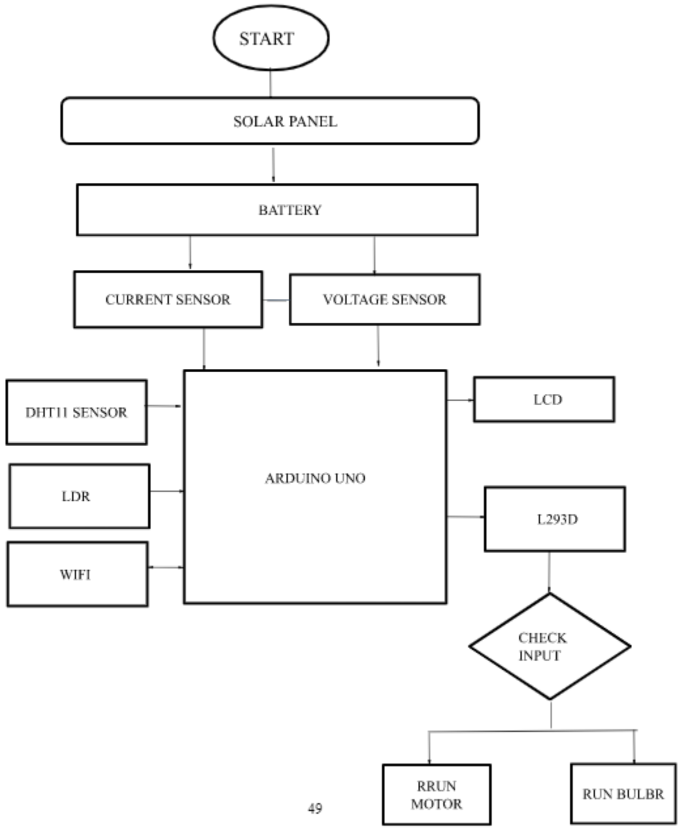


FIG: FLOW CHART

RESULTS AND DISCUSSIONS

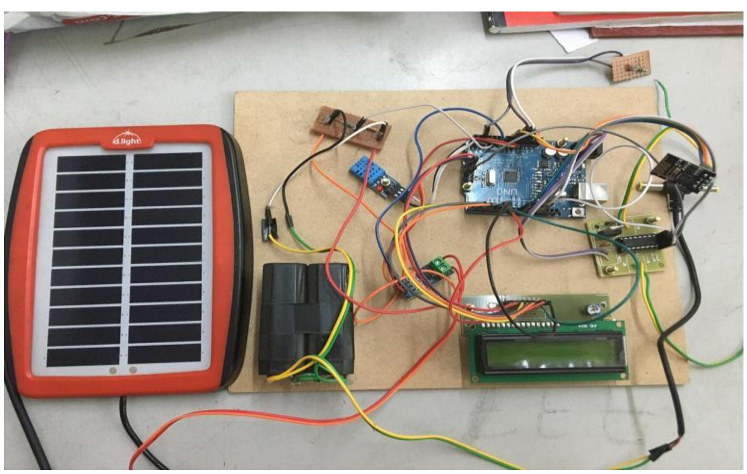


Fig Working Model

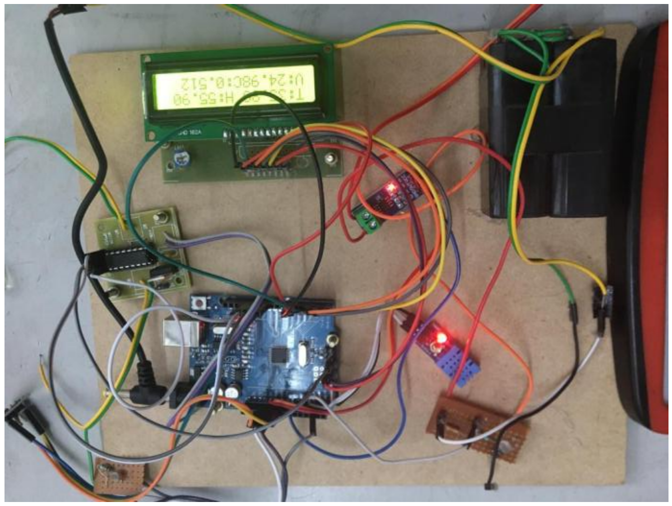


FIG: PARAMETER VALUES

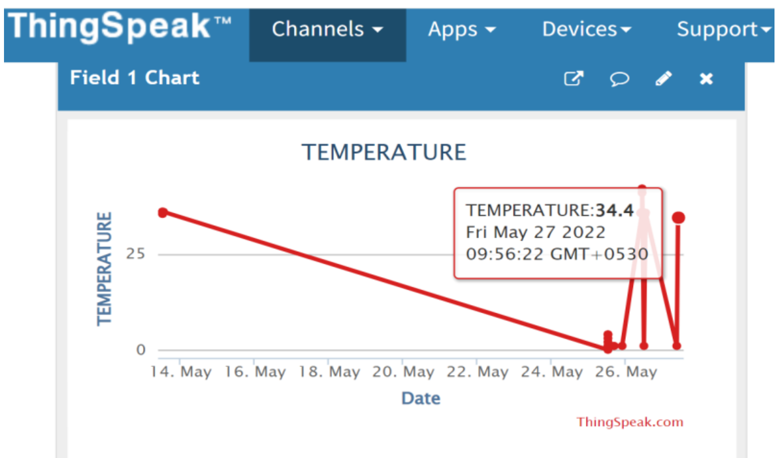


FIG TEMPERATURE GRAPH

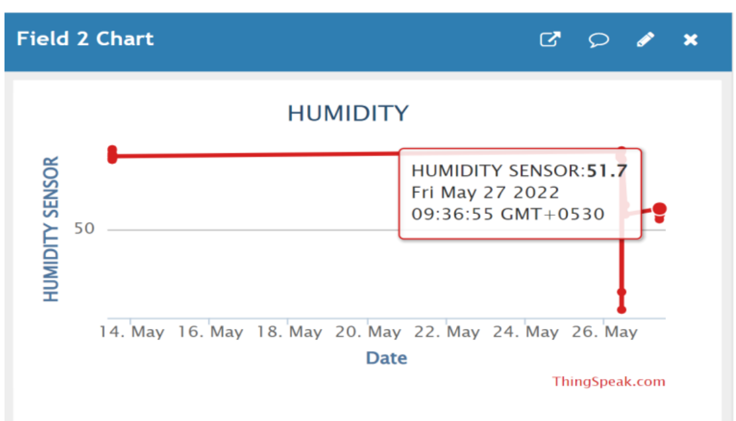


FIG HUMIDITY GRAPH

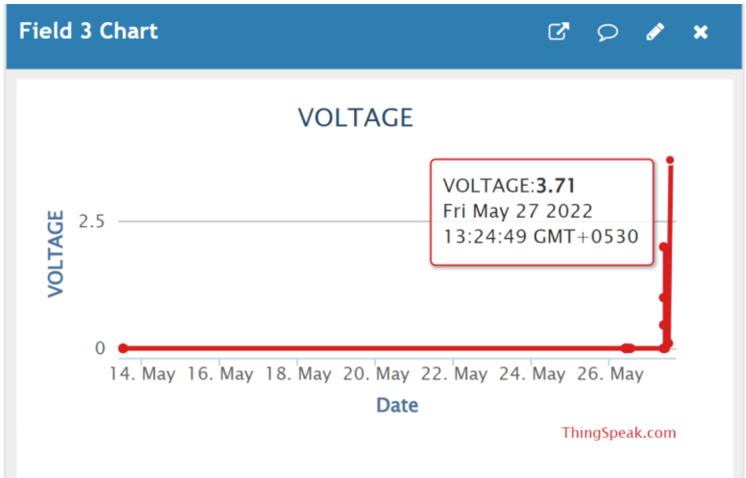


FIG VOLTAGE GRAPH

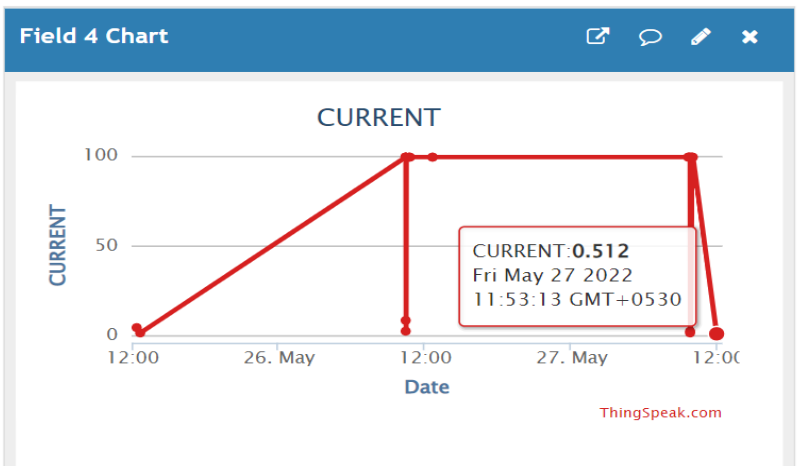


FIG CURRENT GRAPH

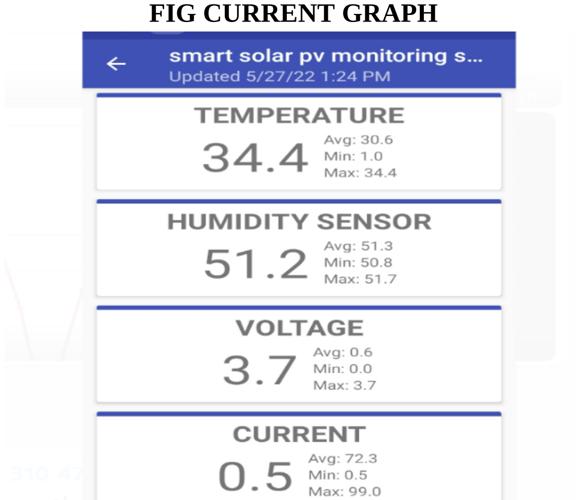


FIG PARAMETER VALUES

CONCLUSION AND FUTURE SCOPE

The integration of renewable energies into the electricity distribution network has become a necessity and consequently the search for new and effective solutions for remote monitoring and control is required. In this project, an IOT-based solar panel remote monitoring system has been proposed to collect data on important parameters of solar panels. The continuous record of performance data and failure data enables by IoT, so that it can be used for analytics for predicting and forecasting the future power generation possibilities, income production etc. The frequent maintenance of the photovoltaic systems also gets prevented by it. IoT will play a major role in accessing the control over the photovoltaic system installed at remote locations or far away from the control center. IOT-based monitoring will improve the energy efficiency of the system, reduce intervention and supervision time, and facilitate network management.

The proposed system stores the voltage and current parameters and keeps updating the new values. By tracking the solar photovoltaic system continuously, the daily or monthly analysis also becomes simple and easy. It is also possible to detect any errors occurring in the system if there is any uncertainty in the generated data by tracking the solar panels that are operated at the maximum capability.

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